



MX2

Born to drive machines

Model: 3G3MX2

200 V Class Three-Phase Input 0.1 to 15 kW

200 V Class Single-Phase Input 0.1 to 2.2 kW

400 V Class Three-Phase Input 0.4 to 15 kW

USER'S MANUAL



OMRON

Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

OMRON Product References

All OMRON products are capitalized in this manual. The word "Unit" is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

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Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NONINFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

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Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- o Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- o Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- o Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Disclaimers

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proof-reading errors, or omissions.

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Safety Messages


For the best results with the MX2 Series inverter, carefully read this manual and all of the warning labels attached to the inverter before installing and operating it, and follow the instructions exactly. Keep this manual handy for quick reference.


Definitions and Symbols

A safety instruction (message) includes a "Safety Alert Symbol" and a signal word or phrase such as WARNING or CAUTION. Each signal word has the following meaning:

 **HIGH VOLTAGE** This symbol indicates high voltage related warnings. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment.


Read the message and follow the instructions carefully.

 **WARNING** indicates a potentially hazardous situation that, if not avoided, may result in serious injury or death, or minor or moderate injury. Additionally there may be significant property damage.


 **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in severe property damage.

Step 1 Indicates a step in a series of action steps required to accomplish a goal. The number of the step will be contained in the step symbol.

Note Notes indicate an area or subject of special merit, emphasizing either the product's capability or common errors in operation or maintenance.

 **Tip** Tips give a special instruction that can save time or provide other benefits while installing or using the product. The tip calls attention to an idea that may not be obvious to first-time users of the product.

1 Hazardous High Voltage










 **HIGH VOLTAGE** Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housing or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

1-1 Caution when using Safe Stop Function

When using Safe Stop function, make sure to check whether the safe stop function properly works when installation (before starting operation). Please carefully refer to Appendix E *Safety (ISO 13849-1)* on page 379

2 General Precautions - Read These First!

-  **WARNING** This equipment must be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution may result in bodily injury.
-  **WARNING** The user is responsible to ensure that all driven machinery, drive train mechanism not supplied by OMRON, and process line material are capable of safe operation at an applied frequency of 150% of the maximum selected frequency range to the AC motor. Failure to do so can result in destruction of equipment and injury to personnel should a single-point failure occur.
-  **WARNING** HAZARDOUS OF ELECTRICAL SHOCK. DISCONNECT INCOMING POWER BEFORE CHANGING WIRING, PUT ON OR TAKE OFF OPTIONAL DEVICES OR REPLACE COOLING FANS.
-  **WARNING** Wait at least ten (10) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, there is the danger of electric shock.
-  **Caution** Make sure to read and clearly understand these instructions before working on MX2 series equipment.
-  **Caution** Proper grounds, disconnecting devices and other safety devices and their location are the responsibility of the user and are not provided by OMRON
-  **Caution** Be sure to connect a motor thermal disconnect switch or overload device to the MX2 series controller to assure that the inverter will shut down in the event of an overload or an overheated motor.
-  **HIGH VOLTAGE** Dangerous voltage exists until power light is OFF. Wait at least ten (10) minutes after input power is disconnected before performing maintenance.
-  **WARNING** This equipment has high leakage current and must be permanently (fixed) hard-wire to earth ground via two independent cables.

⚠ WARNING Rotating shafts and above-ground electrical potentials can be hazardous. Therefore, make sure that all electrical work conform to the National Electrical Codes and local regulations. Installation, alignment and maintenance must be performed only by qualified personnel.

⚠ Caution

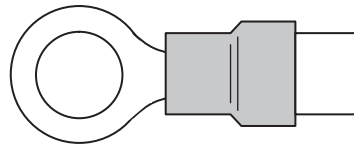
- a) Class I motor must be connected to earth ground via low resistive path (<0.1)
- b) Any motor used must be of a suitable rating.
- c) Motors may have hazardous moving path. In this event suitable protection must be provided.

⚠ Caution Alarm connection may contain hazardous live voltage even when inverter is disconnected. When removing the front cover for maintenance or inspection, confirm that incoming power for alarm connection is completely disconnected.

⚠ Caution Hazardous (main) terminals for any interconnection (motor, contact breaker, filter, etc.) must be inaccessible in the final installation.

⚠ Caution The equipment is intended for installation in a cabinet. The end application must be in accordance with EN 60204-1. Refer to the section "Choosing a Mounting Location" on page 29. The diagram dimensions are to be suitably amended for your application.

⚠ Caution Connection to field wiring terminals must be reliably fixed having two independent means of mechanical support. Use a termination with cable support (figure below), or strain relief, cable clamp, etc.



⚠ Caution A double-pole disconnection device must be fitted to the incoming main power supply close to the inverter. Additionally, a protection device meet IEC 60947-1/ IEC 60947-3 must be fitted at this point (protection device data shown in 2-3-6 *Determining Wire and Fuse Sizes* on page 45).












Note The above instructions, together with any other requirements highlighted in this manual, must be followed for continue LVD (European Low Voltage Directive) compliance.

3 Index to Warnings and Cautions in This Manual

Cautions and Warnings for Orientation and Mounting Procedures

- ⚠ HIGH VOLTAGE** Hazard of electrical shock. Disconnect incoming power before changing wiring, put on or take off optional devices or replace cooling fans. Wait ten (10) minutes before removing the front cover. 22
- ⚠ HIGH VOLTAGE** Hazard of electrical shock. Never touch the naked PCB (printed circuit board) portions while the unit is powered up. Even for switch portion, the inverter must be powered OFF before you change. 29
- ⚠ WARNING** In the cases below involving a general-purpose inverter, a large peak current may flow on the power supply side, sometimes destroying the converter module: 29
1. The unbalance factor of the power supply is 3% or higher.
 2. The power supply capacity is at least 10 times greater than the inverter capacity (or the power supply capacity is 500kVA or more).
 - a) Abrupt power supply changes are expected, due to the conditions such as:
 - b) Several inverters are interconnected with a short bus.
 - c) A thyristor converter and an inverter are interconnected with a short bus.
 - d) An installed phase advance capacitor opens and closes.
- ⚠ Caution** Be sure to install the unit on flame-resistant material such as a steel plate. Otherwise, there is the danger of fire. 29
- ⚠ Caution** Be sure not to place any flammable materials near the inverter. Otherwise, there is the danger of fire. 29
- ⚠ Caution** Be sure not to let the foreign matter enter vent openings in the inverter housing, such as wire clippings, spatter from welding, metal shavings, dust, etc. Otherwise, there is the danger of fire. 30
- ⚠ Caution** Be sure to install the inverter in a place that can bear the weight according to the specifications in the text (Chapter 1, Specifications Tables). Otherwise, it may fall and cause injury to personnel. 30
- ⚠ Caution** Be sure to install the unit on a perpendicular wall that is not subject to vibration. Otherwise, it may fall and cause injury to personnel. 30
- ⚠ Caution** Be sure not to install or operate an inverter that is damaged or has missing parts. Otherwise, it may cause injury to personnel. 2-9Be sure to install the inverter in a well-ventilated room that does not have direct exposure to sunlight, a tendency for high temperature, high humidity or dew condensation, high levels of dust, corrosive gas, explosive gas, inflammable gas, grinding-fluid mist, salt damage, etc. Otherwise, there is the danger of fire. 30
- ⚠ Caution** Be sure to maintain the specified clearance area around the inverter and to provide adequate ventilation. Otherwise, the inverter may overheat and cause equipment damage or fire. 32

Wiring - Warnings for Electrical Practice and Wire Specifications

-  **WARNING** “USE 60/75 C Cu wire only” or equivalent. For models 3G3MX2-AB004, -AB007, -AB022, -A2015, -A2022, -A2037, -A2055, -A2075. **45**
-  **WARNING** “USE 75 C Cu wire only” or equivalent. For models 3G3MX2-AB002, -AB004, A2002, -A2004, -A2007, -A4022, -A4030, -A4040, -A4055, -A4075. **45**
-  **WARNING** “USE 60 C Cu wire only” or equivalent. For models 3G3MX2-A4004, -A4007, and -A4015. **45**
-  **WARNING** “Open Type Equipment.”..... **46**
-  **WARNING** “Suitable for use on a circuit capable of delivering not more than 100k rms symmetrical amperes, 240V maximum when protected by Class CC, G, J or R fuses or circuit breaker having an interrupting rating not les than 100,000 rms symmetrical amperes, 240 volts maximum”. For 200V models..... **42**
-  **WARNING** “Suitable for use on a circuit capable of delivering not more than 100k rms symmetrical amperes, 480V maximum when protected by Class CC, G, J or R fuses or circuit breaker having an interrupting rating not les than 100,000 rms symmetrical amperes, 480 volts maximum.” For 400V models **42**
-  **HIGH VOLTAGE** Be sure to ground the unit. Otherwise, there is a danger of electric shock and/or fire. **42**
-  **HIGH VOLTAGE** Wiring work shall be carried out only by qualified personnel. Otherwise, there is a danger of electric shock and/or fire. **42**
-  **HIGH VOLTAGE** Implement wiring after checking that the power supply is OFF. Otherwise, you may incur electric shock and/or fire. **42**
-  **HIGH VOLTAGE** Do not connect wiring to an inverter operate an inverter that is not mounted according to the instructions given in this manual.....**42**
 Otherwise, there is a danger of electric shock and/or injury to personnel.
-  **WARNING** Make sure the input power to the inverter is OFF. If the drive has been powered, leave it OFF for ten minutes before continuing.....**55**.

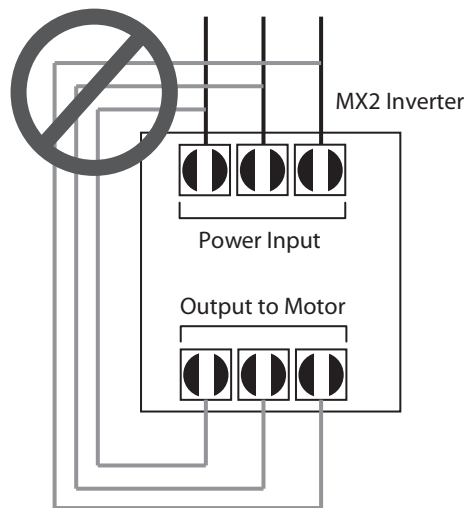
Wiring - Cautions for Electrical Practice

- ⚠ **Caution** Fasten the screws with the specified fastening torque in the table provided. Check for any loose screws. Otherwise, there is danger of fire. **46**

- ⚠ **Caution** Be sure that the input voltage matches the inverter specifications;
 - Single phase 200V to 240V 50/60Hz (up to 2.2kW) for “AB” model
 - Three phase 200V to 240V 50/60Hz (up to 15kW) for “A2” model
 - Three phase 380V to 480V 50/60Hz (up to 15kW) for “A4” model **49**

- ⚠ **Caution** Be sure not to power a three-phase-only inverter with single phase power. Otherwise, there is the possibility of damage to the inverter and the danger of fire. **49**

- ⚠ **Caution** Be sure not to connect an AC power supply to the output terminals. Otherwise, there is the possibility of damage to the inverter and the danger of injury and/or fire. **50**



- ⚠ **Caution** Be sure to use a specified type of braking resistor/regenerative braking unit. In case of a braking resistor, install a thermal relay that monitors the temperature of the resistor. Not doing so might result in a moderate burn due to the heat generated in the braking resistor/regenerative braking unit. Configure a sequence that enables the inverter power to turn off when unusual overheating is detected in the braking resistor/regenerative braking unit.

Transporting and Installation

- Do not drop or apply strong impact on the product. Doing so may result in damaged parts or malfunction.
- Do not hold by the terminal block cover, but hold by the fins during transportation.
- Do not connect any load other than a three-phase inductive motor to the U, V and W output terminals.

⚠ Caution Remarks for using ground fault interrupter breakers in the main power supply: Adjustable frequency inverter with integrated CE-filters and shielded (screened) motor cables have a higher leakage current toward earth GND. Especially at the moment of switching ON this can cause an inadvertent trip of ground fault interrupters. Because of the rectifier on the input side of the inverter there is the possibility to stall the switch-off function through small amounts of DC current. **50**

Please observe the following:

- Use only short time-invariant and pulse current-sensitive ground fault interrupters with higher trigger current.
- Other components should be secured with separate ground fault interrupters.
- Ground fault interrupters in the power input wiring of an inverter are not an absolute protection against electric shock. **50**

⚠ Caution Be sure to install a fuse in each phase of the main power supply to the inverter. Otherwise, there is the danger of fire. **50**

⚠ Caution For motor leads, ground fault interrupter breakers and electromagnetic contactors, be sure to size these components properly (each must have the capacity for rated current and voltage). Otherwise, there is the danger of fire. **50**

Powerup Test Caution Messages

⚠ Caution The heat sink fins will have a high temperature. Be careful not to touch them. Otherwise, there is the danger of getting burned. **56**

⚠ Caution The operation of the inverter can be easily changed from low speed to high speed. Be sure to check the capability and limitations of the motor and machine before operating the inverter. Otherwise, there is the danger of injury. **56**













⚠ Caution If you operate a motor at a frequency higher than the inverter standard default setting (50Hz/60Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage and/or injury. **56**

⚠ Caution Check the following before and during the Powerup test. Otherwise, there is the danger of equipment damage.


- Is the shorting bar between the [+1] and [+] terminals installed? DO NOT power or operate the inverter if the jumper is removed.
- Is the direction of the motor rotation correct?
- Did the inverter trip during acceleration or deceleration?
- Were the rpm and frequency meter readings as expected?
- Were there any abnormal motor vibration or noise? **57**









Warnings for Operations and Monitoring

⚠ WARNING Be sure to turn ON the input power supply only after closing the front case. While the inverter is energized, be sure not to open the front case. Otherwise, there is the danger of electric shock. **192**






-  **WARNING** Be sure not to operate electrical equipment with wet hands. Otherwise, there is the danger of electric shock. 192
-  **WARNING** While the inverter is energized, be sure not to touch the inverter terminals even when the motor is stopped. Otherwise, there is the danger of electric shock. 192
-  **WARNING** If the retry mode is selected, the motor may suddenly restart after a trip stop. Be sure to stop the inverter before approaching the machine (be sure to design the machine so that safety for personnel is secure even if it restarts.) Otherwise, it may cause injury to personnel. 192
-  **WARNING** If the power supply is cut OFF for a short period of time, the inverter may restart operating after the power supply recovers if the Run command is active. If a restart may pose danger to personnel, so be sure to use a lock-out circuit so that it will not restart after power recovery. Otherwise, it may cause injury to personnel. 192
-  **WARNING** The Stop Key is effective only when the stop function is enabled. Be sure to enable the Stop Key separately from the emergency stop. Otherwise, it may cause injury to personnel. 192
-  **WARNING** **WARNING:** During a trip event, if the alarm reset is applied and the Run command is present, the inverter will automatically restart. Be sure to apply the alarm reset only after verifying the Run command is OFF. Otherwise, it may cause injury to personnel. 192
-  **WARNING** Be sure not to touch the inside of the energized inverter or to put any conductive object into it. Otherwise, there is a danger of electric shock and/or fire. 192
-  **WARNING** If power is turned ON when the Run command is already active, the motor will automatically start and injury may result. Before turning ON the power, confirm that the RUN command is not present. 192
-  **WARNING** When the Stop key function is disabled, pressing the Stop key does not stop the inverter, nor will it reset a trip alarm. 192
-  **WARNING** Be sure to provide a separate, hard-wired emergency stop switch when the application warrants it. 192
-  **WARNING** If the power is turned ON and the Run command is already active, the motor starts rotation and is dangerous! Before turning power ON, confirm that the Run command is not active. 205
-  **WARNING** After the Reset command is given and the alarm reset occurs, the motor will restart suddenly if the Run command is already active. Be sure to set the alarm reset after verifying that the Run command is OFF to prevent injury to personnel. 210


Cautions for Operations and Monitoring


-  **Caution** The heat sink fins will have a high temperature. Be careful not to touch them. Otherwise, there is the danger of getting burned. 56


-  **Caution** The operation of the inverter can be easily changed from low speed to high speed. Be sure to check the capability and limitations of the motor and machine before operating the inverter. Otherwise, it may cause injury to personnel. **191**
-  **Caution** If you operate a motor at a frequency higher than the inverter standard default setting (50Hz/60Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage. **191**
-  **Caution** It is possible to damage the inverter or other devices if your application exceeds the maximum current or voltage characteristics of a connection point. **193**
-  **Caution** Be sure to turn OFF power to the inverter before changing the short circuit bar position to change SR/SK. Otherwise, damage to the inverter circuitry may occur. **201**
-  **Caution** Be careful not to turn PID clear ON and reset the integrator sum when the inverter is in Run mode (output to motor is ON). Otherwise, this could cause the motor to decelerate rapidly, resulting in a trip.
-  **HIGH VOLTAGE** When set RDY function ON, there will be a voltage appear at motor output terminals U, V and W even if the motor is in stop mode. So never touch the inverter power terminal even the motor is not running
-  **Caution** CAUTION: The digital outputs (relay and/or open collector) available on the drive must not be considered as safety related signals. The outputs of the external safety relay must be used for integration into a safety related control/command circuit.
-  **HIGH VOLTAGE** Dangerous voltage exists even after the Safe Stop is activated. It does NOT mean that the main power has been removed.


Warnings and Cautions for Troubleshooting and Maintenance

-  **WARNING** Wait at least ten (10) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, there is the danger of electric shock.
-  **WARNING** Make sure that only qualified personnel will perform maintenance, inspection, and part replacement. Before starting to work, remove any metallic objects from your person (wristwatch, bracelet, etc.). Be sure to use tools with insulated handles. Otherwise, there is a danger of electric shock and/or injury to personnel.
-  **WARNING** Never remove connectors by pulling on its wire leads (wires for cooling fan and logic P.C.board). Otherwise, there is a danger of fire due to wire breakage and/or injury to personnel.
-  **Caution** Do not connect the megger to any control terminals such as intelligent I/O, analog terminals, etc. Doing so could cause damage to the inverter.
-  **Caution** Never test the withstand voltage (HIPOT) on the inverter. The inverter has a surge protector between the main circuit terminals above and the chassis ground.


 **Caution** Do not connect the megger to any control circuit terminals such as intelligent I/O, analog terminals, etc. Doing so could cause damage to the inverter.


 **Caution** Never test the withstand voltage (HIPOT) on the inverter. The inverter has a surge protector between the main circuit terminals above and the chassis ground.


 **Caution** The life of the capacitor depends on ambient temperatures. Refer to the diagram of product life specified in the manual. When the capacitor stops operating at the end of the product's life, the inverter must be replaced.


 **HIGH VOLTAGE** Be careful not to touch wiring or connector terminals when working with the inverters and taking measurements. Be sure to place the measurement circuitry components above in an insulated housing before using them


4 General Warnings and Cautions

 **WARNING** Never modify the unit. Otherwise, there is a danger of electric shock and/or injury.

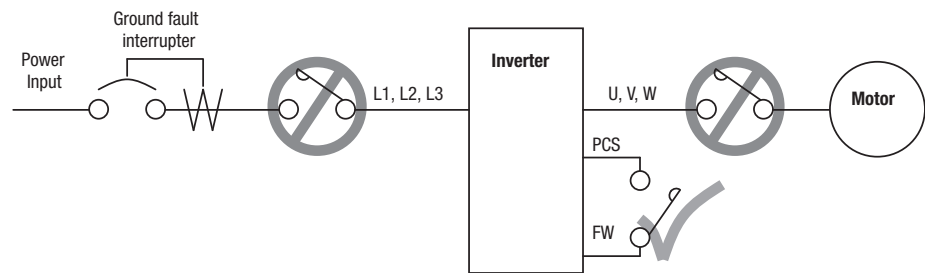
 **Caution** Withstand voltage test and insulation resistance tests (HIPOT) are executed before the units are shipped, so there is no need to conduct these tests before operation.

 **Caution** Do not attach or remove wiring or connectors when power is applied. Also, do not check signals during operation.

 **Caution** Be sure to connect the grounding terminal to earth ground.

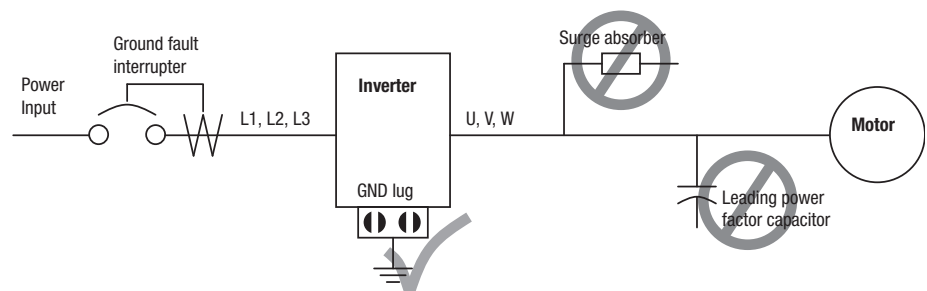
 **Caution** When inspecting the unit, be sure to wait ten minutes after turning OFF the power supply before opening the cover.

⚠ Caution Do not stop operation by switching OFF electromagnetic contactors on the primary or secondary side of the inverter.



When there has been a sudden power failure while an operation instruction is active, then the unit may restart operation automatically after the power failure has ended. If there is a possibility that such an occurrence may harm humans, then install an electromagnetic contactor (Mgo) on the power supply side, so that the circuit does not allow automatic restarting after the power supply recovers. If the optional remote operator is used and the retry function has been selected, this will also cause automatic restarting when a Run command is active. So, please be careful.

⚠ Caution Do not insert leading power factor capacitors or surge absorbers between the output terminals of the inverter and motor.



When there has been a sudden power failure while an operation instruction is active, then the unit may restart operation automatically after the power failure has ended. If there is a possibility that such an occurrence may harm humans, then install an electromagnetic contactor (Mgo) on the power supply side, so that the circuit does not allow automatic restarting after the power supply recovers. If the optional remote operator is used and the retry function has been selected, this will also cause automatic restarting when a Run command is active. So, please be careful.

⚠ Caution MOTOR TERMINAL SURGE VOLTAGE SUPPRESSION FILTER
(For the 400 V CLASS)

In a system using an inverter with the voltage control PWM system, a voltage surge caused by the cable constants such as the cable length (especially when the distance between the motor and the inverter is 10m or more) and cabling method may occur at the motor terminals. A dedicated filter of the 400 V class for suppressing this voltage surge is available. Be sure to install a filter in this situation.

⚠ Caution EFFECTS OF POWER DISTRIBUTION SYSTEM ON INVERTER

In the case below involving a general-purpose inverter, a large peak current can flow on the power supply side, sometimes destroying the converter module:

1. The unbalance factor of the power supply is 3% or higher.
2. the power supply capacity is at least 10 times greater than the inverter capacity (or the power supply capacity is 500 kVA or more).
3. Abrupt power supply changes are expected, due to conditions such as:
 - a) Several inverters are interconnected with a short bus.
 - b) A thyristor converter and an inverter are interconnected with a short bus.
 - c) An installed phase advance capacitor opens and closes.

Where these conditions exist or when the connected equipment must be highly reliable, you MUST install an input side AC-reactor of 3% (at a voltage drop at rated current) with respect to the supply voltage on the power supply side. Also, where the effects of an indirect lightning strike are possible, install a lightning conductor.

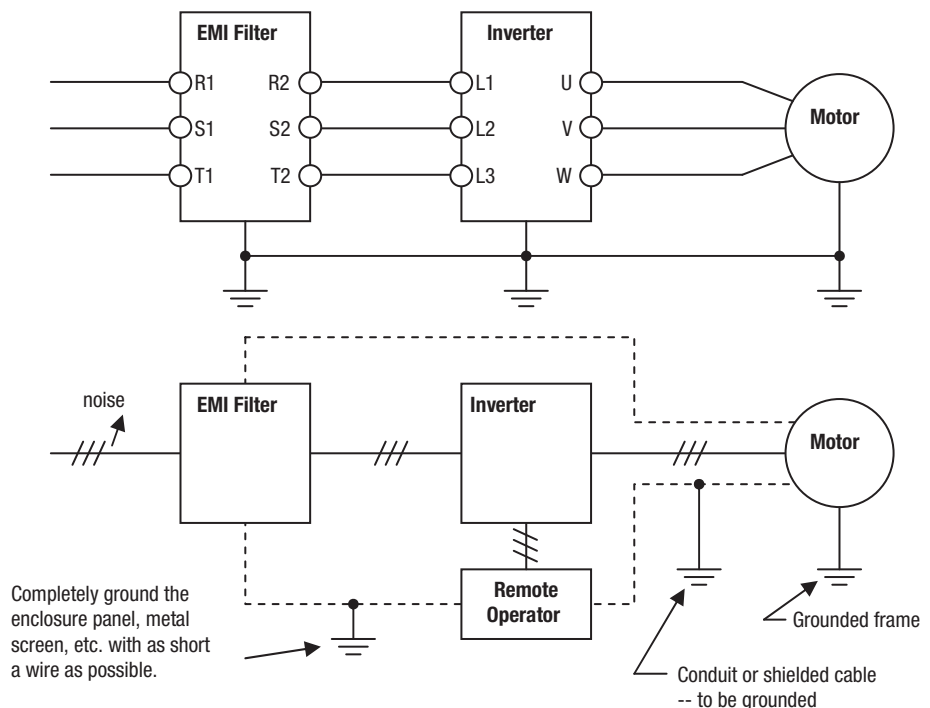
⚠ Caution SUPPRESSION FOR NOISE INTERFERENCE FROM INVERTER

The inverter uses many semiconductor switching elements such as transistors and IGBTs. Thus, a radio receiver or measuring instrument located near the inverter is susceptible to noise interference.

To protect the instruments from erroneous operation due to noise interference, they should be used well away from the inverter. It is also effective to shield the whole inverter structure.

The addition of an EMI filter on the input side of the inverter also reduces the effect of noise from the commercial power line on external devices.

Note that the external dispersion of noise from the power line can be minimized by connecting an EMI filter on the primary side of the inverter.



⚠ Caution When the EEPROM error E08 occurs, be sure to confirm the setting values again.

- ⚠ Caution** When using normally closed active state settings (C011 to C017) for externally commanded Forward or Reverse terminals [FW] or [RV], the inverter may start automatically when the external system is powered OFF or disconnected from the inverter! So do not use normally closed active state settings for Forward or Reverse terminals [FW] or [RV] unless your system design protects against unintended motor operation.
- ⚠ Caution** In all the instrumentations in this manual, covers and safety devices are occasionally removed to describe the details. While operating the product, make sure that the covers and safety devices are placed as they were specified originally and operate it according to the instruction manual.
- ⚠ Caution** Do not discard the inverter with household waste. Contact an industrial waste management company in your area who can treat industrial waste without polluting the environment.

5 Precautions for Safe Use

Installation and Storage

Do not store or use the product in the following places.

- Locations subject to direct sunlight.
- Locations subject to ambient temperature exceeding the specifications.
- Locations subject to relative humidity exceeding the specifications.
- Locations subject to condensation due to severe temperature fluctuations.
- Locations subject to corrosive or flammable gases.
- Locations subject to exposure to combustibles.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

Transporting, Installation and Wiring

- Do not drop or apply strong impact on the product. Doing so may result in damaged parts or malfunction.
- Do not hold by the front cover and terminal block cover, but hold by the fins during transportation.
- Do not connect an AC power supply voltage to the control input/output terminals. Doing so may result in damage to the product.
- Be sure to tighten the screws on the terminal block securely. Wiring work must be done after installing the unit body.
- Do not connect any load other than a three-phase inductive motor to the U, V, and W output terminals.
- Take sufficient shielding measures when using the product in the following locations. Not doing so may result in damage to the product.
 - Locations subject to static electricity or other forms of noise.
 - Locations subject to strong magnetic fields.
 - Locations close to power lines.

Operation and Adjustment

- Be sure to confirm the permissible range of motors and machines before operation because the inverter speed can be changed easily from low to high.
- Provide a separate holding brake if necessary.
- If the Drive Programming stops during multi-function output, the output status is held. Take safety precautions such as stopping peripheral devices.
- If the clock command is used in Drive Programming, an unexpected operation may occur due to weak battery. Take measures such as detecting a weak battery by a check that the clock data returns to the initial setting and stopping the inverter

or programs. When the LCD Digital Operator is removed or disconnected, Drive Programming is in a waiting status by the clock command.

Maintenance and Inspection

- Be sure to confirm safety before conducting maintenance, inspection or parts replacement.
- The capacitor service life is influenced by the ambient temperature. Refer to “Smoothing Capacitor Life Curve” described in the manual. When a capacitor reaches the end of its service life and does not work as the product, you need to replace the capacitor.
- When disposing of LCD digital operators and wasted batteries, follow the applicable ordinances of your local government. When disposing of the battery, insulate it using tape.



The following display must be indicated when products using lithium primary batteries (with more than 6 ppb of perchlorate) are transported to or through the State of California, USA.

Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

The 3G3AX-OP05 has the lithium primary battery (with more than 6 ppb of perchlorate). Label or mark the above display on the exterior of all outer shipping packages of your products when exporting your products which the 3G3AX-OP05 are installed to the State of California, USA.

- Do not short + and –, charge, disassemble, heat, put into the fire, or apply strong impact on the battery. The battery may leak, explode, produce heat or fire. Never use the battery which was applied strong impact due to such as fall on the floor, it may leak.
- UL standards establish that the battery shall be replaced by an expert engineer. The expert engineer must be in charge of the replacement and also replace the battery according to the method described in this manual.
- When the display of LCD Digital Operator can not be recognized due to the service life, replace the LCD Digital Operator.

6 UL[®] Cautions, Warnings and Instructions

Warnings and Cautions for Troubleshooting and Maintenance


The warnings and instructions in this section summarizes the procedures necessary to ensure an inverter installation complies with Underwriters Laboratories guidelines.


⚠ WARNING Use 60/75 C Cu wire only. (for models: 3G3MX2-A2001, -A2002, -A2004, -A2007, -AB015, -AB022, -A4004, -A4007, -A4015, -A4022, -A4030)


⚠ WARNING Use 75 C Cu wire only. (for models: 3G3MX2-AB001, -AB002, -AB004, -AB007, -A2015, -A2022, -A2037, -A2055, -A2075, -A2110, -A2150, -A4040, -A4055, -A4075, -A4110 and -A4150)


⚠ WARNING Suitable for use on a circuit capable of delivering not more than 100,000 rms Symmetrical Amperes, 240 or 480V maximum.

-  **WARNING** When protected by CC, G, J, or R class Fuses, or when Protected By A Circuit Breaker Having An Interrupting Rating Not Less Than 100,000 rms Symmetrical Amperes, 240 or 480 Volts Maximum.

-  **WARNING** Install device in pollution degree 2 environment.

-  **WARNING** Maximum Surrounding Air Temperature 50°C

-  **WARNING** Solid state motor overload protection is provided in each model

-  **WARNING** Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes

Terminal symbols and Screw size

| Inverter Model | Screw Size | Required Torque (N-m) | Wire range |
|---|------------|-----------------------|-----------------------------|
| 3G3MX2-AB001, 3G3MX2-AB002, 3G3MX2-AB004 | M4 | 1.0 | AWG16 (1.3mm ²) |
| 3G3MX2-AB007 | M4 | 1.4 | AWG12 (3.3mm ²) |
| 3G3MX2-AB015, 3G3MX2-AB022 | M4 | 1.4 | AWG10 (5.3mm ²) |
| 3G3MX2-A2001, 3G3MX2-A2002, 3G3MX2-A2004, 3G3MX2-A2007 | M4 | 1.0 | AWG16 (1.3mm ²) |
| 3G3MX2-A2015 | M4 | 1.4 | AWG14 (2.1mm ²) |
| 3G3MX2-A2022 | M4 | 1.4 | AWG12 (3.3mm ²) |
| 3G3MX2-A2037 | M4 | 1.4 | AWG10 (5.3mm ²) |
| 3G3MX2-A2055, 3G3MX2-A2075 | M5 | 3.0 | AWG6 (13mm ²) |
| 3G3MX2-A2110 | M6 | 5.9 to 8.8 | AWG4 (21mm ²) |
| 3G3MX2-A2150 | M8 | 5.9 to 8.8 | AWG2 (34mm ²) |
| 3G3MX2-A4004, 3G3MX2-A4007, 3G3MX2-A4015 | M4 | 1.4 | AWG16 (1.3mm ²) |
| 3G3MX2-A4022, 3G3MX2-A4030 | M4 | 1.4 | AWG14 (2.1mm ²) |
| 3G3MX2-A4040 | M4 | 1.4 | AWG12 (3.3mm ²) |
| 3G3MX2-A4055, 3G3MX2-A4075 | M5 | 3.0 | AWG10 (5.3mm ²) |
| 3G3MX2-A4110, 3G3MX2-A4150 | M6 | 5.9 to 8.8 | AWG6 (13mm ²) |

7 Fuse Sizes

The inverter shall be connected with a UL Listed Cartridge Nonrenewable fuse, rated 600Vac with the current ratings as shown in the table below.

| Inverter Model | Type | Rating |
|---|---------|----------------|
| 3G3MX2-AB001, 3G3MX2-AB002, 3G3MX2-AB004 | Class J | 10A, AIC 200kA |
| 3G3MX2-AB007 | | 15A, AIC 200kA |
| 3G3MX2-AB015 | | 20A, AIC 200kA |
| 3G3MX2-AB022 | | 30A, AIC 200kA |
| 3G3MX2-A2001, 3G3MX2-A2002, 3G3MX2-A2004 | | 10A, AIC 200kA |
| 3G3MX2-A2007, 3G3MX2-A2015 | | 15A, AIC 200kA |
| 3G3MX2-A2022 | | 20A, AIC 200kA |
| 3G3MX2-A2037, 3G3MX2-A2055 | | 30A, AIC 200kA |
| 3G3MX2-A2075 | | 40A, AIC 200kA |
| 3G3MX2-A2110, 3G3MX2-A2150 | | 80A, AIC 200kA |
| 3G3MX2-A4004, 3G3MX2-A4007, 3G3MX2-A4015, 3G3MX2-A4022 | | 10A, AIC 200kA |
| 3G3MX2-A4030, 3G3MX2-A4040 | | 15A, AIC 200kA |
| 3G3MX2-A4055, 3G3MX2-A4075 | | 20A, AIC 200kA |
| 3G3MX2-A4110 | | 30A, AIC 200kA |
| 3G3MX2-A4150 | | 40A, AIC 200kA |

8 Revision History

A manual revision history appears as a suffix to the catalogue number located at the lower left of the front and back covers.

Cat. No. I570-E2-02

↑
Revision code

| Revision code | Revision date | Description |
|---------------|---------------|---|
| 01 | 2009 | First version |
| 02 | January 2013 | Second version New functionality and IP54 models |

SECTION 1

Getting Started

1-1 Introduction

1-1-1 Main Features

Congratulation on your purchase of an MX2 Series Omron inverter! This inverter drive features state-of-the-art circuitry and components to provide high performance. The housing footprint is exceptionally small, given the size of the corresponding motor. The Omron MX2 product line includes more than a dozen inverter models to cover motor sizes from 1/8 horsepower to 20 horsepower, in either 240 VAC or 480 VAC power input versions.

The main features are:

- 200 V and 400 V class, 0.1 to 15 kW inverters having dual rating
- Drive programming function integrated
- Built-in RS485 MODBUS RTU as standard, other FieldBus optional
- New current suppressing function
- Sixteen programmable speed levels
- PID control adjusts motor speed automatically to maintain a process variable value
- Password protection to avoid unexpected parameter change

Additionally the products produced in November 09 or later includes these new features:

- Permanent magnet motor control
- 5 line LCD support with Read and Write capability (Copy function) and Real Time Clock Trip History

The design in Omron inverters overcomes many of the traditional trade-offs between speed, torque and efficiency. The performance characteristics are:

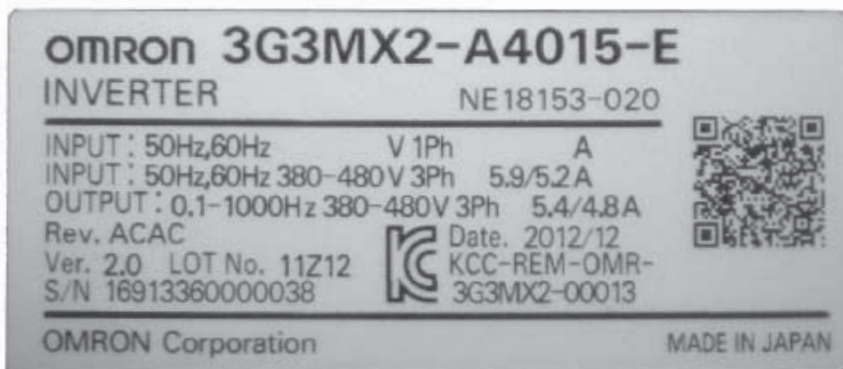
- High starting torque of 200% at 0.5 Hz
- Continuous operation at 100% torque within a 1:10 speed range (6/60 Hz/ 5/50 Hz) without motor derating.
- Fan has ON/OFF selection to provide longer life for cooling fan.

A full line of accessories from Omron is available to complete your motor application:

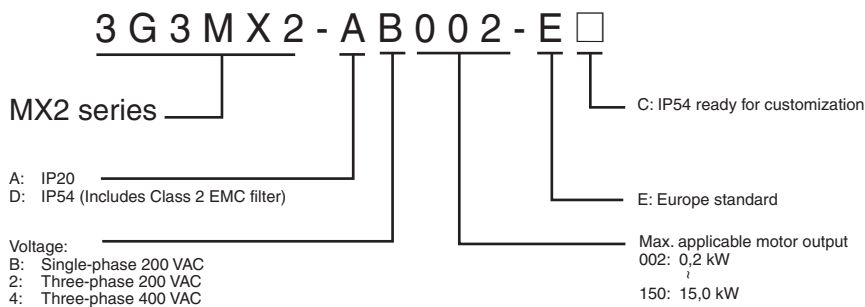
- Integrated USB port for PC communication
- Digital remote operator keypad
- Integrated brake chopper
- EMC filter (footprint type C1) optional

1-1-2 Inverter Specification Label

The Omron MX2 inverters have product labels located on the right side of the housing, as pictured below. Be sure to verify that the specifications on the labels match your power source, and application safety requirements.



The model number for a specific inverter contains useful information about its operating characteristics. Refer to the model number legend below:



1-2 MX2 Inverter Specifications

1-2-1 Model-specific tables for 200 V and 400 V class inverters

The following tables are specific to MX2 inverters for the 200 V and 400 V class model groups. Note that *General Specifications* on page 7 in this chapter apply to both voltage class groups. Footnotes for all specification tables follow the table below.

| Item | | | Single-phase 200 V class Specifications | | | | | |
|--------------------------------|------------------|----|---|-------|--------|-------|----------------------------|----------------------------|
| 3G3MX2 inverters, 200 V models | | | AB001 | AB002 | AB004F | AB007 | AB015 | AB022 |
| Applicable motor size *2 | kW | VT | 0.2 | 0.4 | 0.55 | 1.1 | 2.2 | 3.0 |
| | | CT | 0.1 | 0.2 | 0.4 | 0.75 | 1.5 | 2.2 |
| | HP | VT | 1/4 | 1/2 | 3/4 | 1.5 | 3 | 4 |
| | | CT | 1/8 | 1/4 | 1/2 | 1 | 2 | 3 |
| Rated capacity (kVA) | 200 V | VT | 0.4 | 0.6 | 1.2 | 2.0 | 3.3 | 4.1 |
| | | CT | 0.2 | 0.5 | 1.0 | 1.7 | 2.7 | 3.8 |
| | 240 V | VT | 0.4 | 0.7 | 1.4 | 2.4 | 3.9 | 4.9 |
| | | CT | 0.3 | 0.6 | 1.2 | 2.0 | 3.3 | 4.5 |
| Loss at 100% load | | W | 12 | 22 | 30 | 48 | 79 | 104 |
| Efficiency at rated load | | % | 89.5 | 90 | 93 | 94 | 95 | 95.5 |
| Rated input voltage | | | Single-phase: 200 V-15% to 240 V+10%, 50/60 Hz±5% | | | | | |
| Rated output voltage *3 | | | 3-phase: 200 to 240 V (proportional to input voltage) | | | | | |
| Rated output current (A) | VT | | 1.2 | 1.9 | 3.5 | 6.0 | 9.6 | 12.0 |
| | CT | | 1.0 | 1.6 | 3.0 | 5.0 | 8.0 | 11.0 |
| Starting torque *6 | | | 200% at 0.5 Hz | | | | | |
| Braking | Without resistor | | 100%: ≤50 Hz 50%: ≤60 Hz | | | | 70%: ≤50 Hz 50%: ≤60 Hz | 20%: ≤50 Hz 20%: ≤60 Hz |
| | With resistor | | 150% | | | | 100% | |
| DC braking | | | Variable operating frequency, time, and braking force | | | | | |
| Weight | kg | | 1.0 | 1.0 | 1.1 | 1.4 | 1.8 | 1.8 |
| | lb | | 2.2 | 2.2 | 2.4 | 3.1 | 4.0 | 4.0 |

Footnotes for the preceding table and the tables that follow:

- Note 1** The protection method conforms to JEM 1030.
- Note 2** The applicable motor refers to a standard 3-phase motor (4p). When using other motors, care must be taken to prevent the rated motor current (50/60 Hz) from exceeding the rated output current of the inverter.
- Note 3** The output voltage decreases as the main supply voltage decreases (except when using the AVR function). In any case, the output voltage cannot exceed the input power supply voltage.
- Note 4** To operate the motor beyond 50/60 Hz, consult the motor manufacturer for the maximum allowable rotation speed.
- Note 5** For achieving approved input voltage rating categories:
 - 460 to 480 VAC - Over-voltage category 2
 - 380 to 460 VAC - Over-voltage category 3
 To meet the Over-voltage category 3, insert an EN or IEC standard compliant isolation transformer that is earth grounded and star connected (for Low Voltage Directive).
- Note 6** At the rated voltage when using a standard 3-phase, 4-pole motor.

- Note 7** The braking torque via capacitive feedback is the average deceleration torque at the shortest deceleration (stopping from 50/60 Hz as indicated). It is not continuous regenerative braking torque. The average deceleration torque varies with motor loss. This value decreases when operating beyond 50 Hz. If a large regenerative torque is required, the optional regenerative braking unit and a resistor should be used.
- Note 8** The frequency command is the maximum frequency at 9.8 V for input voltage 0 to 10 VDC, or at 19.6 mA for input current 4 to 20 mA. If this characteristic is not satisfactory for your application, contact your Omron representative.
- Note 9** If the inverter is operated outside the region shown in the graph in the derating curve, the inverter may be damaged or its service life may be shortened. Set *bbb* Carrier Frequency Adjustment in accordance with the expected output current level. See derating curve section for the detailed information of the inverter operating range.
- Note 10** The storage temperature refers to the short-term temperature during transportation.
- Note 11** Conforms to the test method specified in JIS C0040 (1999). For the model types excluded in the standard specifications, contact your Omron sales representative.
- Note 12** Watt losses are calculated values based on specification of main semi-conductors. You must take suitable margin when designing cabinet based on these values. Otherwise there is a possibility of heating trouble.

| Item | | | Three-phase 200V class Specifications | | | | | |
|--------------------------------|------------------|-----------------------------|---|-------|-------|-------|----------------------------|-------|
| 3G3MX2 inverters, 200 V models | | | A2001 | A2002 | A2004 | A2007 | A2015 | A2022 |
| Applicable motor size *2 | kW | VT | 0.2 | 0.4 | 0.75 | 1.1 | 2.2 | 3.0 |
| | | CT | 0.1 | 0.2 | 0.4 | 0.75 | 1.5 | 2.2 |
| | HP | VT | 1/4 | 1/2 | 1 | 1.5 | 3 | 4 |
| | | CT | 1/8 | 1/4 | 1/2 | 1 | 2 | 3 |
| Rated capacity (kVA) | 200 V | VT | 0.4 | 0.6 | 1.2 | 2.0 | 3.3 | 4.1 |
| | | CT | 0.2 | 0.5 | 1.0 | 1.7 | 2.7 | 3.8 |
| | 240 V | VT | 0.4 | 0.7 | 1.4 | 2.4 | 3.9 | 4.9 |
| | | CT | 0.3 | 0.6 | 1.2 | 2.0 | 3.3 | 4.5 |
| Loss at 100% load | W | 12 | 22 | 30 | 48 | 79 | 104 | |
| Efficiency at rated load | % | 89.5 | 90 | 93 | 94 | 95 | 95.5 | |
| Rated input voltage | | | Three-phase: 200 V-15% to 240 V+10%, 50/60 Hz±5% | | | | | |
| Rated output voltage *3 | | | Three-phase: 200 to 240 V (proportional to input voltage) | | | | | |
| Rated output current (A) | VT | 1.2 | 1.9 | 3.5 | 6.0 | 9.6 | 12.0 | |
| | CT | 1.0 | 1.6 | 3.0 | 5.0 | 8.0 | 11.0 | |
| Starting torque *6 | | | 200% at 0.5 Hz | | | | | |
| Braking | Without resistor | 100%: ≤50 Hz 50%: ≤60 Hz | | | | | 70%: ≤50 Hz 50%: ≤60 Hz | |
| | With resistor | 150% | | | | | | |
| DC braking | | | Variable operating frequency, time, and braking force | | | | | |
| Weight | kg | 1.0 | 1.0 | 1.1 | 1.2 | 1.6 | 1.8 | |
| | lb | 2.2 | 2.2 | 2.4 | 2.6 | 3.5 | 4.0 | |

| Item | | | Three-phase 200V class Specifications | | | | |
|--------------------------------|------------------|-----------------------------|---|-------|-------|----------------------------|-------|
| 3G3MX2 inverters, 200 V models | | | A2037 | A2055 | A2075 | A2110 | A2150 |
| Applicable motor size *2 | kW | VT | 5.5 | 7.5 | 11 | 15 | 18.5 |
| | | CT | 3.7 | 5.5 | 7.5 | 11 | 15 |
| | HP | VT | 7.5 | 10 | 15 | 20 | 25 |
| | | CT | 5 | 7.5 | 10 | 15 | 20 |
| Rated capacity (kVA) | 200 V | VT | 6.7 | 10.3 | 13.8 | 19.3 | 23.9 |
| | | CT | 6.0 | 8.6 | 11.4 | 16.2 | 20.7 |
| | 240 V | VT | 8.1 | 12.4 | 16.6 | 23.2 | 28.6 |
| | | CT | 7.2 | 10.3 | 13.7 | 19.5 | 24.9 |
| Loss at 100% load | W | 154 | 229 | 313 | 458 | 625 | |
| Efficiency at rated load | % | 96 | 96 | 96 | 96 | 96 | |
| Rated input voltage | | | Single-phase: 200 V-15% to 240 V+10%, 50/60 Hz±5% | | | | |
| Rated output voltage *3 | | | Three-phase: 200 to 240 V (proportional to input voltage) | | | | |
| Rated output current (A) | VT | 19.6 | 30.0 | 40.0 | 56.0 | 69.0 | |
| | CT | 17.5 | 25.0 | 33.0 | 47.0 | 60.0 | |
| Starting torque *6 | | | 200% at 0.5 Hz | | | | |
| Braking | Without resistor | 100%: ≤50 Hz 50%: ≤60 Hz | | | | 70%: ≤50 Hz 50%: ≤60 Hz | |
| | With resistor | 150% | | | | | |
| DC braking | | | Variable operating frequency, time, and braking force | | | | |
| Weight | kg | 2.0 | 3.3 | 3.4 | 5.1 | 7.4 | |
| | lb | 4.4 | 7.3 | 7.5 | 11.2 | 16.3 | |

| Item | | | Three-phase 400V class Specifications | | | | | |
|--------------------------------|------------------|----|---|-------|-------|-------|----------------------------|-------|
| 3G3MX2 inverters, 400 V models | | | A4004 | A4007 | A4015 | A4022 | A4030 | A4040 |
| Applicable motor size *2 | kW | VT | 0.75 | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 |
| | | CT | 0.4 | 0.75 | 1.5 | 2.2 | 3.0 | 4.0 |
| | HP | VT | 1 | 2 | 3 | 4 | 5 | 7.5 |
| | | CT | 1/2 | 1 | 2 | 3 | 4 | 5 |
| Rated capacity (kVA) | 380 V | VT | 1.3 | 2.6 | 3.5 | 4.5 | 5.7 | 7.3 |
| | | CT | 1.1 | 2.2 | 3.1 | 3.6 | 4.7 | 6.0 |
| | 480 V | VT | 1.7 | 3.4 | 4.4 | 5.7 | 7.3 | 9.2 |
| | | CT | 1.4 | 2.8 | 3.9 | 4.5 | 5.9 | 7.6 |
| Loss at 100% load | | W | 35 | 56 | 96 | 116 | 125 | 167 |
| Efficiency at rated load | | % | 92 | 93 | 94 | 95 | 96 | 96 |
| Rated input voltage | | | Three-phase: 380 V-15% to 480 V+10%, 50/60 Hz±5% | | | | | |
| Rated output voltage *3 | | | Three-phase: 380 to 480 V (proportional to input voltage) | | | | | |
| Rated output current (A) | VT | | 2.1 | 4.1 | 5.4 | 6.9 | 8.8 | 11.1 |
| | CT | | 1.8 | 3.4 | 4.8 | 5.5 | 7.2 | 9.2 |
| Starting torque *6 | | | 200% at 0.5 Hz | | | | | |
| Braking | Without resistor | | 100%: ≤50 Hz 50%: ≤60 Hz | | | | 70%: ≤50 Hz 50%: ≤60 Hz | |
| | With resistor | | 150% | | | | | |
| DC braking | | | Variable operating frequency, time, and braking force | | | | | |
| Weight | kg | | 1.5 | 1.6 | 1.8 | 1.9 | 1.9 | 2.1 |
| | lb | | 3.3 | 3.5 | 4.0 | 4.2 | 4.2 | 4.6 |

| Item | | | Three-phase 400V class Specifications | | | |
|--------------------------------|------------------|----|---|-------|-------|-------|
| 3G3MX2 inverters, 400 V models | | | A4055 | A4075 | A4110 | A4150 |
| Applicable motor size *2 | kW | VT | 7.5 | 11 | 15 | 18.5 |
| | | CT | 5.5 | 7.5 | 11 | 15 |
| | HP | VT | 10 | 15 | 20 | 25 |
| | | CT | 7.5 | 10 | 15 | 20 |
| Rated capacity (kVA) | 380 V | VT | 11.5 | 15.1 | 20.4 | 25.0 |
| | | CT | 9.7 | 11.8 | 15.7 | 20.4 |
| | 480 V | VT | 14.5 | 19.1 | 25.7 | 31.5 |
| | | CT | 12.3 | 14.9 | 19.9 | 25.7 |
| Loss at 100% load | | W | 229 | 296 | 411 | 528 |
| Efficiency at rated load | | % | 96 | 96.2 | 96.4 | 96.6 |
| Rated input voltage | | | Three-phase: 380 V-15% to 480 V+10%, 50/60 Hz±5% | | | |
| Rated output voltage *3 | | | Three-phase: 380 to 480 V (proportional to input voltage) | | | |
| Rated output current (A) | VT | | 17.5 | 23.0 | 31.0 | 38.0 |
| | CT | | 14.8 | 18.0 | 24.0 | 31.0 |
| Starting torque *6 | | | 200% at 0.5 Hz | | | |
| Braking | Without resistor | | 100%: ≤50 Hz 50%: ≤60 Hz | | | |
| | With resistor | | 150% | | | |
| DC braking | | | Variable operating frequency, time, and braking force | | | |
| Weight | kg | | 3.5 | 3.5 | 4.7 | 5.2 |
| | lb | | 7.7 | 7.7 | 10.4 | 11.5 |

1-2-2 General Specifications

The following table applies to all MX2 inverters.

| Item | | General Specifications | | |
|--------------------------------|---|--|--|--|
| Protective housing | | IP 20 | | |
| Control method | | Sinusoidal Pulse Width Modulation (PWM) control | | |
| Carrier frequency | | 2 kHz to 15 kHz (derating required depending on the model) | | |
| Output frequency range | | 0.1 to 400 Hz | | |
| Frequency accuracy | | Digital command: 0.01% of the maximum frequency Analog command: 0.2% of the maximum frequency (25°C ±10°C) | | |
| Frequency setting resolution | | Digital: 0.01 Hz; Analog: max. frequency/400 | | |
| Volt./Freq. characteristic | | V/f control (constant torque, reduced torque, free-V/F): base freq. 30 Hz ~400 Hz ad-justable Sensorless vector control, Closed loop control with motor encoder feedback: base freq. 30 Hz ~ 400 Hz ad-justable | | |
| Overload capacity | | Dual rating: CT(Heavy duty) : 60 sec. @ 150% VT(Normal duty) : 60 sec. @ 120% | | |
| Acceleration/deceleration time | | 0.01 to 3600 seconds, linear and S-curve accel/decel, second accel/decel setting available | | |
| Starting torque | | 200% @0.5 Hz (sensorless vector control) | | |
| Input signal | Freq. setting | Operator panel | Up and Down keys / Value settings | |
| | | External signal | 0 to 10 VDC (input impedance 10 k Ohms), 4 to 20 mA (input impedance 100 Ohms), Potentiometer (1 k to 2 k Ohms, 2 W) | |
| | | Via network | RS485 ModBus RTU, other network option | |
| | FWD/REV run | Operator panel | Run/Stop (Forward/Reverse run change by command) | |
| | | External signal | Forward run/stop, Reverse run/stop | |
| | | Via network | RS485 ModBus RTU, other network option | |
| | Intelligent input terminal Seven terminals, sink/source changeable by a short bar 68 functions assignable | | FW (forward run command), RV (reverse run command), CF1~CF4 (multi-stage speed setting), JG (jog command), DB (external braking), SET (set second motor), 2CH (2-stage accel./decel. command), FRS (free run stop command), EXT (external trip), USP (startup function), CS (commercial power switchover), SFT (soft lock), AT (analog input selection), RS (reset), PTC (thermistor thermal protection), STA (start), STP (stop), F/R (forward/reverse), PID (PID disable), PIDC (PID reset), UP (remote control up function), DWN (remote control down function), UDC (remote control data clear), OPE (operator control), SF1~SF7 (multi-stage speed setting; bit operation), OLR (overload restriction), TL (torque limit enable), TRQ1 (torque limit changeover1), TRQ2 (torque limit changeover2), BOK (Braking confirmation), LAC (LAD cancellation), PCLR (position deviation clear), ADD (add frequency enable), F-TM (force terminal mode), ATR (permission of torque command input), KHC (Cumulative power clear), MI1~MI7 (general purpose inputs for Drive Programming), AHD (analog command hold), CP1~CP3 (multistage-position switches), ORL (limit signal of zero-return), ORG (trigger signal of zero-return), SPD (speed/position changeover), GS1,GS2 (STO inputs, safety related signals), 485 (Starting communication signal), PRG (executing Drive Programming), HLD (retain output frequency), ROK (permission of run command), EB (rotation direction detection of B-phase), DISP (display limitation), NO (no function), PSET (preset position) | |

| Item | | General Specifications |
|-----------------------|--|--|
| Output signal | Intelligent output terminal 48 functions assignable | RUN (run signal), FA1~FA5 (frequency arrival signal), OL,OL2 (overload advance notice signal), OD (PID deviation error signal), AL (alarm signal), OTQ (over/under torque threshold), UV (under-voltage), TRQ (torque limit signal), RNT (run time expired), ONT (power ON time expired), THM (thermal warning), BRK (brake release), BER (brake error), ZS (0Hz detection), DSE (speed deviation excessive), POK (positioning completion), ODc (analog voltage input disconnection), OIDc (analog current input disconnection), FBV (PID second stage output), NDC (network disconnect detection), LOG1~LOG3 (Logic output signals), WAC (capacitor life warning), WAF (cooling fan warning), FR (starting contact), OHF (heat sink overheat warning), LOC (Low load), MO1~MO3 (general outputs for Drive Programming), IRDY (inverter ready), FWR (forward operation), RVR (reverse operation), MJA (major failure), WCO (window comparator O), WCOI (window comparator OI), FREF (frequency command source), REF (run command source), SETM (second motor in operation), EDM (STO) (safe torque off performance monitor), OP (option control signal), NO (no function) |
| | Monitor output (analog) | Output freq., output current, output torque, output voltage, input power, thermal load ratio, LAD freq., heat sink temperature, general output (Drive Programming) |
| | Pulse train output (0~10 Vdc, 32 kHz max.) | [PWM output] Output freq., output current, output torque, output voltage, input power, thermal load ratio, LAD freq., heat sink temperature, general output (Drive Programming), OP (option control signal) [Pulse train output] Output frequency, output current, pulse train input monitor |
| Alarm output contact | | ON for inverter alarm (1c contacts, both normally open or closed available.) |
| Alarm output contact | | ON for inverter alarm (1c contacts, both normally open or closed available.) |
| Other functions | | Free-V/f, manual/automatic torque boost, output voltage gain adjustment, AVR function, reduced voltage start, motor data selection, auto-tuning, motor stabilization control, reverse running protection, simple position control, simple torque control, torque limiting, automatic carrier frequency reduction, energy saving operation, PID function, non-stop operation at instantaneous power failure, brake control, DC injection braking, dynamic braking (BRD), frequency upper and lower limiters, jump frequencies, curve accel and decel (S, U, inversed U, EL-S), 16-stage speed profile, fine adjustment of start frequency, accel and decel stop, process jogging, frequency calculation, frequency addition, 2-stage accel/decel, stop mode selection, start/end freq., analog input filter, window comparators, input terminal response time, output signal delay/hold function, rotation direction restriction, stop key selection, software lock, safe stop function, scaling function, display restriction, password function, user parameter, initialization, initial display selection, cooling fan control, warning, trip retry, frequency pull-in restart, frequency matching, overload restriction, over current restriction, DC bus voltage AVR |
| Protective function | | Over-current, over-voltage, under-voltage, overload, brake resistor overload, CPU error, memory error, external trip, USP error, ground fault detection at power on, temperature error, internal communication error, driver error, thermistor error, brake error, safe stop, overload at low speed, modbus communication error, option error, encoder disconnection, speed excessive, Drive Programming command error, Drive Programming nesting error, Drive Programming execution error, Drive Programming user trip |
| Operating environment | Temperature | Operating (ambient): -10 to 50°C / Storage: -20 to 65°C Note: Some types requires special derating depending on installation conditions and carrier frequency selected. Refer to "1-2-4 Derating Curves" for more information. |
| | Humidity | 20 to 90% humidity (non-condensing) |
| | Vibration | 5.9m/s ² (0.6G), 10 to 55 Hz |
| | Location | Altitude 1,000m or less, indoors (no corrosive gasses or dust) |
| Coating color | | Black |
| Options | | Remote operator unit, cables for the units, braking unit, braking resistor, AC reactor, DC reactor, EMC filter, fieldbus |

1-2-3 Signal Ratings

Detailed ratings are in .

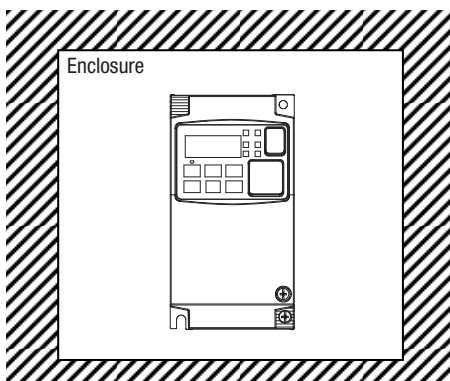
| Signal / Contact | Ratings |
|---------------------------|--|
| Built-in power for inputs | 24V DC, 100 mA maximum |
| Discrete logic inputs | 27 VDC maximum |
| Discrete logic outputs | 50 mA maximum ON state current, 27 VDC maximum OFF state voltage |
| Analog output | 10bit / 0 to 10 VDC, 1 mA |
| Analog input, current | 4 to 19.6 mA range, 20 mA nominal |
| Analog input, voltage | 0 to 9.8 VDC range, 10 VDC nominal, input impedance 10 k |
| +10 V analog reference | 10 VDC nominal, 10 mA maximum |
| Alarm relay contacts | 250 VAC, 2.5 A (R load) max., 0.2 A (I load, P.F. = 0.4) max. 100 VAC, 10 mA min 30 VDC, 3.0 A (R load) max., 0.7 A (I load, P.F. = 0.4) max.) 5 VDC, 100 mA min. |

1-2-4 Derating Curves

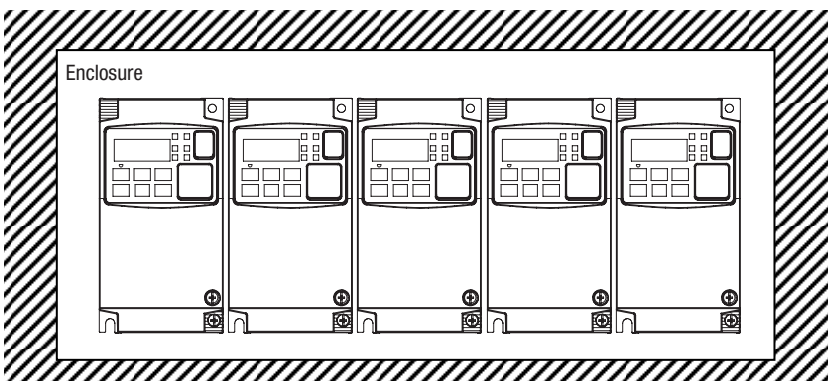
The maximum available inverter current output is limited by the carrier frequency and ambient temperature. Choosing a higher carrier frequency tends to decrease audible noise, but it also increases the internal heating of the inverter, thus decreasing (derating) the maximum current output capability. Ambient temperature is the temperature just outside the inverter housing such as inside the control cabinet where the inverter is mounted. A higher ambient temperature decreases (derates) the inverter's maximum current output capacity.

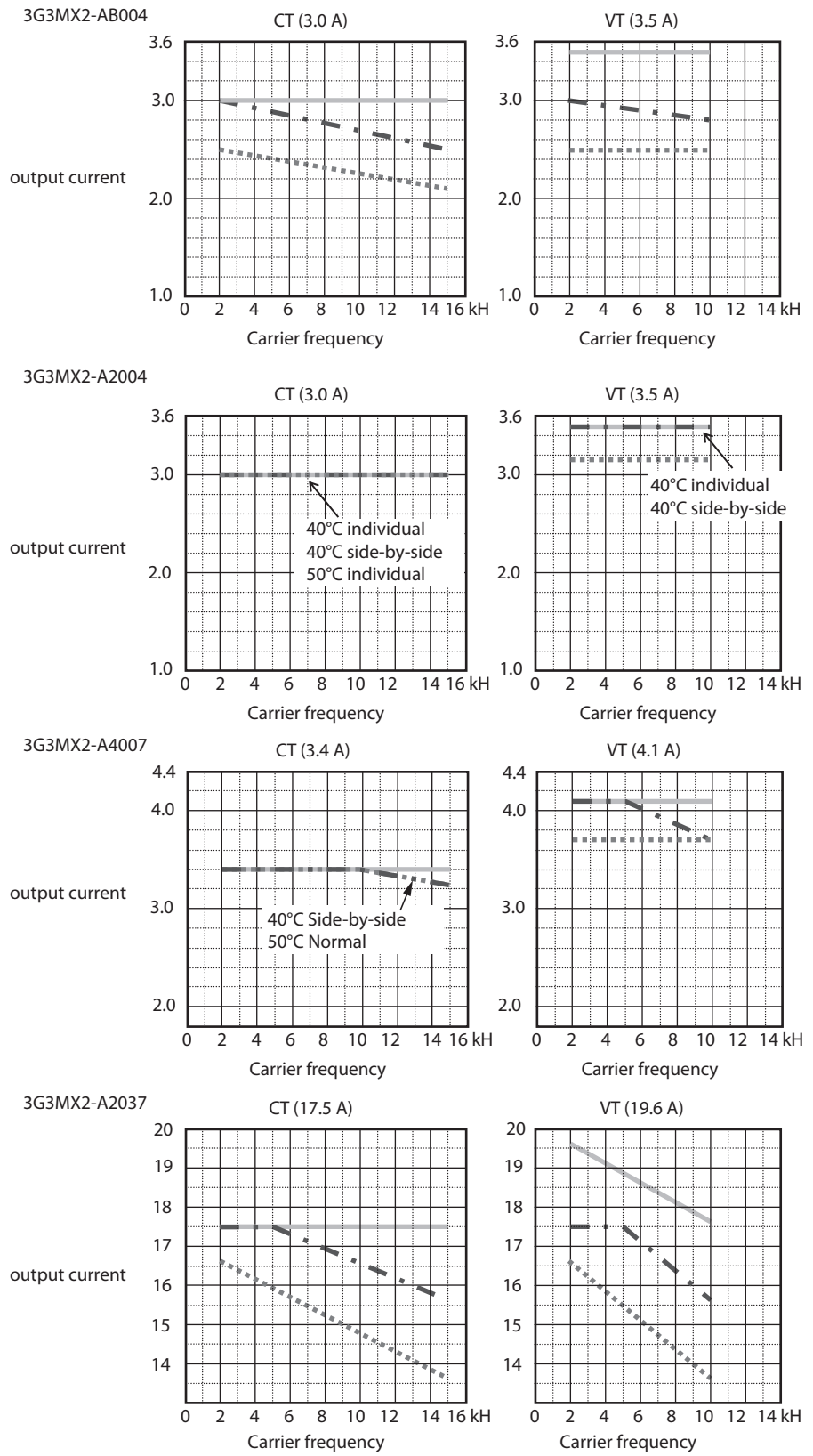
An inverter up to 4.0 kW may be mounted individually in an enclosure or side-by-side with other inverter(s) as shown below. Side-by-side mounting causes greater derating than mounting inverters separately. Graphs for either mounting methods are included in this section. Refer to *Installation Environment clearance* on page 31 for minimum clearance dimensions for both mounting configurations.

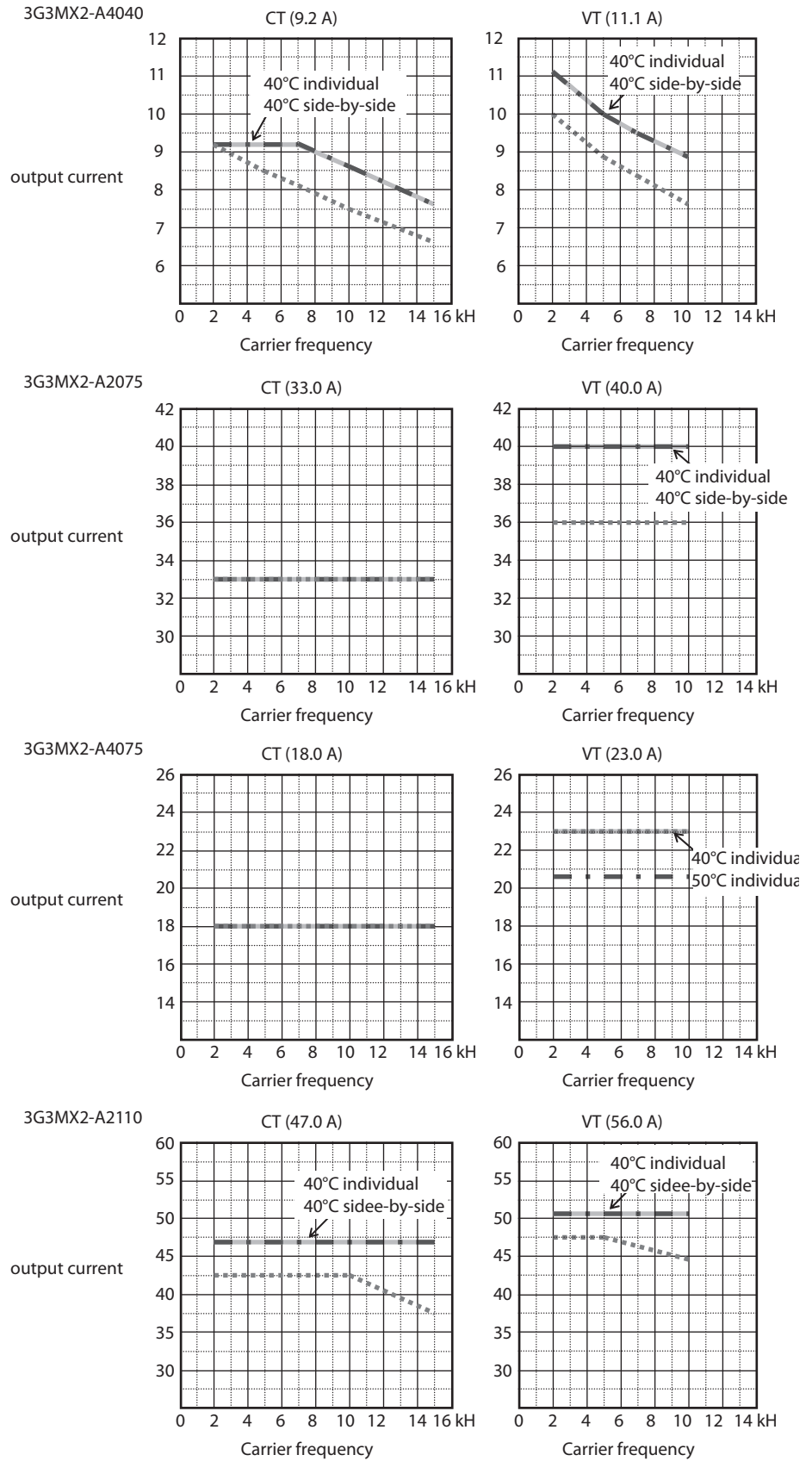
Individual mounting

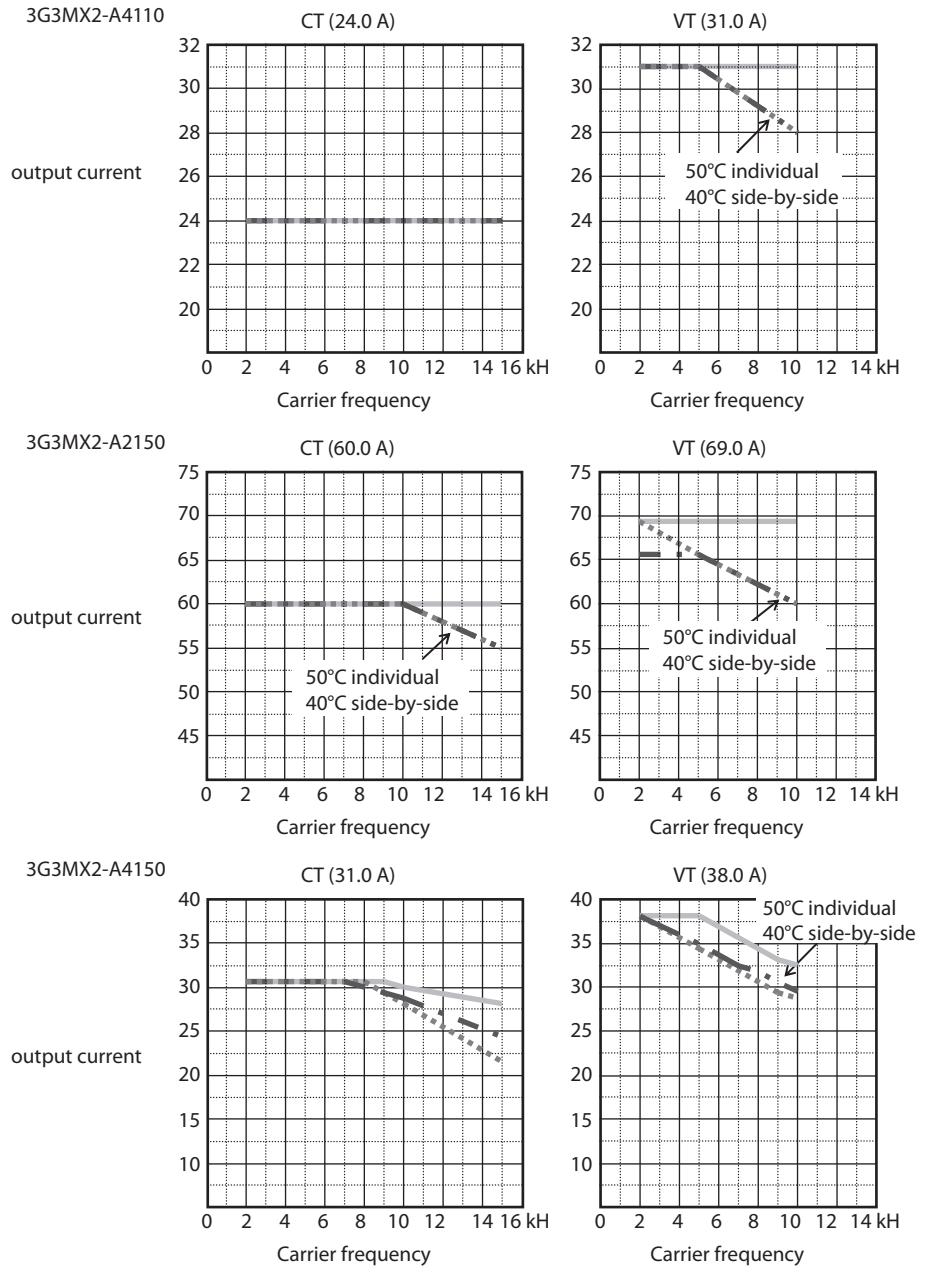


Side-by-side mounting









Ambient Temperature Derating Curves (IP54)

For 11 kW and 15 kW MX2 inverters, the carrier frequency must be limited to 2 kHz maximum.

For all other MX2 inverter models, the curves for individual mounting (ambient temperature 40°C max) are applicable.

1-3 Introduction to Variable-Frequency Drives

1-3-1 The Purpose of Motor Speed Control for Industry

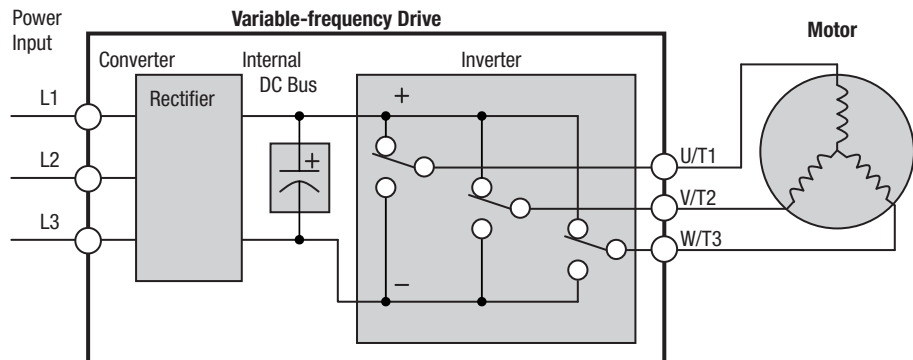
Omron inverters provide speed control for 3-phase AC induction motors. You connect AC power to the inverter, and connect the inverter to the motor. Many applications benefit from a motor with variable speed, in several ways:

- Energy savings - HVAC
- Need to coordinate speed with an adjacent process - textile and printing presses
- Need to control acceleration and deceleration (torque)
- Sensitive loads - elevators, food processing, pharmaceuticals

1-3-2 What is an Inverter

The term *inverter* and *variable-frequency drive* are related and somewhat interchangeable. An electronic motor drive for an AC motor can control the motor's speed by *varying the frequency* of the power sent to the motor.

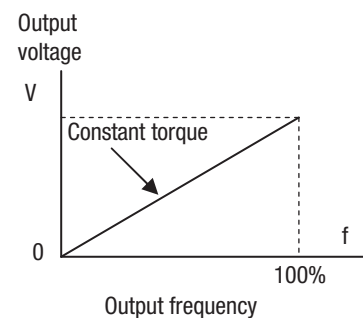
An inverter, in general, is a device that converts DC power to AC power. The figure below shows how the variable-frequency drive employs an internal inverter. The drive first converts incoming AC power to DC through a rectifier bridge, creating an internal DC bus voltage. Then the inverter circuit converts the DC back to AC again to power the motor. The special inverter can vary its output frequency and voltage according to the desired motor speed.



The simplified drawing of the inverter shows three double-throw switches. In Omron inverters, the switches are actually IGBTs (insulated gate bipolar transistors). Using a commutation algorithm, the microprocessor in the drive switches the IGBTs on and off at a very high speed to create the desired output waveforms. The inductance of the motor windings helps smooth out the pulses.

1-3-3 Torque and Constant Volts/Hertz Operation

In the past, AC variable speed drives used an open loop (scalar) technique to control speed. The constant-volts-hertz operation maintains a constant ratio between the applied voltage and the applied frequency. With these conditions, AC induction motors inherently delivered constant torque across the operating speed range. For some applications, this scalar technique was adequate.



Today, with the advent of sophisticated microprocessors and digital signal processors (DSPs), it is possible to control the speed and torque of AC induction motors with unprecedented accuracy. The MX2 utilizes these devices to perform complex mathematical calculations required to achieve superior performance. You can choose various torque curves to fit the needs of your application. Constant torque applies the same torque level across the frequency (speed) range. Variable torque, also called reduced torque, lowers the torque delivered at mid-level frequencies. A torque boost setting will add additional torque in the lower half of the frequency range for the constant and variable torque curves. With the free-setting torque curve feature, you can specify a series of data points that will define a custom torque curve to fit your application.

1-3-4 Inverter Input and Three-phase Power

The Omron MX2 Series of inverters includes two sub-groups: the 200 V class and the 400V class inverters. The drive described in this manual may be used in either the United States or Europe, although the exact voltage level for commercial power may be slightly different from country to country. Accordingly, a 200 V class inverter requires (nominal) 200 to 240 VAC, and 400 V class inverter requires from 380 to 480 VAC.

The 200 V class inverters MX2-B accept single-phase 200 V class input voltage, those MX2-2 three-phase power only. All 400 V class inverters require three-phase power supply.



Tip

If your application only has single phase power available, refer to MX2 inverter of 3HP or less; they can accept single phase input power. Note: Larger models may be able to accept single-phase with derating. Contact your Omron distributor for assistance.

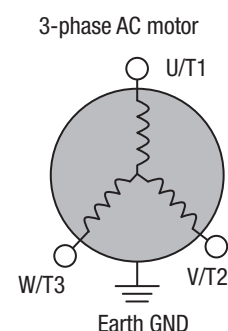
The common terminology for single phase power is line (L) and Neutral (N). Three-phase power connections are usually labeled Line 1 [R/L1], Line 2 [S/L2] and Line 3 [T/L3]. In any case, the power source should include an earth ground connection. That ground connection will need to connect to the inverter chassis and to the motor frame (see “Wire the Inverter Output to Motor” in section 2-3-12 (page 51) and “Inverter output terminal (U/T1, V/T2, W/T3)” in section 2-3-9 (page 47)).

1-3-5 Inverter Output to the Motor

The AC motor must be connected only to the inverter's output terminals. The output terminals are uniquely labeled (to differentiate them from the input terminals) with the designations U/T1, V/T2, and W/T3. This corresponds to typical motor lead connection designations T1, T2, and T3. It is often not necessary to connect a particular motor lead for a new application. The consequence of swapping any two of the three connections is the reversal of the motor direction. In applications where reversed rotation could cause equipment damage or personnel injury, be sure to verify direction of rotation before attempting full-speed operation.

For safety to personnel, you must connect the motor chassis ground to the ground connection at the bottom of the inverter housing.

Notice the three connections to the motor do not include one marked “Neutral” or “Return”. The motor represents a balanced “Y” impedance to the inverter, so there is no need for a separate return. In other words, each of the three “Hot” connections serves also as a return for the other connections, because of their phase relationship.



The Omron inverter is a rugged and reliable device. The intention is for the inverter to assume the role of controlling power to the motor during all normal operations. Therefore, this manual instructs you not to switch off power to the inverter *while the motor is running* (unless it is an emergency stop). Also, do not install or use disconnect switches in the wiring from the inverter to the motor (except thermal disconnect). Of course, safety-related devices such as fuses must be in the design to break power during a malfunction, as required by NEC and local codes.

1-3-6 Intelligent Functions and Parameters

Much of this manual is devoted to describing how to use inverter functions and how to configure inverter parameters. The inverter is micro-processor-controlled, and has many independent functions. The microprocessor has an on-board EEPROM for parameter storage. The inverter's front panel keypad provides access to all functions and parameters, which you can access through other devices as well. The general name for all these devices is the digital operator, integrated operator, or digital operator panel. Chapter 2 will show you how to get a motor running, using a minimal set of function commands or configuring parameters.

The optional read/write programmer will let you read and write inverter EEPROM contents from the programmer. This feature is particularly useful for OEMs who need to duplicate a particular inverter's settings in many other inverters in assembly-line fashion.

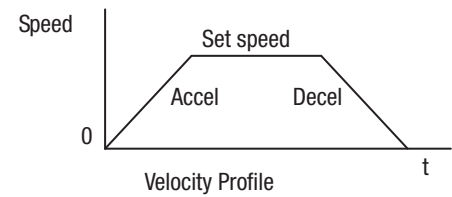
1-3-7 Braking

In general, braking is a force that attempts to slow or stop motor rotation. So it is associated with motor deceleration, but may also occur even when the load attempts to drive the motor faster than the desired speed (overhauling). If you need the motor and load to decelerate quicker than their natural deceleration during coasting, we recommend installing a braking resistor. The dynamic braking unit (built into MX2) sends excess motor energy into a resistor to slow the motor and load (See "*Introduction*" in section 5-1 (page 255) and "*Dynamic Braking*" in section 5-3 (page 262) for more information). For loads that continuously overhaul the motor for extended periods of time, the MX2 may not be suitable (contact your Omron distributor).

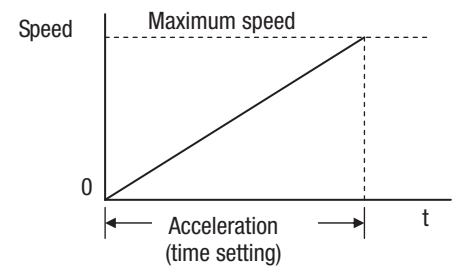
The inverter parameters include acceleration and deceleration, which you can set to match the needs of the application. For a particular inverter, motor, and load, there will be a range of practically achievable accelerations and decelerations.

1-3-8 Velocity Profiles

The MX2 inverter is capable of sophisticated speed control. A graphical representation of that capability will help you understand and configure the associated parameters. This manual makes use of the velocity profile graph used in industry (shown at right). In the example, acceleration is a ramp to a set speed, and deceleration is a decline to a stop.

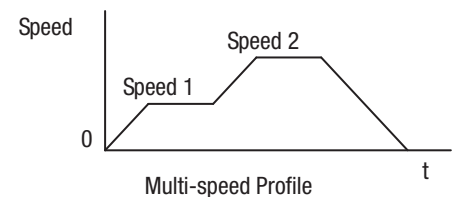


Acceleration and deceleration settings specify the time required to go from a stop to maximum frequency (or vice versa). The resulting slope (speed change divided by time) is the acceleration or deceleration. An increase in output frequency uses the acceleration slope, while a decrease uses the deceleration slope. The accel or decel time a particular speed change depends on the starting and ending frequencies.



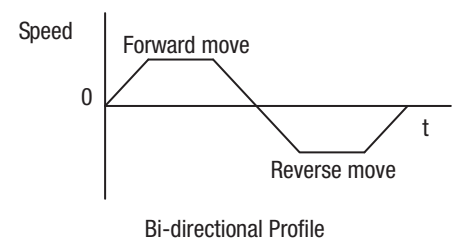
However, the slope is constant, corresponding to the full-scale accel or decel time setting. For example, the full-scale acceleration setting (time) may be 10 seconds - the time required to go from 0 to 60 Hz.

The MX2 inverter can store up to 16 preset speeds. And, it can apply separate acceleration and deceleration transitions from any preset to any other preset speed. A multi-speed profile (shown at right) uses two or more preset speeds, which you can select via intelligent input terminals. This external control can apply any preset speed at any time.



Alternatively, the selected speed is infinitely variable across the speed range. You can use the potentiometer control on the keypad for manual control. The drive accepts analog 0-10 VDC signals and 4-20 mA control signals as well.

The inverter can drive the motor in either direction. Separate FW and RV commands select the direction of rotation. The motion profile example shows a forward motion followed by a reverse motion of shorter duration. The speed presets and analog signals control the magnitude of the speed, while the FWD and REV commands determine the direction before the motion starts.



Note The MX2 can move loads in both directions. However, it is not designed for use in servo-type applications that use a bipolar velocity signal that determines direction.

1-4 Frequently Asked Questions

Q. What is the main advantage in using an inverter to drive a motor, compared to alternative solutions?

A. An inverter can vary the motor speed with very little loss of efficiency, unlike mechanical or hydraulic speed control solutions. The resulting energy savings usually pays for the inverter in a relatively short time.

Q. The term “inverter” is a little confusing, since we also use “drive” and “amplifier” to describe the electronic unit that controls a motor. What does “inverter” mean?

A. The term inverter, drive, and amplifier are used somewhat interchangeably in industry. Nowadays, the term drive, variable-frequency drive, variable-speed drive, and inverter are generally used to describe electronic, microprocessor-based motor speed controllers. In the past, variable-speed drive also referred to various mechanical means to vary speed. Amplifier is a term almost exclusively used to describe drives for servo or stepper motors.

Q. Although the MX2 inverter is a variable speed drive, can I use it in a fixed-speed application?

A. Yes, sometimes an inverter can be used simply as a “soft-start” device, providing controlled acceleration and deceleration to a fixed speed. Other functions of the MX2 may be useful in such applications, as well. However, using a variable speed drive can benefit many types of industrial and commercial motor applications, by providing controlled acceleration and deceleration, high torque at low speeds, and energy savings over alternative solutions.

Q. Can I use an inverter and AC induction motor in a positioning application?

A. That depends on the required precision, and the slowest speed the motor must turn and still deliver torque. The MX2 inverter will deliver full torque while turning the motor at 6Hz (180RPM). DO NOT use an inverter if you need the motor to stop and hold the load position without the aid of a mechanical brake (use a servo or stepper motion control system).

Q. Can the inverter be controlled and monitored via a network?

A. Yes. MX2 inverters have built-in ModBus communications. See Appendix B for more information on network communications.

Q. Why does the manual or other documentation use terminology such as “200 V class” instead of naming the actual voltage, such as “230 VAC”

A. A specific inverter model is set at the factory to work across a voltage range particular to the destination country for that model. The model specifications are on the label on the side of the inverter. A European 200V class inverter (“EU” marking) has different parameter settings than a USA 200 V class.

Q. Why doesn't the motor have a neutral connection as a return to the inverter?

A. The motor theoretically represents a “balanced Y” load if all three stator windings have the same impedance. The Y connection allows each of the three wires to alternatively serve as input or return on alternate half-cycle.

Q. Does the motor need a chassis ground connection?

A. Yes, for several reasons. Most importantly, this provides protection in the event of a short in the motor that puts a hazardous voltage on its housing. Secondly, motors exhibit leakage current that increase with aging. Lastly, a grounded chassis generally emits less electrical noise than an ungrounded one.

Q. What type of motor is compatible with the Omron inverters?

A. Motor type - It must be a three-phase AC induction motor. Use an inverter-grade motor that has at least 800V insulation for 200V class inverters, or 1600V insulation for 400V class.

Motor size - In practice, it's better to find the right size motor for your application; then look for the inverter to match the motor.

Note There may be other factors that will affect motor selection, including heat dissipation, motor operating speed profile, enclosure type, and cooling method.

Q. How many poles should the motor have?

A. Omron inverters can be configured to operate motors with 2, 4, 6, or 8 poles. The greater the number of the poles, the slower the top motor speed will be, but it will have higher torque at the base speed.

Q. Will I be able to add dynamic (resistive) braking to my Omron MX2 drive after the initial installation?

A. Yes, the MX2 inverter already has a dynamic braking circuit built in. Just add the resistor sized to meet the braking requirements. For more information, contact your nearest Omron representative.

Q. How will I know if my application will require resistive braking?

A. For new applications, it may be difficult to tell before you actually test a motor/drive solution. In general, some application can rely on system losses such as friction to serve as the deceleration force, or otherwise can tolerate a long decel time. These applications will not need dynamic braking. However, applications with a combination of a high-inertia load and a required short decel time will need dynamic braking. This is a physics question that may be answered either empirically or through extensive calculations.

Q. Several options related to electrical noise suppression are available for the Omron inverters. How can I know if my application require any of these options?

A. The purpose of these noise filters is to reduce the inverter electrical noise so the operation of nearby electrical devices is not affected. Some applications are governed by particular regulatory agencies, and noise suppression is mandatory. In those cases, the inverter must have the corresponding noise filter installed. Other applications may not need noise suppression, unless you notice electrical interference with the operation of other devices.

Q. The MX2 features a PID control. PID loops are usually associated with water control, flow control processes, heating, or process industries in general. How could the PID loop feature be useful in my application?

A. You will need to determine the particular main variable in your application the motor affects. That is the process variable (PV) for the motor. Over time, a faster motor speed will cause a faster change in the PV than a slow motor speed will. By using the PID loop feature, the inverter commands the motor to run at the optimal speed required to maintain the PV at the desired value for current conditions. Using the PID loop feature will require an additional sensor and other wiring, and is considered an advanced application.

1-5 International Standards

The 3G3MX2 series inverters meet the following international standards.

| Classification | | Applicable standard |
|----------------|--------------------------------|--|
| EC Directives | Machinery Directive 2006/42/EC | EN ISO13849-1:2008 PLd EN 61800-5-2 EN 60204-1 |
| | Low-voltage directive | EN 61800-5-1 |
| | EMC directive | EN 61800-3 |
| UL | | UL508C |
| | | CSA-C22.2 No. 14 |

Safety functions are supported.

The 3G3MX2 series inverters meet requirements for IEC 60204-1 Stop Category 0 operation and ISO 13849-1 Performance Level PLd of the Machinery Directive.

SECTION 2

Inverter Mounting and Installation

2-1 Orientation to Inverter Features

2-1-1 Unpacking and Inspection

Please take a few moments to unpack your new MX2 inverter and perform these steps:






1. Look for any damage that may have occurred during transportation.
2. Verify the contents of the box.
3. Inspect the specifications label on the side of the inverter. Make sure it matches the product part number you ordered.

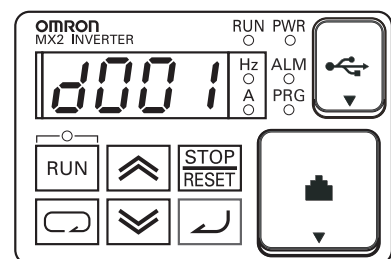
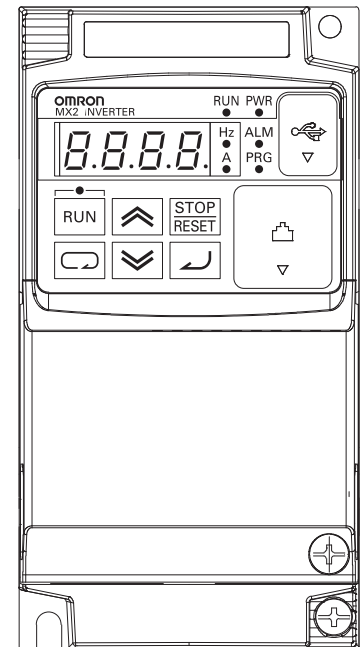
2-1-2 Main Physical Features

The MX2 Series inverters vary in size according to the current output rating and motor size for each model number. All feature the same basic Keypad and connector interface for consistent ease of use. The inverter construction has a heat sink at the back of the housing. The larger models include a fan to enhance heat sink performance. The mounting holes are predrilled in the heat sink for your convenience. Smaller models have two mounting holes, while larger ones have four. Be sure to use all the mounting holes provided.

Never touch the heat sink during or just after operation; it can be very hot.

The electronics housing and front panel are built onto the front of the heat sink.

Inverter Keypad - The inverter uses a digital operator interface, or keypad. The four-digit display can show a variety of performance parameters. LEDs indicate whether the display units are Hertz or Amperes. Other LEDs indicate Power (external), and Run/Stop mode and Program/Monitor Mode status. Membrane keys Run and Stop/Reset control monitor operation. The , ,  and  keys allow an operator to navigate to the inverter's functions and parameter values. The  key is used when changing a parameter.



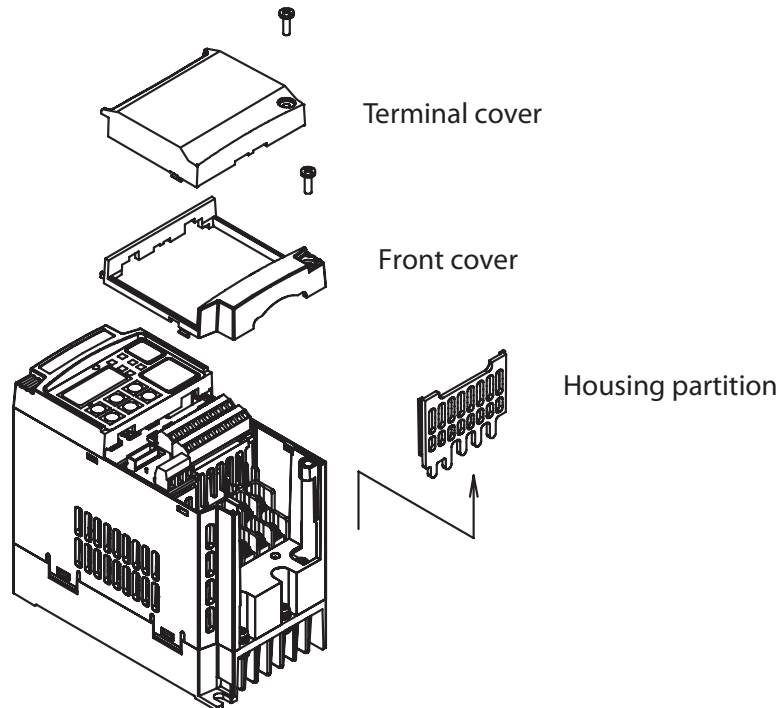
Power Wiring Access - First, ensure no power source is connected to the inverter. If power has been connected, verify that the Power LED is OFF and then wait ten minutes after power down to proceed. After removing the terminal cover and front housing cover, the housing partitions that cover the power and motor wiring exits will be able to slide upward as shown below.

Notice the four wire exit slots in the housing partition. This helps keep the power and motor wiring (to the left) separated from the signal-level logic or analog wiring (to the right).

Remove the housing partition and as shown as set them aside in a secure place while wiring. Be sure to replace them afterward. Never operate the inverter with the partition removed or the front housing cover removed.

The power input and motor 3-phase wiring connect to the lower row of the terminals. The upper row of power terminals connect to optional braking units or DC link choke.

The following section in this chapter will describe system design and guide you through a step-by-step installation process. After the section on wiring, this chapter will show how to use the front panel keys to access functions and edit parameters.



Note The housing partition can be removed without removing the front cover in the following models.

Single-phase 200 V: 0.7 to 2.2 kW

Three-phase 200 V: 1.5 to 15 kW

Three-phase 400 V: All size

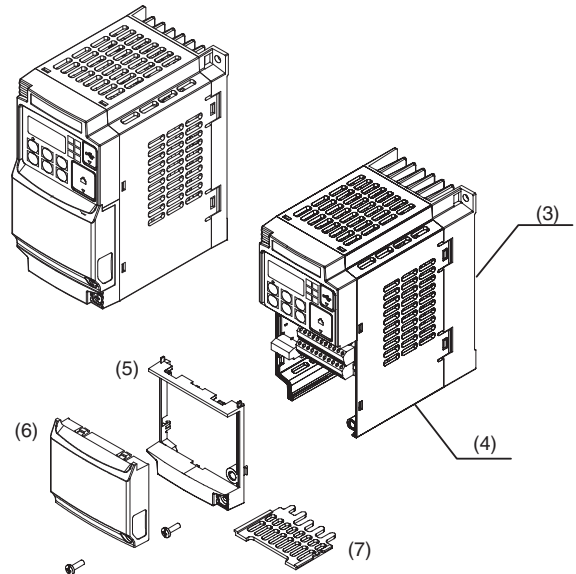
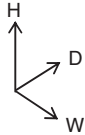
2-1-3 User removable parts by each inverter size.

IP20

1-phase 200 V 0.1, 0.2, 0.4 kW

3-phase 200 V 0.1, 0.2, 0.4, 0.75 kW

Even if the W x H dimension is the same, the D dimension for the cooling fin varies depending on the capacity.

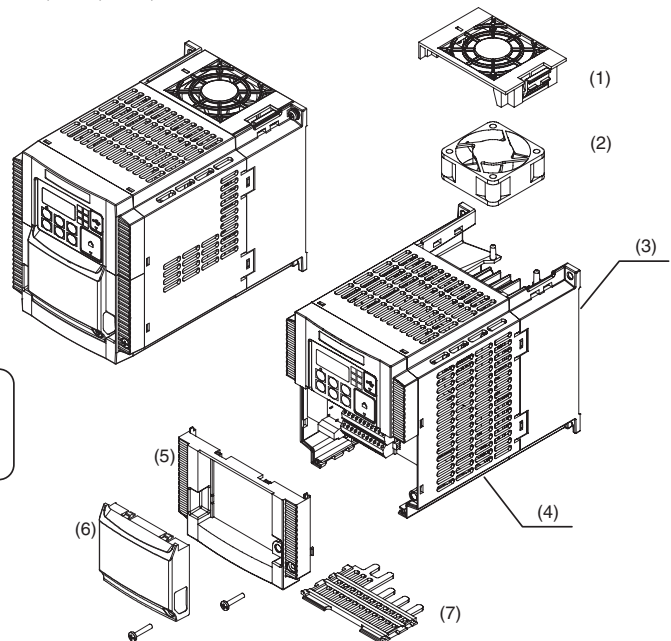
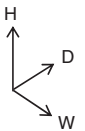


1-phase 200 V 0.75, 1.5, 2.2 kW

3-phase 200 V 1.5, 2.2 kW

3-phase 400 V 0.4, 0.75, 1.5, 2.2, 3.0 kW

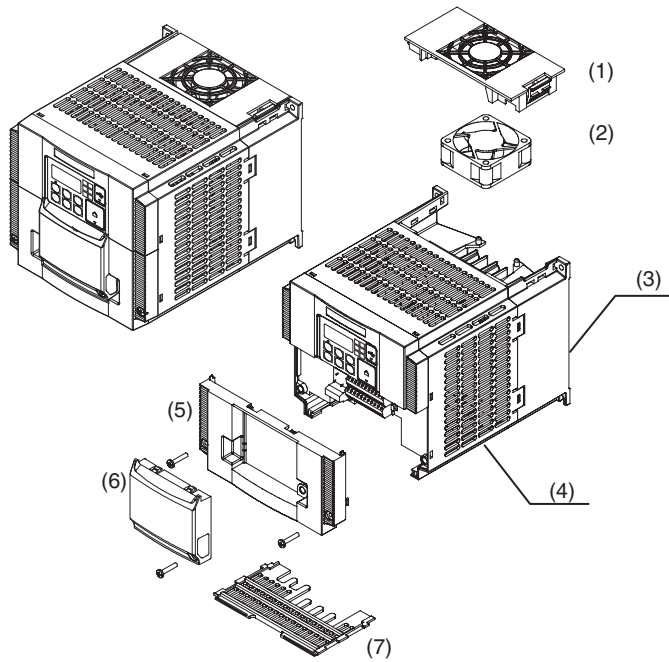
Even if the W x H dimension is the same, the D dimension for the cooling fin varies depending on the capacity.



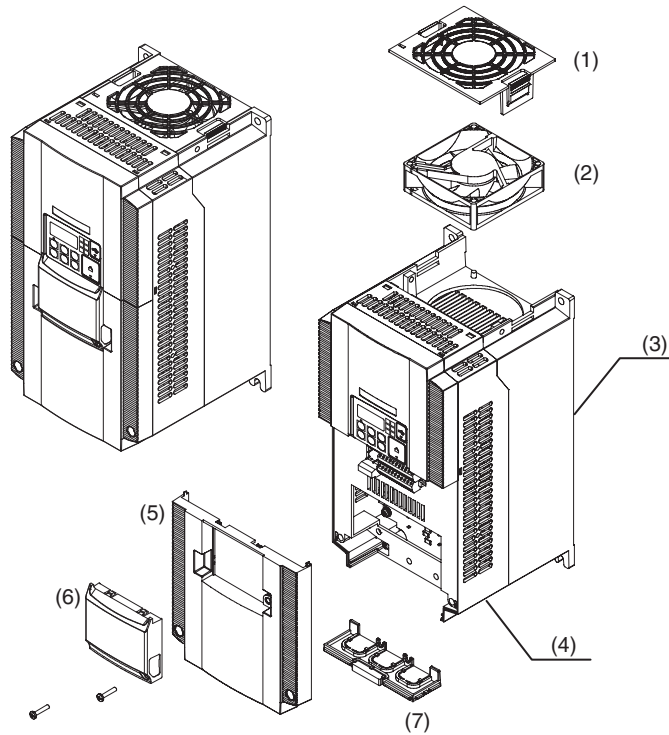
- (1) Cooling fan cover
- (2) Cooling fan
- (3) Cooling fin
- (4) Main housing
- (5) Terminal block cover
- (6) Optional board cover
- (7) Backing plate

Note 3-phase 200 V/0.75 kW models come with a cooling fan.
 1-phase 200 V/0.75 kW models and 3-phase 400 V/0.4 kW/0.75 kW models do not come with a cooling fan.

3-phase 200 V 3.7 kW
3-phase 400V 4.0 kW

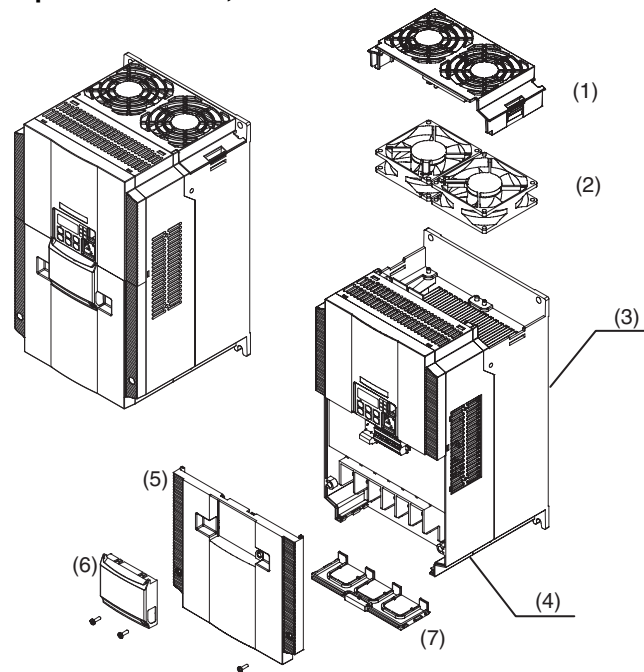


3-phase 200 V 5.5, 7.5 kW
3-phase 400 V 5.5, 7.5 kW

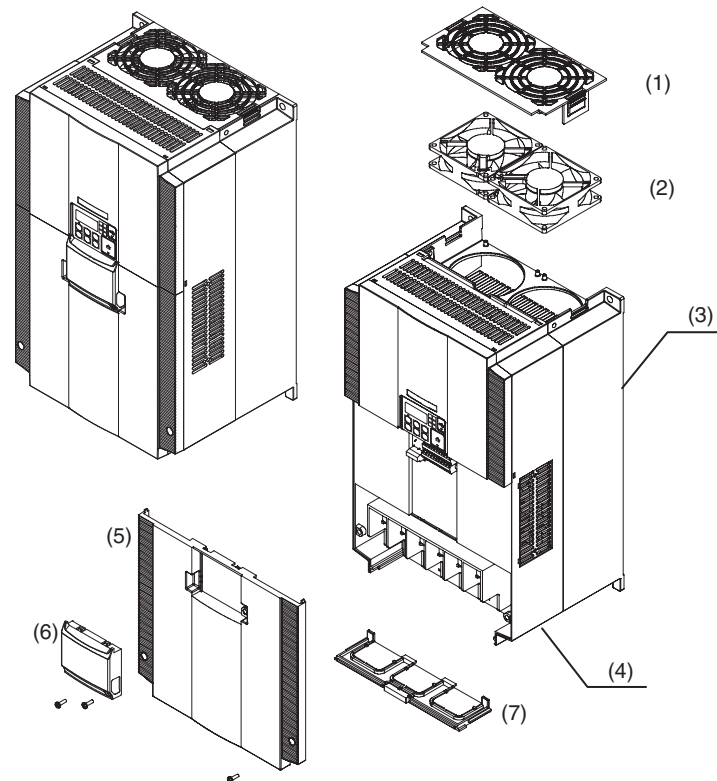


- (1) Cooling fan cover
- (2) Cooling fan
- (3) Cooling fin
- (4) Main housing
- (5) Terminal block cover
- (6) Optional board cover
- (7) Backing plate

3-phase 200 V 11 kW
3-phase 400 V 11, 15 kW

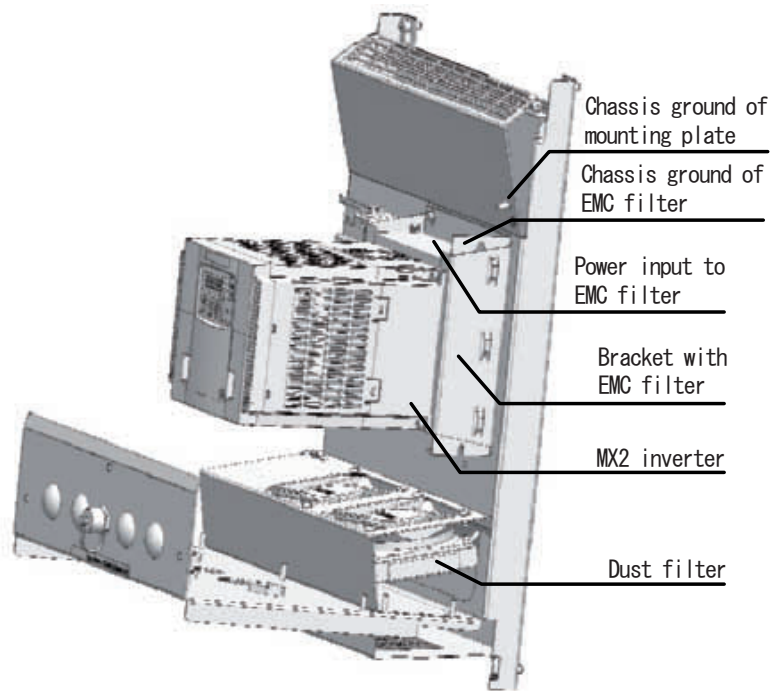
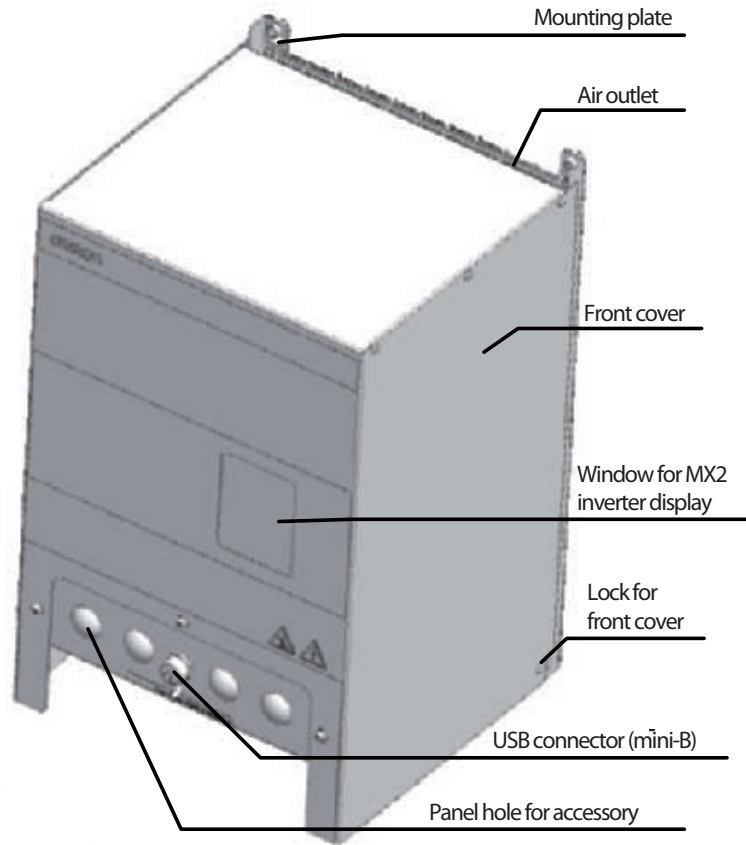


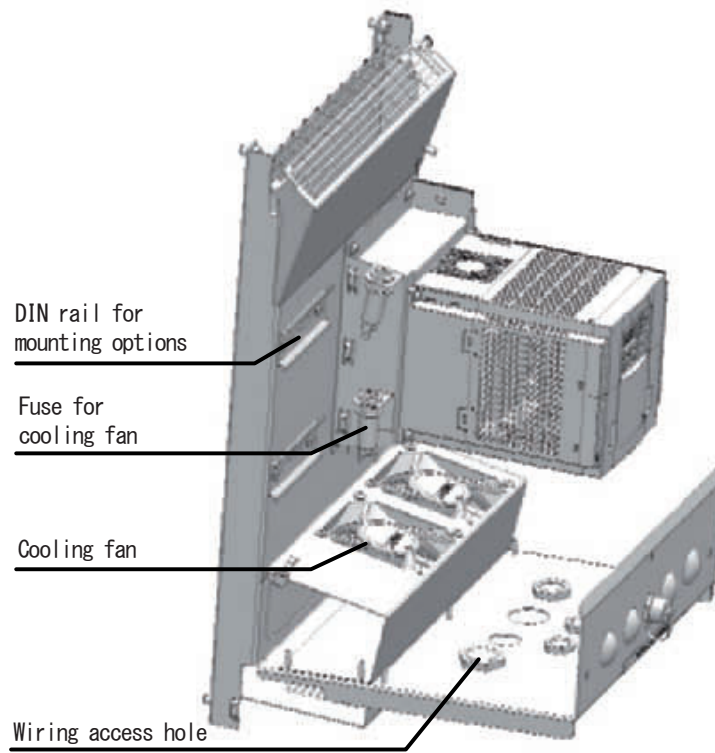
3-phase 200 V 15 kW



- (1) Cooling fan cover
- (2) Cooling fan
- (3) Cooling fin
- (4) Main housing
- (5) Terminal block cover
- (6) Optional board cover
- (7) Backing plate

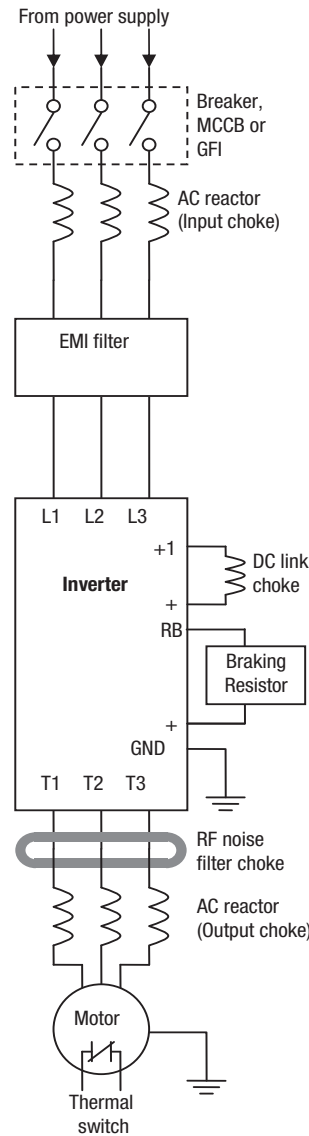
IP54





2-2 Basic System Description

A motor control system will obviously include a motor and inverter, as well as a circuit breaker or fuses for safety. If you are connecting a motor to the inverter on a test bench just to get started, that's all you may need for now. But a system can also have a variety of additional components. Some can be for noise suppression, while others may enhance the inverter's braking performance. The figure and table below show a system with all the **optional** components you might need in your finished application.



| Name | Function |
|--|--|
| Breaker / disconnect | A molded-case circuit breaker (MCCB), ground fault interrupter (GFI), or a fused disconnect device. NOTE: The installer must refer to the local country norms of application to ensure safety and compliance. |
| Input-side AC Reactor | This is useful in reducing low frequency harmonics distortion induced on the power supply lines and as consequence improve the power factor. WARNING: Some applications must use an input-side AC Reactor to prevent inverter damage. See <i>Warning</i> on next page. |
| EMC filter (for CE applications, see Appendix D) | Reduces the conducted high frequency noise on the power supply wiring between the inverter and the power distribution system. Connect to the inverter primary (input) side. |
| DC link choke | Reduce harmonics generated by the inverter motor driving section, by smoothing the current demand of the capacitors. |
| Braking Resistor | Used to dissipate regenerative energy from the motor that is accumulated into the DC bus charging the capacitors and increasing the voltage. |
| Radio noise output filter | Electrical noise interference may occur on nearby equipment such as a radio receiver. This magnetic choke filter helps reduce very high frequency radiated noise (can also be used on input). |
| Output-side AC Reactor | This reactor in its standard type (only L inductor), prevents the high voltage ringing of PWM modulation to reach the motor, compensating for the capacity of the motor cables, specially with long lengths. For more effective (and expensive) options, like sinus filter (targetting network-like waveforms) or dV/dt filters, please check with your dealer. |

Note Note that some components are required for regulatory agency compliance (see SECTION 5 *Inverter System Accessories* and Appendix D *CE-EMC Installation Guidelines*).

⚠ WARNING In the cases below involving a general-purpose inverter, a large peak current can flow on the power supply side, sometimes destroying the converter module:

1. The unbalance factor of the power supply is 3% or higher.
2. The power supply capacity is at least 10 times greater than the inverter capacity (or the power supply capacity is 500k VA or more).
3. Abrupt power supply changes are expected, due to conditions such as:
 - a. Several inverters are interconnected with a short bus.
 - b. A thyristor converter and an inverter are interconnected with a short bus.
 - c. An installed phase advance capacitor opens and closes.

Where these conditions exist or when the connected equipment must be highly reliable, you **MUST** install an input-side AC reactor of 3% (at a voltage drop at rated current) with respect to the supply voltage on the power supply side. Also, where the effects of an indirect lightning strike are possible, install a lightning conductor.

2-3 Step-by-Step Basic Installation

This section will guide you through the following basic steps of installation:

| Step | Activity | Page |
|------|---|---------|
| 1 | Choose a mounting location in compliance with the Warnings and Cautions. See notes below. | page 29 |
| 2 | Check the mounting location for adequate ventilation | page 32 |
| 3 | Cover the inverter's ventilation openings to prevent debris from entering. | page 42 |
| 4 | Check the inverter dimensions for footprint and mounting hole locations. | page 34 |
| 5 | Study the Cautions, Warnings, wire and fuse sizes, and terminal torque specifications before wiring the inverter. | page 42 |
| 6 | Connect wiring for the inverter power input. | page 46 |
| 7 | Wire the inverter output to the motor. | page 51 |
| 8 | Uncover the inverter's ventilation openings applied in Step 3. | page 55 |
| 9 | Perform the Powerup Test. (This step includes several sub steps.) | page 56 |
| 10 | Make observations and check your installation. | page 68 |

Note If the installation is in an EU country, study the EMC installation guidelines in Appendix D *CE-EMC Installation Guidelines*.

Choosing a Mounting Location

Study the following caution messages associated with mounting the inverter. This is the time when mistakes are most likely to occur that will result in expensive rework, equipment damage, or personal injury.

⚠ WARNING Hazard of electrical shock. Never touch the naked PCB (printed circuit board) or bus bars while the unit is powered up. Even for switch portion, the inverter must be powered OFF before you change.

⚠ Caution Be sure to install the unit on flame-resistant material such as steel plate. Otherwise, there is the danger of fire.

⚠ Caution Be sure not to place any flammable materials near the inverter. Otherwise, there is the danger of fire.

- ⚠ **Caution** Be sure not to let the foreign matter enter vent openings in the inverter housing, such as wire clippings, spatter from welding, metal shavings, dust, etc. Otherwise, there is the danger of fire.
- ⚠ **Caution** Be sure to install the inverter in a place that can bear the weight according to the specifications in the text (Chapter 1, Specifications Tables). Otherwise, it may fall and cause injury to personnel.
- ⚠ **Caution** Be sure to install the unit on a perpendicular wall that is not subject to vibration. Otherwise, it may fall and cause injury to personnel.
- ⚠ **Caution** Be sure not to install or operate an inverter that is damaged or has missing parts. Otherwise, it may cause injury to personnel.
- ⚠ **Caution** Be sure to install the inverter in a well-ventilated room that does not have direct exposure to sunlight, a tendency for high temperature, high humidity or dew condensation, high levels of dust, corrosive gas, explosive gas, inflammable gas, grinding-fluid mist, salt damage, etc. Otherwise, there is the danger of fire.

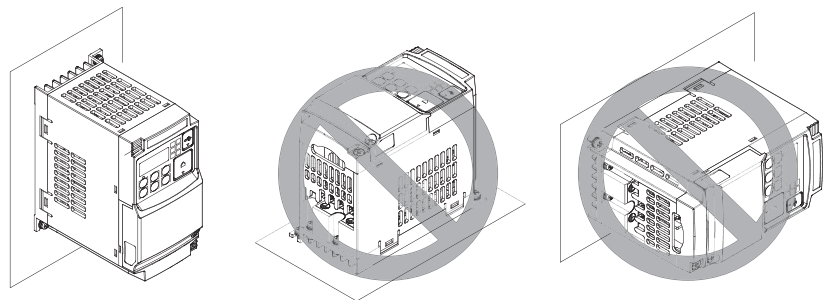
2-3-1 Installation

IP20

Install the Inverter vertically on a wall.

Install the Inverter on a nonflammable wall surface material, like metal.

Other installations are not possible due to heat convection design of the inverter is vertical.



IP54

Installation Steps

1. Choose installation location.
2. Check housing dimensions for footprint and mounting hole locations.
3. Remove the front cover.
4. Mount the mounting plate of the MX2 IP54 housing.
5. Connect all wiring.
6. Check your installation.
7. Attach the front cover.

Installation Locations

Note: Do not store or use the MX2 IP54 housing in locations subject to condensation. Doing so can result in damaging the unit.

Mounting Orientation and Spacing

Always install the housing in an upright position. Leave 10 cm space above and below the housing for proper cooling. Leave 10 cm space to the left and to the right for replacement of the dust filter.

Removing the Front Cover

⚠ WARNING Turn off the power supply before removing the cover. Not doing so may result in a serious injury due to an electric shock.

1. Loosen the three screws that hold the front cover.
2. Pull the bottom of the front cover for about 5 cm.
3. Move the front cover upwards to remove.

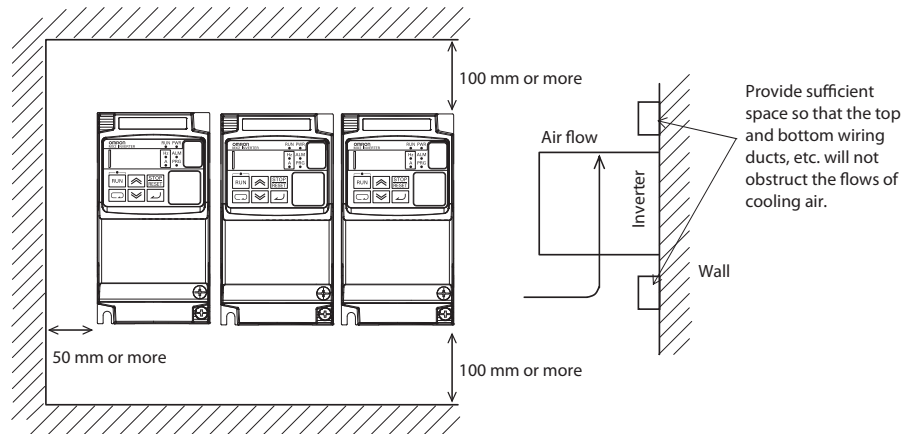
⚠ Caution Only authorized people should be allowed to open the cover.

⚠ Caution Do not touch the cover during the power supply and for some time after the power shutdown. Doing so might result in a moderate burn.

Mounting MX2 IP54 Mounting Plate

All housings use for M6 mounting screws. Be sure to use lock washers or other means to ensure screws do not loosen due to a vibration.

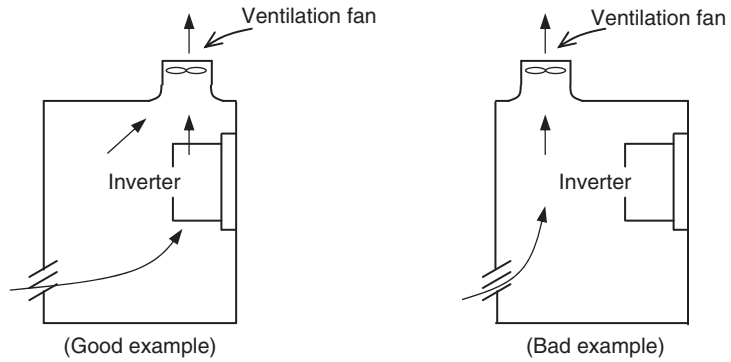
2-3-2 Installation Environment clearance



Make sure the ambient temperature remains within the rated range (–10 to 50°C). Take note that if the ambient temperature reaches or exceeds 40°C, the carrier frequency and output current must be derated (check derating tables per each inverter model in *Derating Curves on page 9*). If the Inverter is used in an environment exceeding the allowable operating temperature range, the product life of the Inverter (specifically, the capacitor) will be shortened.

Measure and check the temperature approx. 5 cm from the bottom center of the Inverter body.

Provide sufficient space around the Inverter because it can become very hot (up to 150°C or so). Or provide the right air ventilation forced cooling flow when designing the enclosure :



Keep the Inverter away from heating elements (such as a Braking Resistor, reactor, etc.).

Although side-by-side installation is possible. The ambient temperature of the installation site must not exceed 40°C and the carrier frequency and output current must be derated if side-by-side installation is used. For details check *Derating Curves on page 9*.

Make sure that the humidity in the installation site is within the allowable operating range (20% to 90% RH), as defined in the standard specifications.

Heat Radiation from Inverter

| 1-phase/3-phase 200 V | | | | | | | | | | | |
|--------------------------------|------|-----|-----|------|-----|------|-----|-----|-----|-----|-----|
| Inverter capacity (kW) | 0.1 | 0.2 | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 |
| Load with 100% loss (W) | 12 | 22 | 30 | 48 | 79 | 104 | 154 | 229 | 313 | 458 | 625 |
| Efficiency at rated output (%) | 89.5 | 90 | 93 | 94 | 95 | 95.5 | 96 | 96 | 96 | 96 | 96 |

| 3-phase 400 V | | | | | | | | | | | |
|--------------------------------|-----|------|-----|-----|-----|-----|-----|-----|------|------|------|
| Inverter capacity (kW) | 0.4 | 0.75 | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 | 11 | 15 | |
| Load with 100% loss (W) | 35 | 56 | 96 | 116 | 125 | 167 | 229 | 296 | 411 | 528 | |
| Efficiency at rated output (%) | 92 | 93 | 94 | 95 | 96 | 96 | 96 | 96 | 96.2 | 96.4 | 96.6 |

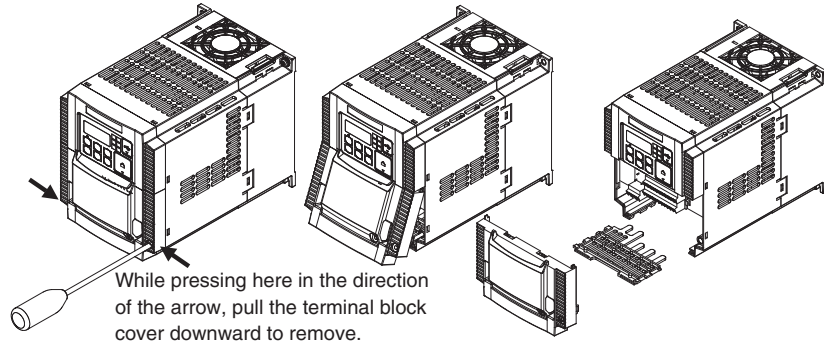
⚠ Caution Be sure to maintain the specified clearance area around the inverter and to provide adequate ventilation. Otherwise, the inverter may overheat and cause equipment damage or fire.

2-3-3 Installation/Removal Method of the Terminal Block Cover

2-3-3-1 Removal method

Loosen the screw(s) (1 or 2 locations) securing the terminal block cover.

While pressing the bottom of the terminal block cover in the direction of the arrow, pull the terminal block cover downward to remove.

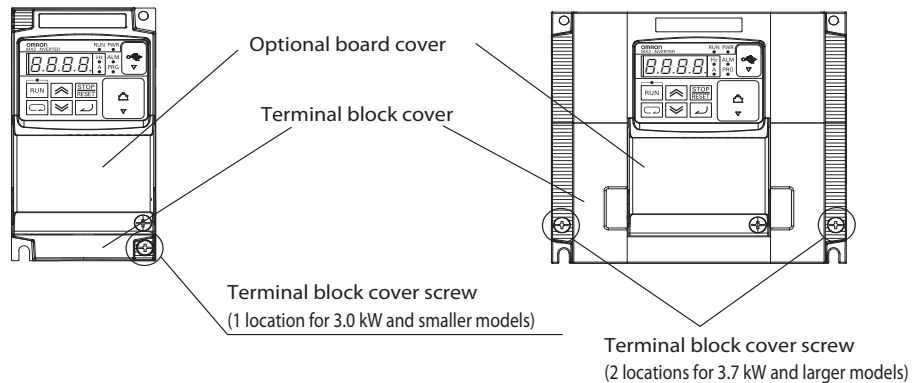


The terminal block cover is secured with one screw at the bottom right for 3.0 kW and smaller models, or with two screws on both sides for 3.7 kW and larger models.

The optional board cover is affixed with screws onto the terminal block cover, but it is not affixed onto the main unit. Accordingly, the terminal block cover can be removed without removing the optional board cover.

2-3-3-2 Installation method

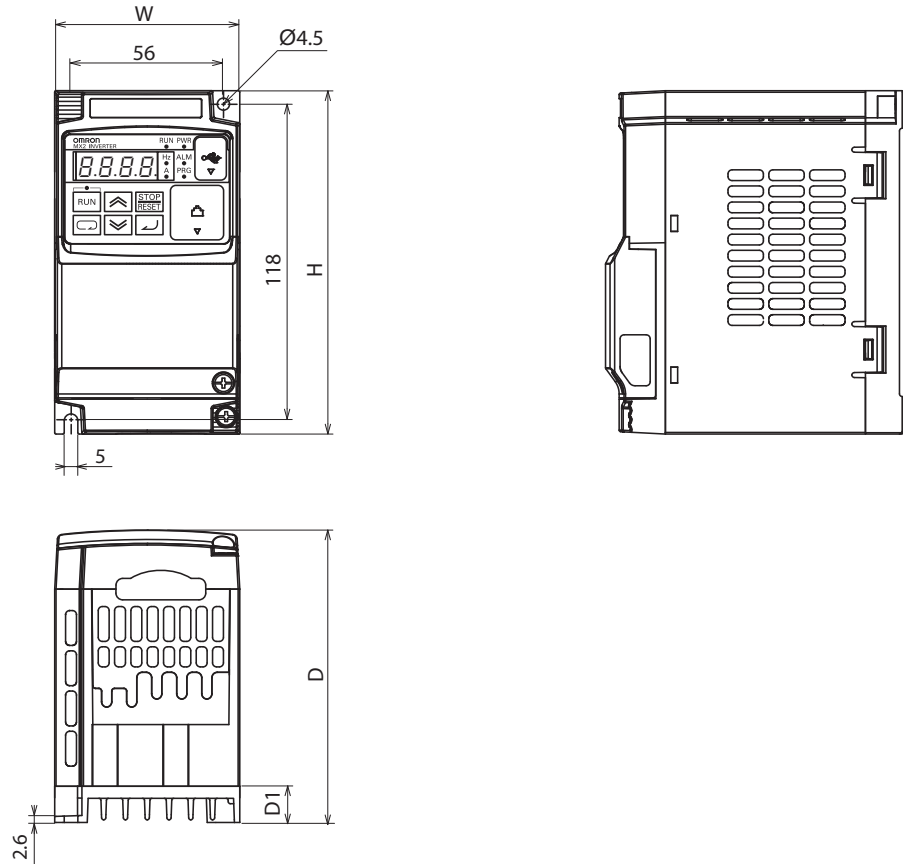
Follow the removal procedure in reverse. Set the top side of the terminal block cover onto the main unit and push in the cover until you hear a “click” sound.



2-3-4 Inverter Dimensions

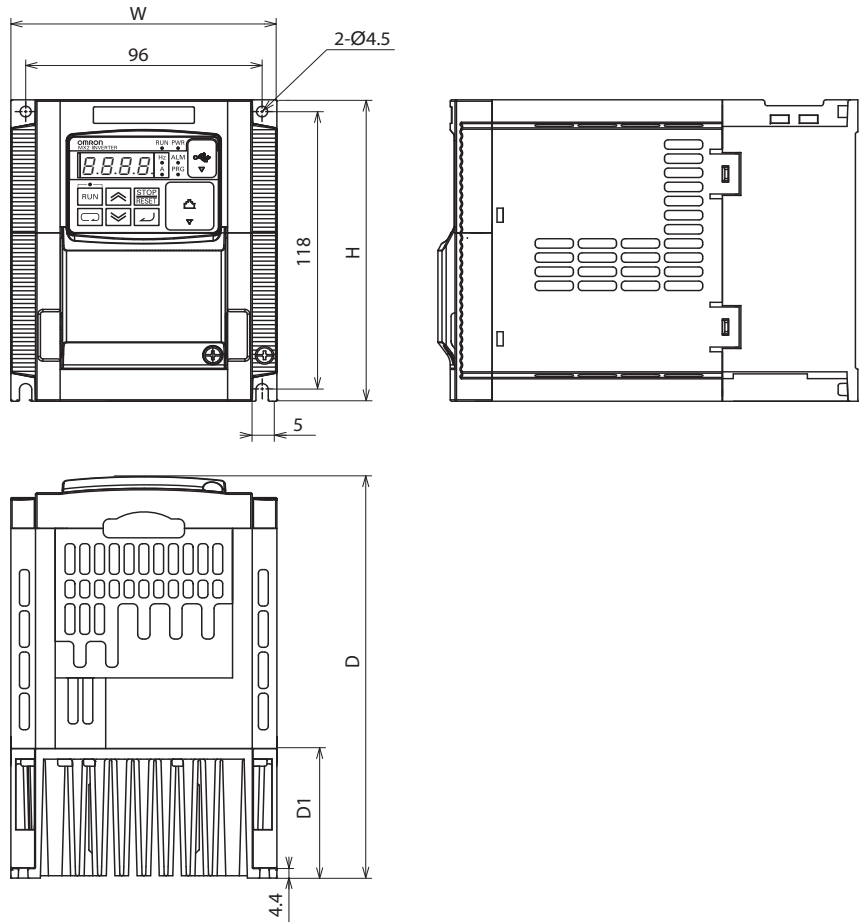
IP20

Locate the applicable drawing on the following pages for your inverter. Dimensions are given in millimeters (inches) format.

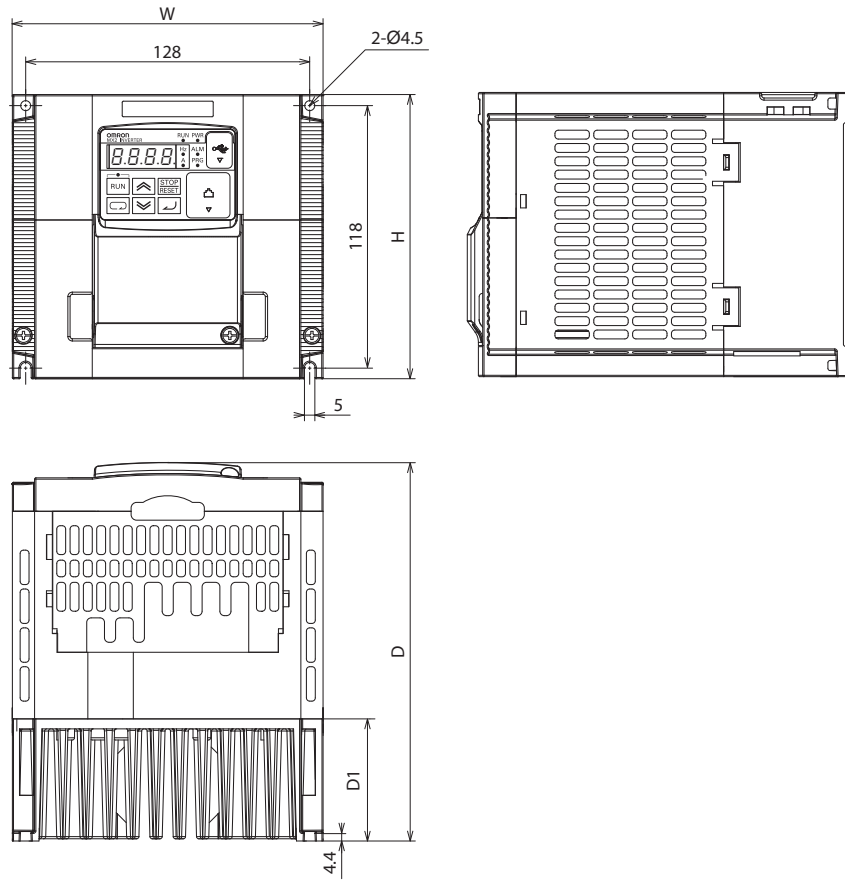


| Power | Type | W (mm) | H (mm) | D (mm) | D1 (mm) |
|----------------------|--------------|--------|--------|--------|---------|
| Single-phase 200V | 3G3MX2-AB001 | 68 | 128 | 109 | 13.5 |
| | 3G3MX2-AB002 | | | | |
| | 3G3MX2-AB004 | | | 122.5 | 27 |
| 3-phase 200 V | 3G3MX2-A2001 | 68 | 128 | 109 | 13.5 |
| | 3G3MX2-A2002 | | | | |
| | 3G3MX2-A2004 | | | 122.5 | 27 |
| | 3G3MX2-A2007 | | | 145.5 | 50 |

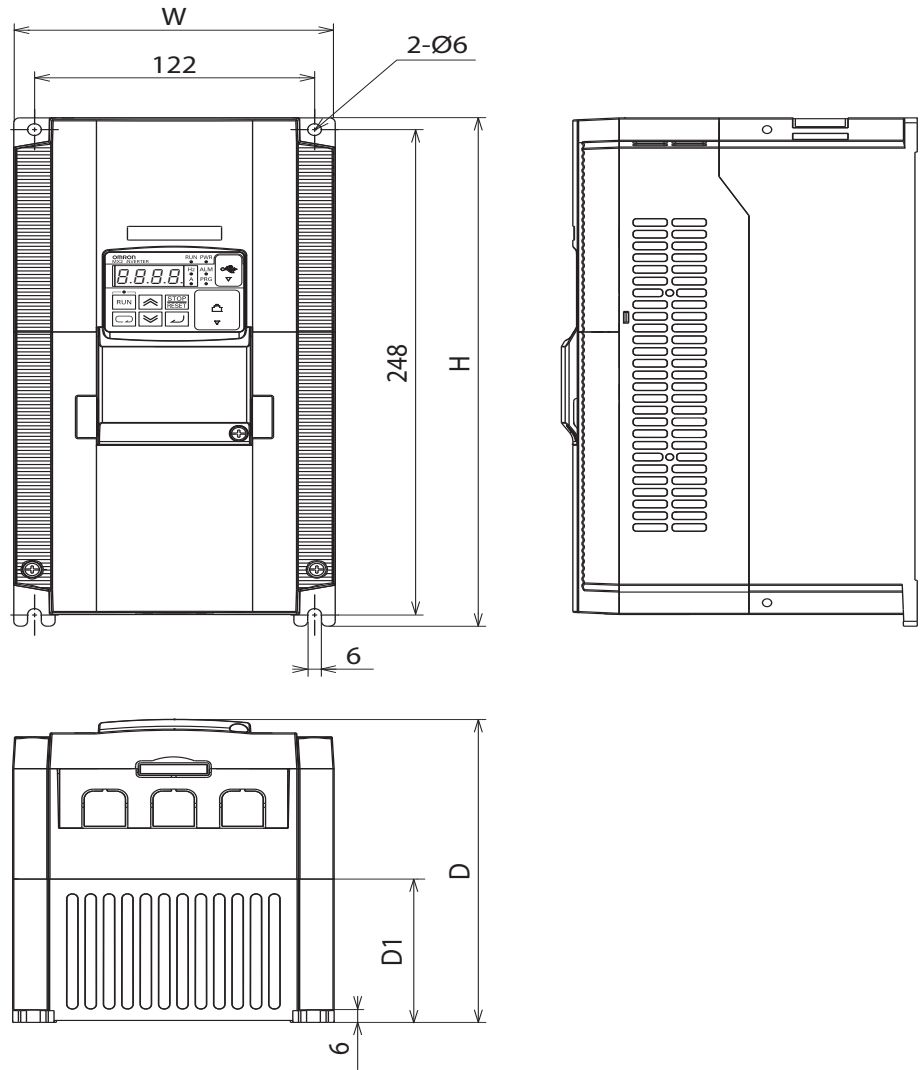
Note Some inverter housing require two mounting screws, while other requires four. Be sure to use lock washers or other means to ensure screws do not loosen due to vibration.



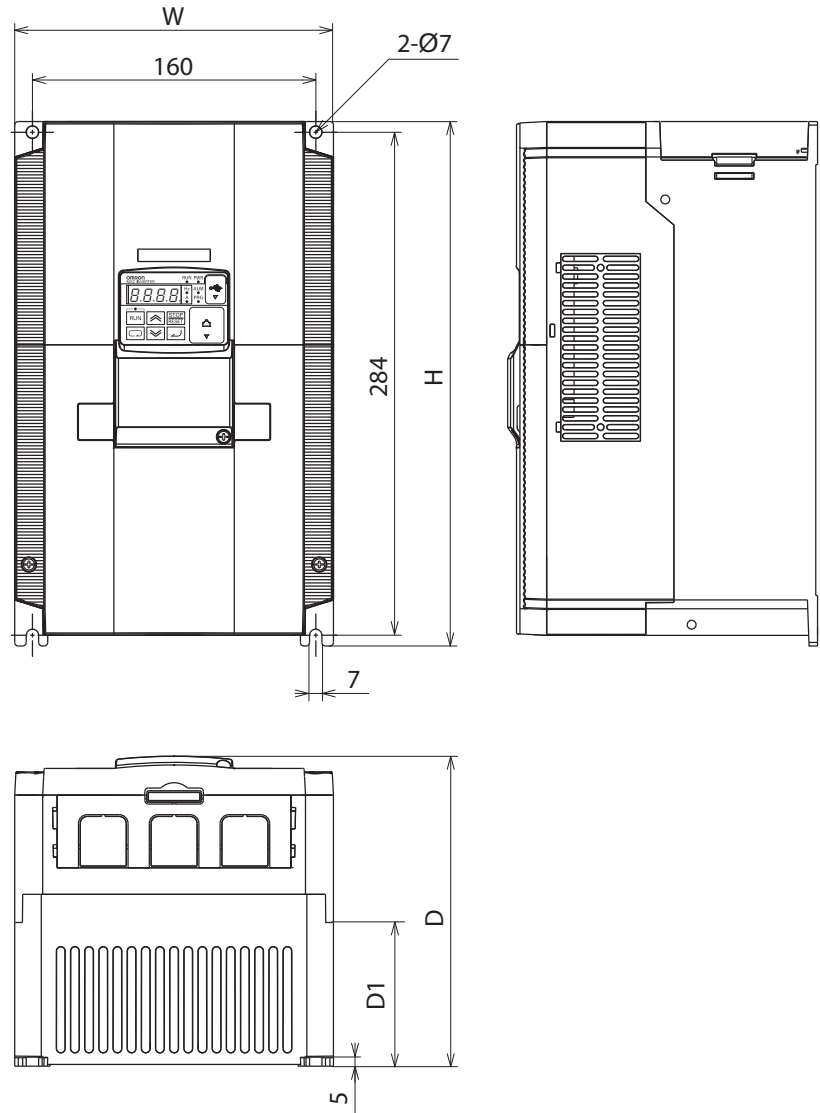
| Power | Type | W (mm) | H (mm) | D (mm) | D1 (mm) |
|-----------------------|--------------|--------|--------|--------|---------|
| Single-phase 200 V | 3G3MX2-AB007 | 108 | 128 | 170.5 | 55 |
| | 3G3MX2-AB015 | | | | |
| | 3G3MX2-AB022 | | | | |
| 3-phase 200 V | 3G3MX2-A2015 | | | 170.5 | 55 |
| | 3G3MX2-A2022 | | | | |
| 3-phase 400V | 3G3MX2-A4004 | | | 143.5 | 28 |
| | 3G3MX2-A4007 | 170.5 | 55 | | |
| | 3G3MX2-A4015 | | | | |
| | 3G3MX2-A4022 | | | | |
| | 3G3MX2-A4030 | | | | |



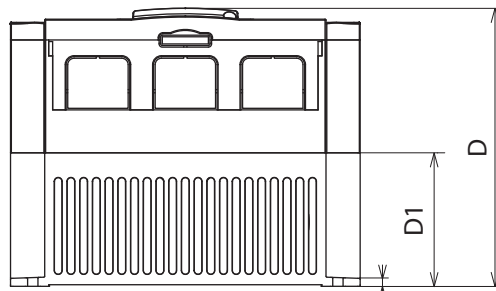
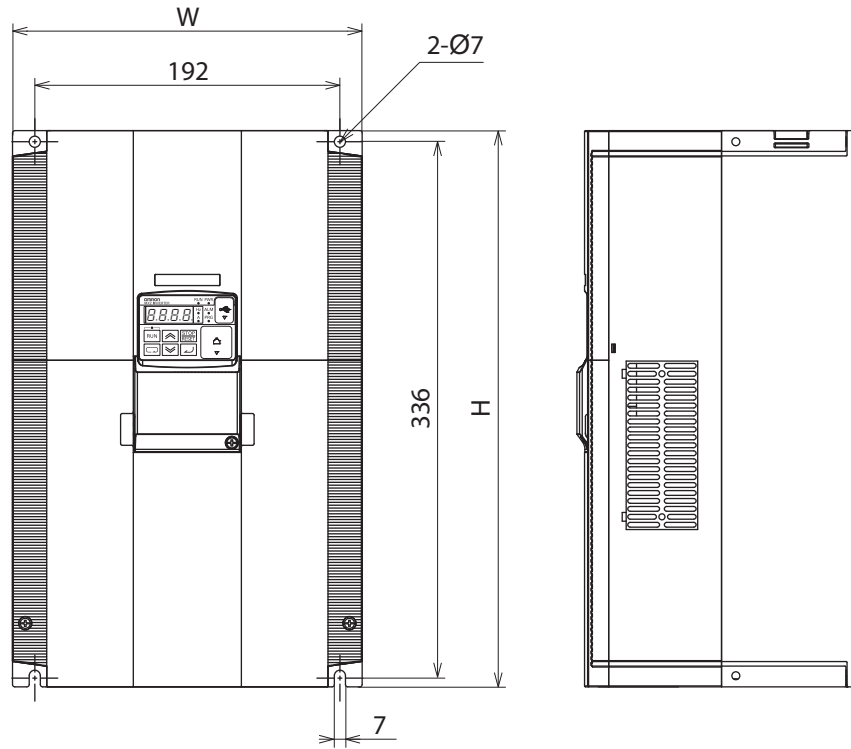
| Power | Type | W (mm) | H (mm) | D (mm) | D1 (mm) |
|---------------|--------------|--------|--------|--------|---------|
| 3-phase 200 V | 3G3MX2-A2037 | 140 | 128 | 170,5 | 55 |
| 3-phase 400 V | 3G3MX2-A4040 | | | | |



| Power | Type | W (mm) | H (mm) | D (mm) | D1 (mm) |
|---------------|--------------|--------|--------|--------|---------|
| 3-phase 200 V | 3G3MX2-A2055 | 140 | 260 | 155 | 73.3 |
| | 3G3MX2-A2075 | | | | |
| 3-phase 400 V | 3G3MX2-A4055 | | | | |
| | 3G3MX2-A4075 | | | | |

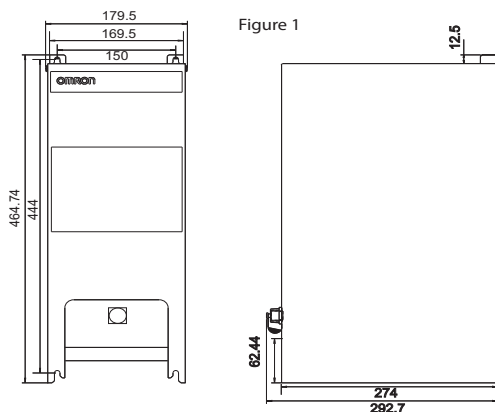


| Power | Type | W (mm) | H (mm) | D (mm) | D1 (mm) |
|---------------|--------------|--------|--------|--------|---------|
| 3-phase 200 V | 3G3MX2-A2110 | 180 | 296 | 175 | 97 |
| 3-phase 400 V | 3G3MX2-A4110 | | | | |
| | 3G3MX2-A4150 | | | | |

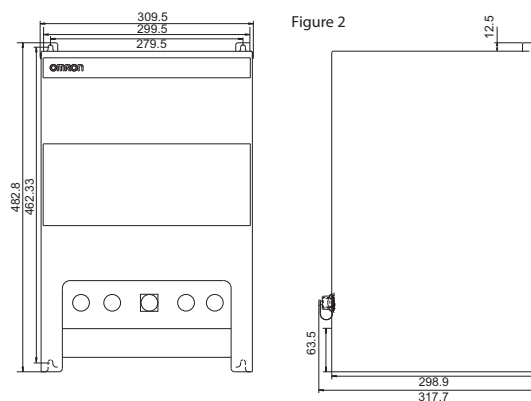


| Power | Type | W (mm) | H (mm) | D (mm) | D1 (mm) |
|---------------|--------------|--------|--------|--------|---------|
| 3-phase 200 V | 3G3MX2-A2150 | 220 | 350 | 175 | 84 |

IP54

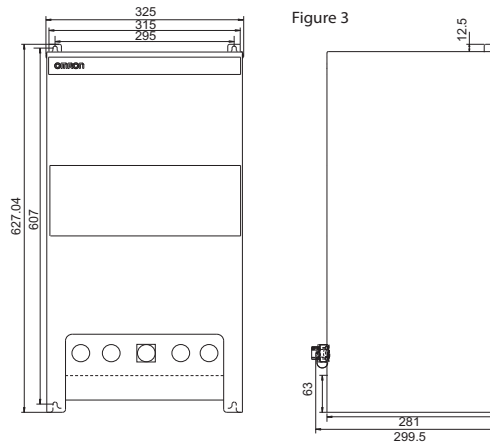


| Figure 1 | |
|--------------------|----------------|
| Power | Type |
| Single-phase 200 V | 3G3MX2-DB001-E |
| | 3G3MX2-DB002-E |
| | 3G3MX2-DB004-E |
| 3-phase 200 V | 3G3MX2-D2001-E |
| | 3G3MX2-D2002-E |
| | 3G3MX2-D2004-E |
| | 3G3MX2-D2007-E |

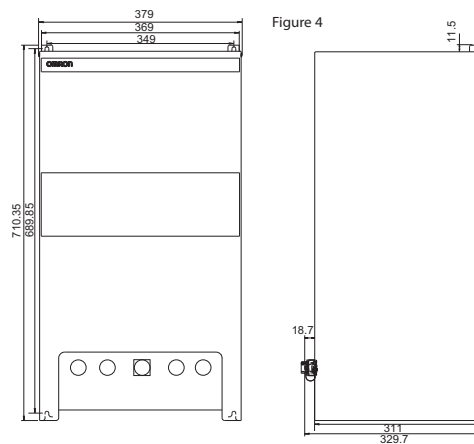


| Figure 2 | |
|--------------------|-----------------|
| Power | Type |
| Single-phase 200 V | 3G3MX2-DB001-EC |
| | 3G3MX2-DB002-EC |
| | 3G3MX2-DB004-EC |
| | 3G3MX2-DB007-EC |
| | 3G3MX2-DB015-EC |
| | 3G3MX2-DB022-EC |
| 3-phase 200 V | 3G3MX2-D2001-EC |
| | 3G3MX2-D2002-EC |
| | 3G3MX2-D2004-EC |
| | 3G3MX2-D2007-EC |
| | 3G3MX2-D2015-EC |
| | 3G3MX2-D2022-EC |
| | 3G3MX2-D2037-EC |

| Figure 2 | |
|---------------|-----------------|
| Power | Type |
| 3-phase 400 V | 3G3MX2-D4004-EC |
| | 3G3MX2-D4007-EC |
| | 3G3MX2-D4015-EC |
| | 3G3MX2-D4022-EC |
| | 3G3MX2-D4030-EC |
| | 3G3MX2-D4040-EC |



| Figure 3 | |
|---------------|-----------------|
| Power | Type |
| 3-phase 200 V | 3G3MX2-D2055-EC |
| | 3G3MX2-D2075-EC |
| 3-phase 400 V | 3G3MX2-D4055-EC |
| | 3G3MX2-D4075-EC |

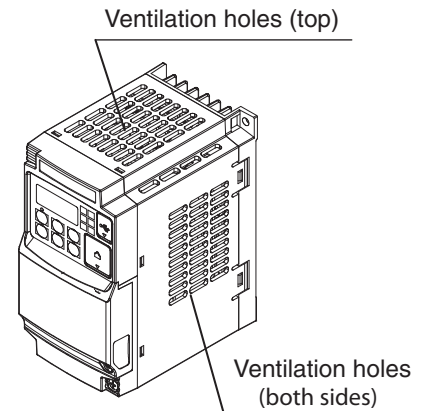


| Figure 4 | |
|---------------|-----------------|
| Power | Type |
| 3-phase 200 V | 3G3MX2-D2110-EC |
| | 3G3MX2-D2150-EC |
| 3-phase 400 V | 3G3MX2-D4110-EC |
| | 3G3MX2-D4150-EC |

2-3-5 Prepare for Wiring

IP20

- Step 1** Before proceeding to the wiring section, it's a good time to *temporarily* covers the inverter's ventilation openings. Paper and masking tape are all that is needed. This will prevent harmful debris such as wire clippings and metal shavings from entering the inverter during installation.



- Step 2** It is very important to perform the wiring steps carefully and correctly. Before proceeding, please study the caution and warning message herebelow.

⚠ WARNING “USE 60/75 C Cu wire only” or equivalent. For models 3G3MX2-A2001, -A2002, -A2004, -A2007, -AB015, -AB022, -A4004, -A4007, -A4015, -A4022, -A4030

⚠ WARNING “USE 75 C Cu wire only” or equivalent. For models 3G3MX2-AB001, -AB002, -AB004, -AB007, -A2015, -A2022, -A2037, A2055, A2075, -A2110, -A2150, -A4040, -A4055, -A4075, -A4110 and -A4150

⚠ WARNING “Suitable for use on a circuit capable of delivering not more than 100k rms symmetrical amperes, 240V maximum when protected by Class CC, G, J or R fuses or circuit breaker having an interrupting rating not less than 100,000 rms symmetrical amperes, 240 volts maximum”. For 200V models.

⚠ WARNING “Suitable for use on a circuit capable of delivering not more than 100k rms symmetrical amperes, 480V maximum when protected by Class CC, G, J or R fuses or circuit breaker having an interrupting rating not less than 100,000 rms symmetrical amperes, 480 volts maximum.” For 400V models.

⚠ HIGH VOLTAGE Be sure to ground the unit. Otherwise, there is a danger of electric shock and/or fire.

⚠ HIGH VOLTAGE Wiring work shall be carried out only by qualified personnel. Otherwise, there is a danger of electric shock and/or fire.

⚠ HIGH VOLTAGE Implement wiring after checking that the power supply is OFF. Otherwise, you may incur electric shock and/or fire.

⚠ HIGH VOLTAGE Do not connect wiring to an inverter or operate an inverter that is not mounted according to the instructions given in this manual. Otherwise, there is a danger of electric shock and/or injury to personnel.

IP54

Connect all wiring via wiring access holes (in the bottom of the MX2 IP54 mounting plate).

Connect the AC power supply voltage to the EMC filter.

Connect the three phase motor to the motor output terminals of the MX2 inverter.

To prevent electric shock, be sure to ground the MX2 EMC filter, the motor, and the MX2 IP54 mounting plate. Use a star ground (single-point) arrangement, and never daisy-chain the grounds (point-to-point).

Connect other wiring if applicable (wiring for I/O, wiring for network communication).

⚠ WARNING Connect the chassis ground terminal of mounting plate to earth ground. Not doing so might result in an electric shock.

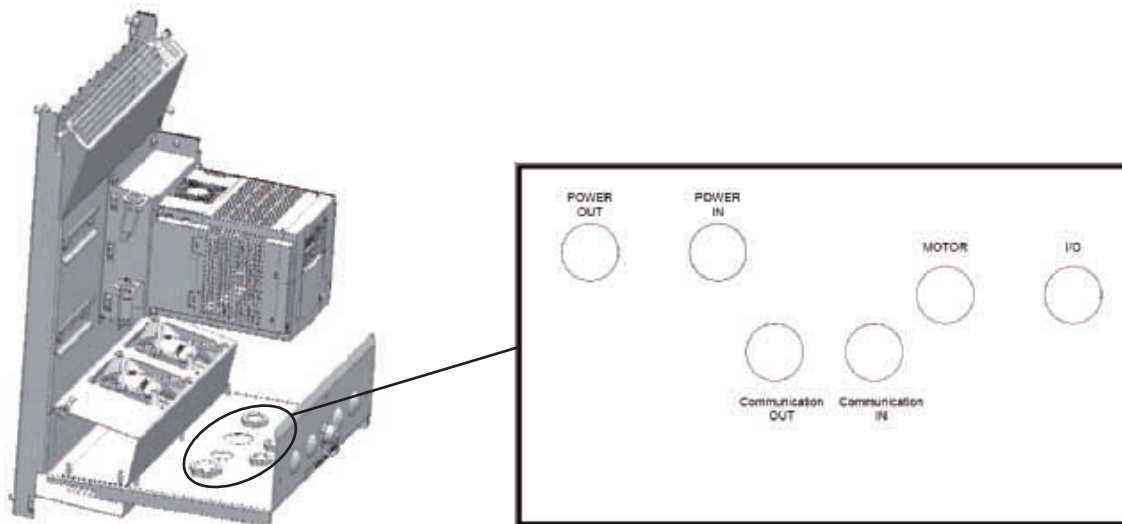
⚠ WARNING Connect the chassis ground terminal of the MX2 EMC filter to earth ground. Not doing so might result in an electric shock.

Note: Check all wiring before turning inverter ON. Not doing so might result in damaging the unit.

Note: Use shielded cables to avoid electrical interference. Not doing so might result in unexpected behaviour or the unit.

Wiring Access Holes

Layout of cable access holes at the bottom of the MX2 IP54 mounting plate. A blinding plug is used for POWER OUT, I/O and Communication IN/OUT access holes.



Cable gland diameters for wiring access holes:

| Housing Type | Power IN/OUT | Motor | I/O | Communication IN/OUT |
|--------------|--------------|-------|-----|----------------------|
| 1 | M16 | M25 | M20 | M16 |
| 2 | M25 | M32 | M20 | M16 |
| 3 | M32 | M40 | M20 | M16 |
| 4 | M40 | M50 | M20 | M16 |

Note: Use IP54 or better cable glands to prevent moisture from entering the unit. Not doing so might result in damaging the unit.

Note: Use cable glands of right size to prevent moisture from entering the unit. Not doing so might result in damaging the unit.

Note: Use EMC cable gland for shielded motor wiring or use the cable bracket supplied with the MX2 IP54 housing. Not doing so might result in unexpected behaviour of the unit due to electrical interference.



Note: Moisture can enter the enclosure when the blinding plug is removed. Do not remove the blinding plug when the wiring access hole is not used. Not doing so might result in damaging the unit.

2-3-6 Determining Wire and Fuse Sizes


The maximum motor currents in your application determines the recommended wire size. The following table gives the wire size in AWG. The “Power Lines” column applies to the inverter input power, output wires to the motor, the earth ground connection, and any other components shown in the “Basic System Description” on page 28. The “Signal Lines” column applies to any wire connecting to the two green connectors just inside the front cover panel.

| Motor Output | | | | Inverter Model | Wiring | | Applicable equipment |
|--------------|------|-----|-----|----------------|---|---|----------------------|
| kW | | HP | | | Power Lines | Signal Lines | |
| VT | CT | VT | CT | | | | |
| 0.2 | 0.1 | ¼ | 1/8 | 3G3MX2-AB001 | AWG16 / 1.3 mm ² (75°C only) | 18 to 28 AWG / 0.14 to 0.75 mm ² shielded wire *4 | 10 A |
| 0.4 | 0.2 | ½ | ¼ | 3G3MX2-AB002 | | | |
| 0.55 | 0.4 | ¾ | ½ | 3G3MX2-AB004 | | | |
| 1.1 | 0.75 | 1.5 | 1 | 3G3MX2-AB007 | AWG12 / 3.3 mm ² (75°C only) | | 15 A |
| 2.2 | 1.5 | 3 | 2 | 3G3MX2-AB015 | AWG10 / 5.3 mm ² | | 30 A |
| 3.0 | 2.2 | 4 | 3 | 3G3MX2-AB022 | | | |
| 0.2 | 0.1 | ¼ | 1/8 | 3G3MX2-A2001 | | AWG16 / 1.3 mm ² | |
| 0.4 | 0.2 | ½ | ¼ | 3G3MX2-A2002 | | | |
| 0.75 | 0.4 | 1 | ½ | 3G3MX2-A2004 | | | |
| 1.1 | 0.75 | 1.5 | 1 | 3G3MX2-A2007 | | | |
| 2.2 | 1.5 | 3 | 2 | 3G3MX2-A2015 | AWG14 / 2.1 mm ² (75°C only) | | 15 A |
| 3.0 | 2.2 | 4 | 3 | 3G3MX2-A2022 | AWG12 / 3.3 mm ² (75°C only) | | 20 A |
| 5.5 | 3.7 | 7.5 | 5 | 3G3MX2-A2037 | AWG10 / 5.3 mm ² (75°C only) | | 30 A |
| 7.5 | 5.5 | 10 | 7.5 | 3G3MX2-A2055 | AWG6 / 13 mm ² (75°C only) | | 40 A |
| 11 | 7.5 | 15 | 10 | 3G3MX2-A2075 | | | |
| 15 | 11 | 20 | 15 | 3G3MX2-A2110 | AWG4 / 21 mm ² (75°C only) | | 80 A |
| 18.5 | 15 | 25 | 20 | 3G3MX2-A2150 | AWG2 / 34 mm ² (75°C only) | | 80 A |
| 0.75 | 0.4 | 1 | ½ | 3G3MX2-A4004 | AWG16 / 1.3 mm ² | | 10 A |
| 1.5 | 0.75 | 2 | 1 | 3G3MX2-A4007 | | | |
| 2.2 | 1.5 | 3 | 2 | 3G3MX2-A4015 | | | |
| 3.0 | 2.2 | 4 | 3 | 3G3MX2-A4022 | AWG14 / 2.1 mm ² | | 15 A |
| 4.0 | 3.0 | 5 | 4 | 3G3MX2-A4030 | | | |
| 5.5 | 4.0 | 7.5 | 5 | 3G3MX2-A4040 | AWG12 / 3.3 mm ² (75°C only) | | 20 A |
| 7.5 | 5.5 | 10 | 7.5 | 3G3MX2-A4055 | AWG10 / 5.3 mm ² (75°C only) | | 20 A |
| 11 | 7.5 | 15 | 10 | 3G3MX2-A4075 | | | |
| 15 | 11 | 20 | 15 | 3G3MX2-A4110 | AWG6 / 13 mm ² (75°C only) | | 40 A |
| 18.5 | 15 | 25 | 20 | 3G3MX2-A4150 | AWG6 / 13 mm ² (75°C only) | | 40 A |

- Note 1** Field wiring must be made by a UL-Listed and CSA-certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed by using the crimping tool specified by the connector manufacturer.
- Note 2** Be sure to consider the capacity of the circuit breaker to be used.
- Note 3** Be sure to use a larger wire gauge if power line length exceeds 66 ft. (20 m).
- Note 4** Use 18 AWG / 0.75 mm² wire for the alarm signal wire ([AL0], [AL1], [AL2] terminals).

2-3-7 Terminal Dimensions and Torque Specs

The terminal screw dimensions for all MX2 inverters are listed in table below. This information is useful in sizing spade lug or ring lug connectors for wire terminations.

 **Caution** Tighten the screws with the specified torque in the table below. Check for any loosening of screws. Otherwise, there is the danger of fire.

| Types | Screw Diameter | Width (mm) | Tightening Torque (N·m) |
|---|----------------|------------|-------------------------|
| 3G3MX2 - AB001, AB002, AB004 3G3MX2 - A2001, A2002, A2004, A2007 | M3.5 | 7.6 | 1.0 |
| 3G3MX2 - AB007, AB015, AB022 3G3MX2 - A2015, A2022, A2037 3G3MX2 - A4004, A4007, A4015, A4022, A4030, A4040 | M4 | 10 | 1.4 |
| 3G3MX2 - A2055, A2075 3G3MX2 - A4055, A4075 | M5 | 13 | 3.0 |
| 3G3MX2 - A2110 3G3MX2 - A4110, A4150 | M6 | 17.5 | 3.9 to 5.1 |
| 3G3MX2 - A2150 | M8 | 23 | 5.9 to 8.8 |

2-3-8 Inverter Supply Input (R/L1, S/L2, T/L3)

Step 3 In this step, you will connect wiring to the input of the inverter. First, you must determine whether the inverter model you have required three-phase power only with terminals **[R/L1]**, **[S/L2]**, and **[T/L3]**, or single-phase power only with terminals **[L1]** and **[N]**. Refer to the specifications label (on the side of the inverter) for the acceptable power source types!

2-3-8-1 Earth leakage circuit breaker

Use an earth leakage breaker for circuit (wiring) protection between the power supply and the main power supply terminals (R/L1, S/L2, T/L3).

An earth leakage breaker may malfunction at high frequencies as those generated by an inverter. Use an earth leakage breaker with a large high-frequency sensitive current rating.

When sensitivity of 30mA or even less earth leakage maybe required in certain applications (e.g. domestic), short motor cable and convenient low-leakage EMC filters should be selected. Check with your supplier for additional indications.

2-3-8-2 Magnetic contactor

When the Inverter protective function is activated, your system may fail or an accident may occur. Connect a magnetic contactor to turn off the Inverter power supply.

Do not start or stop the Inverter by switching ON/OFF the magnetic contactor provided in the Inverter power supply input (primary) circuit and output (secondary) circuit. To start or stop the Inverter via an external signal, use the operation command terminals (FW, RV) on the control circuit terminal block.

Do not use this Inverter with an input phase loss connection. The Inverter operating with 1-phase input may be causing a trip (due to undervoltage, overcurrent, etc.) or damage to the Inverter.

Do not turn on the power and then turn it off again more than once every 3 minutes. Doing so may damage the Inverter.

2-3-9 Inverter output terminal (U/T1, V/T2, W/T3)

For connection of the output terminal, use the compatible cable or a cable with a larger section. Otherwise, the output voltage between the Inverter and the motor may drop.

Do not mount a phase advance capacitor or surge absorber, because these devices may cause the Inverter to trip or cause damage to the capacitor or surge absorber.

If the cable length exceeds 20 m (particularly, with 400 V class), a surge voltage may be generated at the motor terminal depending on stray capacitance or inductance of the cable, causing the motor to risk his isolation (depending on motor isolation class and conditions).

To suppress surge voltage, output filters are recommended. From simple choke and output dV/dt filters to sinus filters.

To connect several motors, provide a thermal protection relay for each, as the inverter can not recognize how current is shared among the motors.

The RC value of each thermal relay should be 1.1 times larger than the motor rated current. The relay may trip earlier depending on the cable length. In this case, connect an AC reactor to the Inverter output.

2-3-10 DC Reactor Connection (+1, P/+2)

This terminal is used to connect the optional DC reactor.

By factory default, a shorting bar has been connected between terminals +1 and P/+2. Before connecting the DC reactor, remove this shorting bar.

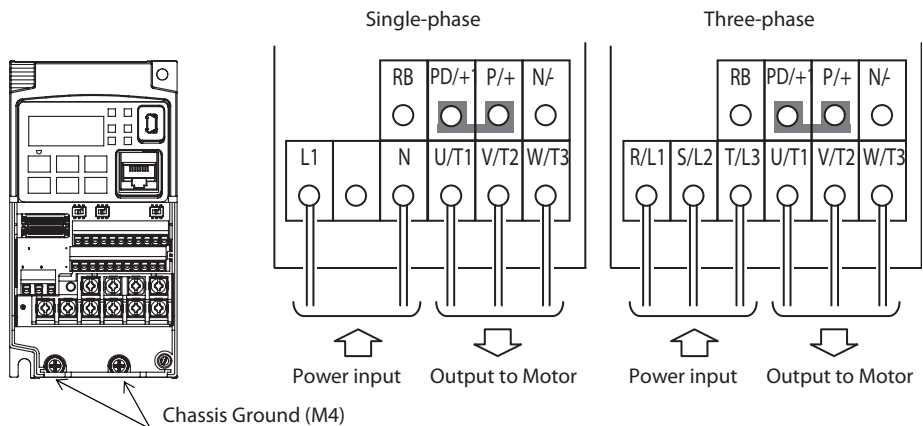
The length of the DC reactor connection cable should be 5 m or shorter.

If the DC reactor is not being used, do not remove the shorting bar.

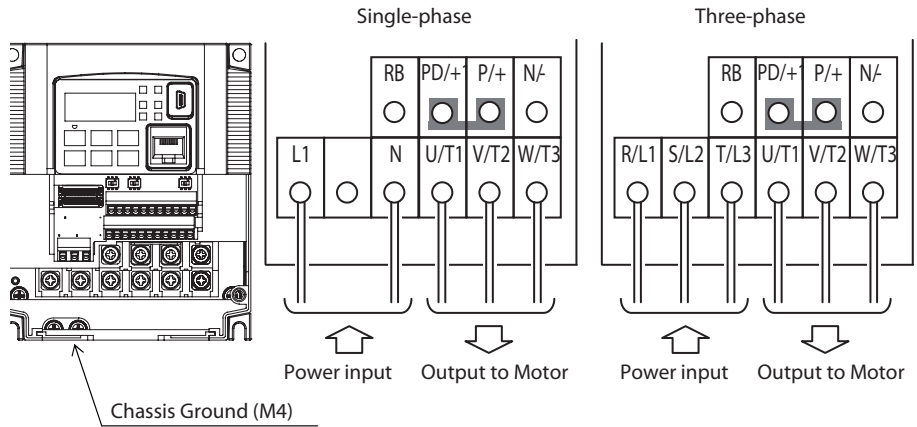
If you remove the shorting bar without connecting the DC reactor, no power is supplied to the Inverter main circuit, disabling operation.

2-3-11 Power connections for each inverter size

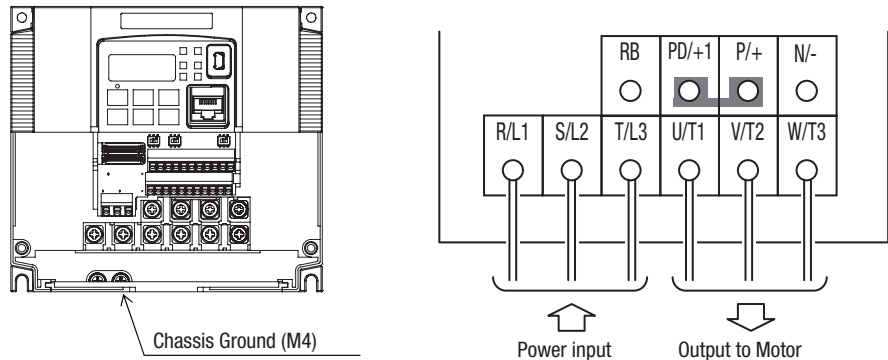
Single-phase 200 V 0.1 to 0.4 kW
 Three-phase 200 V 0.1 to 0.75 kW



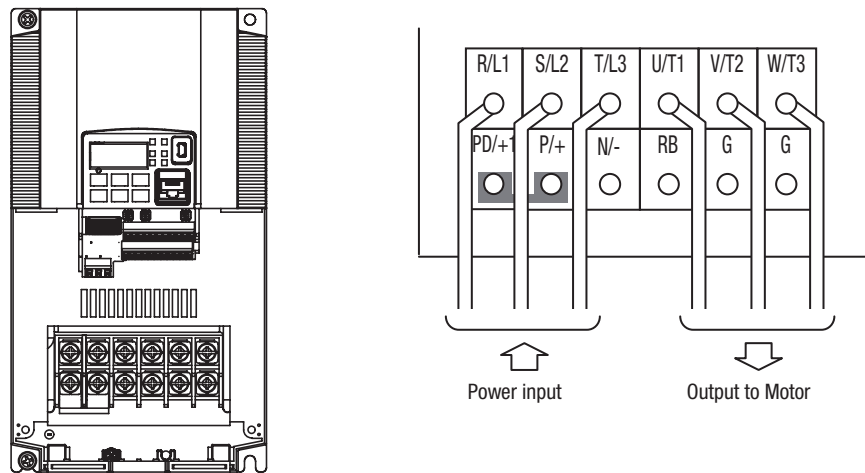
Single-phase 200 V 0.75 to 2.2 kW
 Three-phase 200 V 1.5, 2.2 kW
 Three-phase 400 V 0.4 to 3.0 kW



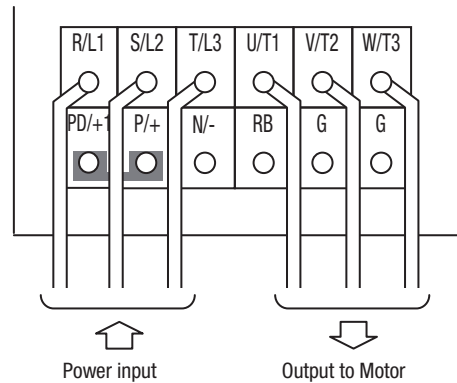
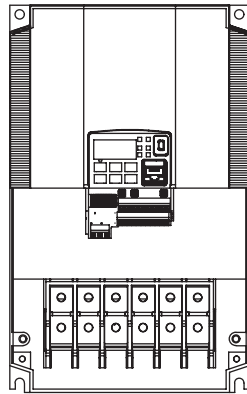
Three-phase 200 V 3.7 kW
 Three-phase 400 V 4.0 kW



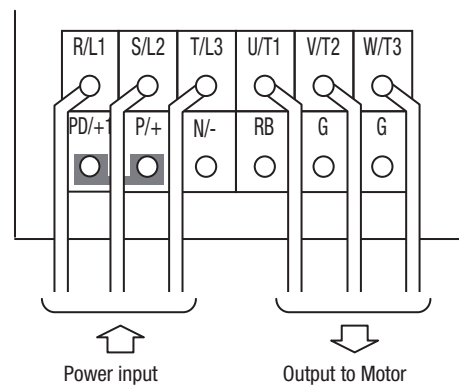
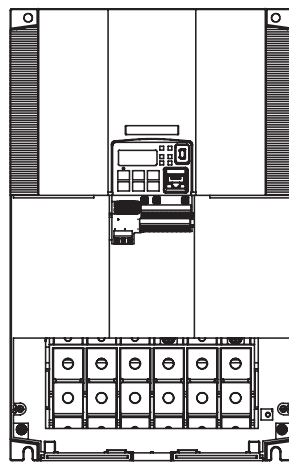
Three-phase 200 V 5.5, 7.5 kW
 Three-phase 400 V 5.5, 7.5 kW



**Three-phase 200 V 11 kW
Three-phase 400 V 11, 15 kW**



Three-phase 200 V 15 kW



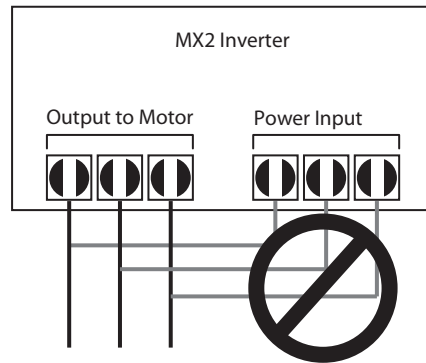
Note An inverter powered by a portable power generator may receive a distorted power waveform, overheating the generator. In general, the generator capacity should be five times that of the inverter (kVA).

⚠ Caution Be sure that the input voltage matches the inverter specifications:

- Single-phase 200 to 240 V 50/60 Hz (0.1 kW~2.2 kW) for 3G3MX2-AB models
- Three-phase 200 to 240 V 50/60 Hz (0.1 kW~15 kW) for 3G3MX2-A2 models
- Three-phase 380 to 480 V 50/60 Hz (0.4 kW~15 kW) for 3G3MX2-A4 models

⚠ Caution Be sure not to power a three-phase-only inverter with single phase power. Otherwise, there is the possibility of damage to the inverter and the danger of fire.

- ⚠ Caution** Be sure not to connect an AC power supply to the output terminals. Otherwise, there is the possibility of damage to the inverter and the danger of injury and/or fire.



- ⚠ Caution** Remarks for using ground fault interrupter breakers in the main power supply: Adjustable frequency inverter with integrated CE-filters and shielded (screened) motor cables have a higher leakage current toward earth GND. Especially at the moment of switching ON this can cause an inadvertent trip of ground fault interrupters. Because of the rectifier on the input side of the inverter there is the possibility to stall the switch-off function through small amounts of DC current.

Please observe the following:

- Use only short time-invariant and pulse current-sensitive ground fault interrupters with higher trigger current.
- Other components should be secured with separate ground fault interrupters.
- Ground fault interrupters in the power input wiring of an inverter are not an absolute protection against electric shock.

- ⚠ Caution** Be sure to install a fuse in each phase of the main power supply to the inverter. Otherwise, there is the danger of fire.

- ⚠ Caution** For motor leads, ground fault interrupter breakers and electromagnetic contactors, be sure to size these components properly (each must have the capacity for rated current and voltage). Otherwise, there is the danger of fire.

2-3-12 Wire the Inverter Output to Motor

Step 4 The process of motor selection is beyond the scope of this manual. However, it must be an AC induction motor with three phases. It should also come with a chassis ground lug. If the motor does not have three power input leads, stop the installation and verify the motor type. Other guidelines for wiring the motor include:

- Use an inverter-grade motor for maximum motor life (1600 V insulation).
- For standard motors, use the AC reactor accessory if the wiring between the inverter and motor exceeds 10 meters in length.

Simply connect the motor to the terminals [U/T1], [V/T2], and [W/T3] as shown in page 46 to page 49. This is a good time to connect the chassis ground lug on the drive as well. The motor chassis ground must also connect to the same point. Use a star ground (single-point) arrangement, and never daisy-chain the grounds (point-to-point).

- Check the mechanical integrity of each wire crimp and terminal connection.
- Replace the housing partition that covers access to the power connections.

Special care to be taken when motor is connected through long wires

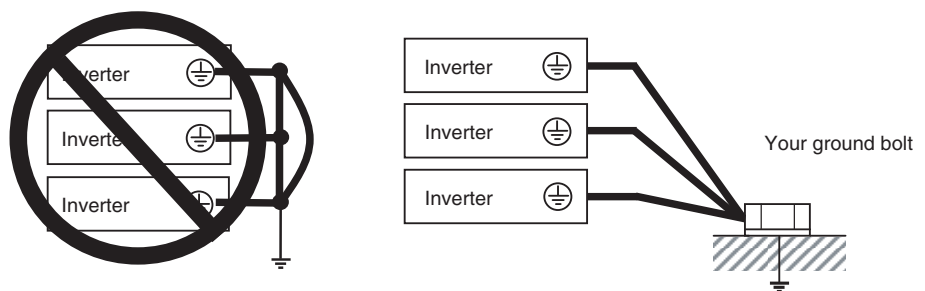
2-3-13 Ground Terminal

To prevent electric shock, be sure to ground the Inverter and the motor.

The 200 V class should be connected to the ground terminal under Class D grounding conditions (conventional Class 3 grounding conditions: 100 Ω or less ground resistance), The 400 V class should be connected to the ground terminal under Class C grounding conditions (conventional special Class 3 grounding conditions: 10 Ω or less ground resistance).

For the ground cable, use the compatible cable or a cable with a larger diameter. Make the cable length as short as possible.

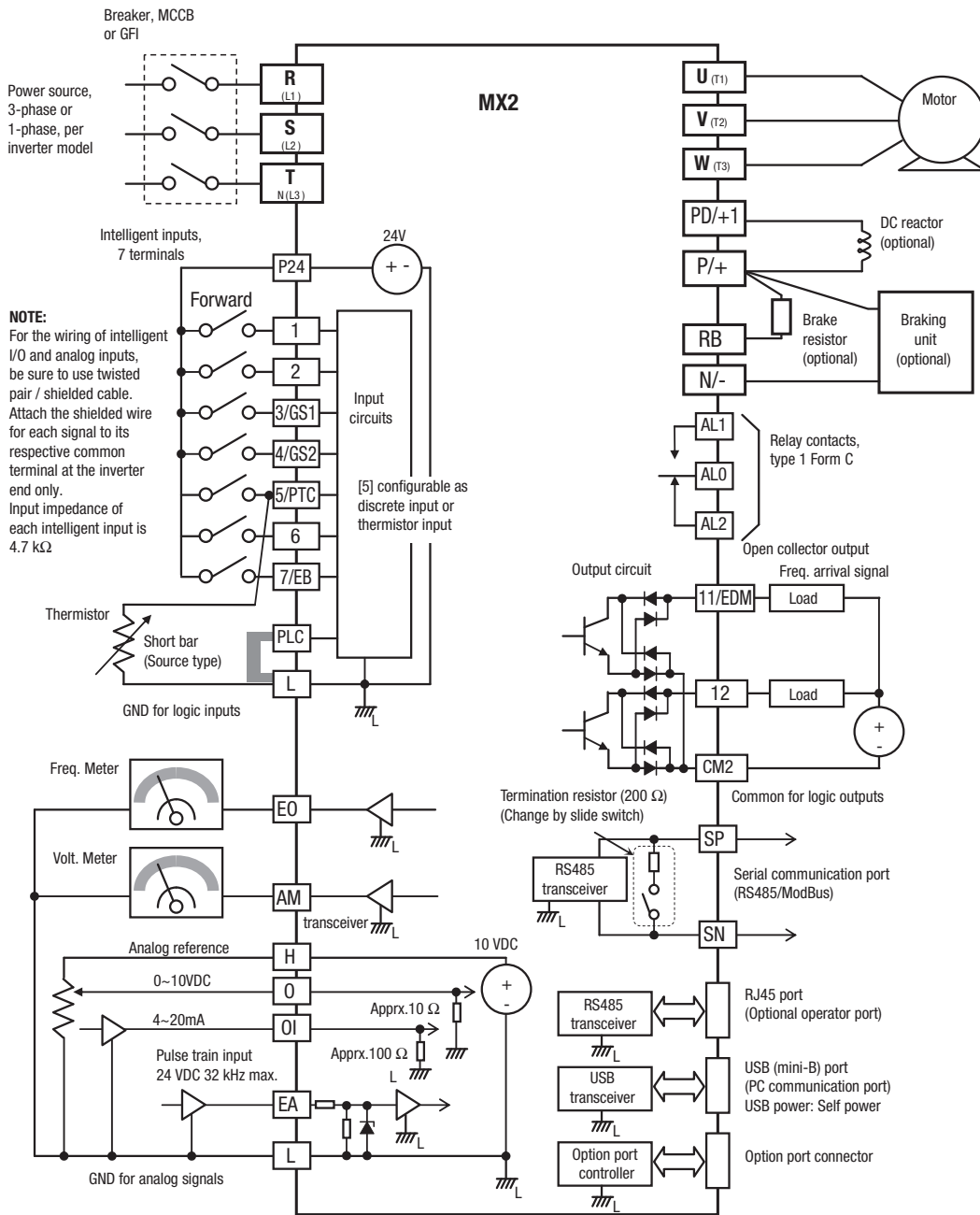
When several Inverters are connected, the ground cable must not be connected across several Inverters, and must not be looped. Otherwise, the Inverter and surrounding control machines may malfunction.



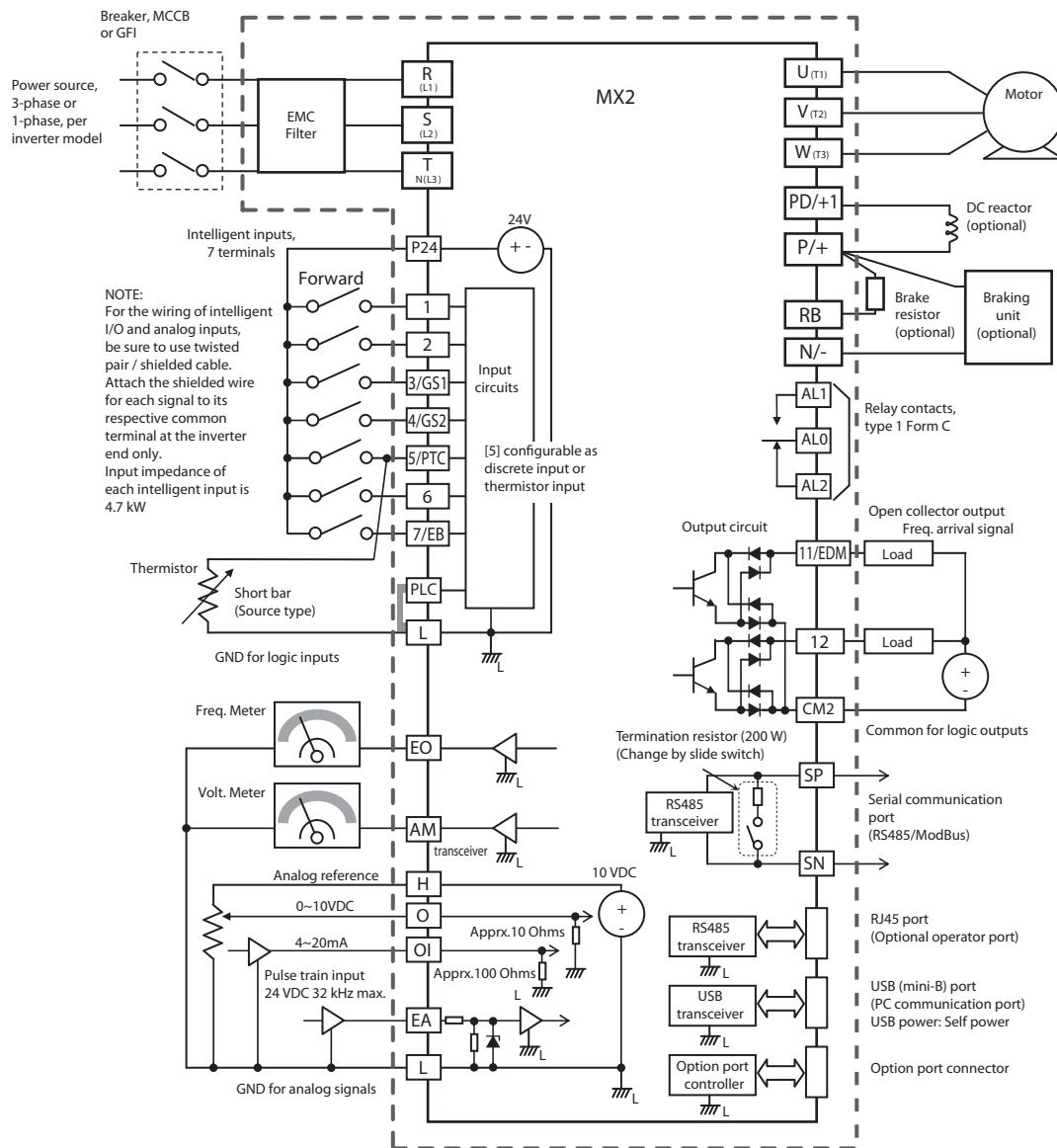
2-3-14 Logic Control Wiring

After completing the initial installation and powerup test in this chapter, you may need to wire the logic signal connector for your application. For new inverter users/applications, we highly recommend that you first complete the powerup test in this chapter without adding any logic control wiring. As a quick reference here is included the control connection diagram. But for more details about inputs and outputs configuration, please check SECTION 4 Operations and Monitoring.

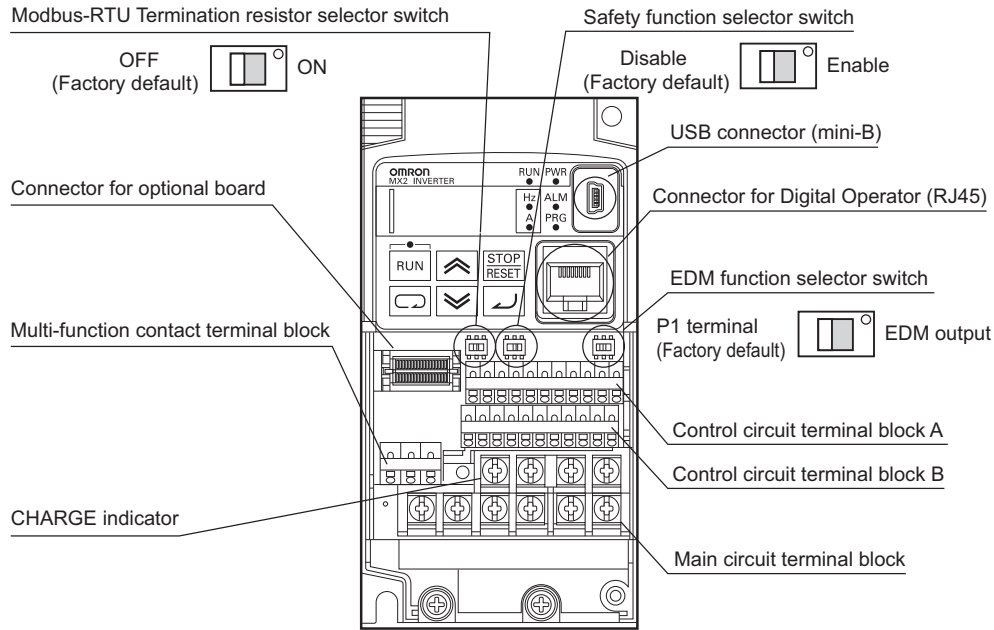
MX2 control wiring quick reference (IP20)



MX2 control wiring quick reference (IP54)



2-3-15 Name of Parts Inside the Terminal Block Cover

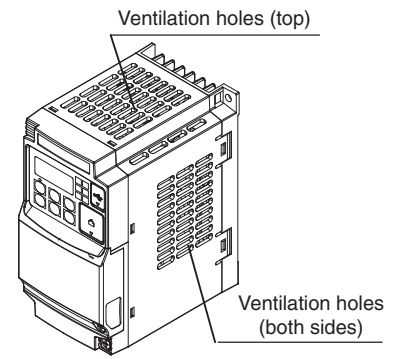


| Name | Description |
|---|---|
| Modbus-RTU Termination resistor selector switch | Use this Terminal Resistor selector switch for RS-485 terminals on the control circuit terminal block. When this switch is turned ON, the internal 200 Ω Resistor is connected. |
| Safety function selector switch | Turn this switch ON when using the safety function. Turn OFF the power before turning this switch ON/OFF. |
| EDM function selector switch | Turn this switch ON when using the EDM output of the safety function. Turn OFF the power cable before turning this switch ON/OFF. |
| USB connector | Use this mini-B USB connector to connect a PC. Even when the Inverter is being operated by a PC, etc., via USB connection, it can still be operated using the Digital Operator. |
| Connector for Digital Operator | Use this connector to connect the Digital Operator. |
| Connector for optional board | Use this connector to mount the optional board. (The optional board will be released soon.) |
| Control circuit terminal blocks A and B | These terminal blocks are used to connect various digital/analog input and output signals for inverter control. |
| Multi-function contact terminal block | Use this SPDT contact terminal block for relay outputs. |
| Main circuit terminal block | Use this terminal block to connect an output to the motor and Bracking Resistor, etc. Also, use this terminal block to connect the inverter to the main power supply. |
| CHARGE indicator (Charge indicator LED) | This LED indicator is lit if the DC voltage of the main circuit (between terminals P/+2 and N/-) remains approx. 45 V or above after the power has been cut off. Before wiring, etc. confirm that the Charge LED indicator is turned OFF. |

2-3-16 Uncover the Inverter Vents

Step 5 After mounting and wiring the inverter, remove any covers from the inverter housing. This includes material over the side ventilation ports.

⚠ WARNING Make sure the input power to the inverter is OFF. If the drive has been powered, leave it OFF for ten minutes before continuing.



2-4 Powerup Test

Step 6 After wiring the inverter and motor, you're ready to do a powerup test. The procedure that follows is designed for the first-time use of the drive. Please verify the following conditions before conducting the powerup test:

- You have followed all the steps in this chapter up to this step.
- The inverter is new, and is securely mounted to a non-flammable vertical surface.
- The inverter is connected to a power source and a motor.
- No additional wiring of the inverter connectors or terminals has been done.
- The power supply is reliable, and the motor is a known working unit, and the motor nameplate ratings match the inverter ratings.
- The motor is securely mounted, and is not connected to any load.

2-4-1 Goals for the Powerup Test

If there are any exceptions to the above conditions at this step, please take a moment to take any measures necessary to reach this basic starting point. The specific goals of this powerup test are:


1. Verify that the wiring to the power supply and motor is correct.
2. Demonstrate that the inverter and motor are generally compatible.
3. Get an introduction to the use of the built-in operator keypad.


The powerup test gives you an important starting to ensure a safe and successful application of the Omron inverter. We highly recommend performing this test before proceeding to the other chapters in this manual.


2-4-2 Pre-test and Operational Precautions


The following instructions apply to the powerup test, or to any time the inverter is powered and operating. Please study the following instructions and messages before proceeding with the powerup test.

1. The power supply must have fusing suitable for the load. Check the fuse size chart presented in Step 5, if necessary.
2. Be sure you have access to a disconnect switch for the drive input power if necessary. However, do not turn OFF power during inverter operation unless it is an emergency.

 **Caution** The heat sink fins will have a high temperature. Be careful not to touch them. Otherwise, there is the danger of getting burned.

 **Caution** The operation of the inverter can be easily changed from low speed to high speed. Be sure to check the capability and limitations of the motor and machine before operating the inverter. Otherwise, there is the danger of injury.

 **Caution** If you operate a motor at a frequency higher than the inverter standard default setting (50 Hz/60 Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage and/or injury.

 **Caution** Check the following before and during the Powerup test. Otherwise, there is the danger of equipment damage.

- Is the shorting bar between the [+1] and [+] terminals installed? DO NOT power or operate the inverter if the jumper is removed.
- Is the direction of the motor rotation correct?
- Did the inverter trip during acceleration or deceleration?
- Were the rpm and frequency meter readings as expected?
- Were there any abnormal motor vibration or noise?

2-4-3 Powering the Inverter

If you have followed all the steps, cautions and warnings up to this point, you're ready to apply power. After doing so, the following events should occur:

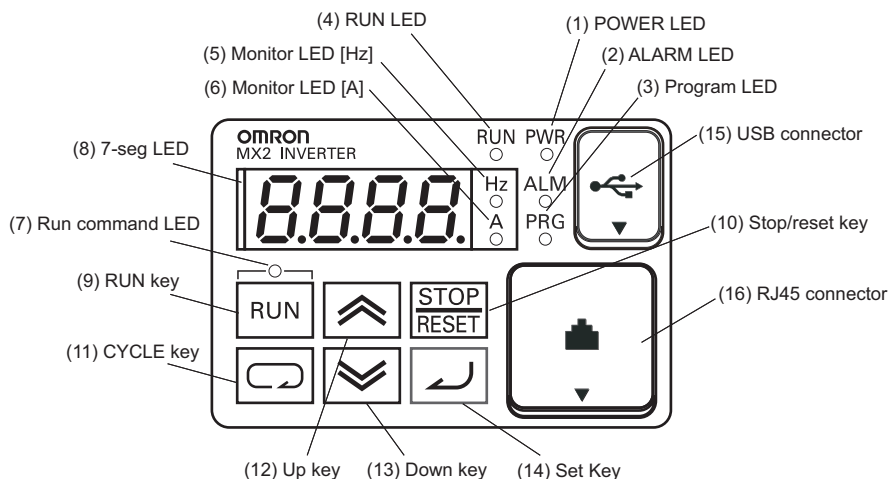
- The *POWER* LED will illuminate.
- The numeric (7-segment) LEDs will display a test pattern, then stop at 0.0.
- The *Hz* LED will be ON.

If the motor starts running unexpectedly or any other problem occurs, press the STOP key. Only if necessary should you remove power to the inverter as a remedy.

Note If the inverter has been previously powered and programmed, the LEDs (other than the *POWER* LED) may illuminate differently than as indicated above. If necessary, you can initialize all parameters to the factory default settings. See “*Restoring Factory Default Settings*” on page 279.

2-5 Using the Front Panel Keypad

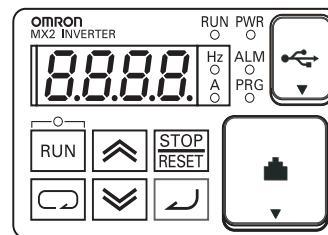
Please take a moment to familiarize yourself with the keypad layout shown in the figure below. The display is used in programming the inverter's parameters, as well as monitoring specific parameter values during operation.



| Items | Contents |
|----------------------|--|
| (1) POWER LED | Turns ON (Green) while the inverter is powered up. |
| (2) ALARM LED | Turns ON (Red) when the inverter trips. |
| (3) Program LED | · Turns ON (Green) when the display shows changeable parameter. · Blinks when there is a mismatch in setting. |
| (4) RUN LED | Turns ON (Green) when the inverter is driving the motor. |
| (5) Monitor LED [Hz] | Turns ON (Green) when the displayed data is frequency related. |
| (6) Monitor LED [A] | Turns ON (Green) when the displayed data is current related. |
| (7) Run command LED | Turns ON (Green) when a Run command is set to the operator. (Run key is effective.) |
| (8) 7-seg LED | Shows each parameter, monitors etc. |
| (9) Run key | Makes inverter run. |
| (10) Stop/reset key | · Makes inverter decelerates to a stop. · Reset the inverter when it is in trip situation |
| (11) CYCLE key | · Go to the top of next function group, when a function mode is shown · Cancel the setting and return to the function code, when a data is shown · Moves the cursor to a digit left, when it is in digit-to-digit setting mode · Pressing for 1 second leads to display data of <i>d00 l</i> , regardless of current display. |
| (12) Up key | · Increase or decrease the data. |
| (13) Down key | · Pressing the both keys at the same time gives you the digit-to-digit edit. |
| (14) SET key | · Go to the data display mode when a function code is shown · Stores the data and go back to show the function code, when data is shown. · Moves the cursor to a digit right, when it is in digit-to-digit display mode |
| (15) USB connector | Connect USB connector (mini-B) for using PC communication |
| (16) RJ45 connector | Connect RJ45 jack for remote operator |

2-5-1 Keys, Modes, and Parameters

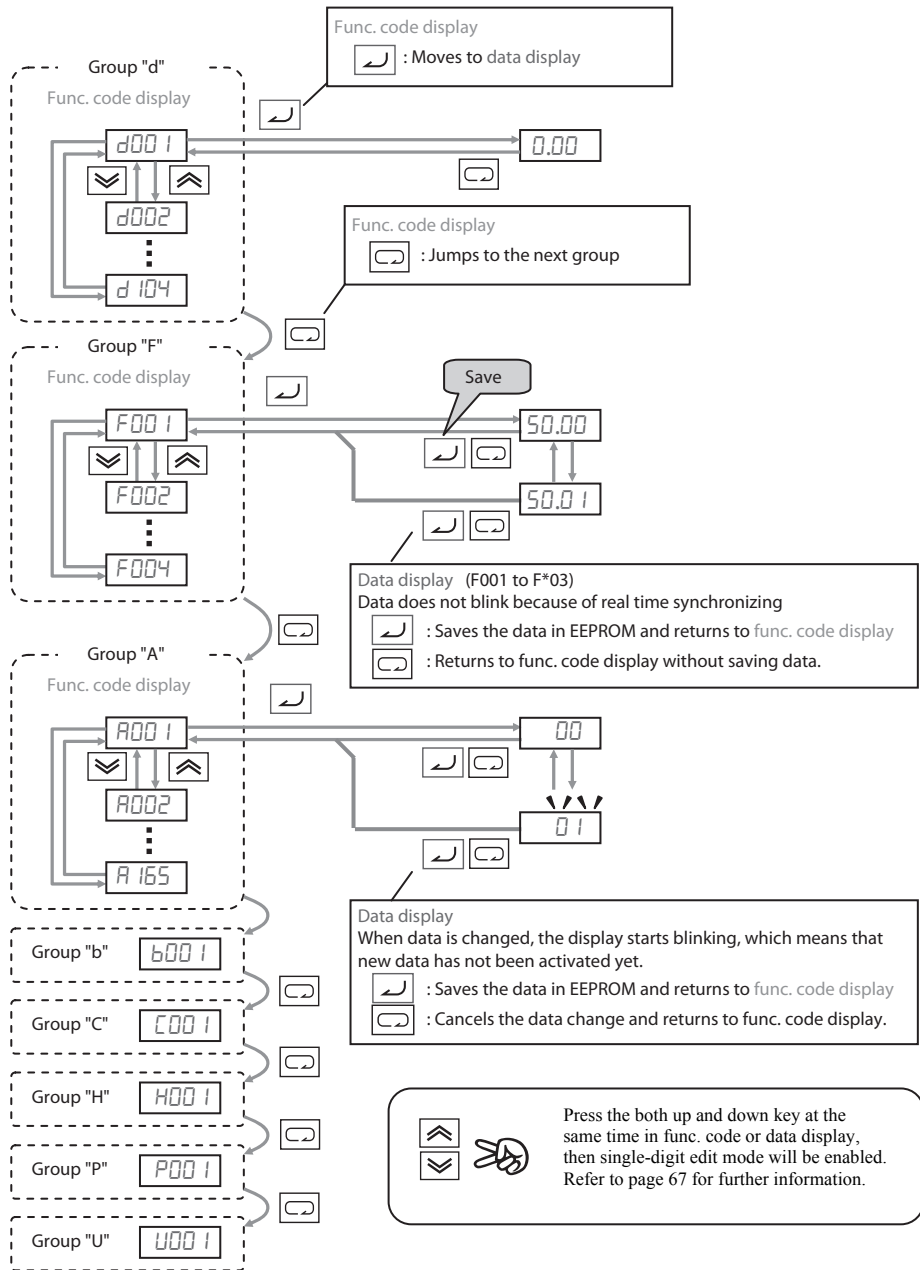
The purpose of the keypad is to provide a way to change modes and parameters. The term *function* applies to both monitoring modes and parameters. These are all accessible through *function codes* that are primary 4-character codes. The various functions are separated into related groups identifiable by the left-most character, as the table shows.



| Function Group | Type (Category) of Function | Mode to Access | PRG LED Indicator |
|----------------|---|----------------|-------------------|
| "d" | Monitoring functions | Monitor | ○ |
| "F" | Main profile parameters | Program | ● |
| "A" | Standard functions | Program | ● |
| "b" | Fine tuning functions | Program | ● |
| "C" | Intelligent terminal functions | Program | ● |
| "H" | Motor constant related functions | Program | ● |
| "P" | Pulse train input, torque, Drive Programming, and communication related functions | Program | ● |
| "U" | User selected parameters | Program | ● |
| "E" | Error codes | — | — |

2-5-2 Keypad Navigation Map

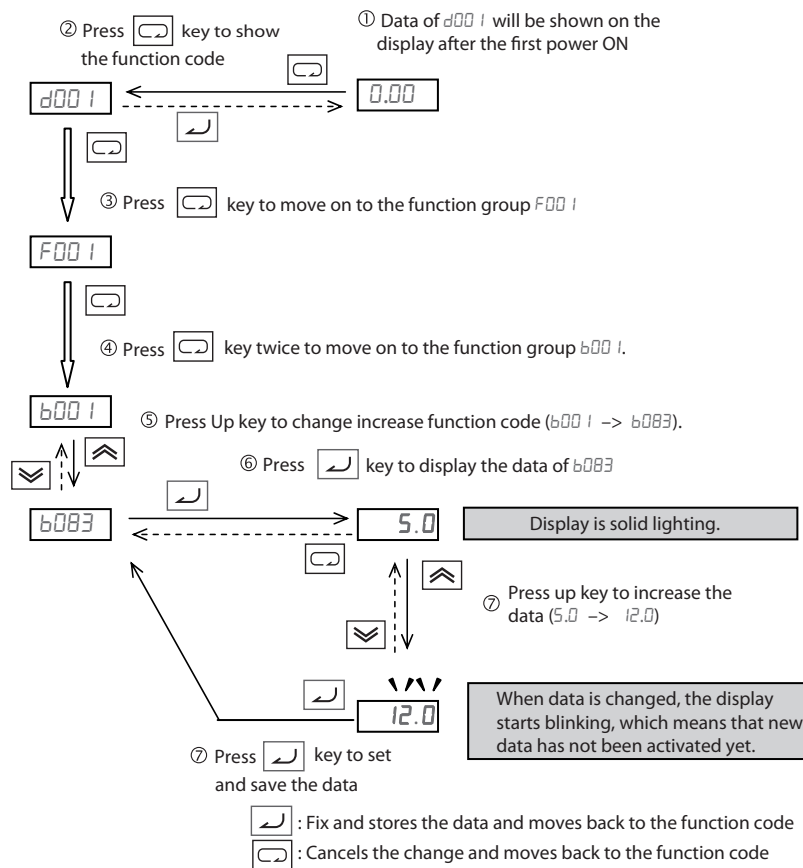
The MX2 Series inverter drives have many programmable functions and parameters. Chapter 3 will cover these in detail, but you need to access just a few items to perform the powerup test. The menu structure makes use of function codes and parameter codes to allow programming and monitoring with only a 4-digit display and keys and LEDs. So, it is important to become familiar with the basic navigation map of parameters and functions in the diagram below. You may later use this map as a reference.



Note Pressing the **Next Group** key will make the display go to the top of next function group, regardless the display contents. (e.g. A02 1 → **Next Group** → b00 1)

[Setting example]

After power ON, changing from 0.00 display to change the b003 (carrier frequency) data.



Note Function code **bxxx** are for monitor and not possible to change. Function codes **Fxxx** other than **FHHH** are reflected on the performance just after changing the data (before pressing key), and there will be no blinking.

| | When a function code is shown... | When a data is shown... |
|-----|------------------------------------|---|
| key | Move on to the next function group | Cancels the change and moves back to the function code |
| key | Move on to the data display | Fix and stores the data and moves back to the function code |
| key | Increase function code | Increase data value |
| key | Decrease function code | Decrease data value |

Note Keep pressing for more than 1 second leads to d001 display, regardless the display situation. But note that the display will circulates while keep pressing the key because of the original function of the key. (e.g. F001 -> A001 -> b001 -> C001 -> ... -> displays 50.00 after 1 second)

2-5-3 Selecting Functions and Editing Parameters

To prepare to run the motor in the powerup test, this section will show how to configure the necessary parameters:

1. Select the digital operator as the source of motor speed command (**A001=02**).
2. Select the digital operator as the source of the RUN command (**A002=02**).
3. Set the motor base frequency (**A003**) and AVR voltage of the motor (**A002**).
4. Set the motor current for proper thermal protection (**b012**).
5. Set the number of poles for the motor (**H004**).

The following series of programming tables are designed for successive use. Each table uses the previous table's final state as the starting point. Therefore, start with the first and continue programming until the last one. If you get lost or concerned that some of the other parameters setting may be incorrect, refer to "Restoring Factory Default Settings" on page 279.

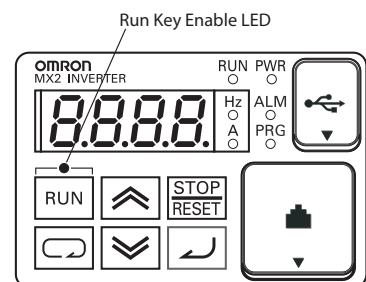
Prepare to Edit Parameters – This sequence begins with powering ON the inverter, then it shows how to navigate to the "A" Group parameters for subsequent settings. You can also refer to the "Keypad Navigation Map" on page 60 for orientation throughout the steps.

| Action | Display | Func./Parameter |
|------------------------|---------|--|
| Turn ON the inverter | | Inverter output frequency displayed (0Hz in stop mode) |
| Press the key | | "A" group selected |
| Press the key 2 times | | "A" group selected |






1. Select the digital operator for Speed Command – The inverter output frequency can be set from several sources, including an analog input, memory setting, or the network, for example. The powerup test uses the keypad as the speed control source for your convenience. Note that the default setting depends on the country.

| Action | Display | Func./Parameter |
|-----------------------------|---------|--|
| (Starting point) | | "A" Group selected Speed command source setting |
| Press the key | | 00... Potentiometer of ext. operator 01... Control terminals 02... Digital operator (F001) 03... ModBus network etc. |
| Press the / key to select | | 02... Digital operator (selected) |
| Press the key to store | | Stores parameter, returns to "A001" |

2. Select the digital operator for RUN Command – To RUN command causes the inverter to accelerate the motor to the selected speed. The Run command can arrive from various sources, including the control terminals, the Run key on the keypad or the network. In the figure to the right, notice the Run Key Enable LED, just above the Run key. If the LED is ON, the Run key is already selected as the source, and you may skip this step. Note that the default setting depends on the country.









If the Potentiometer Enable LED is OFF, follow these steps below (the table resumes action from the end of the previous table).

| Action | Display | Func./Parameter |
|---|---------|---|
| (Starting point) | A001 | Speed command source setting |
| Press the  key | A002 | Run command source setting |
| Press the  key | 01 | 01... Control terminals 02... Digital operator 03... ModBus network input etc. |
| Press the  /  key to select | 02 | 02... Digital operator (selected) |
| Press the  key to store | A002 | Stores parameter, returns to "A002" |

Note After completing the steps above, the Run Key Enable LED will be ON. This does not mean the motor is trying to run; it means that the RUN key is now enabled. DO NOT press the RUN key at this time – complete the parameter setup first.

3. Set the Motor Base Frequency and AVR voltage of the motor – The motor is designed to operate at a specific AC frequency. Most commercial motors are designed for 50/60 Hz operation. First, check the motor specifications. Then follow the steps below to verify the setting or correct it for your motor. DO NOT set it greater than 50/60 Hz unless the motor manufacturer specifically approves operation at the higher frequency.






| Action | Display | Func./Parameter |
|---|--------------------|--|
| (Starting point) | A002 | Run command source setting |
| Press the  key once | A003 | Base frequency setting |
| Press the  key | 60.0 or 50.0 | Default value for the base frequency US = 60 Hz, Europe = 50 Hz |
| Press the  /  key to select | 60.0 | Set to your motor specs (your display may be different) |
| Press the  key | A003 | Stores parameter, returns to "A003" |

 **Caution** If you operate a motor at a frequency higher than the inverter standard default setting (50 Hz/60 Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage.

Set the AVR Voltage Setting – The inverter has an Automatic Voltage Regulation (AVR) function. It adjusts the output voltage to match the motor's nameplate voltage rating. The AVR smoothes out fluctuation in the input power source, but note that it does not boost the voltage in the event of a brown-out. Use the AVR setting (A002) that most closely matches the one for your motor.







- 200 V class: 200 / 215 / 220 / 230 / 240 VAC
- 400 V class: 380 / 400 / 415 / 440 / 460 / 480 VAC

To set the motor voltage, follow the steps on the following table.

| Action | Display | Func./Parameter |
|---|--------------------|---|
| (Starting point) | A003 | Base frequency setting |
| Press the  key and hold until → | A0B2 | AVR voltage select |
| Press the  key | A230 or A400 | Default value for AVR voltage: 200 V class= 230 VAC 400 V class= 400 VAC (HFE) = 460 VAC (HFU) |
| Press the  /  key to select | A2 15 | Set to your motor specs (your display may be different) |
| Press the  key | A0B2 | Stores parameter, returns to "A0B2" |

4. Set the Motor Current – The inverter has thermal overload protection that is designed to protect the inverter and motor from overheating due to an excessive load. The inverter's uses the motor's current rating to calculate the time-based heating effect. This protection depends on using correct current rating for your motor. The level of electronic thermal setting, parameter **b0 12**, is adjustable from 20% to 100% of the inverter's rated current. A proper configuration will also help prevent unnecessary inverter trip events.

Read the motor's current rating on its manufacturer's nameplate. Then follow the steps below to configure the inverter's overload protection setting.

| Action | Display | Func./Parameter |
|---|---------|---|
| (Starting point) | A0B2 | AVR voltage select |
| Press the  key | b00 1 | First "B" Group parameter selected |
| Press the  key and hold until → | b0 12 | Level of electronic thermal setting |
| Press the  key | b 150 | Default value will be 100% of inverter rated current |
| Press the  /  key to select | b 140 | Set to your motor specs (your display may be different) |
| Press the  key | b0 12 | Stores parameter, returns to "b0 12" |

5. Set the Number of Motor Poles – The motor's internal winding arrangement determines its number of magnetic poles. The specification label on the motor usually indicates the number of poles. For proper operation, verify the parameter setting matches the motor poles. Many industrial motors have four poles, corresponding to the default setting in the inverter (**H004**).

Follow the steps in the table below to verify the motor poles setting and change if necessary (the table resumes action from the end of the previous table.)

| Action | Display | Func./Parameter |
|-----------------------------|---------|---|
| (Starting point) | | Level of electronic thermal setting |
| Press the key | | "H" Group selected |
| Press the key three times | | Motor poles parameter |
| Press the key | | 2 = 2 poles 4 = 4 poles (default) 6 = 6 poles 8 = 8 poles 10 = 10 poles |
| Press the / key to select | | Set to your motor specs (your display may be different) |
| Press the key | | Stores parameter, returns to "H004" |

This step concludes the parameter setups for the inverter. You are almost ready to run the motor for the first time!

Tip

If you became lost during any of these steps, first observe the state of the PRG LED. Then study the "Keypad Navigation Map" on page 60 to determine the current state of the keypad controls and display. As long as you do not press the key, no parameter will be changed by keypad entry errors. Note that power cycling the inverter causes it to power up Monitor Mode, displaying the value for **d001** (output frequency).

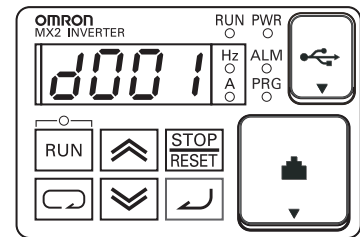
The next section will show you how to monitor a particular parameter from the display. Then you will be ready to run the motor.

2-5-4 Monitoring Parameters with the Display



After using the keypad for parameter editing, it's a good idea to switch the inverter from Program Mode to Monitor Mode. The PRG LED will be OFF, and the Hertz or Ampere LED indicates the display units.

For the powerup test, monitor the motor speed indirectly by viewing the inverter's output frequency. The *output frequency* must not

be confused with *base frequency* (50/60 Hz) of the motor, or the *carrier frequency* (switching frequency of the inverter, in the kHz range). The monitoring functions are in the "D" list, located near the top left of the "Keypad Navigation Map" on page 60.




Output frequency (speed) set – Resuming keypad operation from the previous table, follow the steps below.

| Action | Display | Func./Parameter |
|--|---------|-------------------------|
| (Starting point) | H004 | Motor poles parameter |
| Press the  key four times | F001 | "F" is selected |
| Press the  key | 0.00 | Set frequency displayed |

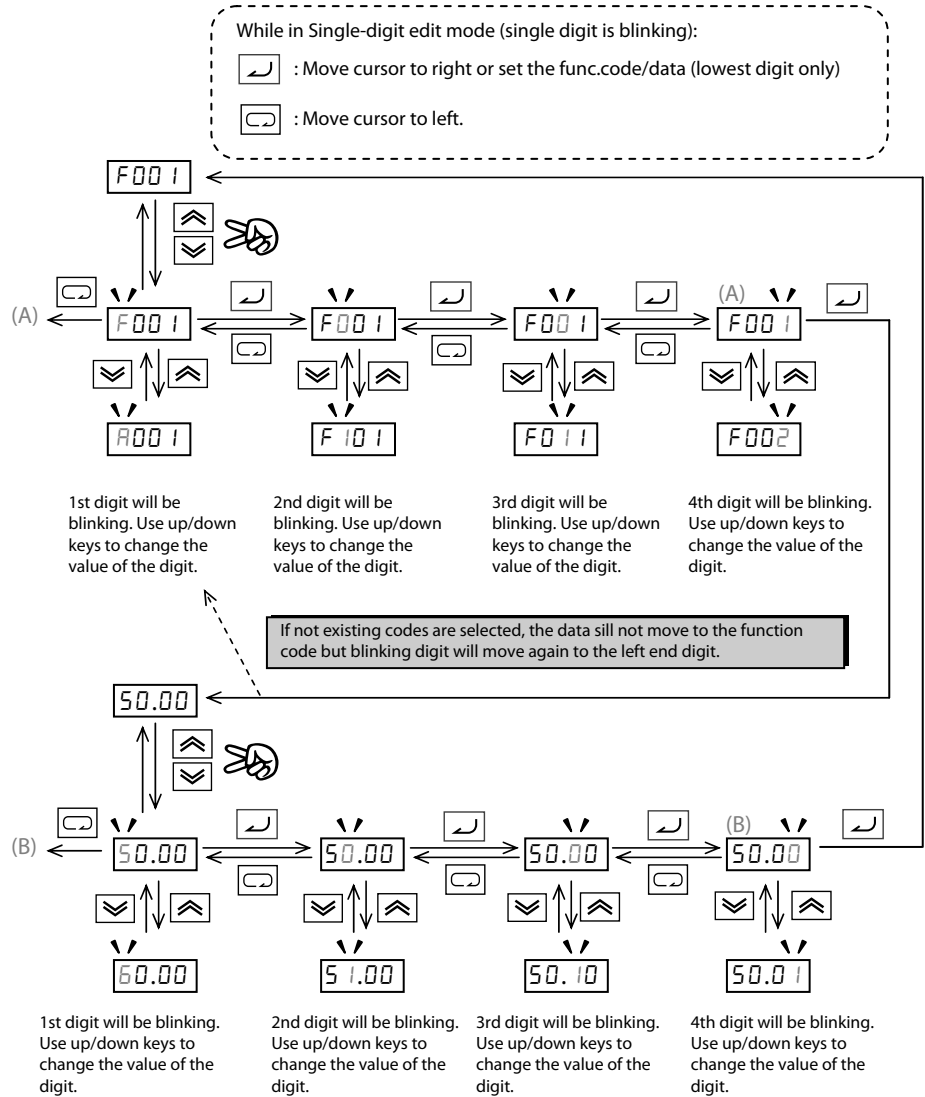
2-5-5 Running the Motor

If you have programmed all the parameters up to this point, you're ready to run the motor! First, review this checklist:

1. Verify the power LED is ON. If not, check the power connections.
2. Verify the Run Key Enable LED is ON. If it is OFF, check the **A002** setting.
3. Verify the PRG LED is OFF. If it is ON, review the instructions above.
4. Make sure the motor is disconnected from any mechanical load.
5. Now, press the RUN key on the keypad. The RUN LED will turn ON.
6. Press the  key for a few seconds. The motor should start turning.
7. Press the STOP key to stop the motor rotation.

2-5-6 Single-Digit Edit Mode

If a target function code or data is far from current data, using the single-digit edit mode makes it quicker. Pressing the up key and down key at the same time leads you to go into the digit-to-digit changing mode.



Note When pressing with cursor on the highest digit, the cursor will jump to the lowest digit. ((A) and (B) in above figure.)

Note When pressing up key and down key at the same time in single-digit edit mode, the single-digit edit mode is disabled and goes back to normal mode.

2-5-7 Powerup Test Observations and Summary

Step 7 Reading this section will help you make some useful observations when first running the motor.

Error Codes – If the inverter displays an error code (format is “E xx”), see “Monitoring Trip Events, History, & Conditions” on page 273 to interpret and clear the error.

Acceleration and Deceleration – The MX2 inverter has programmable acceleration and deceleration value. The test procedure left these at the default value, 10 seconds. You can observe this by setting the frequency *F001* at about half speed before running the motor. Then press RUN, and the motor will take 5 seconds to reach a steady speed. Press the STOP key to see a 5 second deceleration to a STOP.

State of Inverter at Stop – If you adjust the motor's speed to zero, the motor will slow to a near stop, and the inverter turns the outputs OFF. The high-performance MX2 can rotate at a very slow speed with high torque output, but not zero (must use servo systems with position feedback for that feature). This characteristic means you must use a mechanical brake for some applications.

Interpreting the Display – First, refer to the output frequency display read-out. The maximum frequency setting (parameter *A044*) defaults to 50 Hz or 60 Hz (Europe and United States, respectively) for your application.

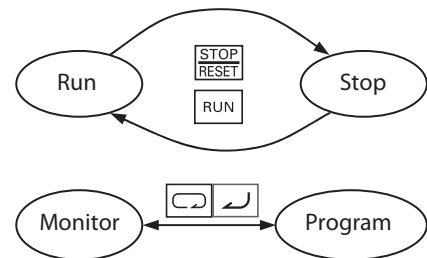
Example: Suppose a 4-pole motor is rated for 60 Hz operation, so the inverter is configured to output 60 Hz at full scale. Use the following formula to calculate the rpm.

$$\text{Speed in RPM} = \frac{\text{Frequency} \times 60}{\text{Pairs of poles}} = \frac{\text{Frequency} \times 120}{\text{\#of poles}} = \frac{60 \times 120}{4} = 1800 \text{ RPM}$$

The theoretical speed for the motor is 1800 rpm (speed of torque vector rotation). However, the motor cannot generate torque unless its shaft turns at a slightly different speed. This difference is called *slip*. So it's common to see a rated speed of approximately 1750 rpm on a 60 Hz, 4-pole motor. Using a tachometer to measure shaft speed, you can see the difference between the inverter output frequency and the actual motor speed. The slip increases slightly as the motor's load increases. This is why the inverter output value is called “frequency”, since it is not exactly equal to motor speed.

Run/Stop Versus Monitor/Program

Modes – The Run LED on the inverter is ON in Run Mode, and OFF in Stop Mode. The Program LED is ON when the inverter is in Program Mode, and OFF for Monitor Mode. All four mode combinations are possible. The diagram to the right depicts the modes and the mode transitions via keypad.



Note Some factory automation devices such as PLCs have alternative Run/Program modes; the device is in either one mode or the other. In the Omron inverter, however, Run Mode alternates with Stop Mode, and Program Mode alternates with Monitor Mode. This arrangement lets you program some value while the inverter is operating – providing flexibility for maintenance personnel.

SECTION 3

Configuring Drive Parameters

3-1 Choosing a Programming Device

3-1-1 Introduction

Omron variable frequency drives (inverters) use the latest electronics technology for getting the right AC waveform to the motor at the right time. The benefits are many, including energy savings and higher machine output or productivity. The flexibility required to handle a broad range of applications has required ever more configurable options and parameters - inverter are now a complex industrial automation component. And this can make a product seem difficult to use, but the goal of this chapter is to make this easier for you.

As the powerup test in 2-4 *Powerup Test* demonstrated, you do not have to program very many parameters to run the motor. In fact, most applications would benefit only from programming just a few, specific parameters. This chapter will explain the purpose of each set of parameters, and help you choose the ones that are important to your application.

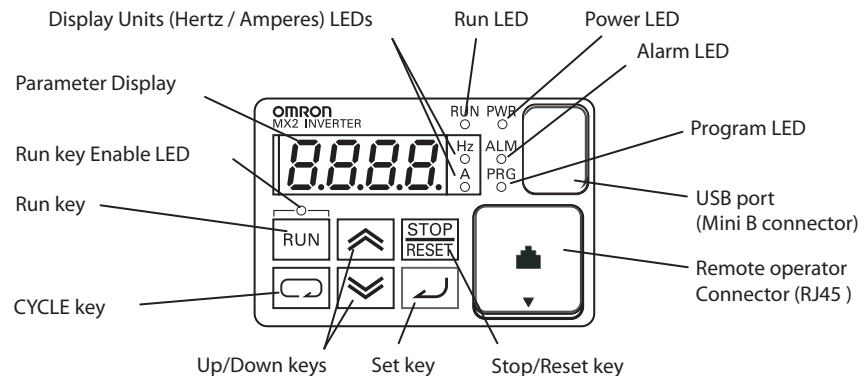
If you are developing a new application for the inverter and a motor, finding the right parameters to change is mostly an exercise in optimization. Therefore, it is okay to begin running the motor with a loosely tuned system. By making specific, individual changes and observing their effects, you can achieve a finely tuned system.

3-1-2 Introduction of Inverter Programming

The front panel keypad is the first and best way to get to know the inverter's capabilities. Every function or programmable parameter is accessible from the keypad.

3-2 Using the Keypad Devices

The MX2 Series inverter front keypad contains all the elements for both monitoring and programming parameters. The keypad layout is pictured below. All other programming devices for the inverter have a similar key arrangement and function.



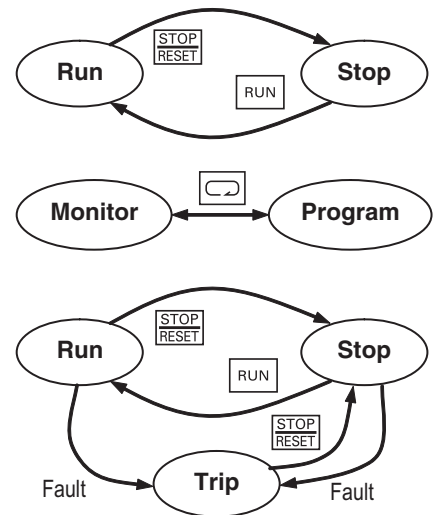
3-2-1 Key and Indicator Legend

- **Run LED** - ON when the inverter output is ON and the motor is developing torque (Run Mode), and OFF when the inverter output is OFF (Stop Mode).
- **Program LED** - This LED is ON when the inverter is ready for parameter editing (Program Mode). It is OFF when the parameter display is monitoring data (Monitor Mode).
- **Run Key Enable LED** - This LED is ON when the inverter is ready to respond to the Run key, OFF when the Run key is disabled.
- **Run Key** - Press this key to run the motor (the Run Enable LED must be ON first). Parameter F004, Keypad Run Key Routing, determines whether the Run key generates a Run FWD or Run REV command.
- **Stop/Reset Key** - Press this key to stop the motor when it is running (uses the programmed deceleration rate). This key will also reset an alarm that has tripped.
- **Parameter Display** - A 4-digit, 7-segment display for parameters and function codes.
- **Display Units, Hertz/Amperes** - One of these LEDs will be ON to indicate the units associated with the parameter display.
- **Power LED** - This is ON when the power input to the inverter is ON.
- **Alarm LED** - ON when an inverter trip is active (alarm relay contact will be closed).
- **Cycle Key** - This key is used to escape from the current situation.
- **Up/Down keys** - Use these keys alternatively to move up or down the lists of parameter and functions shown in the display, and increment/decrement values.
- **Set key** - This key is used to navigate through the lists of parameters and functions for setting and monitoring parameter values. When the unit is in Program Mode and you have edited a parameter value, press the Set key to write the new value to the EEPROM.

3-2-2 Operational Modes

The RUN and PRG LEDs tell just part of the story; Run Mode and Program Modes are independent modes, not opposite modes. In the state diagram to the right, Run alternates with Stop, and Program Mode alternates with Monitor Mode. This is a very important ability, for it shows that a technician can approach a running machine and change some parameters without shutting down the machine.

The occurrence of a fault during operation will cause the inverter to enter Trip Mode as shown. An event such as an output overload will cause the inverter to exit the Run Mode and turn OFF its output to the motor. In the Trip Mode, any request to run the motor is ignored. You must clear the error by pressing the Stop/Reset switch. See 6-2 *Monitoring Trip Events, History, & Conditions* on page 273.



3-2-3 Run Mode Edit

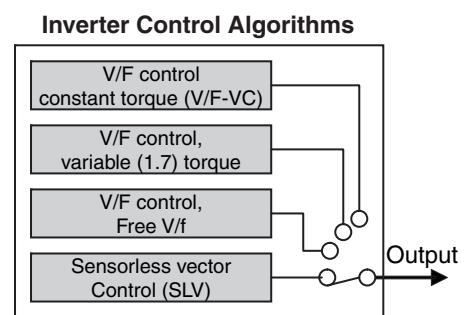
The inverter can be in Run Mode (inverter output is controlling motor) and still allow you to edit certain parameters. This is useful in applications that must run continuously, you need some inverter parameter adjustment.

The parameter tables in this chapter have a column titled "Run Mode Edit". An Ex mark ✖ means the parameter cannot be edited; a Check mark ✓ means the parameter can be edited. The Soft lock selection (parameter *b031*) determines when the Run Mode access permission is in effect and access permission in other conditions, as well. It is the responsibility of the user to choose a useful and safe software lock setting for the inverter operating conditions and personnel. Please refer to 3-6-5 *Software Lock Mode* on page 130 for more information.

| | Run Mode Edit | |
|--|---------------|--|
| | ✖ | |
| | ✓ | |
| | | |

3-2-4 Control Algorithms

The motor control program in the MX2 inverter has two sinusoidal PWM switching algorithms. The intent is that you select the best algorithm for the motor and load characteristics of your application. Both algorithms generate the frequency output in a unique way. Once configured, the algorithm is the basis for other parameter settings as well (see 3-5-4 *Torque Control Algorithms* on page 101). Therefore, choose the best algorithm early in your application design process.



3-2-5 Dual Rate Selection

The MX2 series inverter has Dual Rate, so that it can work in two different types of load condition, Constant torque application and Variable torque application. Select parameter **b049** depending on your application.

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b049 | Dual rate selection | Two options; select codes: 00 ...CT (Constant torque / HD) 01 ...VT (Variable torque / ND) | – | 00 | - |

When changed, the rated output current and related items are changed automatically. Differences between HD and ND are described below.

| | HD | ND |
|-------------------------|---|---|
| Usage | For heavy load with high torque required at start, acceleration or deceleration | For normal load without high torque required. |
| Applications | Elevators, cranes, conveyers, etc. | fans, pumps, air-conditionings |
| Rated current (example) | 1.0 A (3-phase 200 V 0.1 kW) | 1.2 A (3-phase 200 V 0.1 kW) |
| Overload current | 150% 60 sec. | 120% 60 sec. |

Initial values of HD and ND are different shown as below table. Be sure to note that when the dual rate selection **b049** is changed those initial values are also changed except **H003/H203**. (Even if currently set value is within the range of both HD and ND, data is initialized when **b049** is changed.)

| Name | Func. code | HD | | ND | |
|--|--------------|--|--------------------------|---|--------------------------|
| | | Range | initial data | Range | initial data |
| V/f characteristics selection | A044 A244 | 00: Const. torque 01: Reduced torque 02: Free V/F 03: SLV | 00: Const. tq. | 00: Const. torque 01: Reduced torque 02: Free V/F | 00: Const. tq. |
| DC injection braking power | A054 | 0 to 100 (%) | 50 (%) | 0 to 70 (%) | 50 (%) |
| Startup DC injection braking power | A057 | 0 to 100 (%) | 0 (%) | 0 to 70 (%) | 0 (%) |
| DC injection braking carrier frequency | A059 | 2.0 to 15.0 (kHz) | 5.0 (kHz) | 2.0 to 10.0 (kHz) | 2.0 (kHz) |
| Overload limit level | b022 b222 | 0.32 x Rated current to 3.20 x Rated current | 1.50 x Rated current (A) | 0.38 x Rated current to 2.85 x Rated current | 1.20 x Rated current (A) |
| Overload limit level 2 | b025 | | | | |
| Carrier frequency | b083 | 2.0 to 15.0 (kHz) | 10.0 (kHz) | 2.0 to 10.0 (kHz) | 2.0 (kHz) |
| Motor capacity selection | H003 H203 | 0.10 to 18.50 (kHz) | Depends on type | 0.10 to 18.50 (kHz) | One size up than HD |

When ND is selected, following parameters are not displayed.

| Func. code | Name | Func. code | Name |
|------------|---------------------------------------|------------|---------------------------------------|
| d009 | Torque reference monitor | H020/H220 | Motor parameter R1 |
| d010 | Torque bias monitor | H021/H221 | Motor parameter R2 |
| d012 | Output torque monitor | H022/H222 | Motor parameter L |
| b040 | Torque limit selection | H023/H223 | Motor parameter Io |
| b041 | Torque limit 1 | H024/H224 | Motor parameter J |
| b042 | Torque limit 2 | H030/H230 | Motor parameter R1 (auto-tuning data) |
| b043 | Torque limit 3 | H031/H231 | Motor parameter R2 (auto-tuning data) |
| b044 | Torque limit 4 | H032/H232 | Motor parameter L (auto-tuning data) |
| b045 | Torque LADSTOP selection | H033/H233 | Motor parameter Io (auto-tuning data) |
| b046 | Reverse rotation prevention selection | H034/H234 | Motor parameter J (auto-tuning data) |

| Func. code | Name | Func. code | Name |
|------------|---|------------|--|
| C054 | Over-torque/under-torque selection | P033 | Torque reference input selection |
| C055 | Overtorque level (FW, PW) | P034 | Torque reference setting |
| C056 | Overtorque level (RV, RG) | P036 | Torque bias mode |
| C057 | Overtorque level (RV, PW) | P037 | Torque bias value |
| C058 | Overtorque level (FW, RG) | P038 | Torque bias polarity selection |
| C059 | Signal output mode of Over/under torque | P039 | Speed limit value in torque control (FW) |
| H001 | Auto-tuning selection | P040 | Speed limit value in torque control (RV) |
| H002/H202 | Motor parameter selection | P041 | Speed/torque control switching time |
| H005/H205 | Speed response | - | - |

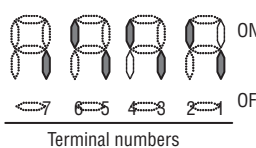
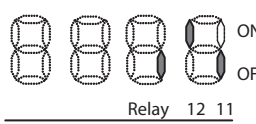
When ND is selected, following functions are not displayed in intelligent terminals.

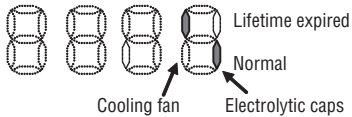
| Intelligent input terminals | | Intelligent output terminals | |
|-----------------------------|---------------------------------|------------------------------|--------------|
| 40: TL | Torque limit enabled | 07: OTQ | Overtorque |
| 41: TRQ1 | Torque limit switching 1 | 10: TRQ | Torque limit |
| 42: TRQ2 | Torque limit switching 2 | - | - |
| 52: ATR | Torque command input permission | - | - |

3-3 “D” Group: Monitoring Functions

You can access important parameter values with the “D” Group monitoring functions, whether the inverter is in Run Mode or Stop Mode. After selecting the function code number for the parameter you want to monitor, press the Function key once to show the value on the display. In functions *d005* and *d006*, the intelligent terminals use individual segments of the display to show ON/OFF status.

If the inverter display is set to monitor a parameter and powerdown occurs, the inverter stores the present monitor function setting. For your convenience, the display automatically returns to the previously monitored parameter upon the next powerup.

| “D” Function | | | Run Mode Edit | Units |
|--------------|-------------------------------|---|---------------|-------|
| Func. Code | Name | Description | | |
| <i>d001</i> | Output frequency monitor | Real time display of output frequency to motor from 0.00 to 400.00 (Hz) If <i>b163</i> is set high, output frequency (<i>F001</i>) can be changed by up/down key with <i>d001</i> monitoring. | – | Hz |
| <i>d002</i> | Output current monitor | Filtered display of output current to motor, range is 0.00 to 9999.00 | – | A |
| <i>d003</i> | Rotation direction monitor | Three different indications: “Fwd” ...Forward “STOP” ...Stop “REV” ...Reverse | – | – |
| <i>d004</i> | PID feedback value monitor | Displays the scaled PID process variable (feedback) value (<i>P015</i> is scale factor), 0.00 to 999000.0 | – | - |
| <i>d005</i> | Multi-function input monitor | Displays the state of the intelligent input terminals:  | – | – |
| <i>d006</i> | Multi-function output monitor | Displays the state of the intelligent output terminals:  | – | – |
| <i>d007</i> | Output frequency monitor | Displays the output frequency scaled by the constant in <i>b085</i> . Decimal point indicates range: 0.00 to 40000.0 | – | - |
| <i>d008</i> | Real frequency monitor | Displays the actual frequency, range is -400.00 to 400.00 | – | Hz |
| <i>d009</i> | Torque reference monitor | Displays the torque command, range is -200. to +200. | – | % |
| <i>d010</i> | Torque bias monitor | Displays the torque bias value, range is -200. to +200. | – | % |
| <i>d012</i> | Output torque monitor | Displays the output torque, range is -200. to +200. | – | % |
| <i>d013</i> | Output voltage monitor | Voltage of output to motor, Range is 0.0 to 600.0 | – | V |
| <i>d014</i> | Input power monitor | Displays the input power, range is 0.0 to 100.0 | – | KW |
| <i>d015</i> | Integrated power monitor | Displays watt-hour of the inverter, range is 0.0 to 9999000.0 | – | – |
| <i>d016</i> | Total RUN time | Displays total time the inverter has been in RUN mode in hours. Range is 0 to 9999 / 1000 to 9999 / 100 to 999 (10,000 to 99,900) | – | hours |

| “D” Function | | | Run Mode Edit | Units |
|--------------|---------------------------------|---|---------------|-------|
| Func. Code | Name | Description | | |
| d017 | Power ON time monitor | Displays total time the inverter has been powered up in hours. Range is 0 to 9999 / 1000 to 9999 / 100 to 999 (10,000 to 99,900) | — | hours |
| d018 | Fin temperature monitor | Temperature of the cooling fin, range is -20.0~150.0 | — | °C |
| d022 | Life assessment monitor | Displays the state of lifetime of electrolytic capacitors on the PWB and cooling fan.  | — | — |
| d023 | Program counter | Range is 0 to 1024 | — | — |
| d024 | Program number | Range is 0 to 9999 | — | — |
| d025 | Drive Programming monitor (UM0) | Result of Drive Programming execution, range is: -2147483647~2147483647 | — | — |
| d026 | Drive Programming monitor (UM1) | Result of Drive Programming execution, range is: -2147483647~2147483647 | — | — |
| d027 | Drive Programming monitor (UM2) | Result of Drive Programming execution, range is: -2147483647~2147483647 | — | — |
| d029 | Position command monitor | -268435455~+268435455 | — | — |
| d030 | Current position monitor | -268435455~+268435455 | — | — |
| d031 | Clock | Setting Data and Time for LCD digital operator | — | — |
| d050 | Dual monitor | Displays two different data configured in b160 and b161 . | — | — |
| d060 | Inverter mode | Displays currently selected inverter mode: IM, PM | — | — |
| d062 | Frequency source monitor | 0: Operator 1 to 15: Multi-speed freq. 1 to 15 16: Jog frequency 18: Modbus network 19: Option 21: Potentiometer 22: Pulse train 23: Calculated function output 24: EzSQ (Drive Programming) 25: [O] input 26: [OI] input 27: [O] + [OI] | — | — |
| d063 | Run source monitor | 1: Terminal 2: Operator 3: Modbus network 4: Option | — | — |
| d080 | Fault frequency monitor | 0 to 65535 | — | — |
| d081 | Fault monitor 1 (Latest) | Error code (condition of occurrence) | — | — |
| d082 | Fault monitor 2 | Output frequency [Hz] | — | — |
| d083 | Fault monitor 3 | Output current [A] | — | — |
| d084 | Fault monitor 4 | Internal DC voltage [V] | — | — |
| d085 | Fault monitor 5 | RUN time [h] | — | — |
| d086 | Fault monitor 6 | ON time [h] | — | — |
| d090 | Warning monitor | Warning code 0 to 385 | — | — |
| d102 | DC voltage monitor | Voltage of inverter internal DC bus, Range is 0.0 to 999.9 | — | V |

| “D” Function | | | Run Mode Edit | Units |
|--------------|--|--|---------------|-------|
| Func. Code | Name | Description | | |
| d 103 | Regenerative braking load rate monitor | Usage ratio of integrated brake chopper, range is 0.0~100.0 | — | % |
| d 104 | Electronic thermal monitor | Accumulated value of electronic thermal detection, range is from 0.0~100.0 | — | % |
| d 130 | Analog input O monitor | 0 to 1023 | — | — |
| d 131 | Analog input OI monitor | 0 to 1023 | — | — |
| d 133 | Pulse train input monitor | 0.00 to 100.00 | — | % |
| d 153 | PID deviation monitor | -327.68 to 327.67 | — | % |
| d 154 | Insertion point PID deviation | -9999.00 to 9999.00 | — | % |
| d 155 | PID output monitor | 0.00 to 9999.00 if (A071: 01) -9999.00 to 9999.00 if (A071: 02) | — | % |

3-3-1 Trip Event and History Monitoring

The trip event and history monitoring feature lets you cycle through related information using the keypad. See *6-2 Monitoring Trip Events, History, & Conditions* on page 273 for more details.

| “D” Function | | | Run Mode Edit | Units |
|--------------|--------------------------|--|---------------|--------|
| Func. Code | Name | Description | | |
| d080 | Fault frequency monitor | Number of trip events, Range is 0 to 65530 | — | events |
| d081 | Fault monitor 1 (Latest) | Displays trip event information: <ul style="list-style-type: none"> • Error code • Output frequency at trip point • Motor current at trip point • DC bus voltage at trip point • Cumulative inverter operation time at trip point • Cumulative power-ON time at trip point | — | — |
| d082 | Fault monitor 2 | | — | — |
| d083 | Fault monitor 3 | | — | — |
| d084 | Fault monitor 4 | | — | — |
| d085 | Fault monitor 5 | | — | — |
| d086 | Fault monitor 6 | | — | — |
| d090 | Warning monitor | Displays the warning code 0 to 385 | — | — |

3-3-2 Output Frequency Monitor [d001]

Displays the output frequency of the inverter. During stop, “0.00” is displayed. The monitor LED indicator “Hz” is lit while the d001 setting is displayed.

| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|--------------------------------------|----------------|-----------------|------|
| d001 | Output frequency monitor | 0.00 to 400.00 | - | Hz |
| b163 | d001/d007 Freq. set in monitoring | 00: OFF | 00 | - |
| | | 01: ON | | |
| Related functions | | A001, F001 | | |

- If Frequency Reference Selection is set to Digital Operator (A001 = 02), enabling d001/d007 Freq. set in monitoring (b163 = 01) lets you change the Output Frequency Monitor (d001) setting using the Increment/Decrement keys only during operation.
- Changed Output Frequency Monitor (d001) will be reflected to the Output Frequency Setting (F001). Pressing the Enter key stores the setting in the EEPROM.
- Since F001 is rewritten while d001 is still displayed, there may be a time gap between the key operation and display change depending on the acceleration/deceleration time.
- While the PID function is activated or being stopped, the output frequency cannot be changed.
- The frequency cannot be changed in the individual input mode by pressing the Increment/Decrement keys simultaneously.

3-3-3 Output Current Monitor [d002]

Displays the output current value of the inverter. During stop, “0.0” is displayed.

The monitor LED indicator “A” is lit while the d002 setting is displayed.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|------------------------|--|-----------------|------|
| d002 | Output current monitor | 0.00 to 9999.00 The minimum unit varies depending on the capacity | - | A |

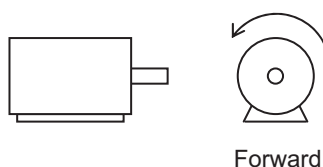
3-3-4 Rotation Direction Monitor [d003]

Displays the rotation direction of the inverter.

The RUN LED indicator is lit during forward/reverse rotation.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|----------------------------|--------------|-----------------|------|
| d003 | Rotation direction monitor | FWD: Forward | - | - |
| | | STOP: Stop | | |
| | | REV: Reverse | | |

In general, the forward direction of the motor is the counterclockwise direction as viewed from the axial direction.



3-3-5 PID Feedback Value Monitor [d004]

When "01: Enabled" or "02: Reverse output enabled" is selected in PID Selection (A071), the PID feedback value can be monitored.

Also, conversion is possible using PID Scale (A075).

"d004 display" = "Feedback value [%]" X PID Scale (A075).

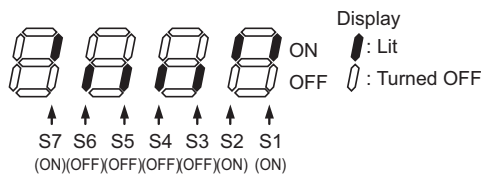
| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|----------------------------|--|-----------------|------|
| d004 | PID feedback value monitor | 0.00 to 99.99 (Displayed in increments of 0.01.) | - | - |
| | | 100.0 to 999.9 (Displayed in increments of 0.1.) | | |
| | | 1,000. to 9,999. (Displayed in increments of 1.) | | |
| | | 1,000 to 9,999 (Displayed in increments of 10.) | | |
| | | Γ100 to Γ999 (Displayed in increments of 1,000.) | | |
| A075 | PID scale | 0.01 to 99.99 (Displayed in increments of 0.01) | 1.00 | Time |
| Related functions | | A071, A075 | | |

3-3-6 Multi-function Input Monitor [d005]

The LED lighting position indicates the input status of the multi-function inputs.

The item that the built-in CPU recognizes to be "input" is indicated as being ON. This does not depend on the NO/NC contact setting.

Example) Multi-function input terminals S7/EB, S2, S1 : ON
 RP terminal, multi-function input terminals S6, S5/TH, S4/GS2, S3/GS1 : OFF



- If the input terminal response time function is used, the recognition of "input" is delayed.
- Monitoring cannot be performed even when TH (thermistor) is allocated to the multi-function input terminal S5 and a digital signal is input.

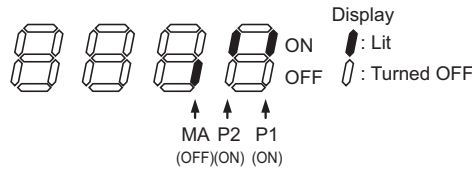
3-3-7 Multi-function Output Monitor [d006]

The LED lighting position indicates the output status of the multi-function output terminals.

The output status of the built-in CPU is indicated. This is not the status of the control circuit terminal.

This does not depend on the NO/NC contact setting.

Example) Multi-function output terminals P2, P1/EDM : ON
 Relay output terminal MA : OFF



3-3-8 Output Frequency Monitor (After Conversion) [d007]

Displays a conversion value based on the coefficient set in Frequency Conversion Coefficient (b086).

This monitor is used to change the unit of displayed data (e.g. motor rpm).

“Display of the Output Frequency Monitor (d007)” = “Output Frequency Monitor (d001)” x “Frequency Conversion Coefficient (b086)”

Example) Displaying rpm of 4-pole motor:

$$\text{Motor rpm } N [\text{min}^{-1}] = (120 \times f [\text{Hz}]) / P [\text{pole}] = f [\text{Hz}] \times 30$$

As such, when b086 = 30.0, a motor rpm of 1800 (60 x 30.0) is displayed at 60 Hz.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|---|---|-----------------|------|
| d007 | Output frequency monitor (after conversion) | 0.00 to 40000.00 | - | - |
| b086 | Frequency conversion coefficient | 0.01 to 99.99 Set in increments of 0.01. (d007 = d001 x b086) | 1.00 | - |
| b163 | d001/d007 Freq. set in monitoring | 00: OFF 01: ON | 00 | - |

- If Frequency Reference Selection is set to Digital Operator (A001 = 02), enabling d001/d007 Freq. set in monitoring (b163 = 01) lets you change the Output Frequency Monitor (d001) setting using the Increment/Decrement keys only during operation.
- Changed Output Frequency (d001) will be reflected to the Output Frequency Setting (F001). Pressing the Enter key stores the setting in the EEPROM.
- Since F001 is rewritten while d007 is still displayed, there may be a time gap between the key operation and display change depending on the acceleration/deceleration time.
- While the PID function is activated or being stopped, the output frequency cannot be changed.
- The frequency cannot be changed in the individual input mode by pressing the Increment/Decrement keys simultaneously.

3-3-9 Real Frequency Monitor [d008]

The actual-frequency monitor d008 will reflect the real motor speed always that the encoder feedback is active by parameter P003=01, independently of parameter A044 and P012 settings.

| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|------------------------|-------------------|-----------------|------|
| d008 | Real frequency monitor | -400.00 to 400.00 | - | Hz |
| Related functions | | P011, H004 | | |

- Set Number of Encoder Pulse (P011) and Motor Pole Number (H004/H204) correctly.

3-3-10 Torque Reference Monitor [d009]

Displays the currently entered torque reference value, when torque control is selected for sensorless vector control.

Torque control becomes active when "52: ATR" is allocated to a multi-function input terminal and the ATR terminal is turned ON.

| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|--------------------------|--------------------------------|-----------------|------|
| d009 | Torque reference monitor | -200. to +200. | - | % |
| Related functions | | A044, C001 to C007, P033, P034 | | |

3-3-11 Torque Bias Monitor [d010]

During sensorless vector control, the currently set torque bias amount is displayed.

| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|---------------------|------------------------|-----------------|------|
| d010 | Torque bias monitor | -200. to +200. | - | % |
| Related functions | | A044, P036, P037, P038 | | |

3-3-12 Output Torque Monitor [d012]

Displays an estimated value of the inverter's output torque.

| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|-----------------------|----------------|-----------------|------|
| d012 | Output torque monitor | -200. to +200. | - | % |
| Related functions | | A044/A244 | | |

Note The power running direction is positive and regeneration direction is negative during forward rotation, while the power running direction is negative and regeneration direction is positive during reverse rotation.

- This display is shown only when the sensorless vector control is selected. If any other control mode is selected, the correct value is not displayed.

3-3-13 Output Voltage Monitor [d013]

Displays the output voltage of the inverter.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|------------------------|--------------|-----------------|------|
| d013 | Output voltage monitor | 0.0 to 600.0 | - | V |

- Set Motor Incoming Voltage Selection (A082/A282) correctly. The correct value may not be displayed.

3-3-14 Input Power Monitor [d014]

Displays the input power (instantaneous value) of the inverter.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|---------------------|--------------|-----------------|------|
| d014 | Input power monitor | 0.0 to 100.0 | - | kW |

3-3-15 Integrated Power Monitor [d015]

Displays the integrated power (electric energy) of the inverter.

The conversion of displayed data is performed with Integrated Power Display Scale (b079).

“d015 display” = “Actual integrated power [kWh]”/”Integrated Power Display Scale (b079)”

Example) If b079 = 100 and the displayed value is 1,000, the actual integrated power is 100,000 [kWh].

The integrated power value can be cleared by setting Integrated Power Clear (b078) to “01”.

The integrated power value can also be cleared via terminal input, if “53: KHC (Integrated power clear)” is allocated to any of the multi-function inputs.

When Integrated Power Display Scale (b079) is set to “1000”, up to “999,000,000” [kWh] can be displayed.

This parameter is saved in the EEPROM when the power is shut off.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|---------------------------------------|--|-----------------|------|
| d015 | Integrated power monitor | 0.0 to 9999. Displayed in increments of the setting unit 1 kW x (b079) | - | - |
| | | 1000 to 9999 Displayed in increments of the setting unit 10 kW x (b079) | | |
| | | Γ100 to Γ999 Displayed in increments of the setting unit 1,000 kW x (b079). | | |
| b078 | Integrated power clear | 00: Normal | 00 | - |
| | | 01: Perform integrated power clear (01 is reset to 00 after the clear) | | |
| b079 | Integrated power display gain | 1. to 1000. | 1. | - |
| C001 to C007 | Multi-function input 1 to 7 selection | 53: KHC (integrated power clear) | - | - |

3-3-16 Total RUN Time [d016]

Displays the total RUN time of the inverter.

This parameter is saved in the EEPROM when the power is shut off.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|----------------|--|-----------------|------|
| d016 | Total RUN time | 0.0 to 9,999. Displays in increments of 1 hour. | - | h |
| | | 1,000 to 9,999 Displays in increments of 10 hours. | | |
| | | Γ100 to Γ999 (Displayed in increments of 1,000 hours.) | | |

Note Initialization will not clear the setting.

3-3-17 Power ON Time Monitor [d017]

Displays the total power ON time of the inverter.

This parameter is saved in the EEPROM when the power is shut off.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|-----------------------|--|-----------------|------|
| d017 | Power ON time monitor | 0.0 to 9,999. Displays in increments of 1 hour. | - | h |
| | | 1,000 to 9,999 Displays in increments of 10 hours. | | |
| | | Γ100 to Γ999 (Displayed in increments of 1,000 hours.) | | |

Note Initialization will not clear the setting.

3-3-18 Fin Temperature Monitor [d018]

Displays the temperature of the cooling fin inside the inverter.

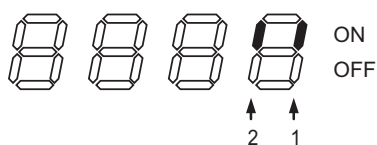
| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|-------------------------|----------------|-----------------|------|
| d018 | Fin temperature monitor | -20.0 to 150.0 | - | °C |

3-3-19 Life Assessment Monitor [d022]

The LED lighting position indicates the status of life assessment signal.

The following two items can be monitored:

- 1: Main circuit board capacitor service life
- 2: Cooling fan life



- The capacitor service life is calculated every 10 minutes. If the inverter is turned on/off frequently within this interval, the capacitor service life cannot be correctly diagnosed.
- The cooling fan life assessment function is not available for 1-phase 200V class motors of 0.4 kW max. and 3-phase 200V class motors of 0.75 kW max., because these motors are not equipped with a cooling fan.

3-3-20 Position Command Monitor [d029]

Position commands can be monitored during simple position control.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|--------------------------|---|-----------------|------|
| d029 | Position command monitor | Displays the position command: -268435455 to 268435455 | - | - |

3-3-21 Current Position Monitor [d030]

The position feedback (d030 monitor) always is monitored when parameter P003=01 (encoder feedback), independently of parameter P012 setting. Monitor d030 is cleared even with P012=00 (simple positioning deactivated) when PCLR is set to ON. The rest of digital inputs related with positioning are not effective when P012=00.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|--------------------------|---|-----------------|------|
| d030 | Current position monitor | Displays the position command: -268435455 to 268435455 | - | - |

3-3-22 Dual Monitor [d050]

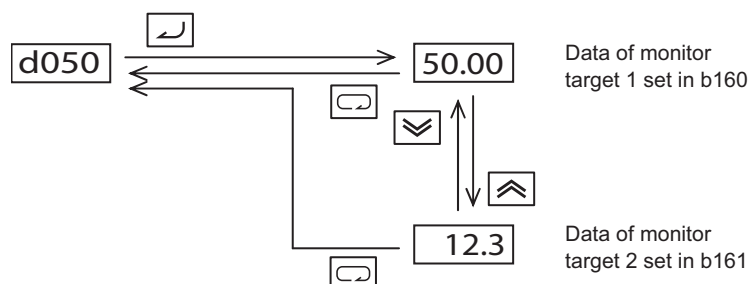
Desired two monitor items can be set and monitored by switching the item using the Increment/Decrement keys.

Set the parameter numbers to be monitored in b160 and b161.

Example) To monitor d001, set “001” in b160/b161.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|-------------------------------|---|-----------------|------|
| d050 | Dual monitor | The two items set in b160 and b161 are monitored. | - | - |
| b160 | 1st parameter of Dual Monitor | 001 to 030 Corresponding to d001 to d030.* | 001 | - |
| b161 | 2nd parameter of Dual Monitor | | 002 | |

* Fault Monitor parameters (d081 to d086) are excluded.



- When d001/d007 Freq. set in monitoring (b163) is set to “01: Enabled”, the output frequencies in d001 and d007 can be changed using the Increment/Decrement keys during operation. It cannot be changed if d001 and d007 are monitored using d050.

3-3-23 Inverter Mode [d060]

Displays the current inverter mode.
The inverter mode is changed using b171.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|---------------|---|-----------------|------|
| d060 | Inverter mode | I-C IM (induction motor) heavy load mode | - | - |
| | | I-V IM (induction motor) light load mode | | |
| | | PM Permanent magnet motor control | | |

3-3-24 Frequency Source Monitor [d062]

It displays the frequency source considering the A001/A201 (1st/2nd motor setting).

| Parameter No. | Function name | Data | Default setting | Unit |
|----------------|--------------------------|------------------------------------|-----------------|------|
| d062 | Frequency source monitor | 0: Operator | - | - |
| | | 1 to 15: Multi-speed freq. 1 to 15 | | |
| | | 16: Jog frequency | | |
| | | 18: Modbus network | | |
| | | 19: Option | | |
| | | 21: Potentiometer | | |
| | | 22: Pulse train | | |
| | | 23: Calculated function output | | |
| | | 24: EzSQ (Drive Programming) | | |
| | | 25: [O] input | | |
| | | 26: [OI] input | | |
| 27: [O] + [OI] | | | | |

3-3-25 Run Command Source Monitor [d063]

It displays the RUN command source considering the A002/A202 (1st/2nd motor setting).

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|--------------------|-------------------|-----------------|------|
| d063 | Run source monitor | 1: Terminal | - | - |
| | | 2: Operator | | |
| | | 3: Modbus Network | | |
| | | 4: Option | | |

3-3-26 Fault Frequency Monitor [d080]

Displays the number of times the inverter has tripped.

This number is saved in the EEPROM when the power is turned off.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|-------------------------|--|-----------------|------|
| d080 | Fault frequency monitor | 0. to 9999. | - | Time |
| | | 1,000 to 6,553 (Displayed in increments of 10.) | | |

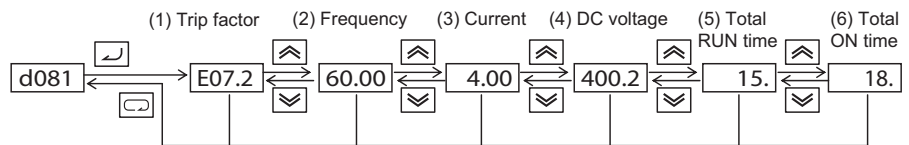
3-3-27 Fault Monitors 1 to 6 [d081 to d086]

Displays the records of the last 6 errors. Error records are saved in the EEPROM when the power is turned off.

The record of the latest error is displayed under Fault Monitor 1 (d081).

(Display)

- (1) Cause of trip (One of E01 to E83 is displayed.)
- (2) Output frequency [Hz] at the time of tripping.
- (3) Output current [A] at the time of tripping. If the inverter is currently stopped (E*.1), the monitor value may become zero.
- (4) P-N DC voltage [V] in the main circuit at the time of tripping. If tripping occurs due to ground fault at power-on, the monitor value may become zero.
- (5) Total inverter RUN time [h] before the trip.
- (6) Total inverter power ON time [h] before the trip.



---- is shown if no trip has occurred.

3-3-28 Warning Monitor [d090]

If the set data is inconsistent with other data, a warning is displayed.

While a warning is present, the Program LED (PRG) indicator remains lit until the data is corrected.

3-3-29 DC Voltage Monitor [d102]

The inverter P-N DC voltage (DC voltage between the inverter terminals P/+2 and N/-) is displayed.

During operation, the monitor value changes depending on the actual DC voltage of the inverter.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|--------------------|--------------|-----------------|------|
| d102 | DC voltage monitor | 0.0 to 999.9 | - | V |

3-3-30 Regenerative Braking Load Rate Monitor [d103]

Displays a regenerative braking load rate. When the displayed value exceeds the value set in the Usage Rate of Regenerative Braking (b090), the inverter trips because of "E06 (Braking resistor overload protection)".

| Parameter No. | Function name | Data | Default setting | Unit |
|-------------------|--|--------------|-----------------|------|
| d103 | Regenerative braking load rate monitor | 0.0 to 100.0 | - | % |
| Related functions | | b090 | | |

3-3-31 Electronic Thermal Monitor [d104]

Displays an electronic thermal load rate. When the displayed value exceeds 100%, the inverter trips because of "E05 (Overload protection)".

When the power is shut off, the displayed value changes to 0. Also when totaling does not occur for 10 minutes, the displayed value changes to 0.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|----------------------------|--------------|-----------------|------|
| d104 | Electronic thermal monitor | 0.0 to 100.0 | - | % |

3-3-32 Analog Input O/OI Monitors [d130/d131]

Displays the analog input O/OI value. The data range is from 0 to 1023 and it can be read from Modbus and Drive Programming.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|-------------------------|-----------|-----------------|------|
| d130 | Analog input O monitor | 0 to 1023 | - | - |
| d131 | Analog input OI monitor | | | |

3-3-33 Pulse Train Input Monitor [d133]

The pulse train input monitor (terminal EA) is always valid, independently of any parameter setting. This monitor shows the value after full scale conversion and filter processing but before bias addition.

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|---------------------------|----------------|-----------------|------|
| d133 | Pulse train input monitor | 0.00 to 100.00 | - | % |

3-3-34 PID Deviation Monitor [d153]

It displays the PID deviation into d153 monitor. It only operates when PID function is effective (A071=01 or 02).

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|-----------------------|--------------------------------------|-----------------|------|
| d153 | PID deviation monitor | -9999.00 to 9999.00 | - | % |
| A071 | PID selection | 00: OFF (Disabled) | 00 | - |
| | | 01: ON(+) (Enabled) | | |
| | | 02: ON(+/-) (Reverse output enabled) | | |
| A075 | PID scale | 0.01 to 99.99 | 1.00 | - |

d153 = PID deviation x PID scale (A075).

The display by digital operator is shown below:

| Display | Data |
|----------------|----------------------|
| -999 to -100 | -9999.00 to -1000.00 |
| -999. to -100. | -999.99 to -100.00 |
| -99.9 to -10.0 | -99.99 to -10.00 |
| -9.99 to 99.99 | -9.99 to 99.99 |
| 100.0 to 999.9 | 100.00 to 999.99 |
| 1000. to 9999. | 1000.00 to 9999.00 |

3-3-35 PID Output Monitor [d155]

It displays the scaled PID output into d155 monitor. It is enabled only when PID function is effective (A071=01 or 02).

| Parameter No. | Function name | Data | Default setting | Unit |
|---------------|--------------------|--|-----------------|------|
| d155 | PID output monitor | 0.00 to 9999.00 (A071=01) -9999.00 to 9999.00 (A071=02) | - | % |
| A071 | PID selection | 00: OFF (Disabled) | 00 | - |
| | | 01: ON(+) (Enabled) | | |
| | | 02: ON(+/-) (Reverse output enabled) | | |
| A075 | PID scale | 0.01 to 99.99 | 1.00 | - |

d155 = PID output value x PID scale (A075).

Note: PID output value is a value limited by frequency limit (A061/A261) and PID output limit (A078). Monitor d155 displays a value after a limit was set.

The display by digital operator is shown below:

| Display | Data |
|----------------|----------------------|
| -999 to -100 | -9999.00 to -1000.00 |
| -999. to -100. | -999.99 to -100.00 |
| -99.9 to -10.0 | -99.99 to -10.00 |
| -9.99 to 99.99 | -9.99 to 99.99 |
| 100.0 to 999.9 | 100.00 to 999.99 |
| 1000. to 9999. | 1000.00 to 9999.00 |

3-3-36 Local Monitoring with Keypad Connected

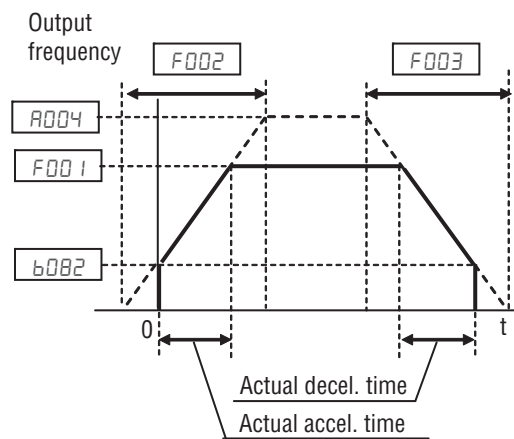
The MX2 inverter's serial port may be connected to an external digital operator. During those times, the inverter keypad keys will not function (except for the Stop key). However, the inverter's 4-digit display still provides the Monitor Mode function, displaying any of the parameters *d001* to *d060*. Function *b150*, Monitor Display Select for Networked Inverter, determines the particular *d00x* parameter displayed. Refer to the previous table.

When monitoring the inverter with external keypad connected, please note the following:

- The inverter display will monitor *d00x* functions according to *b150* setting when a device is already connected to the inverter's serial port at inverter powerup.
- When external keypad is connected, the inverter keypad will also display error codes for inverter trip events. Use the Stop key or inverter Reset function to clear the error. Refer to *6-2-2 Error Codes* on page 273 to interpret the error codes.
- The Stop key can be disabled, if you prefer, by using function *b007*.

3-4 “F” Group: Main Profile Parameters

The basic frequency (speed) profile is defined by parameters contained in the “F” Group as shown to the right. The set running frequency is in Hz, but acceleration and deceleration are specified in the time duration of the ramp (from zero to maximum frequency, or from maximum frequency to zero). The motor direction parameter determines whether the keypad Run key produces a FWD or REV command. This parameter does not affect the intelligent terminal [FW] and [REV] functions, which you configure separately.



Acceleration 1 and Deceleration 1 are the standard default accel and decel values for the main profile. Accel and decel values for an alternative profile are specified by using parameters *Rx92* through *Rx93*. The operator rotation direction selection (*F004*) determines the direction of rotation as commanded only from the keypad. This setting applies to any motor profile (1st or 2nd) in use at t particular time.

| “F” Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>F001</i> | Output frequency setting/monitor | Standard default target frequency that determines constant motor speed, range is 0.0 / start frequency to maximum frequency (<i>A004</i>) | ✓ | 0.00 | Hz |
| <i>F002</i> | Acceleration time 1 | 0.00 to 3600.00 | ✓ | 10.00 | sec. |
| <i>F202</i> | 2nd acceleration time 1 | | ✓ | 10.00 | sec. |
| <i>F003</i> | Deceleration time 1 | | ✓ | 10.00 | sec. |
| <i>F203</i> | 2nd deceleration time 1 | | ✓ | 10.00 | sec. |
| <i>F004</i> | Operator rotation direction selection | Two options; select codes: <i>00</i> ...Forward <i>01</i> ...Reverse | ✗ | 00 | – |

The lower limit of the acceleration/deceleration time (*F002*/*F003*) has been changed to 0.00s. With this setting the inverter will operate automatically like if the LAC digital input was trigger from a digital input. This means that reference speed is directly applied to the output without any ramp as soon as the FW/RV commands are activated. In the same way 0 Hz will be applied directly on the output when the FW/RV command is turned off.

Acceleration and deceleration can be set via Drive Programming as well via the following parameter.

| “P” Function | | | Run Mode Edit | Defaults | |
|--------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>P031</i> | Acceleration/Deceleration time input type | Two options; select codes: <i>00</i> ...Via Digital Operator <i>03</i> ...Via Drive Programming | ✗ | 00 | – |

3-5 "A" Group: Standard Functions

The inverter provides flexibility in how you control Run/Stop operation and set the output frequency (motor speed). It has other control sources that can override the *A001/A002* settings. Parameter *A001* sets the source selection for the inverter's output frequency. Parameter *A002* selects the Run command source (for FW or RV Run commands). The default settings use the input terminals for Europe (EU).

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|-----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>A001</i> | Frequency reference selection | Eight options; select codes: <i>00</i> ...VR (Digital Operator) <i>01</i> ...Terminal <i>02</i> ...Operator (F001) <i>03</i> ...ModBus (RS485) <i>04</i> ...Option <i>06</i> ...Pulse train frequency <i>07</i> ...EzSQ (Drive Programming) <i>10</i> ...Math (Operator function result) | x | <i>01</i> | – |
| <i>A201</i> | Frequency reference selection, 2nd motor | | x | <i>01</i> | – |
| <i>A002</i> | Run command selection | Five options; select codes: <i>01</i> ...Terminal <i>02</i> ...Operator (F001) <i>03</i> ...ModBus (RS485) <i>04</i> ...Option | x | <i>01</i> | – |
| <i>A202</i> | Run command selection, 2nd motor | | x | <i>01</i> | – |

Frequency Source Setting - For parameter *A001*, the following table provides a further description of each option, and a reference to other page(s) for more information.

| Code | Frequency Source | Refer to page(s)... |
|-----------|---|----------------------------|
| <i>00</i> | POT on ext. operator - The range of rotation of the knob matches the range defined by <i>b002</i> (start frequency) to <i>A004</i> (max. frequency), when external operator is used | - |
| <i>01</i> | Control terminal - The active analog input signal on analog terminals [O] or [OI] sets the output frequency | 93, 240, 248, 250 |
| <i>02</i> | Function <i>F001</i> setting - The value in <i>F001</i> is a constant, used for the output frequency | 89 |
| <i>03</i> | ModBus network input - The network has a dedicated register for inverter output frequency | 318 |
| <i>04</i> | Option - Select when an option card is connected and use the frequency source from the option | (manual of each option) |
| <i>06</i> | Pulse train input - The pulse train given to EA terminal. The pulse train must be 24 VDC and 32 kHz max. | 179, 251 |
| <i>07</i> | Via Drive Programming - The frequency source can be given by the Drive Programming function, when it is used | (Drive Programming manual) |
| <i>10</i> | Calculate function output - The Calculated function has user-selectable analog input sources (A and B). The output can be the sum, difference, or product (+, -, x) of the two outputs. | 118 |

Run Command Source Setting - For parameter **A002**, the following table provides a further description of each option, and a reference to other page(s) for more information.

| Code | Run Command Source | Refer to page(s)... |
|-----------|---|-------------------------|
| 01 | Control terminal - The [FW] or [RV] input terminals control Run/Stop operation | 205 |
| 02 | Keypad Run key - The Run and Stop keys provide control | 70 |
| 03 | ModBus network input - The network has a dedicated coil for Run/Stop command and a coil for FW/RV | 318 |
| 04 | Option - Select when an option card is connected and use the frequency source from the option | (manual of each option) |

A001/A002 Override Sources - The inverter allows some sources to override the setting for output frequency and Run command in **A001** and **A002**. This provides flexibility for applications that occasionally need to use a different source, leaving the standard settings in **A001/A002**.

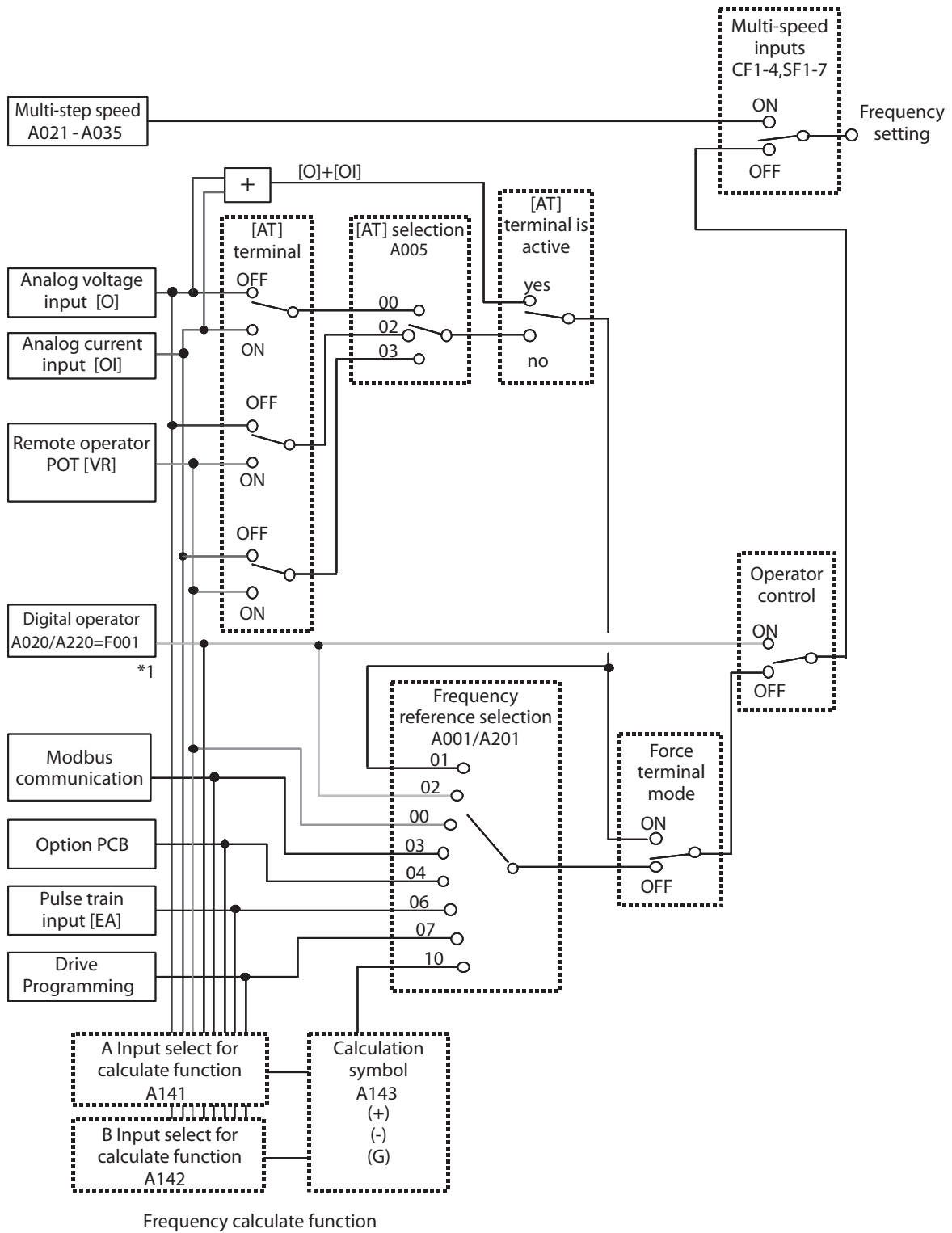
The inverter has other control sources that can temporarily override the parameter **A001** setting, forcing a different output frequency source. The following table lists all frequency source setting methods and their relative priority (“1” is the highest priority).

| Priority | A001 Frequency Source Setting Method | Refer to page... |
|----------|--|------------------|
| 1 | [CF1] to [CF4] Multi-speed terminals | 96 |
| 2 | [OPE] Operator Control intelligent input | 214 |
| 3 | [F-TM] intelligent input | 218 |
| 4 | [AT] terminal | 250 |
| 5 | A001 Frequency source setting | 90 |

The inverter also has other control sources that can temporarily override the parameter **A002** setting, forcing a different Run command source. The following table lists all Run command setting methods and their relative priority (“1” is the highest priority).

| Priority | A002 Run Command Setting Method | Refer to page... |
|----------|--|------------------|
| 1 | [OPE] Operator Control intelligent input | 214 |
| 2 | [F-TM] intelligent input | 218 |
| 3 | A002 Run command source setting | 90 |

The figure below shows the correlation diagram of all frequency source setting methods and their relative priority.



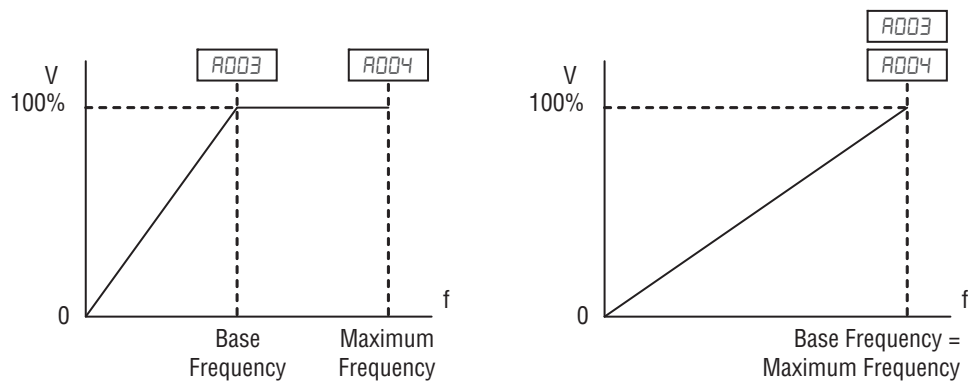
Frequency calculate function

Note 1: You can set the inverter output frequency with function F001 only when you have specified "02" for the frequency source setting A001. If the setting of function A001 is other than "02", function F001 operates as the frequency command monitoring function. And by setting the frequency set in monitoring active (b163=01), you can change the inverter output frequency with function d001 or d007.

3-5-1 Basic Parameter Settings

These settings affect the most fundamental behavior of the inverter - the outputs to the motor. The frequency of the inverter's AC output determines the motor speed. You may select from three different sources for the reference speed. During application development you may prefer using the potentiometer, but you may switch to an external source (control terminal setting) in the finished application, for example.

The base frequency and maximum frequency settings interact according to the graph below (left). The inverter output operation follows the constant V/f curve until it reaches the full-scale output voltage at the base frequency. This initial straight line is the constant-torque part of the operating characteristic. The horizontal line over to the maximum frequency serves to let the motor run faster, but at a reduced torque. This is the constant-power operating range. If you want the motor to output constant torque over its entire operating range (limited to the motor nameplate voltage and frequency rating), then set the base frequency and maximum frequency equal as shown (below right).



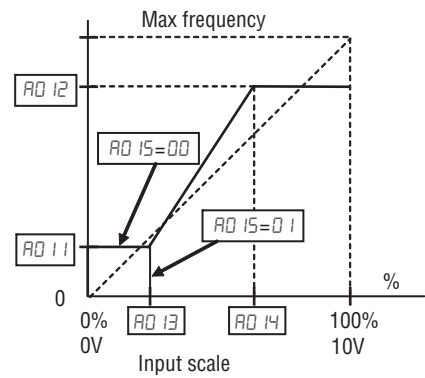
Note The "2nd motor" settings in the table in this chapter store an alternate set of parameters for a second motor. The inverter can use the 1st set or 2nd set of parameters to generate the output frequency to the motor. See "Configuring the Inverter for Multiple Motors" on page 172.

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A003 | Base frequency | Settable from 30 Hz to the maximum frequency (A004) | * | 50.0 | Hz |
| A203 | 2nd set base frequency | Settable from 30 Hz to the 2 nd maximum frequency (A204) | * | 50.0 | Hz |
| A004 | Maximum frequency | Settable from the base frequency to 400 Hz | * | 50.0 | Hz |
| A204 | 2nd maximum frequency | Settable from the 2 nd base frequency to 400 Hz | * | 50.0 | Hz |

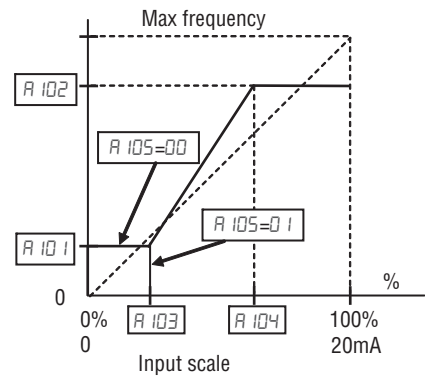
3-5-2 Analog Input Settings

The inverter has the capability to accept an external analog input that can command the output frequency to the motor. Voltage input (0-10 V) and current input (4-20 mA) are available on separate terminals ([O] and [OI] respectively). Terminal [L] serves as signal ground for the two analog inputs. The analog input settings adjust the curve characteristics between the analog input and the frequency output.

Adjusting [O-L] characteristics - In the graph to the right, *AD 13* and *AD 14* select the active portion of the input voltage range. Parameters *AD 11* and *AD 12* select the start and end frequency of the converted output frequency range, respectively. Together, these four parameters define the major line segment as shown. When the line does not begin at the origin (*AD 11* and *AD 13* > 0), then *AD 15* defines whether the inverter outputs 0 Hz or the *AD 11*-specified frequency when the analog input value is less than the *AD 13* setting. When the input voltage is greater than the *AD 14* ending value, the inverter outputs the ending frequency specified by *AD 12*.



Adjusting [OI-L] characteristics - In the graph to the right, *A 103* and *A 104* select the active portion of the input current range. Parameters *A 101* and *A 102* select the start and end frequency of the converted output frequency range, respectively. Together, these four parameters define the major line segment as shown. When the line does not begin at the origin (*A 101* and *A 103* > 0), then *A 105* defines whether the inverter outputs 0 Hz or the *A 101*-specified frequency when the analog input value is less than the *A 103* setting. When the input voltage is greater than the *A 104* ending value, the inverter outputs the ending frequency specified by *A 102*.



Adjusting [VR-L] characteristics - This is used when an optional operator is used. Refer to parameters *A 161* ~ *A 165* for the details.

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>AD05</i> | O/OI selection | Three options; select codes: <i>00</i> ... [O]/[OI] Switches between O/OI via terminal AT <i>02</i> ... [O]/VR Switches between O/FREQ adjuster via terminal AT <i>03</i> ... [OI]/VR Switches between OI/FREQ adjuster via terminal AT (Enabled only when 3G3AX-OP01 is used) | * | 00 | - |
| <i>AD 11</i> | O start frequency | The output frequency corresponding to the analog input range starting point, range is 0.00 to 400.0 | * | 0.00 | Hz |
| <i>AD 12</i> | O end frequency | The output frequency corresponding to the analog input range ending point, range is 0.0 to 400.0 | * | 0.00 | Hz |
| <i>AD 13</i> | O start ratio | The starting point (offset) for the active analog input range, range is 0 to 100 | * | 0 | % |
| <i>AD 14</i> | O end ratio | The ending point (offset) for the active analog input range, range is 0 to 100 | * | 100 | % |

| “A” Function | | | Run Mode Edit | Defaults | |
|--------------|--------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>AD 15</i> | O start selection | Two options; select codes: <i>00</i> ... Start FQ <i>01</i> ... 0 Hz | * | 01 | – |
| <i>AD 16</i> | O, O2, OI sampling | Range n = 1 to 31, 1 to 30 : x2ms filter 31: 500ms fixed filter with ±0.1kHz hys. | * | 8 | Spl. |

The [AT] terminal selects whether the inverter uses the voltage [O] or current [OI] input terminals for external frequency control. When intelligent input [AT] is ON, you can set the output frequency by applying a current input signal at [OI]-[L]. When the [AT] input is OFF, you can apply a voltage input signal at [O]-[L] to set the output frequency. Note that you must also set parameter *AD 1* = 01 to enable the analog terminal set for controlling the inverter frequency.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|-------------------------------------|-------|--------------------------|
| <i>16</i> | AT | Analog Input Voltage/Current Select | ON | See the table down below |
| | | | OFF | |
| Valid for inputs: | | <i>000 1~0007</i> | | Example : |
| Required settings: | | <i>AD 1 = 0 1</i> | | |
| Notes: Combination of <i>AD 05</i> setting and [AT] input for analog input activation. | | | | |
| <i>AD 05</i> | [AT] Input | Analog Input Configuration | | |
| <i>00</i> | ON | [OI] | | |
| | OFF | [O] | | |
| <i>02</i> | ON | Keypad Pot | | |
| | OFF | [O] | | |
| <i>03</i> | ON | Keypad Pot | | |
| | OFF | [OI] | | |

- Be sure to set the frequency source setting *AD 1=0 1* to select the analog input terminals.

If [AT] is not assigned to any of the intelligent input terminal, inverter recognizes the input [O]+[OI].

AD 16: External Frequency Filter Time Constant - This filter smoothes the analog input signal for the inverter's output frequency reference.

- *AD 16* sets the filter range from n=1 to 30. This is a simple moving average calculation, where n (number of samples) is variable.
- *AD 16=3 1* is a special value. It configures the inverter to use a movable deadband feature. Initially the inverter uses the 500 ms of filter time constant. Then, the deadband is employed for each subsequent average of 16 samples. The deadband works by ignoring small fluctuations in each new average: less than ±0.1 Hz change. When a 30-sample average exceeds this deadband, then the inverter applies that average to the output frequency reference, and it also becomes the new deadband comparison point for subsequent sample averages.

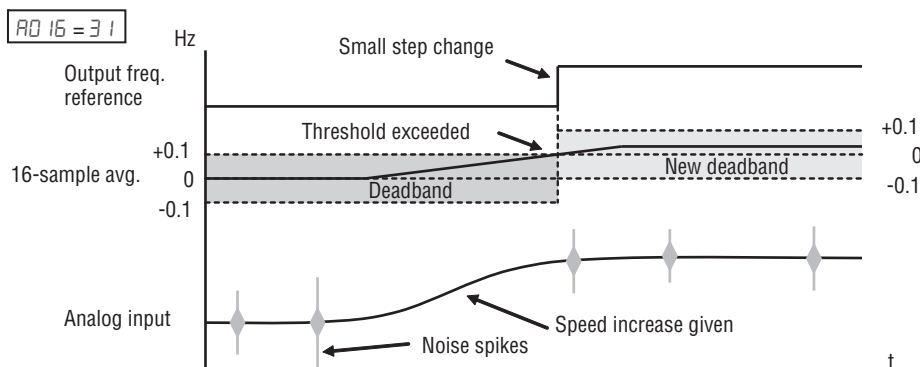
The example graph below shoes a typical analog input waveform. The filter removes the noise spikes. When a speed change (such as level increase)

occurs, the filter naturally has a delayed response. Due to the deadband feature (AD 15=3 1), the final output changes only when the 30-sample average moves past the deadband threshold.



Tip

The deadband feature is useful in applications that requires a very stable output frequency but use an analog input for the speed reference. Example application: A grinding machine uses a remote potmeter for operator speed input. After a setting change, the grinder maintains a very stable speed to deliver a uniform finished surface.



3-5-3 Multi-speed and Jog Frequency Setting

Multi-speed - The MX2 inverter has the capability to store and output up to 16 preset frequencies to the motor (AD20 to AD35). As in traditional motion terminology, we call this *multi-speed profile* capability. These preset frequencies are selected by means of digital inputs to the inverter. The inverter applies the current acceleration or deceleration setting to change from the current output frequency to the new one. The first multi-speed setting is duplicated for the second motor settings (the remaining 15 multi-speeds apply only to the first motor).

| "A" Function | | | Run Mode Edit | Defaults | |
|---------------|--|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| AD 19 | Multi-step speed selection | Select codes: 00... Binary operation (16 speeds selectable with 4 terminals) 0 1... Bit operation (8 speeds selectable with 7 terminals) | * | 00 | - |
| AD20 | Multi-step speed reference 0 | Defines the first speed of a multi-speed profile, range is 0.00 / start frequency to 400Hz AD20 = Speed 0 (1st motor) | ✓ | 6.00 | Hz |
| AD20 | 2nd multi-step speed reference 0 | Defines the first speed of a multi-speed profile or a 2 nd motor, range is 0.00 / start frequency to 400Hz AD20 = Speed 0 (2nd motor) | ✓ | 6.00 | Hz |
| AD2 1 to AD35 | Multi-step speed reference 1 to 15 | Defines 15 more speeds, range is 0.00 / start frequency to 400 Hz. AD2 1=Speed 1 ~ AD35=Speed15 AD2 1 ~ AD35 | ✓ | 0.00 | Hz |
| C 159 | Multi-step speed/position determination time | Masks the transition time when changing the combination of inputs. Range is 0 to 200 (x10 ms) | * | 0 | |

There are two ways for speed selection, that are “binary operation” and “bit operation”.

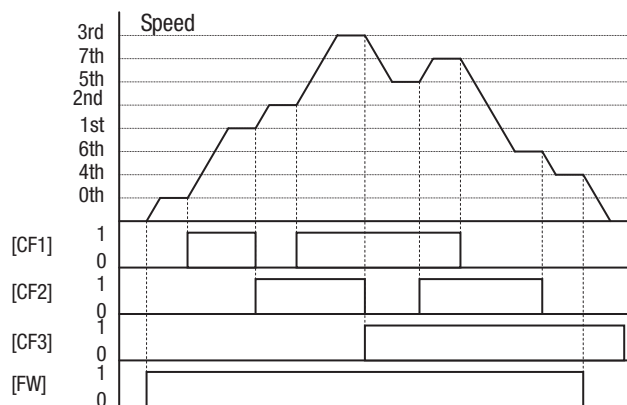
For binary operation ($R019=00$), you can select 16 speeds by combination of 4 digital inputs. And for bit operation ($R019=01$), you can select 8 speeds by using 7 digital inputs. Please refer to the following figures for detailed explanation.

Binary operation (“1”=ON)

| Speed | Param. | CF4 | CF3 | CF2 | CF1 |
|----------|--------|-----|-----|-----|-----|
| Speed 0 | A020 | 0 | 0 | 0 | 0 |
| Speed 1 | A021 | 0 | 0 | 0 | 1 |
| Speed 2 | A022 | 0 | 0 | 1 | 0 |
| Speed 3 | A023 | 0 | 0 | 1 | 1 |
| Speed 4 | A024 | 0 | 1 | 0 | 0 |
| Speed 5 | A025 | 0 | 1 | 0 | 1 |
| Speed 6 | A026 | 0 | 1 | 1 | 0 |
| Speed 7 | A027 | 0 | 1 | 1 | 1 |
| Speed 8 | A028 | 1 | 0 | 0 | 0 |
| Speed 9 | A029 | 1 | 0 | 0 | 1 |
| Speed 10 | A030 | 1 | 0 | 1 | 0 |
| Speed 11 | A031 | 1 | 0 | 1 | 1 |
| Speed 12 | A032 | 1 | 1 | 0 | 0 |
| Speed 13 | A033 | 1 | 1 | 0 | 1 |
| Speed 14 | A034 | 1 | 1 | 1 | 0 |
| Speed 15 | A035 | 1 | 1 | 1 | 1 |

Note When choosing a subset of speeds to use, always start at the top of the table, and with the least-significant bit: CF1, CF2, etc

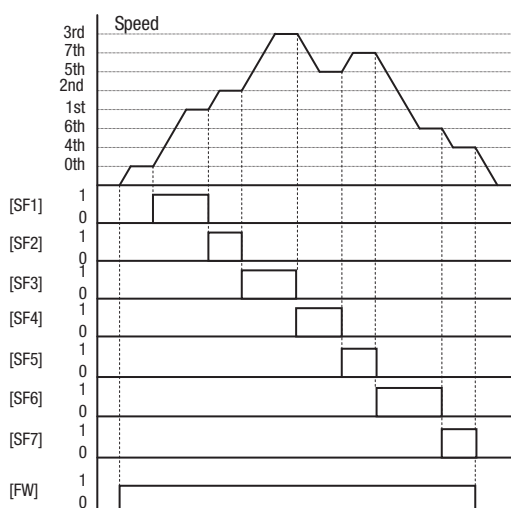
The example with eight speeds in the figure below shows how input switches configured for CF1-CF3 functions can change the motor speed in real time.



Note Speed 0 depends on $R001$ parameter value.

Bit operation (“1”=ON, “X”=regardless the condition (ON or OFF))

| Speed | Param. | SF7 | SF6 | SF5 | SF4 | SF3 | SF2 | SF1 |
|---------|--------|-----|-----|-----|-----|-----|-----|-----|
| Speed 0 | $R020$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Speed 1 | $R021$ | X | X | X | X | X | X | 1 |
| Speed 2 | $R022$ | X | X | X | X | X | 1 | 0 |
| Speed 3 | $R023$ | X | X | X | X | 1 | 0 | 0 |
| Speed 4 | $R024$ | X | X | X | 1 | 0 | 0 | 0 |
| Speed 5 | $R025$ | X | X | 1 | 0 | 0 | 0 | 0 |
| Speed 6 | $R026$ | X | 1 | 0 | 0 | 0 | 0 | 0 |
| Speed 7 | $R027$ | 1 | 0 | 0 | 0 | 0 | 0 | 0 |



The example with eight speeds in the figure below shows how input switches configured for SF1-SF7 functions can change the motor speed in real time.

NOTE: Speed 0 depends on *AD01* parameter value.

Digital Input configuration for binary operation





| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|---|--|--|
| 02 | CF1 | Multi-speed Select, Bit 0 (LSB) | ON | Bin encoded speed select, Bit 0, logical 1 |
| | | | OFF | Bin encoded speed select, Bit 0, logical 0 |
| 03 | CF2 | Multi-speed Select, Bit 1 | ON | Bin encoded speed select, Bit 1, logical 1 |
| | | | OFF | Bin encoded speed select, Bit 1, logical 0 |
| 04 | CF3 | Multi-speed Select, Bit 2 | ON | Bin encoded speed select, Bit 2, logical 1 |
| | | | OFF | Bin encoded speed select, Bit 2, logical 0 |
| 05 | CF4 | Multi-speed Select, Bit 3 (MSB) | ON | Bin encoded speed select, Bit 3, logical 1 |
| | | | OFF | Bin encoded speed select, Bit 3, logical 0 |
| Valid for inputs: | | <i>C001</i> ~ <i>C007</i> | Example (some CF inputs require input configuration; some are default inputs): | |
| Required settings: | | <i>F001</i> , <i>AD01</i> =02, <i>AD20</i> to <i>AD35</i> | | |
| <ul style="list-style-type: none"> When programming the multi-speed settings, be sure to press the key each time and then set the next multi-speed setting. Note that when the key is not pressed, no data will be set. When a multi-speed setting more than 50 Hz (60 Hz) is to be set, it is necessary to program the maximum frequency <i>AD04</i> high enough to allow that speed | | | | |
| See I/O specs on page 9 and page 195. | | | | |

While using the multi-speed capability, you can monitor the present frequency with monitor function *d001* during each segment of a multi-speed operation.


Note When using the Multi-speed Select settings CF1 to CF4, do not display parameter *F001* or change the value of *F001* while the inverter is in Run Mode (motor running). If it is necessary to check the value of *F001* during Run Mode, please monitor *d001* instead of *F001*.

There are two ways to program the speeds into the registers *AD20* to *AD35*:

1. Standard keypad programming
2. Programming using the CF switches. Set the speed following these steps:
 - a) Turn the Run command OFF (Stop Mode).
 - b) Turn inputs ON to select desired Multi-speed. Display the value of *F001* on the digital operator.

- c) Set the desired output frequency by pressing the  and  keys.
- d) Press the  key once to store the set frequency. When this occurs, *F001* indicates the output frequency of Multi-speed n.
- e) Press the  key once to confirm that the indication is the same as the set frequency.
- f) Repeat operations in 2. a) to 2. e) to set the frequency of other Multi-speeds.

Digital Input configuration for bit operation

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|------------------------------------|-------|--|
| 32~3B | SF1~SF2 | Multistage Speed ~ Bit Operation | ON | Makes multistage speed by combination of the inputs. |
| | | | OFF | |
| Valid for inputs: | | <i>C001~C007</i> | | |
| Required settings: | | <i>F001, A001=02, A020 to A035</i> | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> • When programming the multi-speed settings, be sure to press the  key each time and then set the next multi-speed setting. Note that when the key is not pressed, no data will be set. • When a multi-speed setting more than 50Hz (60 Hz) is to be set, it is necessary to program the maximum frequency <i>A004</i> high enough to allow that speed | | | | |

Jog Frequency - The jog speed setting is used whenever the Jog command is active. The jog speed setting range is arbitrarily limited to 9.99 Hz, to provide safety during manual operation. The acceleration to the jog frequency is

instantaneous, but you can choose from six modes for the best method for stopping the jog operation.

| “A” Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A038 | Jogging frequency | Defines limited speed for jog, range is from start frequency to 9.99 Hz | ✓ | 6.00 | Hz |
| A039 | Jogging stop selection | Define how end of jog stops the motor; six options: 00... FRS (Free running on jogging stop/Disabled in operation) 01... DEC (Deceleration stop on jogging stop/Disabled in operation) 02... DB (DC injection braking on jogging stop/Disabled in operation) 03... FRS (RUN) (Free running on jogging stop/Disabled in operation) 04... DEC (RUN) (Deceleration stop on jogging stop/Enabled in operation) 05... DB (RUN) (DC injection braking on jogging stop/Enabled in operation) | * | 04 | |

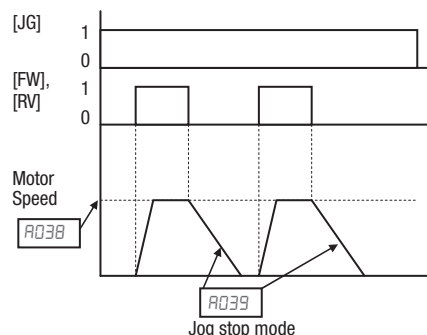
With options 0,1 and 2 on parameter A039 the JOG command is not accepted if the inverter is already running, so is necessary to activate the JG terminal before the FW or REV commands.

For jogging operation, turn JG terminal ON at first and then turn FW or RV terminal on.

When jogging stop mode A039=02 or 05, DC braking data is needed.

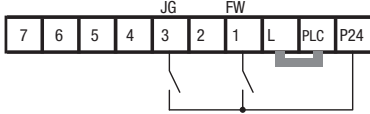
During jogging operation, frequency can be set with output frequency setting F001.

Jogging does not use an acceleration ramp, so we recommend setting the jogging frequency A038 to 5 Hz or less to prevent tripping



To enable the Run key on the digital operator for jog input, set the value 01 (terminal mode) in A002 (Run command source).

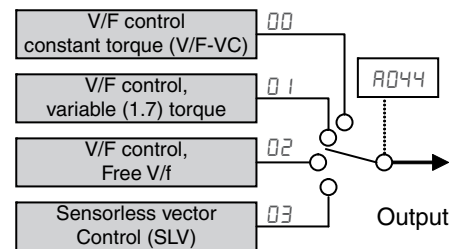
| Option Code | Terminal Symbol | Function Name | State | Description |
|-------------|-----------------|---------------|-------|--|
| 05 | JG | Jogging | ON | Inverter is in Run Mode, output to motor runs at jog parameter frequency |
| | | | OFF | Inverter is in Stop Mode |

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|----------------------------------|-------|---|
| Valid for inputs: | | C001~C007 | | Example (requires input configuration – see page 153):  |
| Required settings: | | A002=01, A03B>b0B2, A03B>0, A039 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> No jogging operation is performed when the set value of jogging frequency A03B is smaller than the start frequency b0B2, or the value is 0 Hz. Be sure to stop the motor when switching the function [JG] ON or OFF. | | | | |

3-5-4 Torque Control Algorithms

The inverter generates the motor output according to the V/f algorithm selected. Parameter **A044** selects the inverter algorithm for generating the frequency output, as shown in the diagram to the right (**A244** for 2nd motor). The factory default is **00** (constant torque).

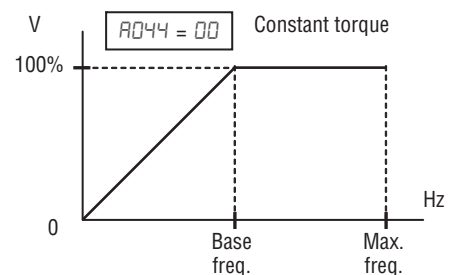
Inverter Torque Control Algorithms



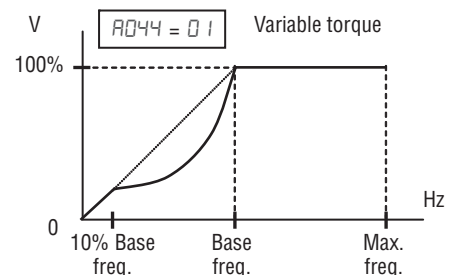
Review the following description to help you choose the best torque control algorithm for your application.

The built-in V/f curves are oriented toward developing constant torque or variable torque characteristics (see graphs below). You can select either constant torque or reduced torque V/f control.

Constant and Variable (Reduced) Torque - The graph at right shows the constant torque characteristic from 0 Hz to the base frequency **A003**. The voltage remains constant for output frequencies higher than the base frequency.



The graph above (right) shows the variable (reduced) torque curve, which has a constant torque characteristic from 0 Hz to 10% of the base frequency. This helps to achieve higher torque at low speed with reduced torque curve at higher speeds.



Sensorless Vector Control - You can achieve high torque performance (200% torque at 0.5 Hz of output frequency) without motor speed feedback (encoder feedback), which is so-called sensorless vector control (SLV control).

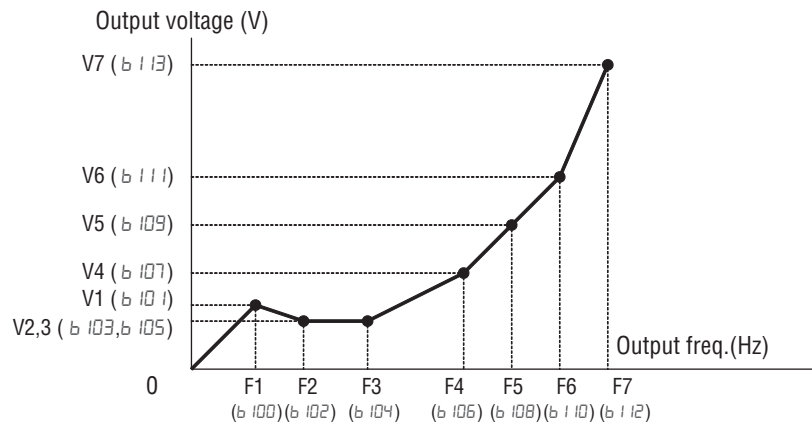
Free V/F Control - The free V/F setting function allows you to set an arbitrary V/F characteristics by specifying the voltages and frequencies (**b100~b113**) for the seven points on the V/F characteristic curve.

The free V/F frequencies 1 to 7 set by this function must always be in the collating sequence of "1<2<3<4<5<6<7".

Since all the free V/F frequencies are set to 0 Hz as default (factory setting), specify their arbitrary values (being set with free-setting V/F frequency 7). The inverter does not operate the free V/F characteristics with the factory setting.

Enabling the free V/F characteristics setting function disables the torque boost selection (**A041/A241**), base frequency setting (**A003/A203**), and maximum fre-

quency setting (R004/R204) automatically. (The inverter regard the value of free-setting V/F frequency 7 (b 112) as the maximum frequency.)

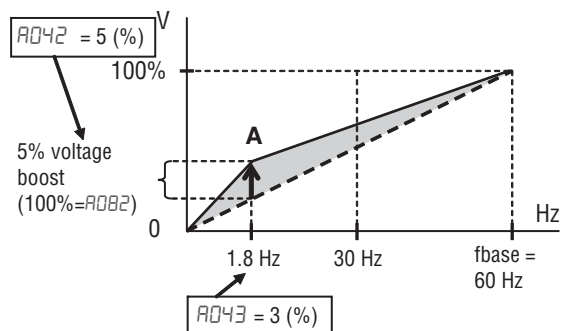


| Item | Code | Set range | Remarks |
|----------------------|------|--|---|
| Free V/f frequency 7 | b112 | 0 to 400 (Hz) | Setting of the output freq. at each breakpoint of the V/F characteristic curve |
| Free V/f frequency 6 | b110 | Free-setting V/F freq.5 to freq.7 (Hz) | |
| Free V/f frequency 5 | b108 | Free-setting V/F freq.4 to freq.6 (Hz) | |
| Free V/f frequency 4 | b106 | Free-setting V/F freq.3 to freq.5 (Hz) | |
| Free V/f frequency 3 | b104 | Free-setting V/F freq.2 to freq.4 (Hz) | |
| Free V/f frequency 2 | b102 | Free-setting V/F freq.1 to freq.3 (Hz) | |
| Free V/f frequency 1 | b100 | 0 to Free-setting V/F freq.2 (Hz) | |
| Free V/f voltage 7 | b113 | 0.0 to 800.0 (V) | Setting of the output voltage at each breakpoint of the V/F characteristic curve ¹ |
| Free V/f voltage 6 | b111 | | |
| Free V/f voltage 5 | b109 | | |
| Free V/f voltage 4 | b107 | | |
| Free V/f voltage 3 | b105 | | |
| Free V/f voltage 2 | b103 | | |
| Free V/f voltage 1 | b101 | | |

¹ Even if the voltage higher than input is set as a free-setting V/F voltage 1 to 7, the inverter output voltage cannot exceed the inverter input voltage or that specified by the AVR voltage selection. Carefully note that selecting an inappropriate control system (V/F characteristics) may result in overcurrent during motor acceleration or deceleration or vibration of the motor or other machine driven by the inverter.

Manual Torque Boost -

The Constant and Variable Torque algorithms feature an adjustable torque boost curve. When the motor load has a lot of inertia or starting friction, you may need to increase the low frequency starting torque characteristics by boosting the voltage above the normal V/f ratio (shown at right). The function attempts to compensate for voltage drop in the motor primary winding in the low speed range.

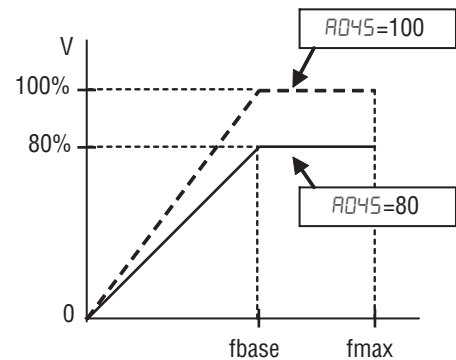


The function attempts to compensate for voltage drop in the motor primary winding in the low speed range.

The boost is applied from zero to the base frequency. You set the breakpoint of the boost (point A on the graph) by using parameters R042 and R043. The manual boost is calculated as an addition to the standard V/f curve.

Be aware that running the motor at a low speed for a long time can cause motor overheating. This is particularly true when manual torque boost is ON, or if the motor relies on a built-in fan for cooling.

Voltage gain - Using parameter A045 you can modify the voltage gain of the inverter (see graph at right). This is specified as a percentage of the full scale output voltage. The gain can be set from 20% to 100%. It should be adjusted in accordance with the motor specifications. Gain can be changed even during operation in V/f mode, and while stopped in SLV mode.



After the setting is done, please be sure to reset (terminal RS on/off) to recalculate the motor constant.

Refrain from change the setting value suddenly (within 10%). Inverter may overvoltage trip due to the rapid change of output voltage.

Voltage compensation gain and slip compensation gain - Using parameters A046 and A047, you can obtain better performance under automatic torque boost mode (A041=0). See following table for the concept of adjustment, including other parameters.

| Symptom | Adjustment | Adjust item |
|--|---|-------------|
| Motor torque is not enough at low speed (The motor does not rotate at low speed) | Increase the voltage setting for manual torque boost, step by step/ | A042 / A242 |
| | Increase the voltage compensation gain for automatic torque boost, step by step | A046 / A246 |
| | Increase the slip compensation gain for automatic torque boost, step by step | A047 / A247 |
| | Reduce carrier frequency | b083 |
| Motor speed decreases (stalls) when a load is given to the motor | Increase the slip compensation gain for automatic torque boost, step by step | A047 / A247 |
| Motor speed increases when a load is given to the motor | Decrease the slip compensation gain for automatic torque boost, step by step | A047 / A247 |
| The inverter trips due to overcurrent when a load is given to the motor | Decrease the voltage setting for manual torque boost, step by step | A042 / A242 |
| | Decrease the voltage compensation gain for automatic torque boost, step by step | A046 / A246 |
| | Decrease the slip compensation gain for automatic torque boost, step by step | A047 / A247 |

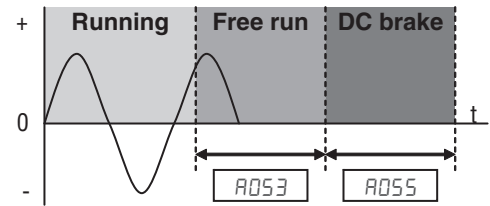
| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A041 | Torque boost selection | Two options: | × | 00 | — |
| A241 | 2nd torque boost selection | 00... Manual torque boost 01... Automatic torque boost | × | 00 | — |
| A042 | Manual torque boost voltage | Can boost starting torque between 0 and 20% above normal V/f curve, range is 0.0 to 20.0% | ✓ | 1.0 | % |
| A242 | 2nd manual torque boost voltage | | ✓ | 1.0 | % |
| A043 | Manual torque boost frequency | Sets the frequency of the V/f breakpoint A in graph (top of previous page) for torque boost, range is 0.0 to 50.0% | ✓ | 5.0 | % |
| A243 | 2nd manual torque boost frequency | | ✓ | 5.0 | % |

| "A" Function | | | Run Mode Edit | Defaults | |
|---------------------|--|--|----------------------|-----------------|--------------|
| Func. Code | Name | Description | | EU | Units |
| A044 | V/f characteristics selection | Four available V/f curves; 00... VC (Constant torque) 01... VP (Reduced torque) 02... Free V/F 03... SLV (Sensorless vector control) | ✗ | 00 | – |
| A244 | 2nd V/f characteristics selection | | ✗ | 00 | – |
| A045 | Output voltage gain | Sets voltage gain of the inverter, range is 20 to 100% | ✓ | 100 | % |
| A245 | Output voltage gain, 2nd motor | | ✓ | 100 | % |
| A046 | Automatic torque boost voltage compensation gain | Sets voltage compensation gain under automatic torque boost, range is 0 to 255 | ✓ | 100 | – |
| A246 | 2nd automatic torque boost voltage compensation gain | | ✓ | 100 | – |
| A047 | Automatic torque boost slip compensation gain | Sets slip compensation gain under automatic torque boost, range is 0 to 255 | ✓ | 100 | – |
| A247 | 2nd automatic torque boost slip compensation gain | | ✓ | 100 | – |

3-5-5 DC Braking (DB) Settings

Normal DC braking performance

– The DC braking feature can provide additional stopping torque when compared to a normal deceleration to a stop. DC braking is particularly useful at low speeds when normal deceleration torque is minimal.

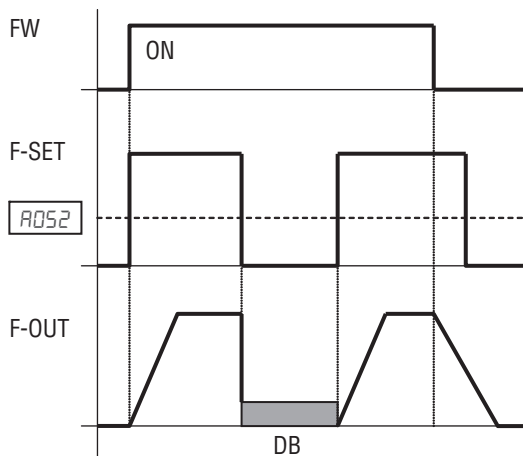


When you set **A051** to **01** (Enable during stop), and the RUN command (FW/RV signal) turns OFF, the inverter injects a DC voltage into the motor windings during deceleration below a frequency you can specify (**A052**).

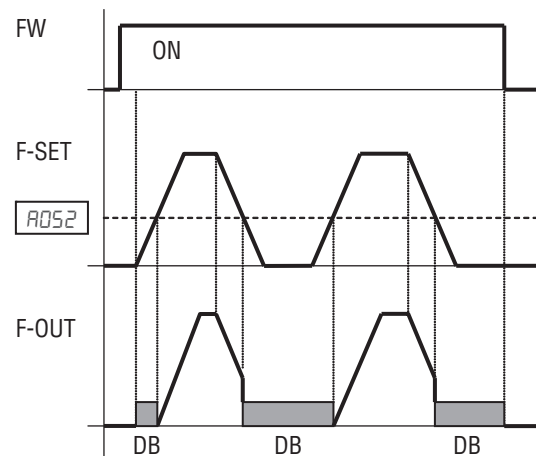
The braking power (**A054**) and duration (**A055**) can both be set. You can optionally specify a wait time before DC braking (**A053**), during which the motor will free run.

DC Braking - Frequency Detection – You can instead set DC braking to operate during RUN mode only, by setting **A051** to **02** (Frequency detection). In this case DC braking operates when the output frequency comes down to the one you specified in **A052** while the RUN command is still active. Refer to the graphs figures below.

External DB and Internal DC braking are invalid during the frequency detection mode.



Example 1: Step change in F-SET



Example 2: Analog change in F-SET

Example 1, (above left) shows the performance with **A051=02** with a step-changing frequency reference. In this case, when the reference goes to 0, the inverter immediately starts DC braking because the set point drops below the value specified in **A052**. DC braking continues until the set point exceeds **A052**. There will be no DC braking at next downward transition because the FW input is OFF.

Example 2, (above right) shows a gradually changing frequency reference, for example by analog input. In this case, there will be a DC braking period at starting because the frequency set point is lower than the value specified in **A052**.

⚠ Caution Be careful to avoid specifying to long braking time or to high carrier frequency that can cause motor overheating. If you use DC braking, we recommend using a motor with a built-in thermistor, and wiring it to the inverter's thermistor input (see 4-5-8 *Thermistor Thermal Protection* on page 211). Also refer to the motor manufacturer's specifications for duty-cycle recommendations during DC braking.

DC braking performance at start can also be set separately (*A057* and *A058*).
 And carrier frequency of DC braking performance can also be set separately (*A059*)..

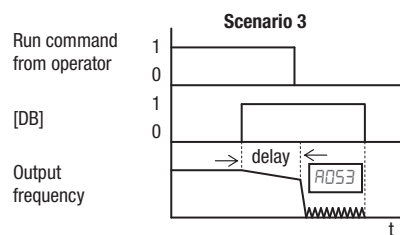
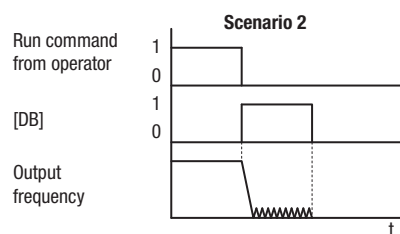
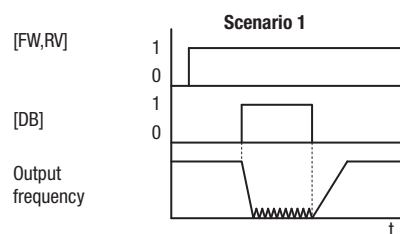
| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>A051</i> | DC injection braking selection | Three options; select codes: <i>00</i> ... OFF (Disabled) <i>01</i> ... ON (Enabled) <i>02</i> ... ON(FQ) (Frequency control [A052]) | * | 01 | – |
| <i>A052</i> | DC injection braking frequency | The frequency at which DC braking begins, range is from the start frequency (<i>b002</i>) to 60.00 Hz | * | 0.50 | Hz |
| <i>A053</i> | DC injection braking delay time | The delay from the end of controlled deceleration to start of DC braking (motor free runs until DC braking begins), range is 0.0 to 5.0 sec. | * | 0.0 | sec. |
| <i>A054</i> | DC injection braking power | Level of DC braking force, settable from 0 to 100% | * | 50 | % |
| <i>A055</i> | DC injection braking time | Sets the duration for DC braking, range is from 0.0 to 60.0 seconds | * | 0.5 | sec. |
| <i>A056</i> | DC injection braking method selection | Two options; select codes: <i>00</i> ... Edge operation <i>01</i> ... Level operation | * | 01 | – |
| <i>A057</i> | Startup DC injection braking power | Level of DC braking force at start, settable from 0 to 100% | * | 0 | % |
| <i>A058</i> | Startup DC injection braking time | Sets the duration for DC braking, range is from 0.0 to 60.0 seconds | * | 0.0 | sec. |
| <i>A059</i> | DC injection braking carrier frequency | Carrier frequency of DC braking performance, range is from 2.0 to 15.0 kHz | * | 5.0 | sec. |

Additionally is possible to trigger the DC injection by a digital input when the terminal [DB] is turned ON. Set the following parameters to do it

- *A053* – DC braking delay time setting. The range is 0.1 to 5.0 seconds.
- *A054* – DC braking force setting. The range is 0 to 100%.

The scenarios to the right help show how DC braking works in various situations.

1. Scenario 1 – The [FW] or [RV] terminal is ON. When [DB] is ON, DC braking is applied. When [DB] is OFF again, the output frequency ramps to the prior level.
2. Scenario 2 – The Run command is applied from the operator keypad. When the [DB] terminal is ON, DC braking is applied. When the [DB] terminal is OFF again, the inverter output remains OFF.

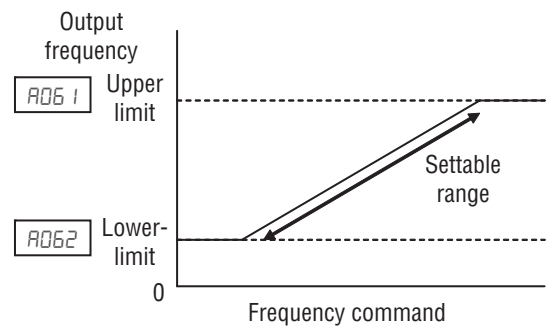


3. Scenario 3 – The Run command is applied from the operator keypad. When the [DB] terminal is ON, DC braking is applied after the delay time set by *A053* expires. The motor is in a free-running (coasting) condition. When the [DB] terminal is OFF again, the inverter output remains OFF.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|---------------------|-------------------|---|
| 07 | DB | External DC Braking | ON | Applies DC injection braking during deceleration |
| | | | OFF | Does not apply DC injection braking during deceleration |
| Valid for inputs: | | | <i>C00 1~C007</i> | |
| Required settings: | | | <i>A053, A054</i> | |
| Notes: | | | | |
| <ul style="list-style-type: none"> • Do not use the [DB] input continuously or for a long time when the DC braking force setting <i>A054</i> is high (depends on the motor application). • Do not use the [DB] feature for continuous or high duty cycle as a holding brake. The [DB] input is designed to improve stopping performance. Use a mechanical brake for holding a stop position. | | | | |

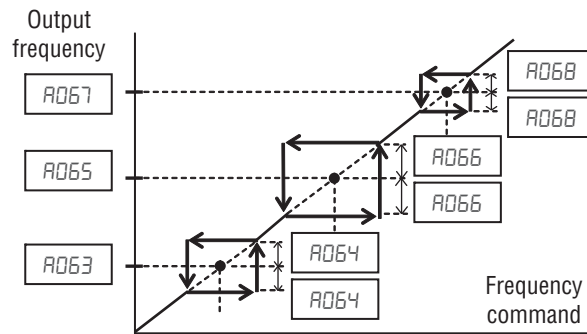
3-5-6 Frequency-related Functions

Frequency Limits - Upper and lower limits can be imposed on the inverter output frequency. These limits will apply regardless of the source of the speed reference. You can configure the lower frequency limit to be greater than zero as shown in the graph. The upper limit must not exceed the rating of the motor or capability of the machinery. The maximum frequency setting (*A004/A204*) takes precedence over frequency upper limit (*A061/A261*).



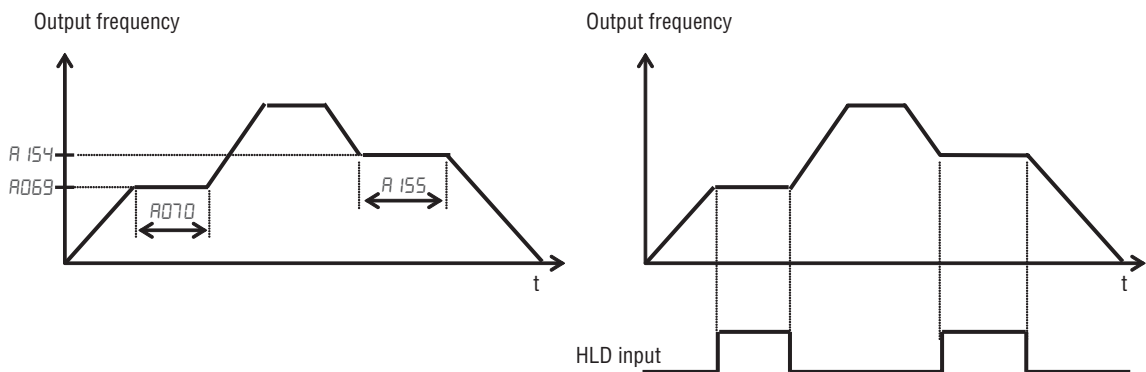
| “A” Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>A061</i> | Frequency upper limit | Sets a limit on output frequency less than the maximum frequency (<i>A004/A204</i>). Range is from frequency lower limit (<i>A062/A262</i>) to maximum frequency (<i>A004/A204</i>). 0.0 setting is disabled >0.0 setting is enabled | * | 0.00 | Hz |
| <i>A261</i> | 2nd frequency upper limit | | | | |
| <i>A062</i> | Frequency lower limit | Sets a limit on output frequency greater than zero. Range is start frequency (<i>b082</i>) to frequency upper limit (<i>A061/A261</i>) 0.0 setting is disabled >0.0 setting is enabled | * | 0.00 | Hz |
| <i>A262</i> | 2nd frequency lower limit | | | | |

Jump Frequencies - Some motors or machines exhibit resonances at particular speed(s), which can be destructive for prolonged running at those speeds. The inverter has up to three *jump frequencies* as shown in the graph. The hysteresis around the jump frequencies causes the inverter output to skip around the sensitive frequency values.



| "A" Function | | | Run Mode Edit | Defaults | |
|----------------------|-----------------------------|--|---------------|----------------------|-------|
| Func. Code | Name | Description | | EU | Units |
| A063 A065 A067 | Jump frequency 1 to 3 | Up to 3 output frequencies can be defined for the output to jump past to avoid motor resonances (center frequency) Range is 0.00 to 400.00 Hz | * | 0.00 0.00 0.00 | Hz |
| A064 A066 A068 | Jump frequency width 1 to 3 | Defines the distance from the center frequency at which the jump around occurs Range is 0.00 to 10.00 Hz | * | 0.50 0.50 0.50 | Hz |

Acceleration stop/Deceleration stop - The acceleration stop and deceleration stop frequency setting allows you to make the inverter wait, upon starting the motor or upon decelerating the motor, until the motor slip becomes less when the motor load causes a large moment of inertia. Use this function if the inverter trips because of overcurrent when starting or decelerating the motor. This function operates with every acceleration and deceleration pattern, regardless the acceleration and deceleration curve selection (A097 and A098). Instead of setting A069, A070, A154 and A155, acceleration and deceleration can be held by intelligent input configured as "B3:HLD".



| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A069 | Acceleration stop frequency | Sets the frequency to hold acceleration, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| A070 | Acceleration stop time | Sets the duration of acceleration hold, range is 0.0 to 60.0 seconds | * | 0.0 | sec. |
| A154 | Deceleration hold frequency | Sets the frequency to hold deceleration, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| A155 | Deceleration hold time | Sets the duration of deceleration hold, range is 0.0 to 60.0 seconds | * | 0.0 | sec. |

3-5-7 PID Control

When enabled, the built-in PID loop calculates an ideal inverter output value to cause a loop feedback process variable (PV) to move closer in value to the set point (SP). The frequency command serves as the SP. The PID loop algorithm will read the analog input for the process variable (you specify the current or voltage input) and calculate the output.

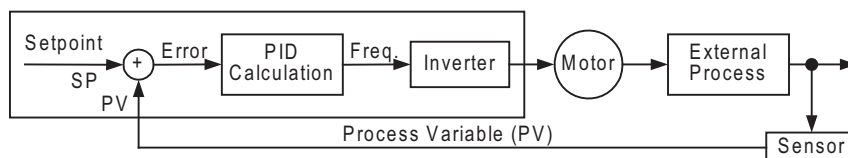
| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|----------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A071 | PID selection | Enables PID function, three option codes: 00... OFF (Disabled) 01... ON(+) (Enabled) 02... ON (+/-) (Reverse output enabled) | * | 00 | — |
| A072 | PID P gain | Proportional gain has a range of 0.00 to 25.00 | ✓ | 1.0 | — |
| A073 | PID I gain | Integral time constant has a range of 0.0 to 3600.0 seconds | ✓ | 1.0 | sec |
| A074 | PID D gain | Derivative time constant has a range of 0.00 to 100.00 seconds | ✓ | 0.00 | sec |
| A075 | PID scale | Process Variable (PV), scale factor (multiplier), range of 0.01 to 99.99 | * | 1.00 | — |
| A076 | PID feedback selection | 00... OI 01... O 02... ModBus (RS485) 03... Pulse (Pulse train frequency) 10... Math (Operation function output) | * | 00 | — |
| A077 | Reverse PID function | Two option codes: 00: OFF (Deviation = Target value - Feedback value) 01: ON (Deviation = Feedback value - Target value) | * | 00 | — |
| A078 | PID output limit function | Sets the limit of PID output as percent of full scale, range is 0.0 to 100.0% | * | 0.0 | — |
| A079 | PID feed forward selection | Selects source of feed forward gain, option codes: 00... Disabled 01... O 02... OI | * | 00 | — |

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|--------------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A156 | PID sleep function action threshold | Sets the threshold for the action, set range 0.00~400.00 Hz | * | 0.00 | Hz |
| A157 | PID sleep function action delay time | Sets the delay time for the action, set range 0.0~25.5 sec | * | 0.0 | sec |

Note The setting *A073* for the integrator is the integrator's time constant T_i , not the gain. The integrator gain $K_i = 1/T_i$. When you set *A073* = 0, the integrator is disabled.

In standard operation, the inverter uses a reference source selected by parameter *A001* for the output frequency, which may be a fixed value (*F001*), a variable set by the front panel potentiometer, or value from an analog input (voltage or current). To enable PID operation, set *A071* = 0. This causes the inverter to calculate the target freq, or setpoint.

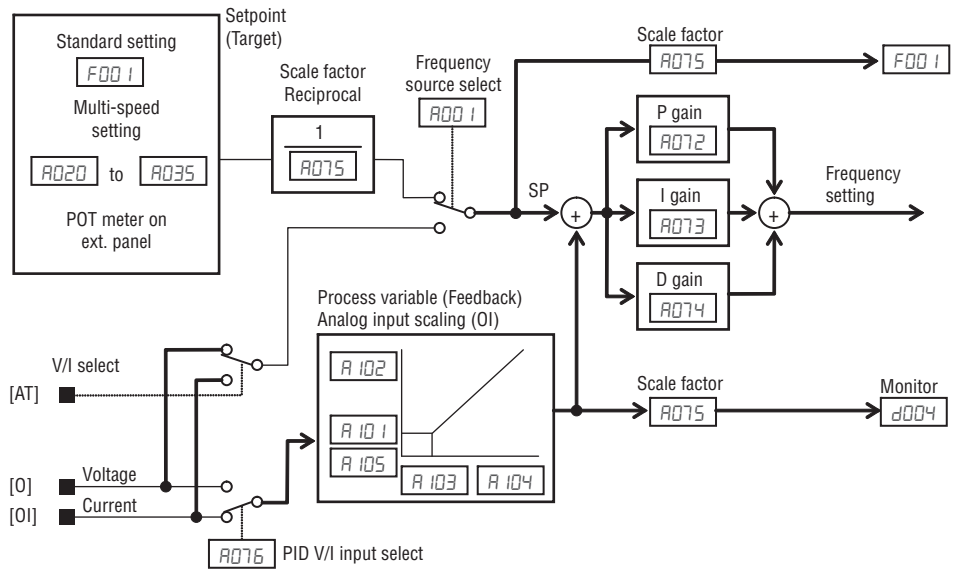
A calculated target frequency can have a lot of advantages. It lets the inverter adjust the motor speed to optimize some other process of interest, potentially saving energy as well. Refer to the figure below. The motor acts upon the external process. To control that external process, the inverter must monitor the process variable. This requires wiring a sensor to either the analog input terminal [O] (voltage) or terminal [OI] (current).



When enabled, the PID loop calculates the ideal output frequency to minimize the loop error. This means we no longer command the inverter to run at a particular frequency, but we specify the ideal value for the process variable. That ideal value is called the *setpoint*, and is specified in the units of the external process variable. For a pump application it may be gallons/minute, or it could be air velocity or temperature for an HVAC unit. Parameter *A075* is a scale factor that relates the external process variable units to motor frequency. The figure below is a more detailed diagram of the function.

The PID Disable function temporarily suspends PID loop execution via an intelligent input terminal. It overrides the parameter *A071* (PID Enable) to stop PID execution and return to normal motor frequency output characteristics. The use of PID Disable on an intelligent input terminal is optional. Of course, any use of the PID loop control requires setting PID Enable function *A071* = 0.

The PID Clear function forces the PID loop integrator sum = 0. So, when you turn ON an intelligent input configured as [PIDC], the integrator sum is reset to zero. This is useful when switching from manual control to PID loop control and the motor is stopped.



Caution Be careful not to turn PID Clear ON and reset the integrator sum when the inverter is in Run Mode (output to motor is ON). Otherwise, this could cause the motor to decelerate rapidly, resulting in a trip.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---------------|-------|---|
| 23 | PID | PID Disable | ON | Disables PID loop execution |
| | | | OFF | Allows PID loop execution |
| 24 | PIDC | PID Clear | ON | Force the value of the integrator to zero |
| | | | OFF | No change in PID loop execution |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | A071 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The use of [PID] and [PIDC] terminals are optional. Use A071 I=0 if you want PID loop control enabled all the time. | | | | |

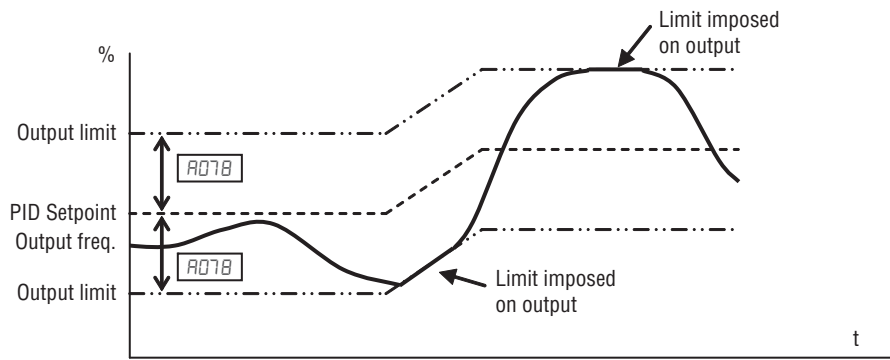
3-5-8 PID Loop Configuration

The inverter's PID loop algorithm is configurable for various applications.

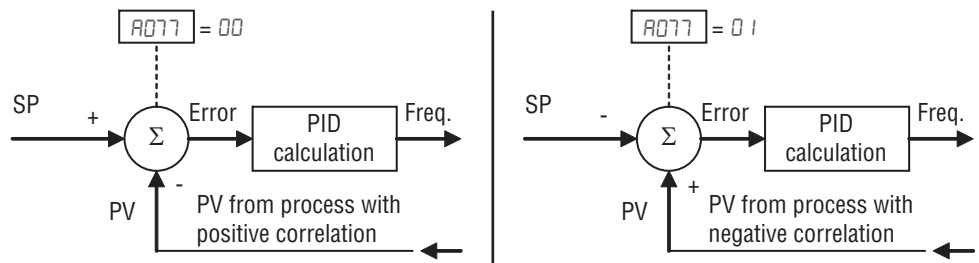
PID Output Limit - The PID loop controller has a built-in output limit function. This function monitors the difference between the PID setpoint and the loop output (inverter output frequency), measured as a percentage of the full scale range of each. The limit is specified by parameter A078.

- When the difference |(Setpoint - loop output)| is smaller than or equal to the A078 limit value, the loop controller operates in its normal linear range.
- When the difference |(Setpoint - loop output)| is larger than the A078 limit value, the loop controller changes the output frequency as needed so that the difference does not exceed the limit.

The diagram below shows PID setpoint changes and the related output frequency behavior when a limit value in **A078** exists.

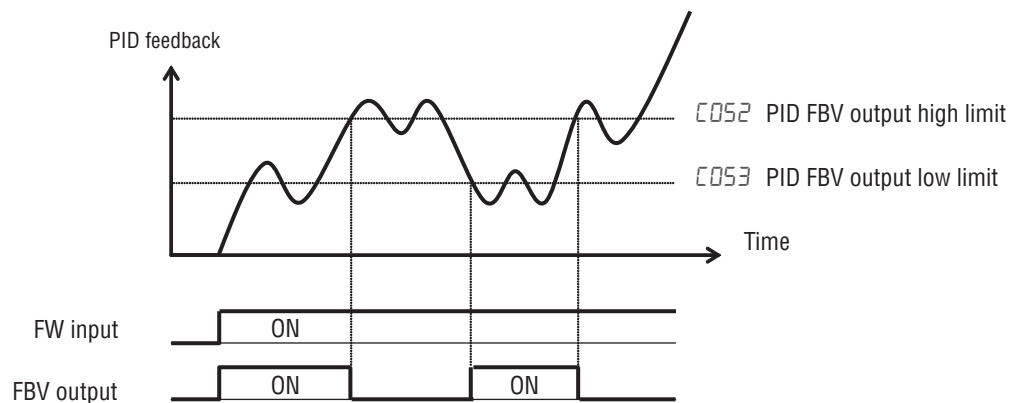


Deviation (error) Inversion - In typical heating loops or ventilation loops, an increase in energy into the process results in an *increasing* PV. In this case, the Loop Error = (SP - PV). For cooling loops, an increase in energy into the process results in a *decreasing* PV. In this case, the Loop Error = -(SP - PV). Use **A077** to configure the error term.



PID deviation output - If PID deviation "ε" exceeds the value in **C044**, output signal configured as **D04** (OD) is activated.

PID feedback comparison output - If PID feedback is below Feedback Low Limit **C053** and the inverter is in RUN mode the output turns ON, it remains active until feedback gets over the PID High Limit **C052** or inverter pass to Stop mode.



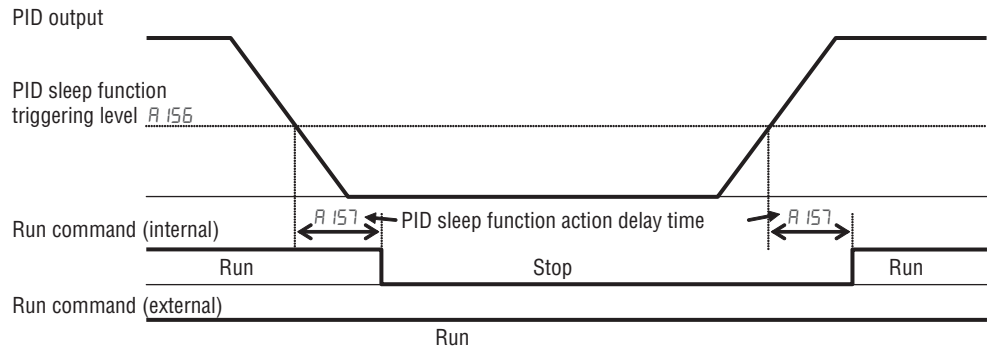
PID scaling - When PID scale parameter (**A075**) is set, following variables are scaled.

$$(\text{monitored}) = (\text{variable}) \times (\text{A075})$$

| | | | | | | | |
|------|------|------|------|------|------|------|------|
| d004 | F001 | A011 | A012 | A020 | A220 | A021 | A022 |
| A023 | A024 | A025 | A026 | A027 | A028 | A029 | A030 |
| A031 | A032 | A033 | A034 | A035 | A101 | A102 | A145 |

3-5-9 PID Sleep Function

The inverter shuts off the output when the PID output becomes less than the specified value (P156) in case of PID is set enabled, or shuts off when the frequency command becomes less than the specified value in case of PID is set disabled. And if the PID output or frequency command exceeds the specified value (P156) for a specified period (P157), inverter automatically restarts the operation. This is the PID sleep function.



- PID Sleep function is always enabled, even the PID function is disabled.

3-5-10 Automatic Voltage Regulation (AVR) Function

The automatic voltage regulation (AVR) feature keeps the inverter output waveform at a relatively constant amplitude during power input fluctuations. This can be useful if the installation is subject to input voltage fluctuations. However, the inverter cannot boost its motor output to a voltage higher than the power input voltage. If you enable this feature, be sure to select the proper voltage class setting for your motor.

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|----------------------------------|--|---------------|-------------|-------|
| Func. Code | Name | Description | | EU | Units |
| P0B1 | AVR selection | Automatic (output) voltage regulation, selects from three type of AVR functions, three option codes: 00... Always ON 01... Always OFF 02... OFF during deceleration | × | 02 | — |
| P2B1 | AVR selection, 2nd motor | | × | 02 | — |
| P0B2 | AVR voltage selection | 200V class inverter settings: 200/215/220/230/240 | × | 230/ 400 | V |
| P2B2 | AVR voltage selection, 2nd motor | 400V class inverter settings: 380/400/415/440/460/480 | × | 230/ 400 | V |
| P0B3 | AVR filter time constant | Define the time constant of the AVR filter, range is 0.000 to 10.000 sec. | × | 0.300 | sec |
| P0B4 | AVR deceleration gain | Gain adjustment of the braking performance, range is 50 to 200% | × | 100 | % |

Note The motor behave as generator during deceleration and the energy is regenerated to the drive. As a result, the DC voltage in the inverter increases and cause over-voltage trip when exceeding the OV level. When the voltage is set high, deceleration time can be set shorter thanks to the energy consumption due to the increase of losses in inverter. In order to set deceleration time shorter without over-voltage trip, please try to set AVR off during deceleration or to tune the AVR filter time constant and AVR deceleration gain.

3-5-11 Energy Savings Mode / Optional Accel/Decel

Energy Saving Mode - This function allows the inverter to deliver the minimum power necessary to maintain speed at any given frequency. This works best when driving variable torque characteristic loads such as fans and pumps. Parameter *A0B5=01* enables this function and *A0B6* controls the degrees of its effect. A setting of 0.0 yields slow response but high accuracy, while a setting of 100 will yield a fast response with lower accuracy.

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>A0B5</i> | Energy-saving operation mode | Two option codes: <i>00</i> ... Normal operation <i>01</i> ... Eco (Energy-saving operation) | * | 00 | — |
| <i>A0B6</i> | Energy-saving response/accuracy adjustment | Range is 0.0 to 100.0 %. | ✓ | 50.0 | % |

The acceleration time is controlled so that the output current is below the level set by the Overload Restriction Function if enabled (Parameters *b021*, *b022*, and *b023*). If Overload Restriction is not enabled, then the current limit used is 150% of the inverter's rated output current.

The deceleration time is controlled so that the output current is maintained below 150% of the inverter's rated current, and the DC bus voltage is maintained below the OV Trip level (400 V or 800 V).

Note If the load exceeds the rating of the inverter, the acceleration time may be increased.

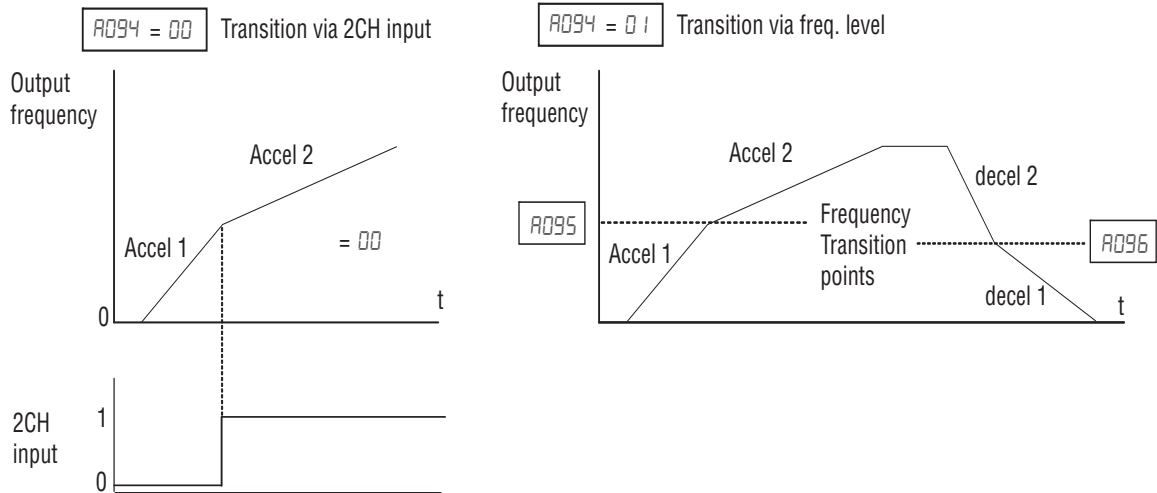
Note If using a motor with a capacity that is one size smaller than the inverter rating, enable the Overload Restriction function (*b021*) and set the Overload Restriction Level (*b022*) to 1.5 times the motor nameplate current.

Note Be aware that the acceleration and deceleration times will vary, depending on the actual load conditions during each individual operation of the inverter.

Note When analog input is a source of frequency command, be sure to set analog filter *A016=31* (500 ms). Otherwise, there can be the case that this energy saving function doesn't work well.

3-5-12 Second Acceleration and Deceleration Functions

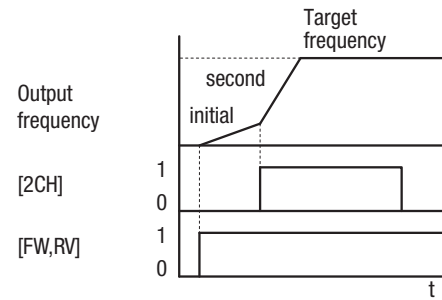
The MX2 inverter features two-stage acceleration and deceleration ramps. This gives flexibility in the profile shape. You can specify the frequency transition point, the point at which the standard acceleration (*F002*) or deceleration (*F003*) changes to the second acceleration (*A092*) or deceleration (*A093*). Or you can use intelligent input [2CH] to trigger this transition. These profile options are also available for the second motor settings. Select a transition method via *A094* as depicted below. Be careful not to confuse the *second acceleration/deceleration settings* with settings for the *second motor*!



| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>A092</i> | Acceleration time 2 | 0.00 to 3600.00 | ✓ | 10.00 | sec |
| <i>A292</i> | 2nd acceleration time 2 | | ✓ | 10.00 | sec |
| <i>A093</i> | Deceleration time 2 | | ✓ | 10.00 | sec |
| <i>A293</i> | 2nd deceleration time 2 | | ✓ | 10.00 | sec |
| <i>A094</i> | Select method to switch to Acc2/Dec2 profile | Three options for switching from 1st to 2nd accel/decel: | × | 00 | – |
| <i>A294</i> | Select method to switch to Acc2/Dec2 profile, 2nd motor | <i>00</i> ... 2CH-Terminal (Switched via multi-function input 09) <i>01</i> ... Preset FQ (Switched by setting) <i>02</i> ... FWD-REV (Enabled only when switching forward/reverse) | × | 00 | – |
| <i>A095</i> | Acc1 to Acc2 frequency transition point | Output frequency at which Accel1 switches to Accel2, range is 0.00 to 400.00 Hz | × | 0.00 | Hz |
| <i>A295</i> | Acc1 to Acc2 frequency transition point, 2nd motor | | × | 0.00 | Hz |
| <i>A096</i> | Dec1 to Dec2 frequency transition point | Output frequency at which Decel1 switches to Decel2, range is 0.00 to 400.00 Hz | × | 0.00 | Hz |
| <i>A296</i> | Dec1 to Dec2 frequency transition point, 2nd motor | | × | 0.00 | Hz |

Note For *A095* and *A096* (and for 2nd motor settings), if you set a very rapid Acc1 or Dec1 time (less than 1.0 second), the inverter may not be able to change rates to Acc2 or Dec2 before reaching the target frequency. In that case, the inverter decreases the rate of Acc1 or Dec1 in order to achieve the second ramp to the target frequency.

Switch between accelerations and decelerations could be done also using terminal [2CH], when this input is turned ON the inverter changes the rate of acceleration and deceleration from the initial settings (*F002* and *F003*) to use the second set of acceleration/ deceleration values. When the terminal is turned OFF, the inverter is returned to the original acceleration and deceleration time (*F002* acceleration time 1, and *F003* deceleration time 1). Use *A092* (acceleration time 2) and *A093* (deceleration time 2) to set the second stage acceleration and deceleration times.



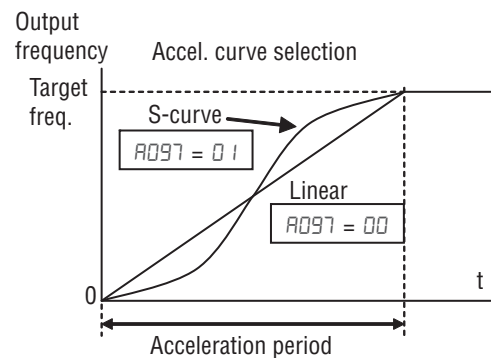
In the graph shown above, the [2CH] becomes active during the initial acceleration. This causes the inverter to switch from using acceleration 1 (*F002*) to acceleration 2 (*A092*).

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---|---------------------|--|
| 09 | 2CH | Two-stage Acceleration and Deceleration | ON | Frequency output uses 2nd-stage acceleration and deceleration values |
| | | | OFF | Frequency output uses the initial acceleration 1 and deceleration 1 values |
| Valid for inputs: | | | C00 1~C007 | |
| Required settings: | | | A092, A093, A094=00 | |
| Notes: | | | | |
| <ul style="list-style-type: none"> Function <i>A094</i> selects the method for second stage acceleration. It must be set = 00 to select the input terminal method in order for the [2CH] terminal assignment to operate. | | | | |

3-5-13 Accel/Decel

Standard acceleration and deceleration is linear. The inverter CPU can also calculate an S-curve acceleration or deceleration curve as shown. This profile is useful for favoring the load characteristics in particular applications.

Curve settings for acceleration and deceleration are independently selected. To enable the S-curve, use function *A097* (acceleration) and *A098* (deceleration).



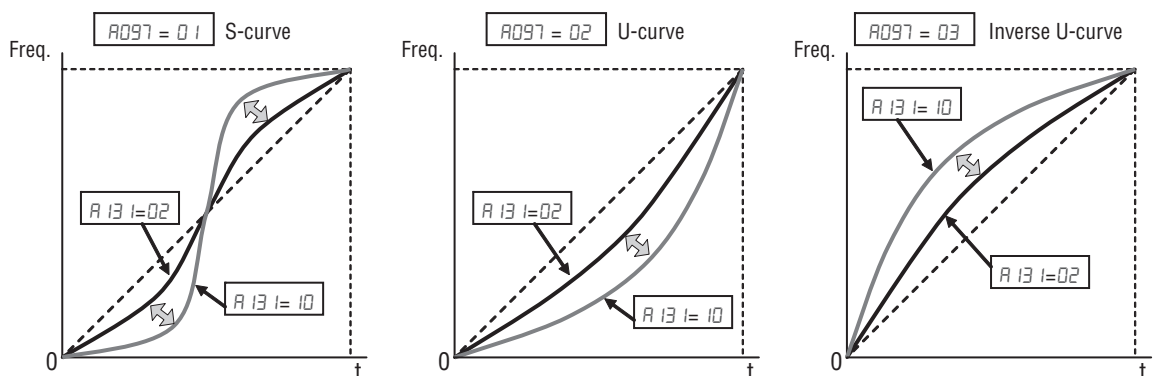
| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A097 | Acceleration curve selection | Set the characteristic curve of Acc1 and Acc2, five options: 00... Linear 01... S curve 02... U curve 03... inv.U curve 04... EL-S curve | * | 01 | - |
| A098 | Deceleration curve selection | Set the characteristic curve of Dec1 and Dec2, options are same as above (A097) | * | 01 | - |

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|--|-------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| A 131 | Acceleration curve parameter | Range is 01 to 10 | × | 02 | — |
| A 132 | Deceleration curve parameter | Range is 01 to 10 | × | 02 | — |
| A 150 | EL-S-curve ratio 1 during acceleration | Range is 0 to 50% | × | 10 | % |
| A 151 | EL-S-curve ratio 2 during acceleration | Range is 0 to 50% | × | 10 | % |
| A 152 | EL-S-curve ratio 1 during deceleration | Range is 0 to 50% | × | 10 | % |
| A 153 | EL-S-curve ratio 2 during deceleration | Range is 0 to 50% | × | 10 | % |

Acceleration / deceleration pattern summary

| Setting | 00 | 01 | 02 | 03 | 04 |
|-----------------------|-------------------|---|---|-----------------|--|
| Curve | Linear | S-curve | U-curve | Inverse U-curve | EL S-curve |
| R097 (Accel. pattern) | | | | | |
| R098 (Decel. pattern) | | | | | |
| Remarks | Standard pattern. | Effective for preventing the collapse of cargo carried by lift or conveyor for example. | Effective for the tension control of winding machine, to prevent cutting the object to be wound, for example. | | Effective for lift application because of the shock less start and stop. |

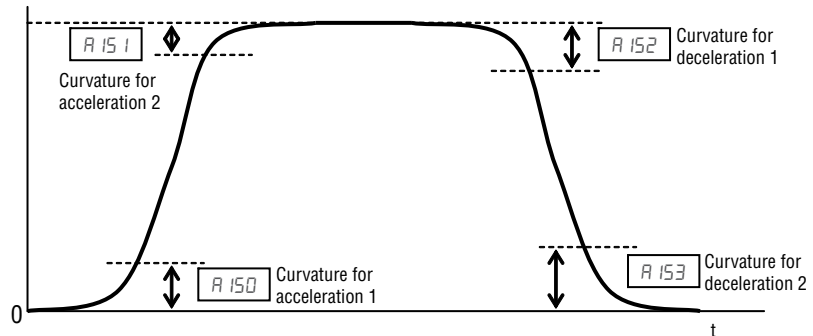
A 131 Curve constant (swelling)



Large A 131 value will result in a big swelling. A 132 is the same concept as above.

A 150~A 153 Curvature of EL-S-curve

When using EL-S-curve pattern, you can set the curvatures individually for acceleration and deceleration. If all the curvatures are set to 50%, the EL-S-curve pattern will be equivalent to the S-curve pattern.



For use of EL-S curve be sure to use select multi-speed as frequency source to avoid nuisance change of frequency during acceleration and deceleration.

3-5-14 Additional Analog Input Settings

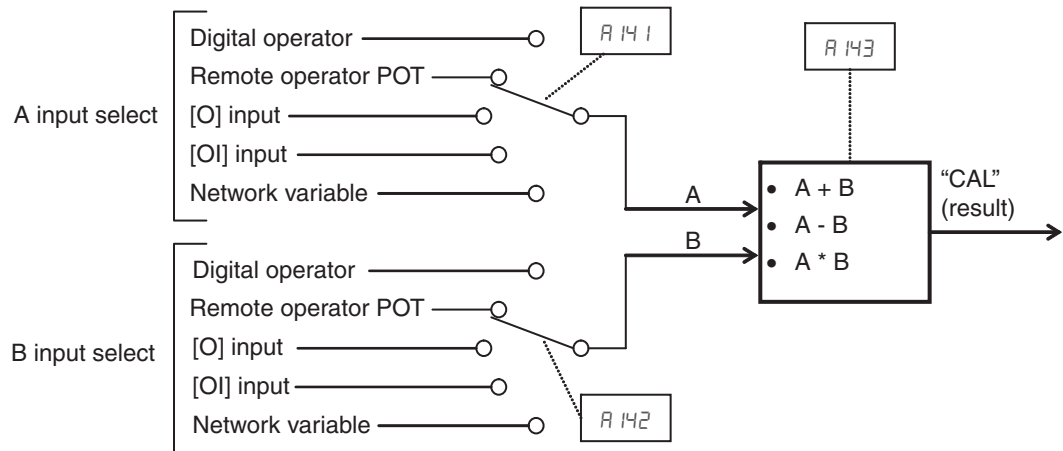
Input Range Settings - The parameters in the following table adjust the input characteristics of the analog current input. When using the inputs to command the inverter output frequency, these parameters adjust the starting and ending ranges for the current, as well as the output frequency range. Related characteristic diagrams are located in 3-5-2 *Analog Input Settings* on page 93.

Analog sampling setting is the value specified in **A0 15**.

| Func. Code | Name | Description | Run Mode Edit | Defaults | |
|------------|---------------------------------------|---|---------------|----------|-------|
| | | | | EU | Units |
| A 101 | OI input active range start frequency | The output frequency corresponding to the analog input range starting point, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| A 102 | OI input active range end frequency | The output frequency corresponding to the current input range ending point, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| A 103 | OI input active range start ratio | The starting point (offset) for the current input range, range is 0 to OI end ratio | * | 20 | % |
| A 104 | OI input active range end ratio | The ending point (offset) for the current input range, range is OI start ratio to 100 | * | 100 | % |
| A 105 | OI input start frequency enable | Two options; select codes: 00... Start FQ (Use OI start frequency [A101]) 01... 0 Hz | * | 00 | - |

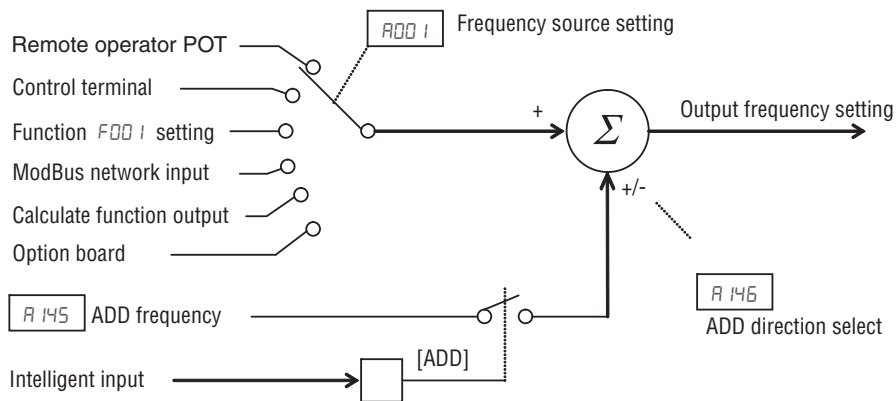
Refer to parameter **A0 11** to **A0 15** for analog voltage input.

Analog Input Calculate Function - The inverter can mathematically combine two input sources into one value. The Calculate function can either add, subtract, or multiply the two selected sources. This provides the flexibility needed by various applications. You can use the result for the output frequency setting (use *R001=10*) or for the PID Process Variable (PV) input (use *R075=03*).



| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------------------|---|---------------|-----------|-------|
| Func. Code | Name | Description | | EU | Units |
| <i>R 141</i> | Operation frequency input A setting | <i>00</i> ...Operator (Digital Operator (F001)) | * | <i>02</i> | — |
| <i>R 142</i> | Operation frequency input B setting | <i>01</i> ...VR (Digital Operator (FREQ adjuster)) <i>02</i> ...O (Input O) <i>03</i> ...OI (Input OI) <i>04</i> ...Modbus (RS485) <i>05</i> ...Option 1 <i>06</i> ...Option 2 <i>07</i> ...Pulse (Pulse train frequency) | * | <i>03</i> | — |
| <i>R 143</i> | Operator selection | Calculates a value based on the A input source (<i>R 141</i> selects) and B input source (<i>R 142</i> selects). Three options: <i>00</i> ... ADD (Addition (A + B)) <i>01</i> ... SUB (Substraction (A - B)) <i>02</i> ... MUL (Multiplication (A x B)) | * | <i>00</i> | — |

Add Frequency - The inverter can add or subtract on offset value to the output frequency setting which is specified by *R001* (will work with any of the five possible sources). The ADD Frequency is a value you can store in parameter *R 145*. the ADD Frequency is summed with or subtracted from the output frequency setting only when the [ADD] terminal is ON. Function *R 146* selects whether to add or subtract. By configuring an intelligent input as the [ADD] terminal, your application can selectively apply the fixed value in *R 145* to offset (positively or negatively) the inverter output frequency in real time.



| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| R 145 | Frequency addition amount | An offset value that is applied to the output frequency when the [ADD] terminal is ON. Range is 0.00 to 400.00 Hz | ✓ | 0.00 | Hz |
| R 146 | Frequency addition direction | Two options: 00... ADD (Add A145 value to output frequency) 01... SUB (Subtract A145 value from output frequency) | ✗ | 00 | – |

Input Range Settings - The parameters in the following table adjust the input characteristics of the VR (POT meter on external operator) input. When using the inputs to command the inverter output frequency, these parameters adjust the starting and ending ranges of POT, as well as the output frequency range. Related characteristic diagrams are located in "Analog Input Settings" in this chapter.

Analog sampling setting is the value specified in **R015**.

| "A" Function | | | Run Mode Edit | Defaults | |
|--------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| R 161 | [VR] input active range start frequency | The output frequency corresponding to the analog input range starting point, range is 0.00 to 400.00 Hz | ✗ | 0.00 | Hz |
| R 162 | [VR] input active range end frequency | The output frequency corresponding to the current input range ending point, range is 0.00 to 400.00 Hz | ✗ | 0.00 | Hz |
| R 163 | [VR] input active range start current | The starting point (offset) for the POT range, range is 0 to 100% | ✗ | 0 | % |
| R 164 | [VR] input active range end voltage | The ending point (offset) for the POT range, range is 0 to 100% | ✗ | 100 | % |
| R 165 | [VR] input start frequency enable | Two options; select codes: 00: Start FQ 01: 0 Hz | ✗ | 01 | – |

3-6 “B” Group: Fine Tuning Functions

The “B” Group of functions and parameters adjust some of the more subtle but useful aspects of motor control and system configuration.

3-6-1 Automatic Restart Mode

The restart mode determines how the inverter will resume operation after a fault causes a trip event. The five options provide advantages for your applications. Frequency matching allows the inverter to read the motor speed by virtue of its residual magnetic flux and restart the output at the corresponding frequency. The inverter can attempt a restart a certain number of times depending on the particular trip event:

- Over-current trip, restart up to 3 times
- Over-voltage trip, restart up to 3 times

When the inverter reaches the maximum number of restarts (3), you must power cycle the inverter to reset its operation.

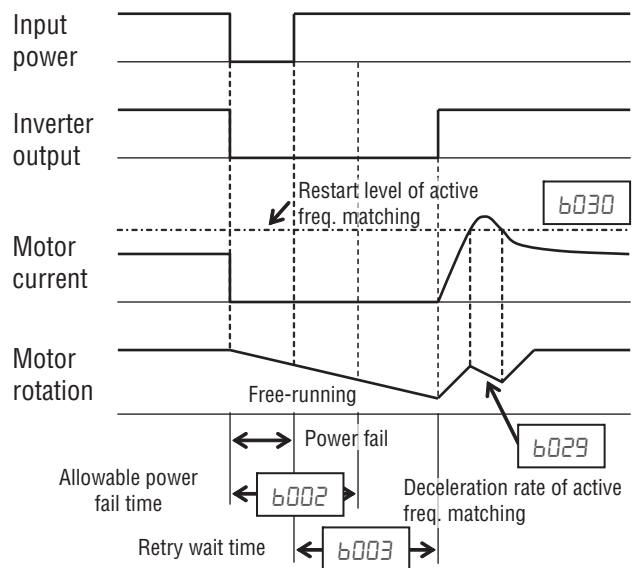
Other parameters specify the allowable under-voltage level and the delay time before restarting. The proper settings depend on the typical fault conditions for your application, the necessity of restarting the process in unattended situations, and whether restarting is always say.

If the actual power failure time is shorter than the **b002** set value, inverter resumes from the set frequency in **b011**.

The resumption mode is called “active frequency matching” and the inverter performs reduced voltage start to avoid over-current trip.

If the motor current exceeds the **b030** set value during this period, the inverter decelerates according to the **b029** set value and helps to reduce the motor current.

Power failure < allowable power fail time (b022), Inverter resumes



When the motor current is less than **b030**, the inverter increases motor speed toward the set speed. The inverter continues this retry process until the motor speed comes to the previous set speed.

Overload restriction (**b021**~**b028**) is not valid when active frequency matching is activated.

If the actual power failure time is longer than the **b002** set value, the inverter does not resume and the motor will coast to stop.

Automatic restart (retry) related parameters.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b001 | Retry selection | Select inverter restart method, Five option codes: 00... Trip (Alarm) 01... 0 Hz start 02... f-match (Frequency matching start) 03... f-match-Trip (Trip after frequency matching deceleration stop) 04... Actv. f-match (Active Frequency Matching restart) | * | 00 | – |
| b002 | Allowable momentary power interruption time | The amount of time a power input under-voltage can occur without tripping the power failure alarm. Range is 0.3 to 25.0 sec. If under-voltage exists longer than this time, the inverter trips, even if the restart mode is selected. | * | 1.0 | sec. |
| b003 | Retry wait time | Time delay after under-voltage condition goes away, before the inverter runs motor again. Range is 0.3 to 100.0 seconds. | * | 1.0 | sec. |
| b004 | Momentary power interruption/undervoltage trip during stop selection | Three option codes: 00... OFF (Disabled) 01... ON (Enabled) 02... Decel-OFF (Disabled during stop and deceleration stop) | * | 00 | – |
| b005 | Momentary power interruption retry time selection | Two option codes: 00... 16 times 01... No limit | * | 00 | – |
| b007 | Frequency matching lower limit frequency setting | Restart the motor from 0Hz if the frequency becomes less than this set value during the motor is coasting, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| b008 | Trip retry selection | Select inverter restart method, Five option codes: 00... TRIP 01... 0 Hz start 02... f-match (Frequency matching start) 03... f-match-Trip (Trip after frequency matching deceleration stop) 04... Actv. F-match (Active Frequency Matching restart) | * | 00 | – |
| b010 | Overvoltage/overcurrent retry time selection | Range is 1 to 3 times | * | 3 | times |
| b011 | Trip retry wait time | Range is 0.3 to 100.0 sec. | * | 1.0 | sec |

3-6-2 Active Frequency Matching Restart

Goal of the active frequency matching is the same as normal frequency matching. Difference is the method. Please select the suitable one for your application.

| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|---|--|---------------|---------------|-------|
| Func. Code | Name | Description | | EU | Units |
| b028 | Active Frequency Matching restart level | Sets the current level of active freq. matching restart, range is 0.32 x Rated current to 3.20 x Rated current | * | Rated current | A |
| b029 | Active Frequency Matching restart parameter | Sets the deceleration rate when active freq. matching restart, range is 0.10 to 3000.0, resolution 0.1 | * | 0.50 | sec. |
| b030 | Starting frequency at Active Frequency Matching restart | Three option codes: 00... Off FQ (Frequency at interruption) 01... Max.FQ (Max. Frequency) 02... Set FQ (Set frequency) | * | 00 | — |

3-6-3 Electronic Thermal Overload Alarm Setting

The thermal overload detection protects the inverter and motor from overheating due to an excessive load for inverter. It uses a current/inverse time curve to determine the trip point, for motor is possible to select between different curves.

For the motor, use the parameters b013 and b910 to select the torque characteristic that matches your load. This allows the inverter to utilize the best thermal overload characteristic for your application.

The torque developed in a motor is directly proportional to the current in the windings, which is also related to the heat generated (and temperature, over time).

Therefore, you must set the thermal overload threshold in terms of current (amperes) for parameter b012. The range is 20% to 100% of the rated current for each inverter model. If the current exceeds the level you specify, the inverter will trip and log an event (error E 05) in the history table. The inverter turns the motor output OFF when tripped. Separate settings are available for the second motor (if applicable) as shown in the following table.

| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|---------------|-------|
| Func. Code | Name | Description | | EU | Units |
| b012 | Electronic thermal level | 0.20 x Rated current to 1.00 x Rated current | * | Rated current | A |
| b212 | 2nd electronic thermal level | | * | Rated current | A |
| b013 | Electronic thermal characteristics selection | Select from three curves, option codes: | * | 00 | |
| b213 | 2nd electronic thermal characteristics selection | 00... Reduced TRQ (Reduced torque characteristics) 01... Const TRQ (Constant torque characteristics) 02... Free set (Free setting) | * | 00 | |
| b015 | Free setting, electronic thermal frequency 1 | Range is 0.00 to b017 | * | 0.00 | Hz |
| b016 | Free setting, electronic thermal current 1 | Range is 0.00 to rated current | * | 0.00 | Amps |
| b017 | Free setting, electronic thermal frequency 2 | Range is 0.00 to b019 | * | 0.00 | Hz |

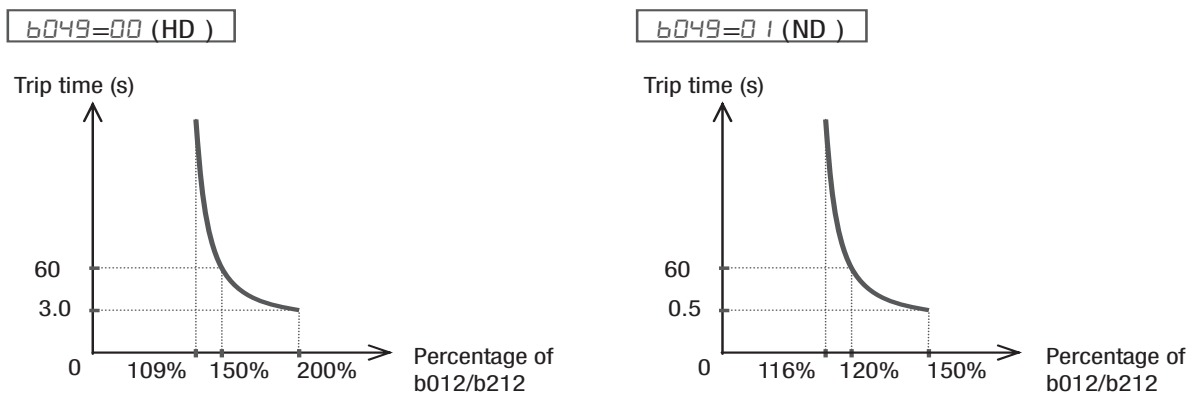
| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b018 | Free setting, electronic thermal current 2 | Range is 0.00 to rated current | * | 0.00 | Amps |
| b019 | Free setting, electronic thermal frequency 3 | Range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| b020 | Free setting, electronic thermal current 3 | Range is 0 to rated current | * | 0.00 | Amps |
| b910 | E. thermal Dec Mode | 00: Off 01: Fixed Linear 02: LinDec Time 03: DecTimeCnst | * | 00 | |
| b911 | E. thermal Dec Time | 0.10 to 100000.00 | * | 600.00 | s |
| b912 | E. thermal Dec TimeCnst | 0.10 to 100000.00 | * | 120.00 | s |
| b913 | E. thermal AccmGain | 1.0 to 200.0 | * | 100.0 | % |

⚠ WARNING When parameter **b012**, level of electronic thermal setting, is set to motor FLA rating (Full Load Ampere nameplate rating), the inverter provides solid state motor overload protection at 115% of motor FLA or equivalent. If parameter **b012** exceeds the motor FLA rating, the motor may overheat and be damaged. Parameter **b012**, level of electronic thermal setting, is a variable parameter.

- Inverter and motor models are be treat separately:
 - E05 error will be reported in case of Motor overload
 - E38 error will be reported in case of Inverter overload
- Inverter protection is set to constant torque characteristic and inverter rated current

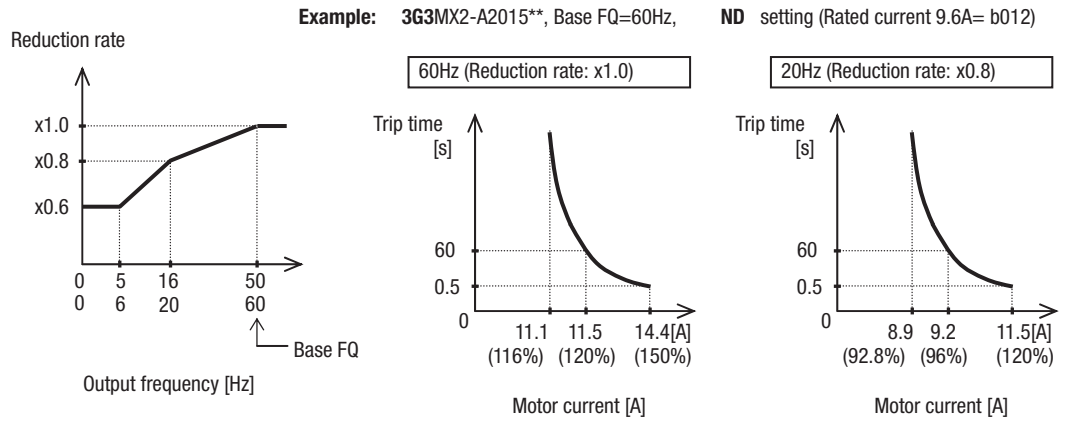
3-6-3-1 Electronic Thermal Characteristic Curve

The characteristic curve depends on dual rate setting in **b049** as follows.

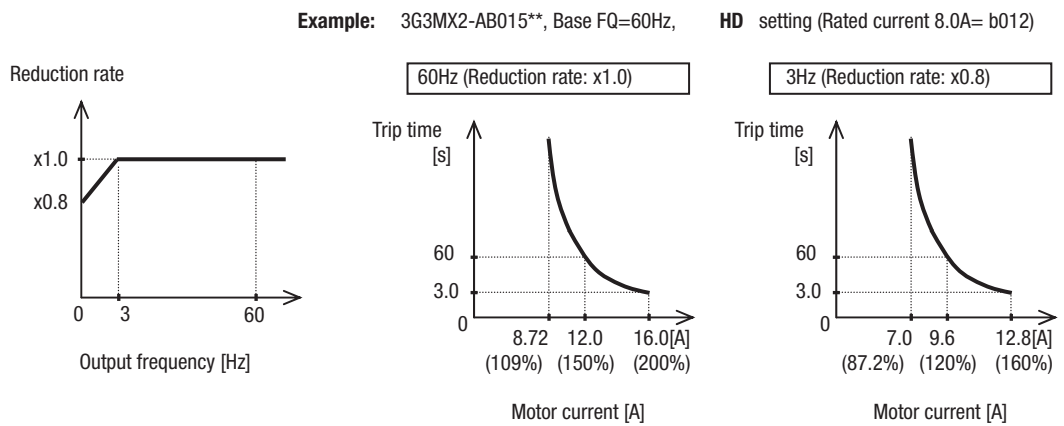


The characteristic curve is unique, but reduction rate depending on frequency is selected in **b013**.

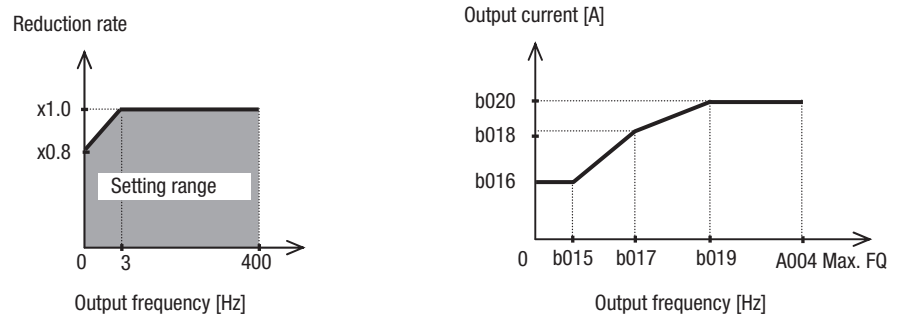
• **Reduced Torque (b0 13=00)**



• **Constant Torque (b0 13=01)**



• **Free setting (b0 13=02)**



3-6-3-2 Motor Cooling Rate

- Several cooling patterns are added

If b910 is set to zero exactly the same model than inverter will be used.

The other options allow to adjust the cooling ramp on a better way and avoid the overload detection in some cases where really the motor is not getting hot.

Thermal decrement mode Off (b910 = 00)

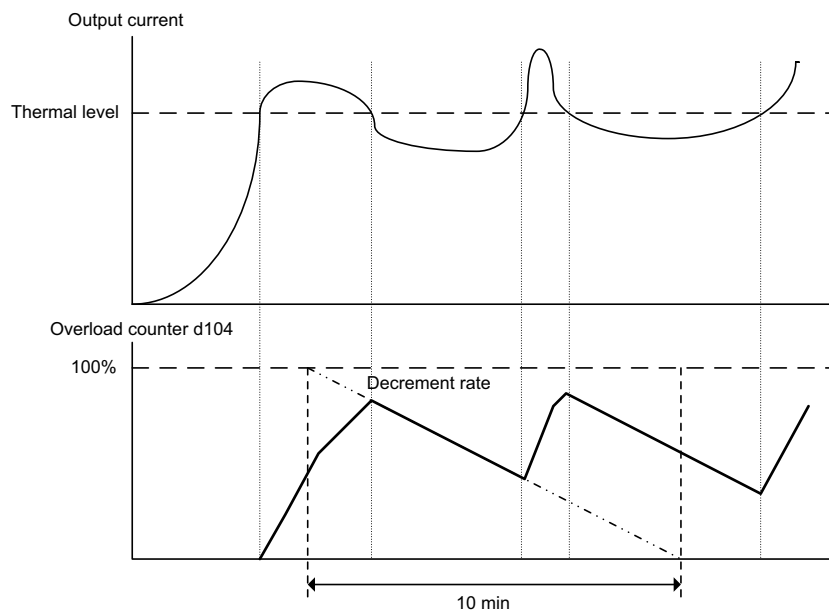
With this method the thermal level increases when the output current is bigger than internal level value (defined in b012). The increase rate is proportional to the overload value.

When this thermal level counter (d104) reach the 100% and overload error E05 is detected. This trip could not be reset within 10 seconds after it appears.

The thermal counter is clear after 10 minutes cycle or when the Reset command is used or at inverter power ON.

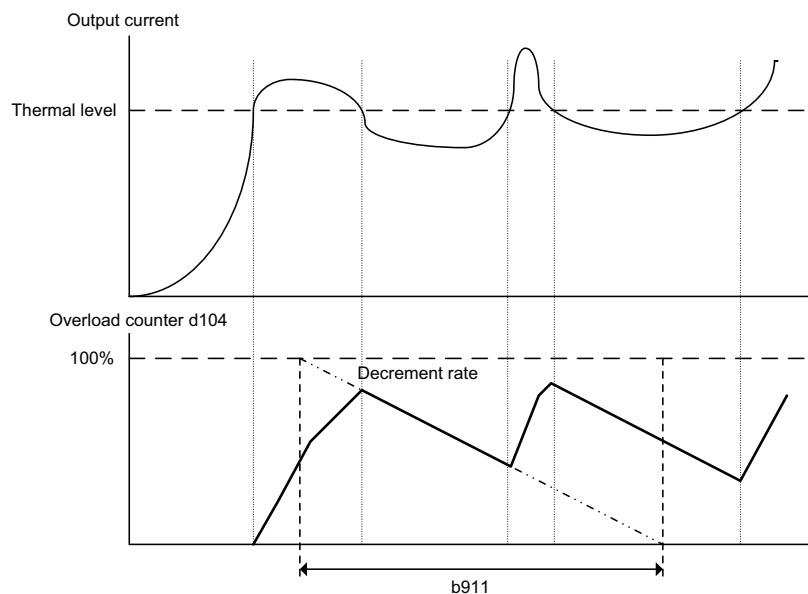
Thermal decrement mode with fixed linear ramp (b910 = 01)

This setting also increase the counter when the output current is bigger than the internal level but on this case a ramp down of the counter is applied when the output current below this level. The decrement rate is fixed to a value of 100% for 10 minutes. Next drawing describes the operation:



Thermal decrement mode with linear decrement ramp (b910 = 02)

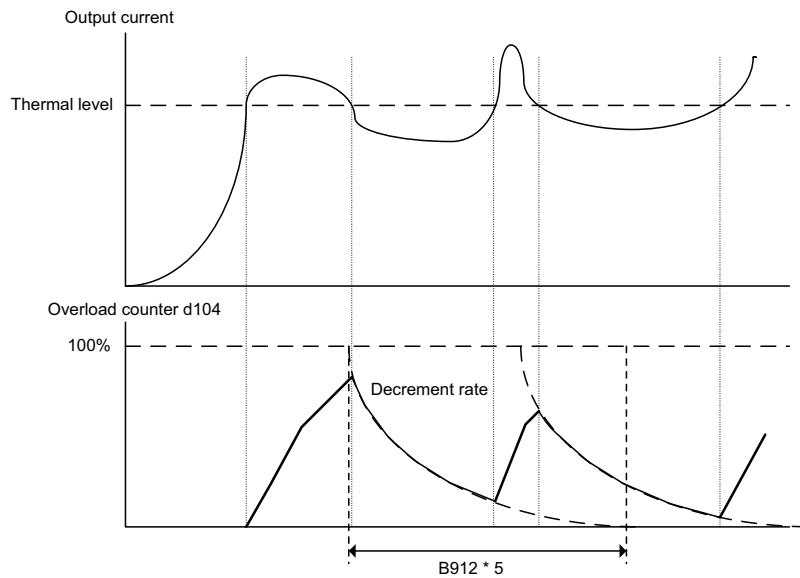
Like with previous option the overload counter will decrease on a linear way when the output current is below the thermal level. But on this case the decrement rate could be adjusted by parameter b911.



Thermal decrement mode by time constant (b910 = 03)

For this option the decrement is performed by a time constant value defined on parameter b912.

The curve from 100% to 0 is approximately 5 times the b912 value.



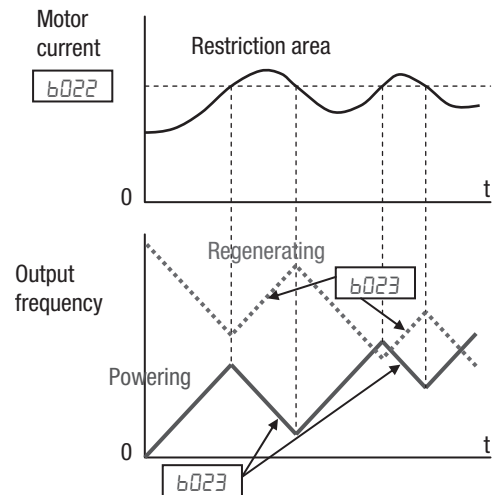
3-6-3-3 Electronic Thermal Warning Output

You can configure this function so that the inverter outputs a warning signal before the electronic thermal protection operates against motor overheating. You can also set the threshold level to output a warning signal with the electronic thermal warning level setting in function “C06 I”.

To output the warning signal, assign parameter “I3” (THM) to one of the intelligent output terminals [11] to [12] (C02 I to C022), or to the relay output terminal (C026).

3-6-4 Current limitation Related Functions

Overload Restriction: b022 If the inverter's output current exceeds a preset current level you specify during acceleration or constant speed, the overload restriction feature automatically reduces the output frequency during powering drive (and can increase the speed during regeneration) to restrict the overload. This feature does not generate an alarm or trip event. You can instruct the inverter to apply overload restriction only during constant speed, thus allowing higher currents for acceleration. Or, you may use the same threshold for both acceleration and constant speed.

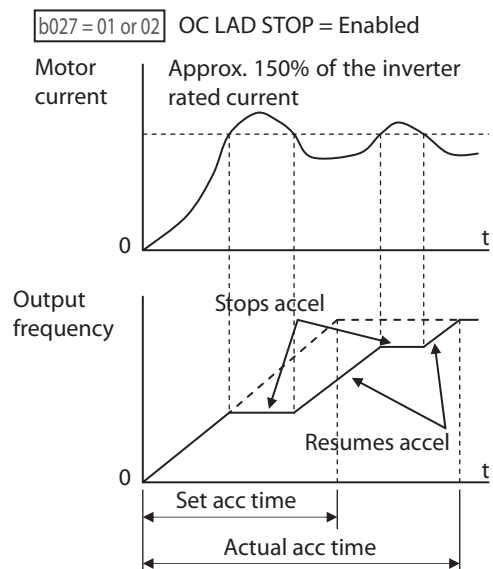


You can specify two types of overload restriction operation by setting functional items b021, b022, b023, and b024, b025, b026 separately. To switch between these two is done by assigning "39 (OLR)" to an intelligent input terminal and make it ON/OFF.

When the inverter detects an overload, it must decelerate the motor to reduce the current until it is less than the threshold. You can choose the rate of deceleration that the inverter uses to lower the output current.

Over-current Trip Suppression: b027 – The Over-current Trip Suppression function monitors the motor current and actively changes the output frequency profile to maintain the motor current within the limits. Although "LAD" refers to "linear acceleration / deceleration", the inverter only "STOPS" the acceleration and deceleration ramp so that it will not cause an over-current trip event.

The graph at right shows an inverter output profile that starts acceleration to a constant speed. At two different points during the acceleration, motor current increases and exceeds the fixed level of Over-current Trip Suppression level.



When the Over-current Trip Suppression feature is enabled by b027=01, the inverter stops the acceleration ramp in each case until the motor current level is again less than the threshold value, which is approximately 180% of the rated current of the inverter.

When using the Over-current Trip Suppression feature, please note the following:

- When the feature is enabled (b027=01), the actual acceleration may be longer than the value set by parameters F002/F202 in some cases.
- With b027=02 the behavior will be the same than with option 01, only difference is that reduced voltage start will be used when the ramp is changed.

- The Over-current Trip Suppression feature does not operate by maintaining a constant motor current. So it is still possible to have an over-current trip event during extreme acceleration.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------------------|--|---------------|-------------------------------|-------|
| Func. Code | Name | Description | | EU | Units |
| b021 | Overload limit selection | Select the operation mode during overload conditions, four options, option codes: 00 OFF (Disabled) 01 ON-Acc/Cnst (Enabled in acceleration/constant speed operation) 02 ON-Cnst (Enabled in constant speed operation) 03 ON-A/C(R) (Enabled in acceleration/constant speed operation (Accelerates during regeneration)) | x | 01 | – |
| b221 | Overload limit selection, 2nd motor | | x | 01 | – |
| b022 | Overload limit level | Sets the level of overload restriction, between 20% and 200% of the rated current of the inverter, setting resolution is 1% of rated current 0.32 x Rated current to 3.20 x Rated current | x | 1.5 | Amps |
| b222 | Overload limit level, 2nd motor | | x | (HD)/1.2 (ND) x Rated current | Amps |
| b023 | Overload limit parameter | Sets the deceleration rate when inverter detects overload, range is 0.1 to 3000.0, resolution 0.1 | x | 1.0 | sec. |
| b223 | Overload limit parameter, 2nd motor | | x | 1.0 | sec. |
| b024 | Overload limit selection 2 | Select the operation mode during overload conditions, four options, option codes: 00 OFF (Disabled) 01 ON-Acc/Cnst (Enabled in acceleration/constant speed operation) 02 ON-Cnst (Enabled in constant speed operation) 03 ON-A/C(R) (Enabled in acceleration/constant speed operation (Accelerates during regeneration)) | x | 01 | – |
| b025 | Overload limit level 2 | Sets the level of overload restriction, between 20% and 200% of the rated current of the inverter, setting resolution is 1% of rated current 0.32 x Rated current to 3.20 x Rated current | x | Rated curr. x 1.5 | |
| b026 | Overload limit parameter 2 | Sets the deceleration rate when inverter detects overload, range is 0.1 to 3000.0, resolution 0.1 | x | 1.0 | sec. |
| b027 | Overcurrent suppression function * | Two option codes: 00 OFF (Disabled) 01 ON (Enabled) 02 ON (Enabled with reduced voltage) | x | 00 | – |

This digital input allows you to change the parameter sets of overload restriction. (Please refer to chapter 3 for the detailed description of the overload restriction function.)

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--|-------|---|
| 39 | OLR | Overload restriction source changeover | ON | Parameter sets b024 , b025 , b026 are enabled. |
| | | | OFF | Parameter sets b021 , b022 , b023 are enabled. |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | b021~b026 | | |

3-6-5 Software Lock Mode

The software lock function keeps personnel from accidentally changing parameters in the inverter memory. Use **b031** to select from various protection levels.

The table below lists all combinations of **b031** option codes and the ON/OFF state of the [SFT] input. Each Check ✓ or Ex ✗ indicates whether the corresponding parameter(s) can be edited. The Standard Parameters column below shows access in permitted for some lock modes. These refer to the parameter tables throughout this chapter, each of which includes a column titled *Run Mode Edit* as shown to the right.

| | Run Mode Edit | |
|--|---------------|--|
| | ✗ | |
| | ✓ | |
| | | |

The marks (Check ✓ or Ex ✗) under the “Run Mode Edit” column title indicate whether access applies to each parameter as defined in the table below. In some lock modes, you can edit only F001 and the Multi-speed parameter group that includes **A020**, **A220**, **A021~A035**, and **A038** (Jog). However, it does not include **A019**, Multi-speed operation selection. The editing access to **b031** itself is unique, and is specified in the right-most two columns below.

| b031 Lock Mode | [SFT] Intelligent Input | Standard Parameters | | F001 and Multi-Speed | b031 | |
|-----------------------|-------------------------|---------------------|----------------------|----------------------|-------------|-----|
| | | Stop | Run | Stop and Run | Stop | Run |
| 00 | OFF | ✓ | Run mode edit access | ✓ | ✓ | ✗ |
| | ON | ✗ | ✗ | ✗ | ✓ | ✗ |
| 01 | OFF | ✓ | Run mode edit access | ✓ | ✓ | ✗ |
| | ON | ✗ | ✗ | ✓ | ✓ | ✗ |
| 02 | (ignored) | ✗ | ✗ | ✗ | ✓ | ✗ |
| 03 | (ignored) | ✗ | ✗ | ✓ | ✓ | ✗ |
| 10 | (ignored) | ✓ | High level access | ✓ | ✓ | ✓ |

Note Since the software lock function **b031** is always accessible, this feature is not the same as password protection used in other industrial control devices. So if you want to use password function, use parameter **b037** together with the **b031**. See section 4-104 for detailed explanation of the password function.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b031 | Soft lock selection | Prevents parameter changes, in five options, option codes: 00 Lock (SFT) (Data other than b031 cannot be changed when terminal SFT is ON.) 01 Only FQ (SFT) (Data other than b031 and the specified frequency parameter cannot be changed when terminal SFT is ON.) 02 Lock (Data other than b031 cannot be changed.) 03 Only FQ (Data other than b031 and the specified frequency parameter cannot be changed.) 10 RUN chg mode (Data other than parameters changeable during operation cannot be changed.) See Appendix C on page 357 for the accessible parameters in this mode. | * | 01 | — |

Note To disable parameter editing when using b031 lock modes 00 and 01, assign the [SFT] function to one of the intelligent input terminals.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------------------|-------|--|
| 15 | SFT | Software Lock | ON | The keypad and remote programming devices are prevented from changing parameters |
| | | | OFF | The parameters may be edited and stored |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | b031 (excluded from lock) | | |

When the terminal [SFT] is turned ON, the data of all the parameters and functions (except the output frequency, depending on the setting of b031) is locked (prohibited from editing). When the data is locked, the keypad keys cannot edit inverter parameters. To edit parameters again, turn OFF the [SFT] terminal input.

3-6-6 Motor Cable Length Parameter

To achieve higher motor control performance, the MX2 inverter has the Motor Cable Length Parameter setting b033. Normally there is no need to adjust this parameter, however in case of long motor cable and/or shielded cable, where there is a comparatively higher earth capacitance, set this parameter higher to achieve better motor control performance.

Note that the parameter is indicative and no formula to calculate the suitable value. Normally, longer the motor cable, bigger the set value. Please adjust depending on your system.

For 11 and 15 kW inverter, it is not needed to set **b033**.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------------|----------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b033 | Motor cable length parameter | Set range is 5 to 20 | ✓ | 10 | – |

3-6-7 Run/power ON warning time

Inverter outputs the operation time over (RNT) or the plug-in time over (ONT) signal when the time specified as the run/power ON warning time (**b034**) is exceeded.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|--------------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b034 | Run time/Power ON time setting | Range is, 0 : Warning disabled 1 to 9999 : 10~99,990 hrs (unit: 10) 1000 to 6553 : 100,000~655,350 hrs (unit: 100) | × | 0 | Hrs. |

1. Operation time over (RNT) signal
 To use this signal function, assign function “11 (RNT)” to one of the intelligent output terminals [11] to [12] (**C021** to **C022**), or to the alarm relay output (C026). Specify the run/power-ON warning time (**b034**).
2. Plug-in time over (ONT) signal
 To use this signal function, assign function “12 (ONT)” to one of the intelligent output terminals [11] to [12] (**C021** to **C022**), or to the alarm relay output (C026). Specify the run/power-ON warning time (**b034**).

3-6-8 Rotation restriction related parameters

Rotation direction restriction: b035 – The rotation direction restriction function allows you to restrict the direction of the motor rotation. This function is effective regardless of the specification of operation command input device (e.g., control terminal or integrated operator). If an operation command to drive the motor in a restricted direction is given, the inverter (display) shows (□□□□).

Reverse run protection: b046 – The reverse run protection function is effective when “**03** (sensorless vector control)” is specified for the V/F characteristic selection (**A044**). For control reasons, especially during motor operation at low speed, the inverter may output a frequency that instructs the motor to rotate in the direction opposite to that specified by the operation command.

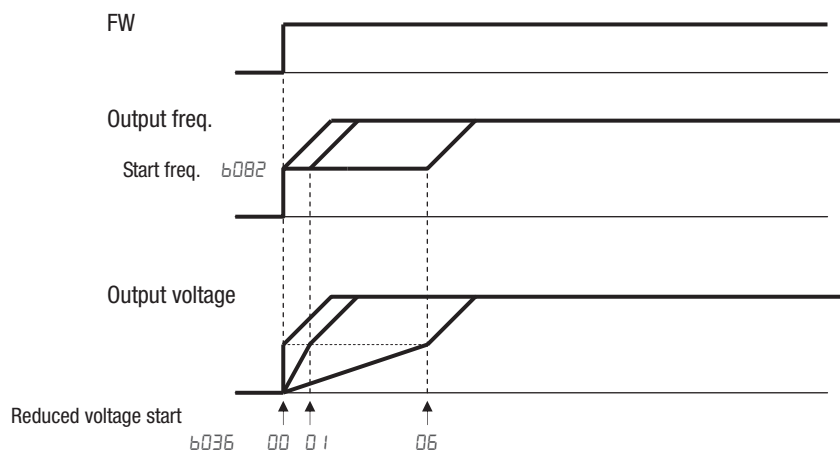
| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------------------------|--|---------------|-----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b035 | Rotation direction limit selection | Three option codes: 00 Free (Forward and Reverse are enabled.) 01 FWD (Only Forward is enabled.) 02 REV (Only Reverse is enabled.) | × | 00 | – |
| b046 | Reverse rotation prevention selection | Two option codes: 00 OFF (Disabled) 01 ON (Enabled) | × | 00 | – |

3-6-9 Reduced voltage start

The reduced voltage start function enables you to make the inverter increase the output voltage gradually when starting the motor.

Set a small value for the reduced voltage start selection (**b036**) if you intend to increase the start torque. On the other hand, setting a small value will cause the inverter to perform full-voltage starting and to easily trip because of over-current.

| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b036 | Reduced voltage startup selection | Set range, 0 (Reduced voltage startup time: small) to 235 (Reduced voltage startup time: large) | * | 02 | — |



3-6-10 Display related parameters

Function code display restriction: **b037** – The function code display restriction allows you to arbitrarily switch the display mode or the display content on the integrated operator.

| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b037 | Display selection | Seven option codes: 00 All (Complete display) 01 Utilized (Individual display of functions) 02 User (User setting) 03 Compare (Data comparison display) 04 Basic (Basic display) 05 Monitor | * | 00 | |

1. Function-specific display mode (**b037=01**)

If a specific function has not been selected, the monitor does not show the parameters concerning the specific function. Following table lists the details of display conditions.

| No. | Displayed conditions | | Displayed func. codes when condition fulfilled. |
|-----|---|---------------------------------------|--|
| 1 | 2 nd motor | C001...C007=08 | F202, F203, A201 to A204, A220, A244, A245, A261, A262, A281, A282, A292 to A296, b212, b213, b221 to b223, C241, H202 to H204, H206 |
| 2 | Drive Programming | A017=01,02 | d023 to d027, P100 to P131 |
| 3 | Sensorless vector control | A044=03 | d009, d010, d012, b040 to b046, C054 to C059, H001, H005, H020 to H024, H030 to H034, P033, P034, P036 to P040 |
| 4 | Sensorless vector control for 2 nd motor | C001...C007=08 AND A244=03 | d009, d010, d012, b040 to b046, C054 to C059, H001, H205, H220 to H224, H230 to H234, P033, P034, P036 to P040 |
| 5 | Free V/F control | A044=02 OR C001...C007=08 AND A244=02 | b100 to b113 |
| 6 | Free setting of electronic-thermal | b013=02 OR C001...C007=08 AND b213=02 | b015 to b020 |
| 7 | VC or VP1.7 control | A044=00,01 | A041 to A043,A046, A047 |
| 8 | VC or VP1.7 control for 2 nd motor | C001...C007=08 AND A244=00,01 | A241 to A243, A246, A247 |
| 9 | DC breaking | A051=01,02 OR C001...C007=07 | A052 to A059 |
| 10 | PID | A071=01,02 | d004, A072 to A079, A156, A157, C044, C052, C053 |
| 11 | EzCOM | C096=01,02 | C098 to C100, P140 to P155 |
| 12 | Curving accel/deceleration | A097,A098=01...04 | A131, A132, A150 to A153 |
| 13 | Controlled deceleration | b050=01,02,03 | b051 to b054 |
| 14 | Breaking | b120=01 | b121 to b127 |
| 15 | Decel. overvolt. suppress | b130=01,02 | b131 to b134 |
| 16 | Simple positioning | P003=01 | d008, P004, P011, P012, P015, P026, P027, P060to P073, P075, P077, H050, H051 |

2. User setting display mode (b037=02)

The monitor displays only the codes and items that are arbitrarily assigned to user parameters (d001~d032), except codes d001, F001 and b037.

Refer to User parameter (d001~d032) section for the detail.

3. Data comparison display mode (b037=03)

The monitor displays only the parameters that have been changed from the factory settings. All monitoring indications dxxx and code F001, b190, b191 are always displayed.

4. Basic display mode (b037=04)

The monitor displays basic parameters. (The monitor display is the factory setting.) The following table lists the parameters that can be displayed in basic display mode.

| No. | Code displayed | Item |
|-----|----------------|--------------------------|
| 1 | d001 ~ d104 | Monitoring indication |
| 2 | F001 | Output frequency setting |
| 3 | F002 | Acceleration time (1) |
| 4 | F003 | Deceleration time (1) |

| No. | Code displayed | Item |
|-----|----------------|--|
| 5 | F004 | Keypad Run key routing |
| 6 | A001 | Frequency source |
| 7 | A002 | Run command source |
| 8 | A003 | Base frequency |
| 9 | A004 | Maximum frequency |
| 10 | A005 | [AT] selection |
| 11 | A020 | Multi-speed frequency 0 |
| 12 | A021 | Multi-speed frequency 1 |
| 13 | A022 | Multi-speed frequency 2 |
| 14 | A023 | Multi-speed frequency 3 |
| 15 | A044 | V/F characteristic curve selection |
| 16 | A045 | V/F gain |
| 17 | A085 | Energy saving operation mode |
| 18 | b001 | Restart mode on power failure / under volt. trip |
| 19 | b002 | Allowable undervoltage power failure time |
| 20 | b008 | Restart mode on over volt. / over curnt. trip |
| 21 | b011 | Retry wait time on over volt. / over curnt. trip |
| 22 | b037 | Function code display restriction |
| 23 | b083 | Carrier frequency |
| 24 | b084 | Initialization mode (parameters or trip history) |
| 25 | b130 | Decel. overvoltage suppression enable |
| 26 | b131 | Decel. overvoltage suppression level |
| 27 | b180 | Initialization trigger |
| 28 | b190 | Password A setting |
| 29 | b191 | Password A for authentication |
| 30 | C021 | Output [11] function |
| 31 | C022 | Output [12] function |
| 32 | C036 | Alarm relay active state |

Initial display selection: b038 – The initial display selection function allows you to specify data displayed on the integrated operator on powerup. The table below lists the display items selectable. (The factory setting is 01 [d001].)


Panel display selection: b150 – When an external operator is connected to MX2 via RS-422 port, the display is locked and shows only one parameter configured by b150.

Automatic return to the initial display: b164 – 10 min. after the last key operation, display returns to the initial parameter set by b038.

Frequency conversion coefficient setting: b086 – By setting b086, converted output frequency is monitored in d007. ($d007 = d001 \times b086$)

Frequency set in monitoring: b163 – If 01 is set in b163, frequency can be changed by up/down key in monitor display d001 and d007.

Action selection in case of external operator disconnection: b165 – When an external operator is disconnected, the inverter behaves according to b165 setting.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|--------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b038 | Initial screen selection | 000 Func. code that  key pressed last displayed. (*) 001~060 d001~d060 displayed 201 F001 displayed 202 B display of LCD operator | * | 001 | – |

| “B” Function | | | Run Mode Edit | Defaults | |
|---------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b086 | Frequency conversion coefficient | Specify a constant to scale the displayed frequency for d007 monitor, range is 0.01 to 99.99 | ✓ | 1.00 | – |
| b 150 | Display ex.operator connected | When an external operator is connected via RS-422 port, the built-in display is locked and shows only one “d” parameter configured in: d00 1 ~ d060 | ✓ | 00 1 | – |
| b 160 | 1 st parameter of Dual Monitor | Set any two “d” parameters in b 160 and b 16 1 , then they can be monitored in d050 . The two parameters are switched by up/down keys. Set range: d00 1 ~ d030 | ✓ | 00 1 | – |
| b 16 1 | 2 nd parameter of Dual Monitor | | ✓ | 002 | – |
| b 163 | Freq. set in monitoring | Two option codes: 00 OFF 0 1 ON | ✓ | 00 | |
| b 164 | Auto return initial display | 10 min. after the last key operation, display returns to the initial parameter set by b038 . Two option codes: 00 OFF 0 1 ON | × | 00 | |
| b 165 | Ex. operator com. Loss action | Five option codes: 00 Trip 0 1 Decel-Trip 02 Ignore 03 Free RUN 04 Decel-Stop | ✓ | 02 | |

Note If the power is off with displaying “000” after the set, **b038** comes when power is on again.


3-6-11 User Parameter Registration

Parameter group “U” is the user parameter. Any function code can be register on these 32 parameters. When display mode is set to be “user parameter” (**b037= 02**) then **U00 1** to **U032** and **d00 1**, **F00 1**, **b037** are displayed.

| “B” Function | | | Run Mode Edit | Defaults | |
|---------------------|-------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b037 | Display selection | Seven option codes: 00 All (Complete display) 0 1 Utilized (Individual display of functions) 02 User (User setting) 03 Compare (Data comparison display) 04 Basic (Basic display) 05 Monitor | × | 00 | |
| U00 1 ~ U032 | User parameters 1 to 32 | Set range, “no”, d00 1~P 183 | × | | |

3-6-12 Automatic User Parameter Registration

The automatic user parameter setting function allows you to make the inverter automatically record changed function codes in U001 to U032. You can use the stored function codes as a history of data change. To enable this function, select "01" (enabling automatic user parameter setting) for the b039.

When any data is changed and  key is pressed, the function code will be stored in U001 to U032 sequentially.

The latest data is in U001, and the oldest one is in U032.

Stored function codes in U001 to U032 are not duplicated. If duplicated function code is changed, old existing function code is deleted. If number of changed function code exceeds 32, the oldest one in U032 is deleted.

| "B" Function | | | Run Mode Edit | Defaults | |
|-------------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b039 | User parameter automatic setting function selection | Two option codes: 00 OFF (Disabled) 01 ON (Enabled) | * | 00 | |
| U001 - U032 | User parameters 1 to 32 | Set range, "no", d001-P183 | * | | |

3-6-13 Torque Limit Function

Torque limit function allows you to limit the motor output when 03 (SLV) is set for the V/F characteristics set at parameter A044. You can select one of the following modes with the torque limit selection (b040).

1. Quadrant-specific setting mode (b040=00)

In this mode, individual torque limit value to be applied to four quadrants (i.e. forward powering, reverse regeneration, reverse powering and forward regeneration) are set as the torque limits 1 to 4 (b041 to b044), respectively.

2. Terminal-switching mode (b040=01)

In this mode, the torque limit values set in the torque limits 1 to 4 (b041 to b044) are switched from one another according to the combination of the states of torque limit switch terminals 1 and 2 (TRQ1 and TRQ2) assigned to intelligent input terminals. A single selected torque limit is valid in all the operating states.

3. Analog voltage input mode (b040=02)

In this mode, the torque limit value is set by a voltage applied to the control circuit terminal O. The voltage range 0 to 10V corresponds to the torque limit value range 0 to 200%. A single selected torque limit is valid in all the operating states.

If parameter "40 (TL: whether to enable torque limitation)" has been assigned to any intelligent input terminal, the torque limit mode selected by the setting of b040 is enabled only when the TL terminal is turned ON. When the TL terminal is turned OFF, torque limit settings are invalid, and the maximum torque setting is applied as a torque limit.

If the TL function has not been assigned to the intelligent input terminal, the torque limit mode selected by the setting of b040 is always enabled.

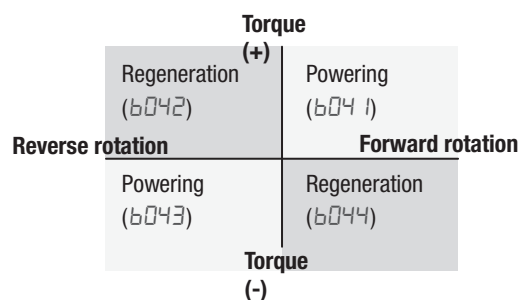
Each torque limit value used for this function is expressed as a ratio of the maximum torque generated when the inverter outputs its maximum current on the assumption that the maximum torque is 200%.

Note that each torque limit value does not represent an absolute value of torque. The actual output torque varies depending on the motor.

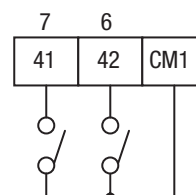
If the torque limited signal function (TRQ) is assigned to an intelligent output terminal, the TRQ signal will turn ON when the torque limit function operates. 100% torque is referred to inverter rated current. Absolute torque value is up to the motor to be combined.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b040 | Torque limit selection | Four option codes: 00 4-quadrant (Four-quadrant separate setting) 01 TRQ input (Terminal switch) 02 [O] input (Analog input) 03 Option 1 | * | 00 | |
| b041 | Torque limit 1 (fwd/power) | Torque limit level in forward powering quadrant, range is 0 to 200%/no(disabled) | * | 200 | % |
| b022 | Torque limit 2 (rev/regen.) | Torque limit level in reverse regen. quadrant, range is 0 to 200%/no(disabled) | * | 200 | % |
| b043 | Torque limit 3 (rev/power) | Torque limit level in reverse powering quadrant, range is 0 to 200%/no(disabled) | * | 200 | % |
| b044 | Torque limit 4 (fwd/regen.) | Torque limit level in forward regen. quadrant, range is 0 to 200%/no(disabled) | * | 200 | % |
| b045 | Torque LADSTOP selection | Two option codes: 00 OFF (Disabled) 01 ON (Enabled) | * | 00 | |

When “00” is specified for the torque limit selection (**b040**), the torque limits 1 to 4 apply as shown to the top right.



When “01” is specified for the torque limit selection (**b040**), the torque limit 1 to 4 are set as shown to the bottom right. The torque limit 1 to 4 are switched by the torque limit switches 1 and 2 assigned to intelligent input terminals 7 and 8, respectively for example:



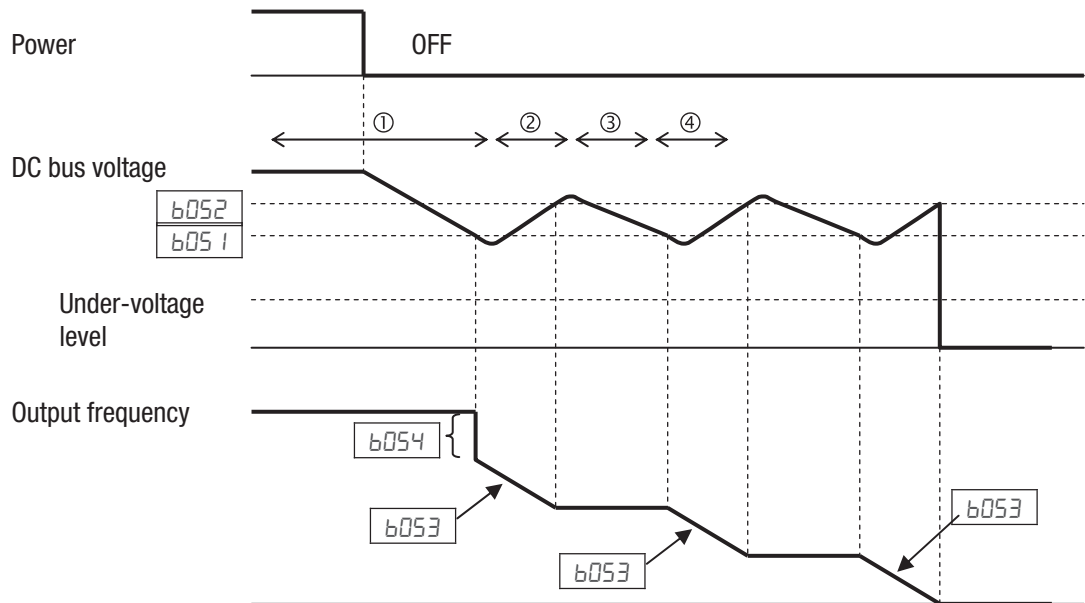
- OFF OFF → **b041**
- ON OFF → **b042**
- OFF ON → **b043**
- ON ON → **b044**

When applying the torque limit function to the motor operation at low speed, also use the overload restriction function to get more stable performance.

Related parameters: Over torque/under torque signal

3-6-14 Controlled Stop Operation at Power Loss

Controlled stop operation at power loss helps avoid tripping or free-running (coasting) of the motor when power is lost while in run mode. The inverter controls the internal DC bus voltage while decelerating the motor, and brings the motor to a controlled stop.



Should power be lost while the inverter is in run mode, this function will have the following effect:

1. When the internal DC bus voltage of the inverter comes down to the set level of **b051**, the inverter decreases the output frequency by the amount set in **b054**. (During this interval the DC bus voltage rises due to regeneration, so does not reach the UV level.)
2. The inverter then continues deceleration according to the value set in **b053**. If the DC bus voltage rises up to the set value of **b052**, the inverter stops deceleration to avoid OV tripping.
3. During this interval, the DC bus voltage decreases again due to lack of input power.
4. When the DC bus voltage comes down to the set value of **b051**, the inverter starts deceleration according to the set value of **b053** again. This process will be repeated as needed until the motor is brought to a stop.

Note If the DC bus voltage comes down to the UV level during this operation, the inverter trips with under-voltage and motor will free-run (coast) to a stop.

Note If the set value of **b052 < b051**, then the inverter internally swaps the **b052** and **b051** values. However the displayed values are not changed.

Note This function cannot be interrupted until it is completed. So if the power is restored during this operation, wait until the operation is done (motor stops) and then give the run command.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|---------------------------------|-------|
| Func. Code | Name | Description | | EU | Units |
| b050 | Selection of non-stop function at momentary power interruption | Four option codes: 00 OFF (Disabled) 01 ON (Enabled) 02 V-Cnst(STOP) (Enabled (deceleration stop)) 03 V-Cnst(RUN) | * | 00 | – |
| b051 | Starting voltage of non-stop function at momentary power interruption | Setting of DC bus voltage to start controlled decel. operation. Range is 0.0 to 1000.0 | * | 220.0 ^{*1} | V |
| b052 | Stop deceleration level of non-stop function at momentary power interruption | Setting the OV-LAD stop level of controlled decel. operation. Range is 0.0 to 1000.0 | * | 360.0 [*] ₁ | V |
| b053 | Deceleration time of non-stop function at momentary power interruption | Range is 0.01 to 3600.00 | * | 1.00 | sec |
| b054 | Deceleration starting width of non-stop function at momentary power interruption | Setting of initial freq. drop. Range is 0.00 to 10.00 Hz | * | 0.00 | Hz |

^{*1} Value is double for 400V type inverter

3-6-15 Window Comparator, Analog disconnection

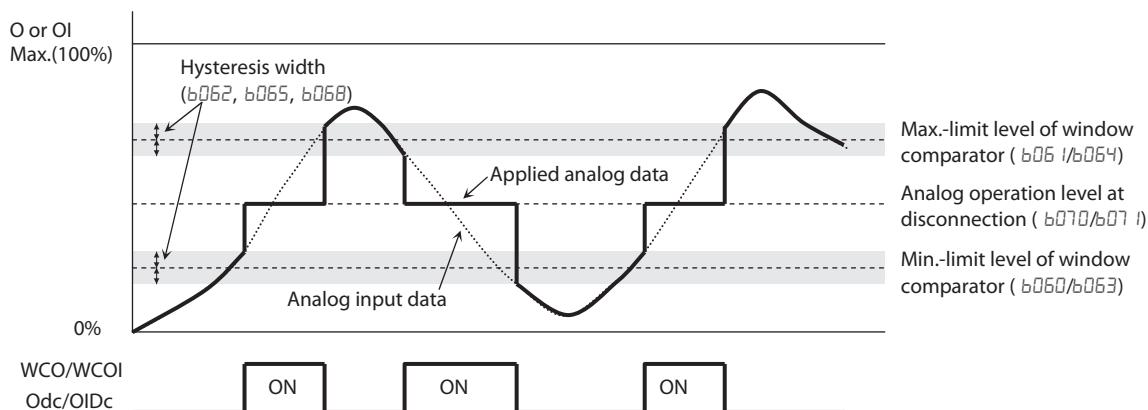
The window comparator function outputs signals when the values of analog inputs O and OI are within the maximum and minimum limits specified for the window comparator. You can monitor analog inputs with reference to arbitrary levels (to find input terminal disconnection and other errors).

You can specify a hysteresis width for the maximum-limit and minimum-limit levels of the window comparator. You can also specify limit levels and a hysteresis width individually for analog inputs O and OI.

You can fix the analog input data to be applied to an arbitrary value when WCO or WCOI is output. For this purpose, specify a desired value as the operation level at O/OI disconnection (b070/b071). When “no” is specified, the analog input data is reflected as input.

Output values of Odc and OIdc are the same as those of WCO and WCOI, respectively.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b060 | Window comparator O upper limit level | Set range, {Min.-limit level (b061) + hysteresis width (b062)x2} to 100% (Minimum of 0%) | ✓ | 100 | % |
| b061 | Window comparator O lower limit level | Set range, 0 to {Max.-limit level (b060) - hysteresis width (b062)x2}% (Maximum of 0%) | ✓ | 0 | % |
| b062 | Window comparator O hysteresis width | Set range, 0 to {Max.-limit level (b060) - Min.-limit level (b061)}/2% (Maximum of 10%) | ✓ | 0 | % |
| b063 | Window comparator OI upper limit level | Set range, {Min.-limit level (b064) + hysteresis width (b065)x2} to 100% (Minimum of 0%) | ✓ | 100 | % |
| b064 | Window comparator OI lower limit level | Set range, 0 to {Max.-limit level (b063) - hysteresis width (b065)x2}% (Maximum of 0%) | ✓ | 0 | % |
| b065 | Window comparator OI hysteresis width | Set range, 0 to {Max.-limit level (b063) - Min.-limit level (b064)}/2% (Maximum of 10%) | ✓ | 0 | % |
| b070 | Analog operation level at O disconnection | Set range, 0 to 100%, or “no” (ignored) | ✗ | no | - |
| b071 | Analog operation level at OI disconnection | Set range, 0 to 100%, or “no” (ignored) | ✗ | no | - |



3-6-16 Ambient Temperature Setting

Sets the ambient temperature where the inverter is installed, so to calculate internally the lifetime of cooling fan. Incorrect data will result in an incorrect calculation result.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------|------------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b075 | Ambient temperature | Set range is, -10~50°C | * | 40 | °C |

3-6-17 Watt-hour related

When the watt-hour monitoring function is selected, the inverter displays the watt-hour value of electric power given to the inverter. You can also convert the value to be displayed to gain data by setting the cumulative input power display gain setting (b079). Value displayed by function d015 is expressed as follows:

$$d015 = \frac{\text{Watt-hour (kWh)}}{\text{Watt-hour gain setting (b079)}}$$

The watt-hour input gain can be set within the range 1 to 1000 in step of 1. You can clear the watt-hour data by specifying “01” for the watt-hour clearance function (b078) and pressing the Stop/Reset key. You can also clear the watt-hour data at an intelligent input terminal by assigning parameter “53” (KHC: watt-hour clearance) to the terminal.

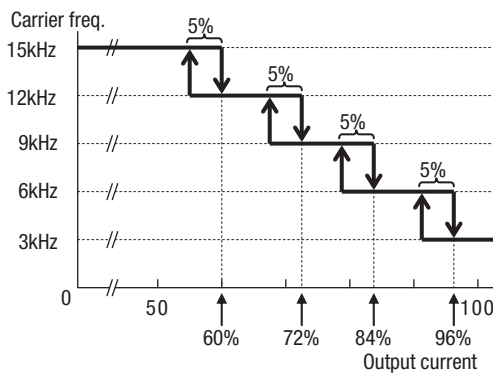
When the watt-hour display gain setting (b079) is set to “1000”, the watt-hour data up to 999000 (kWh) can be displayed.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b078 | Integrated power clear | Two option codes: 00 OFF 01 ON (press Stop/Reset key then clear) | ✓ | 00 | |
| b079 | Integrated power display gain | Set range is, 1~1000. | * | 1 | |

3-6-18 Carrier frequency (PWM) related

Carrier frequency adjustment: b0B3 – The internal *switching frequency* of the inverter circuitry (also called the *chopper frequency*). It is called the carrier frequency because the lower AC power frequency of the inverter “rides” the carrier. The faint, high-pitched sound you hear when the inverter is in Run Mode is characteristic of switching power supplies in general. The carrier frequency is adjustable from 2.0kHz to 15kHz. The audible sound decreases at the higher frequencies, but RFI noise and leakage current may be increased. Refer to the specification derating curves in Chapter 1 to determine the maximum allowable carrier frequency setting for your particular inverter and environmental conditions. Refer also to b0B9 for automatic carrier frequency reduction.

Automatic carrier frequency reduction: b0B9 – The automatic carrier frequency reduction automatically reduces the carrier frequency according to the increase in output current. To enable this function, specify “0 1” for automatic carrier frequency reduction selection (b0B9).



When the output current increases to 60%, 72%, 84%, or 96% of the rated current, this function reduces the carrier frequency to 12, 9, 6, or 3 kHz, respectively. This function restores the original carrier frequency when the output decreases to 5% lower than each reduction start level.

The rate of carrier frequency reduction is 2 kHz per second. The maximum limit of carrier

frequency change by this function is

the value specified for the carrier frequency setting (b0B3); the minimum limit is 3 kHz.

Note If 3 kHz or less freq. has been specified for b0B3, this function is disabled regardless of the setting of b0B9.

[Remark: Above graph is for schematic concept and the profile is a subject to change reflecting the temperature test.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b0B3 | Carrier frequency | Sets the PWM carrier (internal switching frequency), range is 2.0 to 15.0 kHz | * | 10.0 | kHz |
| b0B9 | Automatic carrier reduction | Three option codes: 00 OFF (Disabled) 01 ON (Current) 02 ON (heatsink) | * | 01 | |

3-6-19 Miscellaneous Settings

The miscellaneous settings include scaling factors, initialization modes, and others. This section covers some of the most important settings you may need to configure.

Start frequency adjustment: **b082** – When the inverter starts to run, the output frequency does not ramp from 0Hz. Instead, it steps directly to the start frequency (**b082**), and the ramp proceeds upward from there.

Initialization related: **b084, b085, b094, b180** – These functions allow you to restore the factory default settings. Please refer to *6-3 Restoring Factory Default Settings* on page 279.


Stop key enable function: **b087** – This function allows you to decide whether the stop key on the integrated operator is enabled or not.

Dynamic Braking related functions: **b090, b095, b096**, – These parameters are for using the internal brake chopper so to get more regeneration torque of the motor.

Cooling Fan Control: **b092** – You can select the performance of the cooling fan (if your inverter model includes a fan). This function controls whether the cooling fan stops or keeps on running after the inverter stops the motor. This can result in an additional energy saving and extends fan life.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b082 | Starting frequency | Sets the starting frequency for the inverter output, range is 0.01 to 9.99 Hz | * | 0.50 | Hz |
| b084 | Initialization selection | Select initialized data, five option codes: 00 no (Clears the trip monitor) 01 Trip data (Initializes data) 02 Parameters (Clears the trip monitor and initializes data) 03 Trip+Param (Clears the trip monitor and parameters) 04 Trp+Prm+EzSQ (Clears the trip monitor, parameters and Drive program) | * | 00 | – |
| b085 | Initialization parameter selection | 00 JPN 01 EUR | * | 01 | – |
| b087 | STOP key selection | Select whether the STOP/RESET key on the keypad is enabled, three option codes: 00 ON (Enabled) 01 OFF (Disabled) 02 Only RESET (Disabled only during stop) | * | 00 | – |
| b090 | Usage rate of regenerative braking function | Selects the rate of use (in %) of the regenerative braking resistor per 100 sec. intervals, range is 0.0 to 10.0%. 0%: Function disabled | * | 0.0 | % |
| b092 | Cooling fan control | Selects when the fan is ON during inverter operation, three options: 00 Alws-ON (Always ON) 01 ON in RUN (ON during RUN) 02 ON by temp. | * | 01 | |

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|---|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b093 | Clear elapsed time of cooling fan | Two option codes: 00 OFF 01 CLR | * | 00 | |
| b094 | Initialization target data | Select initialized parameters, four option codes: 00 ALL 01 Exp.COM, TERM 02 Only U*** 03 All exp.U*** | * | 00 | |
| b095 | Regenerative braking function operation selection | Three option codes: 00 OFF (Disabled) 01 RUN-ON (Enabled (Disabled during stop)) 02 Alws-ON (Enabled (Enabled during stop)) | * | 00 | |
| b096 | Regenerative braking function ON level | Range is: 330 to 380 V (200 V class) 660 to 760 V (400 V class) | * | 360/720 | V |
| b097 | BRD resistor | Ohmic value of the braking resistor connected to the drive 100.0 to 600.0 Ω | * | 100.0 | Ω |
| b166 | Data Read/Write selection | Controls the Read and Write protection 00 R/W OK (Read/Write Ok) 01 Protected (Read/Write Protected) | * | 00 | |
| b180 | Initialize trigger (*) | This is to perform initialization by parameter input with b084 , b085 and b094 . Two option codes: 00 No action 01 Initialize | * | 00 | |

Note When 01 is set on **b180**, and  key is pressed, initialization starts immediately and there is not any way to restore the previous parameter setting. MX2 doesn't have a method to trigger the initialization by key action as others Omron inverter models have.

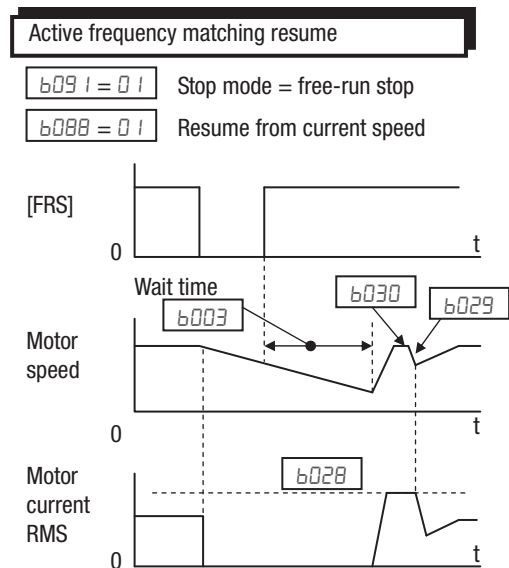
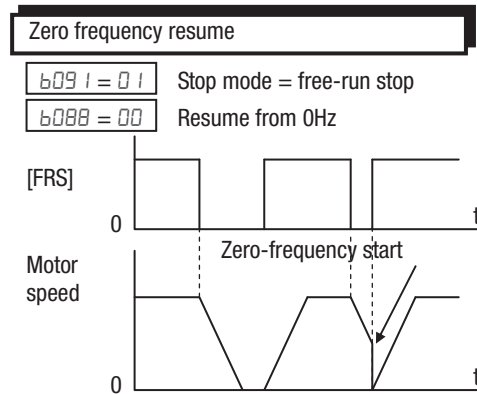
Stop Mode/Restart Mode Configuration: b091/b088 – You can configure how the inverter performs a standard stop (each time Run FWD and REV signals turn OFF). Setting **b091** determines whether the inverter will control the deceleration, or whether it will perform a free-run stop (coast to a stop). When using the free-run stop selection, it is imperative to also configure how you want the inverter to resume control of motor speed. Setting **b088** determines whether the inverter will ensure the motor always resumes at 0 Hz, or whether the motor resumes from its current coasting speed (also called *active frequency matching*). The run command may turn OFF briefly, allowing the motor to coast to a slower speed from which normal operation can resume.

In most applications a controlled deceleration is desirable, corresponding to **b09 l=00**. However, applications such as HVAC fan control will often use a free-run stop (**b09 l=0 l**). This practice decreases dynamic stress on system components, prolonging system life. In this case, you will typically set **b088=0 l** in order to resume from the current speed after a free-run stop (see diagram down below: active frequency matching resume). Note that using the default setting, **b088=00**, can cause trip events when the inverter attempts to force the load quickly to zero speed.

Note Other events can cause (or be configured to cause) a free-run stop, such as power loss (see 3-6-1 *Automatic Restart Mode* on page 121), or an intelligent input terminal [FRS] signal. If all free-run stop behavior is important to your application (such as HVAC), be sure to configure each event accordingly.

An additional parameter further configures all instances of a free-run stop. Parameter B003, Retry Wait Time Before Motor Restart, sets the minimum time the inverter will free-run. For example, if **b003=4** seconds (and **b09 l=0 l**) and the cause of the free-run stop lasts 10 seconds, the inverter will free-run (coast) for a total of 14 seconds before driving the motor again.

The figure at below right describes how active frequency matching resume operates. After waiting the time set in **b003**, the inverter tries to catch the speed of the motor shaft and output speed depends of the setting in **b030**. At this time, if the motor current rises up to the value set in **b028**, the inverter decreases the frequency according to the deceleration time set in **b029**, and finally comes to the required speed. Following are the related parameters for this control.



| Code | Parameter contents |
|--------------|--|
| b028 | Active frequency matching restart level |
| b029 | Active frequency matching restart parameter |
| b030 | Start frequency at active frequency matching restart |
| b088 | Free-run stop selection |
| b09 l | Stop selection |

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b088 | Free-run stop selection | Selects how the inverter resumes operation when free-run stop (FRS) is cancelled, three options: 00 0 Hz start 01 f-match (Frequency matching start) 02 Actv. f-match (Active Frequency Matching restart) | * | 00 | – |
| b091 | Stop mode selection | Select how the inverter stops the motor, two option codes: 00 DEC (decelerate to stop) 01 FRS (free-run to stop) | * | 00 | – |

3-6-20 Free-V/F Settings Related

Please refer to chapter 3 for detailed explanation of the function.

| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|----------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b100 | Free V/F frequency 1 | Set range, 0 ~ value of b102 | * | 0. | Hz |
| b101 | Free V/F voltage 1 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |
| b102 | Free V/F frequency 2 | Set range, value of b100 ~ b104 | * | 0. | Hz |
| b103 | Free V/F voltage 2 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |
| b104 | Free V/F frequency 3 | Set range, value of b102 ~ b106 | * | 0. | Hz |
| b105 | Free V/F voltage 3 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |
| b106 | Free V/F frequency 4 | Set range, value of b104 ~ b108 | * | 0. | Hz |
| b107 | Free V/F voltage 4 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |
| b108 | Free V/F frequency 5 | Set range, value of b106 ~ b110 | * | 0. | Hz |
| b109 | Free V/F voltage 5 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |
| b110 | Free V/F frequency 6 | Set range, value of b108 ~ b112 | * | 0. | Hz |
| b111 | Free V/F voltage 6 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |
| b112 | Free V/F frequency 7 | Set range, b110 ~ 400 | * | 0. | Hz |
| b113 | Free V/F voltage 7 | Set range, 0.0 ~ 800.0 V | * | 0.0 | V |

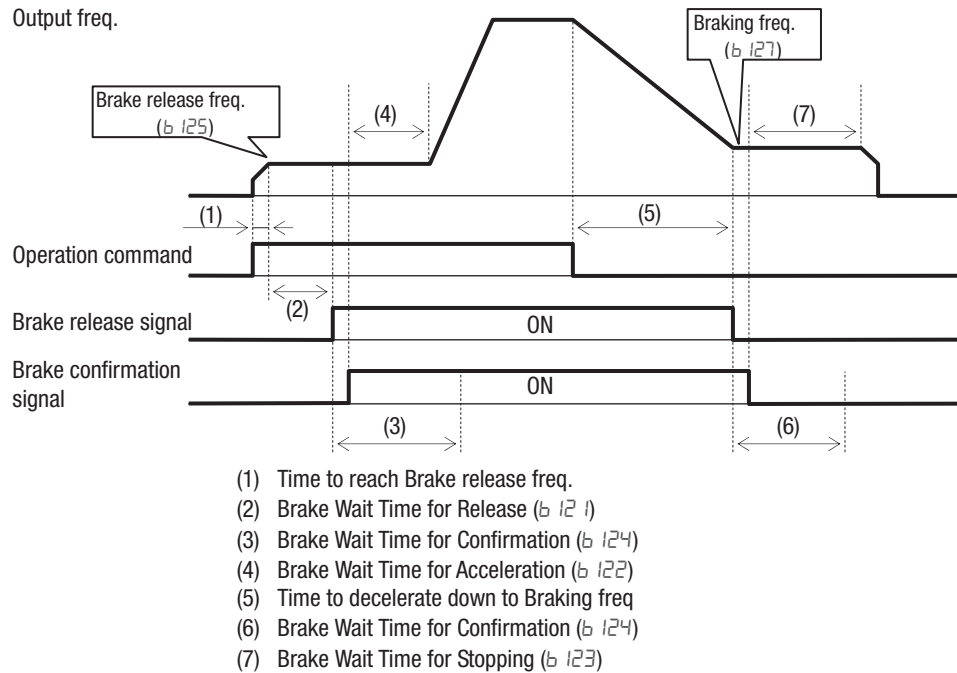
3-6-21 Brake Control Function Related

The brake control function allows you to make the inverter control an external brake used for a lift or other machines. To enable this function, specify “01” (enabling the brake control function) for the Brake Control Enable (**b120**). This function operates as described below.

1. When the inverter receives an operation command, it starts the output and accelerates the motor up to the Brake Release Frequency Setting (**b125**).
2. After the Brake Release Frequency Setting is reached, the inverter waits for the braking wait time (**b121**), and then outputs the brake release signal (BOK). However, if the inverter output current has not reached the brake release current (**b126**), the inverter does not output the brake release signal, but trips and outputs a brake error signal (BER).
3. When the braking confirmation signal (BOK) has been assigned to an intelligent input terminal (that is, when “44” is specified for one of “C001” to “C007”), the inverter waits for the Brake Wait Time for Confirmation (**b124**) without accelerating the motor after receiving the brake release signal. If the inverter does not receive the braking confirmation signal within the braking confirmation time (**b124**), it trips with the braking error signal (BER)

output. When the braking confirmation signal (BOK) has not been assigned to any intelligent input terminal, the Brake Wait Time for Confirmation (**b 124**) is invalid. In such cases, the inverter proceeds to the operation described in item (4) after the output of the brake release signal.

4. After the input of the braking confirmation signal (or the output of the brake release signal [when the BOK signal function is disabled]), the inverter waits for the Brake Wait Time for Acceleration [**b 122**], and then starts accelerating the motor up to the set frequency.
5. When the operation command is turned off, the inverter decelerates the motor down to the braking frequency (**b 127**), and then turns off the brake release signal (BRK).



6. When the braking confirmation signal (BOK) has been assigned to an intelligent input terminal (that is, when “44” is specified for one of “C001” to “C007”), the inverter waits, after turning off the brake release signal, until the braking confirmation is turned off at least for the Brake Wait Time for Confirmation (**b 124**) without decelerating the motor. If the braking confirmation signal is not turned off within the Brake Wait Time for Confirmation (**b 124**), the inverter trips with the braking error signal (BER) output. When the braking confirmation signal (BOK) has not been assigned to any intelligent input terminal, the Brake Wait Time for Confirmation (**b 124**) is invalid. In such cases, the inverter proceeds to the operation described in item (7) after the brake release signal is turned off.
7. After the braking confirmation signal (or the brake release signal [when the BOK signal function is disabled]) is turned off, the inverter waits for the Brake Wait Time for Stopping (**b 123**), and then starts decelerating the motor down to 0 Hz.

Note The above timing chart shows the operation on the assumption that the braking confirmation signal “44” (BOK) is assigned to one of the terminal 1 to 7 (C001~C007). If the BOK signal is not assigned to any terminal, the Brake Wait Time for Acceleration (**b 122**) begins when the brake release signal is turned on, and the Brake Wait Time for Stopping (**b 123**) begins when the brake release signal is turned off.

When using the brake control function, assign the following signal functions to intelligent input and output terminals as needed.

1. To input a signal indicating that the brake is released from the external brake to the inverter, assign the braking confirmation signal (**44**: BOK) to one of the terminal 1~7 (**C00 1~C007**)
2. Assign the brake release signal (**19**: BRK), which is a brake-releasing command, to one of the output terminal 11~12 (**C02 1~C022**). To output a signal when braking is abnormal, assign the brake error signal (**20**: BER) to an output terminal.

When using the brake control function, you are recommended to select the sensorless vector control (**A044=03**) that ensures a high torque performance

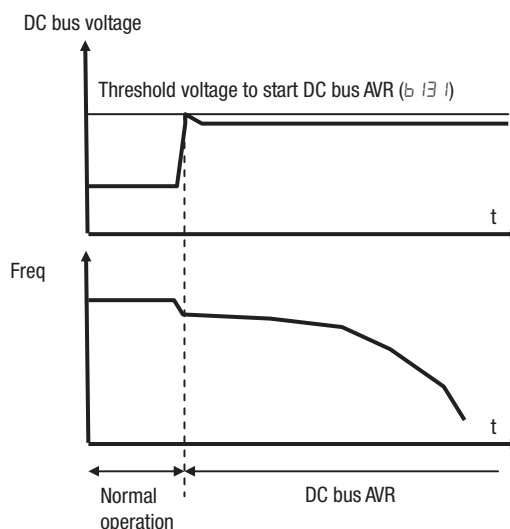
| “B” Function | | | Run Mode Edit | Defaults | |
|--------------|----------------------------------|--|---------------|---------------|-------|
| Func. Code | Name | Description | | EU | Units |
| b 120 | Brake control selection | Two option codes: 00 OFF (Disabled) 01 ON (Enabled with DC injection) 02 ON (Enabled without DC injection) | * | 00 | |
| b 121 | Brake wait time for release | Set range: 0.00 to 5.00 sec | * | 0.00 | Sec |
| b 122 | Brake wait time for acceleration | Set range: 0.00 to 5.00 sec | * | 0.00 | Sec |
| b 123 | Brake wait time for stopping | Set range: 0.00 to 5.00 sec | * | 0.00 | Sec |
| b 124 | Brake wait time for confirmation | Set range: 0.00 to 5.00 sec | * | 0.00 | Sec |
| b 125 | Brake release frequency | Set range: 0.00 to 400.00 Hz | * | 0.00 | Hz |
| b 126 | Brake release current | 0.0 to 3.20 x Rated current | * | Rated current | A |
| b 127 | Brake input frequency | Set range: 0.00 to 400.00 Hz | * | 0.00 | Hz |

When position control is used, the brake sequence doesn't follow exactly the parameter set and brake is just applied when the positioning finish.

3-6-22 DC Bus AVR (Automatic Voltage Regulation) for Deceleration Settings

This function is to achieve stable DC bus voltage in case of deceleration. DC bus voltage rises due to regeneration during deceleration. When this function is activated ($b130=01$ or 02), inverter controls the deceleration time so that the DC bus voltage not to go up to the overvoltage trip level, and leads to the trip-less operation during deceleration.

Please note that the actual deceleration time can be longer in this case.



| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|---|--|---------------|-------------|-------|
| Func. Code | Name | Description | | EU | Units |
| b130 | Overvoltage protection function selection during deceleration | 00 OFF (Disabled) | * | 01 | - |
| | | 01 V-cnst (DC voltage kept constant) | | | |
| | | 02 Accel (Acceleration enabled) | | | |
| b131 | Overvoltage protection level during deceleration | DC bus voltage of suppression. Range is: 200 V class 330 to 395 400 V class 660 to 790 | * | 380/ 760 | V |
| b132 | Overvoltage protection parameter | Accel. rate when $b130=02$. Set range: 0.10 ~ 30.00 sec. | * | 1.00 | sec |
| b133 | Overvoltage protection proportional gain setting | Proportional gain when $b130=01$. Range is: 0.00 to 5.00 | ✓ | 0.20 | - |
| b134 | Overvoltage protection integral time setting | Integration time when $b130=01$. Range is: 0.0 to 150.0 | ✓ | 1.0 | sec |

3-6-23 STO (Safe Torque Off) Setting

Please refer to *Appendix E Safety (ISO 13849-1)* on page 379 for detailed information.

| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|---------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b145 | GS input mode | Two option codes: 00 No trip 01 Trip | * | 00 | |

3-6-24 Inverter Mode Setting

Besides Dual rating selection (**b049**), MX2 supports two different operation modes, standard mode and permanent magnet mode.

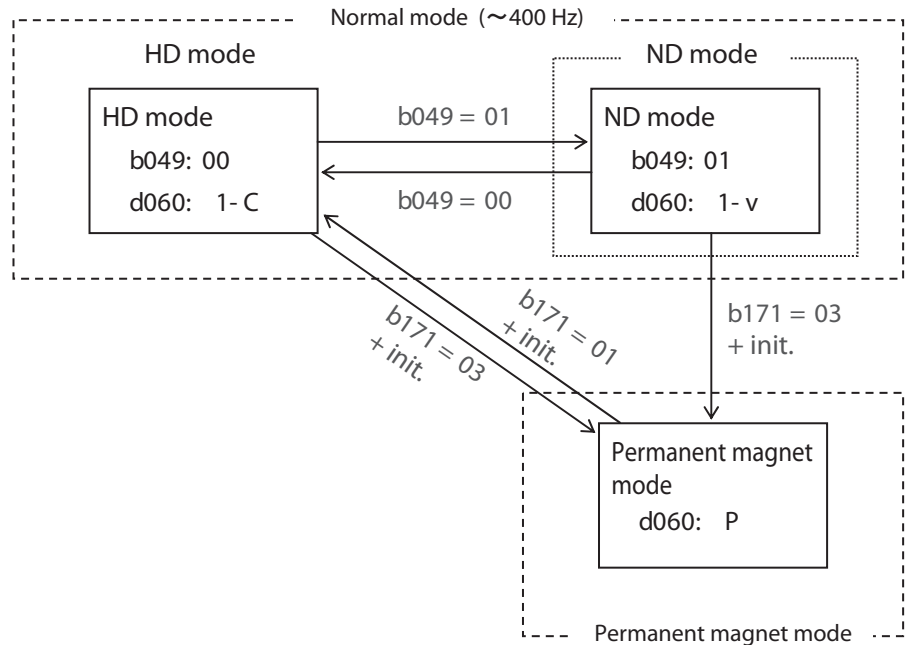
The inverter mode cannot be changed just setting **b171**. After setting **b171**, be sure to execute initialization to activate new mode.

Actual inverter mode can be monitored with **d060**.

| "B" Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| b171 | Inverter mode selection | Two option codes: 00 No function 01 Std. IM 02 Reserved 03 PM | * | 00 | |

Main differences between std. mode and permanent magnet mode are as follows.

| Function | Standard mode | | Permanent Magnet |
|--|--|---|-------------------|
| | HD | ND | |
| Rating | HD | ND | HD |
| Max. freq. (A004) | 400Hz | 400Hz | 400Hz |
| Start freq. (b082) | 0.10 to 9.99 (Hz) | 0.10 to 9.99 (Hz) | 0.10 to 9.99 (Hz) |
| Carrier freq. (b083) | 2.0 to 15.0 (kHz) | 2.0 to 10.0 (kHz) | 2.0 to 15.0 (kHz) |
| V/f characteristic curve (A044) | 00 : Const. torque 01 : Reduced torque 02 : Free V/f 03 : SLV | 00 : Const. torque 01 : Reduced torque 02 : Free V/f | Not available |

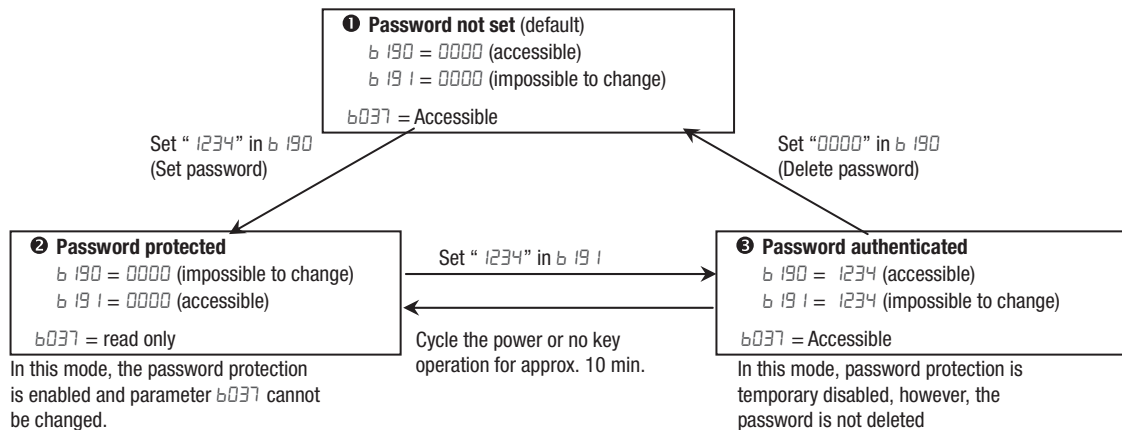


3-6-25 Password Function

The MX2 inverter has password function to prevent from changing parameters or to hide a part of parameters. There are two passwords for **b037** (Function Code Display Restriction) and **b031** (Software Lock) corresponding to password A and password B.

If password is forgotten, there is no way to delete password. Please be careful to set password.

• Overview of password function (Example of password A)

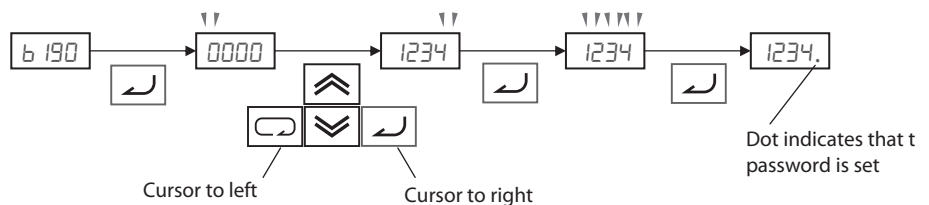


• Function Code Display Restriction Function and Software Lock Function

| Target of password | Function description | Applied parameters for setting password |
|--|--|---|
| Function Code Display Restriction b037 (password A) | Depending on the value in b037 , a part of function codes are not displayed. (Displayed parameters can be changed.) | b 190, b 191 |
| Software Lock b031 (password B) | Depending on the value in b031 , all or a part of parameters can not be changed. (All the function codes and data are displayed.) | b 192, b 193 |

• How to Set Password

1. Set parameter b037 and/or b031 depending on your demand
2. Set password in b190 and/or b192 ("0000" is not available.)



3. Password has been set and locked. Parameter **b037** and/or **b031** cannot be changed.

• How to authenticate the Password

For a person who knows the password, unlock protection as follows.

1. Set password in b191 and/or b193
2. If entered password is matched, "Good (Good)" is displayed for 1 second and password protection is unlocked temporary. If cycling the power or no key operation is pressed during 10 minutes the password protection is enabled again automatically. If entered password doesn't match, "Err (Error)" is displayed and protection is not unlocked.

• **How to change Password**

1. Make password authentication as above.
2. Set new password in b190 and/or b192.

• **How to delete Password**

1. Make password authentication.
2. Set “0000” in b190 and/or b192.
3. Password has been deleted and all the password information is cleared.

3-7 “C” Group: Intelligent Terminal Functions

The seven input terminals [1], [2], [3], [4], [5], [6], and [7] can be configured for any of 72 different functions. The next two tables show how to configure the seven terminals. The inputs are logical, in that they are either OFF or ON. We define these states as OFF=0, and ON=1.

The inverter comes with default options for the seven terminals. These settings are initially unique, each one having its own setting. Note that different selection on parameter b085 may result in different default settings. You can use any option on any terminal, and even use the same option twice to create a logical OR (though usually not required).

Note Terminals [3] and [4] have the ability to be logical inputs, and to be safety inputs in case of safe stop function is selected.

Note Terminal [5] has the ability to be a logical input, and to be an analog input for a thermistor device when PTC function (option code 19) is assigned to that terminal.

3-7-1 Input Terminal Configuration

Functions and Options - The *function codes* in the following table let you assign one of seventy-two options to any of the seven logic inputs for the MX2 inverters. The functions C001 through C007 configure the terminals [1] through [7] respectively. The “value” of these particular parameters is not a scalar value, but it is a discrete number that selects one option from many available options.

For example, if you set function C001=00, you have assigned option 00 (Forward Run) to terminal [1]. The option codes and the specifics of how each one works are in Chap. 4.

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|----------------------------------|-------------|---------------|-------------|-------|
| Func. Code | Name | Description | | EU | Units |
| C001 | Multi-function input 1 selection | 0 to 91, no | * | 00 [FW] | – |
| C002 | Multi-function input 2 selection | | * | 01 [RV] | – |
| C003 | Multi-function input 3 selection | | * | 12 [EXT] | – |
| C004 | Multi-function input 4 selection | | * | 18 [RS] | – |
| C005 | Multi-function input 5 selection | | * | 02 [CF1] | – |
| C006 | Multi-function input 6 selection | | * | 03 [CF2] | – |
| C007 | Multi-function input 7 selection | | * | 06 [JG] | – |

The input logic conversion is programmable for each of the seven inputs default to normally open (active high), but you can select normally closed (active low) in order to invert the sense of the logic.

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C011 | Multi-function input 1 operation selection | Select logic conversion, two option codes: 00... NO 01... NC | x | 00 | – |
| C012 | Multi-function input 2 operation selection | | x | 00 | – |
| C013 | Multi-function input 3 operation selection | | x | 00 | – |
| C014 | Multi-function input 4 operation selection | | x | 00 | – |
| C015 | Multi-function input 5 operation selection | | x | 00 | – |
| C016 | Multi-function input 6 operation selection | | x | 00 | – |
| C017 | Multi-function input 7 operation selection | | x | 00 | – |

Note An input terminal configured for option code 18 ([RS] Reset command) cannot be configured for normally closed operation.

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|--------------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C160 | Input terminal response time 1 | Sets response time of each input terminal, set range: 0 (x 2 [ms]) to 200 (x 2 [ms]) (0 to 400 [ms]) | x | 1 | – |
| C161 | Input terminal response time 2 | | x | 1 | – |
| C162 | Input terminal response time 3 | | x | 1 | – |
| C163 | Input terminal response time 4 | | x | 1 | – |
| C164 | Input terminal response time 5 | | x | 1 | – |
| C165 | Input terminal response time 6 | | x | 1 | – |
| C166 | Input terminal response time 7 | | x | 1 | – |

Note This response time is disregarded when power-on or reset. For example, when the power is up when FW terminal is on, then the operation starts regardless this response time as soon as the internal reset process is completed.

3-7-2 Intelligent Input Terminal Overview

Each of the seven intelligent terminals may be assigned any of the options in the following table. When you program one of the option codes for terminal assignments C001 to C007, the respective terminal assumes the function role of that option code. The terminal functions have a symbol or abbreviation that we use to label a terminal using that function. For example, the “Forward Run” command is [FW]. The physical label on the terminal block connector is simply 1, 2, 3, 4, 5, 6, or 7. However, schematic examples in this manual also use the terminal symbol (such as [FW]) to show the assigned option. The option codes for C011 to C017 determines the active state of the logical input (active high or active low).

Input Function Summary Table - This table shows all intelligent input functions at a glance. Detailed description of these functions, related parameters and settings, and example wiring diagrams are in *4-5 Using Intelligent Input Terminals* on page 201.

| Input Function Summary Table | | | | |
|------------------------------|-----------------|---|-------------|---|
| Option Code | Terminal Symbol | Function Name | Description | |
| 00 | FW | Forward Run/Stop | ON | Inverter is in Run Mode, motor runs forward |
| | | | OFF | Inverter is in Stop Mode, motor stops |
| 01 | RV | Reverse Run/Stop | ON | Inverter is in Run Mode, motor runs reverse |
| | | | OFF | Inverter is in Stop Mode, motor stops |
| 02 | CF1 *1 | Multi-step speed setting binary 1 | ON | Binary encoded speed select, Bit 0, logical 1 |
| | | | OFF | Binary encoded speed select, Bit 0, logical 0 |
| 03 | CF2 | Multi-step speed setting binary 2 | ON | Binary encoded speed select, Bit 1, logical 1 |
| | | | OFF | Binary encoded speed select, Bit 1, logical 0 |
| 04 | CF3 | Multi-step speed setting binary 3 | ON | Binary encoded speed select, Bit 2, logical 1 |
| | | | OFF | Binary encoded speed select, Bit 2, logical 0 |
| 05 | CF4 | Multi-step speed setting binary 4 | ON | Binary encoded speed select, Bit 3, logical 1 |
| | | | OFF | Binary encoded speed select, Bit 3, logical 0 |
| 06 | JG | Jogging | ON | Inverter is in Run Mode, output to motor runs at jog parameter frequency |
| | | | OFF | Inverter is in Stop Mode |
| 07 | DB | External DC injection braking | ON | DC braking will be applied during deceleration |
| | | | OFF | DC braking will not be applied |
| 08 | SET | Set (select) 2 nd motor Data | ON | The inverter uses 2 nd motor parameters for generating frequency output to motor |
| | | | OFF | The inverter uses 1st (main) motor parameters for generating frequency output to motor |
| 09 | 2CH | 2-step acceleration/ deceleration | ON | Frequency output uses 2nd-stage acceleration and deceleration values |
| | | | OFF | Frequency output uses standard acceleration and deceleration values |
| 11 | FRS | Free-run stop | ON | Causes output to turn OFF, allowing motor to free run (coast) to stop |
| | | | OFF | Output operates normally, so controlled deceleration stop motor |
| 12 | EXT | External trip | ON | When assigned input transitions OFF to ON, inverter latches trip event and displays E 12 |
| | | | OFF | No trip event for ON to OFF, any recorded trip events remain in history until reset |
| 13 | USP | Unattended start protection | ON | On powerup, the inverter will not resume a Run command |
| | | | OFF | On powerup, the inverter will resume a Run command that was active before power loss |
| 14 | CS | Commercial switch | ON | Motor can be driven by commercial power |
| | | | OFF | Motor is driven via the inverter |
| 15 | SFT | Soft lock | ON | The keypad and remote programming devices are prevented from changing parameters |
| | | | OFF | The parameters may be edited and stored |
| 16 | AT | Analog input switching | ON | Refer to <i>Analog Input Settings</i> on page 93. |
| | | | OFF | |
| 18 | RS | Reset | ON | The trip condition is reset, the motor output is turned OFF, and powerup reset is asserted |
| | | | OFF | Normal power-ON operation |

| Input Function Summary Table | | | | |
|------------------------------|-----------------|---|-------------|---|
| Option Code | Terminal Symbol | Function Name | Description | |
| 19 | PTC | PTC thermistor Thermal Protection (C005 only) | ANLG | When a thermistor is connected to terminal [5] and [L], the inverter checks for over-temperature and will cause trip event and turn OFF output to motor |
| | | | OPEN | A disconnect of the thermistor causes a trip event, and the inverter turns OFF the motor |
| 20 | STA | 3-wire start | ON | Starts the motor rotation |
| | | | OFF | No change to present motor status |
| 21 | STP | 3-wire stop | ON | Stops the motor rotation |
| | | | OFF | No change to present motor status |
| 22 | F/R | 3-wire forward/reverse | ON | Selects the direction of motor rotation: ON = FWD. While the motor is rotating, a change of F/R will start a deceleration, followed by a change in direction |
| | | | OFF | Selects the direction of motor rotation: OFF = REV. While the motor is rotating, a change of F/R will start a deceleration, followed by a change in direction |
| 23 | PID | PID enabled/disabled | ON | Temporarily disables PID loop control. Inverter output turns OFF as long as PID Enable is active (A07 I=0 I) |
| | | | OFF | Has no effect on PID loop operation, which operates normally if PID Enable is active (A07 I=0 I) |
| 24 | PIDC | PID integral reset | ON | Resets the PID loop controller. The main consequence is that the integrator sum is forced to zero |
| | | | OFF | No effect on PID controller |
| 27 | UP | UP/DWN function accelerated | ON | Accelerates (increases output frequency) motor from current frequency |
| | | | OFF | Output to motor operates normally |
| 28 | DWN | UP/DWN function decelerated | ON | Decelerates (decreases output frequency) motor from current frequency |
| | | | OFF | Output to motor operates normally |
| 29 | UDC | UP/DWN function data clear | ON | Clears the UP/DWN frequency memory by forcing it to equal the set frequency parameter F001. Setting C 10 I must be set=00 to enable this function to work |
| | | | OFF | UP/DWN frequency memory is not changed |
| 31 | OPE | Forced operator | ON | Forces the source of the output frequency setting A00 I and the source of the Run command A002 to be from the digital operator |
| | | | OFF | Source of output frequency set by A00 I and source of Run command set by A002 is used |
| 32 | SF1 | Multi-step speed setting bit 1 | ON | Bit encoded speed select, Bit 1, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 1, logical 0 |
| 33 | SF2 | Multi-step speed setting bit 2 | ON | Bit encoded speed select, Bit 2, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 2, logical 0 |
| 34 | SF3 | Multi-step speed setting bit 3 | ON | Bit encoded speed select, Bit 3, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 3, logical 0 |
| 35 | SF4 | Multi-step speed setting bit 4 | ON | Bit encoded speed select, Bit 4, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 4, logical 0 |
| 36 | SF5 | Multi-step speed setting bit 5 | ON | Bit encoded speed select, Bit 5, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 5, logical 0 |
| 37 | SF6 | Multi-step speed setting bit 6 | ON | Bit encoded speed select, Bit 6, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 6, logical 0 |
| 38 | SF7 | Multi-step speed setting bit 7 | ON | Bit encoded speed select, Bit 7, logical 1 |
| | | | OFF | Bit encoded speed select, Bit 7, logical 0 |
| 39 | OLR | Overload limit switching | ON | Perform overload restriction |
| | | | OFF | Normal operation |

| Input Function Summary Table | | | | |
|------------------------------|-----------------|---------------------------------|-------------|--|
| Option Code | Terminal Symbol | Function Name | Description | |
| 40 | TL | Torque limit enabled | ON | Setting of b040 is enabled |
| | | | OFF | Max. torque is limited with 200% |
| 41 | TRQ1 | Torque limit switching 1 | ON | Torque limit related parameters of Powering/regen, and FW/RV modes are selected by the combinations of these inputs. |
| | | | OFF | |
| 42 | TRQ2 | Torque limit switching 2 | ON | |
| | | | OFF | |
| 44 | BOK | Brake confirmation | ON | Brake confirmation signal received |
| | | | OFF | Brake confirmation signal not received |
| 46 | LAC | LAD cancel | ON | Set ramp times are ignored. Inverter output immediately follows the freq. command. |
| | | | OFF | Accel. and/or decel. is according to the set ramp time |
| 47 | PCLR | Position deviation clear | ON | Clear the position deviation data |
| | | | OFF | Maintain the position deviation data |
| 50 | ADD | Frequency addition | ON | Adds the A145 (add frequency) value to the output frequency |
| | | | OFF | Does not add the A145 value to the output frequency |
| 51 | F-TM | Forced terminal block | ON | Force inverter to use input terminals for output frequency and Run command sources |
| | | | OFF | Source of output frequency set by A001 and source of Run command set by A002 is used |
| 52 | ATR | Torque command input permission | ON | Torque control command input is enabled |
| | | | OFF | Torque control command input is disabled |
| 53 | KHC | Integrated power clear | ON | Clear watt-hour data |
| | | | OFF | No action |
| 56 | MI1 | Drive Programming input 1 | ON | General purpose input (1) is made ON under Drive Programming |
| | | | OFF | General purpose input (1) is made OFF under Drive Programming |
| 57 | MI2 | Drive Programming input 2 | ON | General purpose input (2) is made ON under Drive Programming |
| | | | OFF | General purpose input (2) is made OFF under Drive Programming |
| 58 | MI3 | Drive Programming input 3 | ON | General purpose input (3) is made ON under Drive Programming |
| | | | OFF | General purpose input (3) is made OFF under Drive Programming |
| 59 | MI4 | Drive Programming input 4 | ON | General purpose input (4) is made ON under Drive Programming |
| | | | OFF | General purpose input (4) is made OFF under Drive Programming |
| 60 | MI5 | Drive Programming input 5 | ON | General purpose input (5) is made ON under Drive Programming |
| | | | OFF | General purpose input (5) is made OFF under Drive Programming |
| 61 | MI6 | Drive Programming input 6 | ON | General purpose input (6) is made ON under Drive Programming |
| | | | OFF | General purpose input (6) is made OFF under Drive Programming |
| 62 | MI7 | Drive Programming input 7 | ON | General purpose input (7) is made ON under Drive Programming |
| | | | OFF | General purpose input (7) is made OFF under Drive Programming |

| Input Function Summary Table | | | | |
|------------------------------|-----------------|--|-------------|--|
| Option Code | Terminal Symbol | Function Name | Description | |
| 65 | AHD | Analog command held | ON | Analog command is held |
| | | | OFF | Analog command is not held |
| 66 | CP1 | Position command selection 1 | ON | Multistage position commands are set according to the combination of these switches. |
| | | | OFF | |
| 67 | CP2 | Position command selection 2 | ON | |
| | | | OFF | |
| 68 | CP3 | Position command selection 3 | ON | |
| | | | OFF | |
| 69 | ORL | Zero return limit signal | ON | Limit signal of homing is ON |
| | | | OFF | Limit signal of homing is OFF |
| 70 | ORG | Zero return startup signal | ON | Starts homing operation |
| | | | OFF | No action |
| 73 | SPD | Speed/position switching | ON | Speed control mode |
| | | | OFF | Position control mode |
| 77 | GS1 * | GS1 input | ON | EN60204-1 related signals. Signal input of “Safe torque off” function |
| | | | OFF | |
| 78 | GS2 * | GS2 input | ON | |
| | | | OFF | |
| 81 | 485 | Start EzCOM | ON | Starts EzCOM |
| | | | OFF | No execution |
| 82 | PRG | Drive Programming start | ON | Executing Drive Programming |
| | | | OFF | No execution |
| 83 | HLD | Retain output frequency | ON | Retain the current output frequency |
| | | | OFF | No retention |
| 84 | ROK | Permission of Run command | ON | Run command permitted |
| | | | OFF | Run command is not permitted |
| 85 | EB | Rotation direction detection (C007 only) | ON | Forward rotation |
| | | | OFF | Reverse rotation |
| 86 | DISP | Display limitation | ON | Only a parameter configured in b038 is shown |
| | | | OFF | All the monitors can be shown |
| 90 | UIO | Unprotected inverter operation mode | ON | Unprotected inverter operation mode is enabled |
| | | | OFF | Unprotected inverter operation mode is disabled |
| 91 | PSET | Preset position | ON | P083 value is set to current position |
| | | | OFF | - |
| 255 | no | No allocation | ON | (input ignored) |
| | | | OFF | (input ignored) |

3-7-3 Output Terminal Configuration

The inverter provides configuration for logic (discrete) and analog outputs, shown in the table below.

| “C” Function | | | | Defaults | |
|--------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | Run Mode Edit | EU | Units |
| C021 | Multi-function output terminal 11 selection | 48 programmable functions available for logic (discrete) outputs (see next section) | * | 00 [RUN] | - |
| C022 | Multi-function output terminal 12 selection | | * | 01 [FA1] | - |
| C026 | Relay output (AL2, AL1) function selection | 48 programmable functions available for logic (discrete) outputs (see next section) | * | 05 [AL] | - |

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|----------------|-------|
| Func. Code | Name | Description | | EU | Units |
| C027 | [EO] terminal selection | 13 programmable functions: 00... Output FQ (Output frequency) 01... Output I (Output current) 02... Output TRQ (Output torque) 03... Pulse FQ (Digital output frequency) 04... Output V (Output voltage) 05... Power 06... Thermal (Thermal load rate) 07... LAD-FQ (LAD frequency) 08... Pulse I (Digital current monitor) 10... Heatsink tmp (Fin temperature) 12... YA0 (Drive Programming output) 15... Pulse input 16... Option | * | 07 (LAD-FQ) | – |
| C028 | AM selection | 11 programmable functions: 00... Output FQ (Output frequency) 01... Output I (Output current) 02... Output TRQ (Output torque) 03... Pulse FQ (Digital output frequency) 04... Output V (Output voltage) 05... Power 06... Thermal (Thermal load rate) 07... LAD-FQ (LAD frequency) 10... Heatsink tmp (Fin temperature) 11... Output TRQ sign (Output torque <signed>) 13... YA1 (Drive Programming) 16... Option | * | 00 [Output FQ] | – |
| C030 | Digital current monitor reference value | 0.32 x Rated current to 3.20 x Rated current | ✓ | Rated current | A |
| C047 | Pulse train input scale conversion for EO output | If EO terminal is configured as pulse train input (C027=15), scale conversion is set in C047. Pulse-out = Pulse-in (C047) Set range is 0.01 to 99.99 | ✓ | 1.00 | – |

The output logic conversion is programmable for terminal [11], [12] and the alarm relay terminal. The open-collector output terminal [11] and [12] defaults to normally open (active low), but you can select normally closed (active high) for the terminal in order to invert the sense of the logic. You can invert the logical sense of the alarm relay output as well.

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|---|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| Ⓒ 031 | Multi-function output terminal 11 contact selection | Select logic conversion, two option codes: 00... NO 01... NC | × | 00 | – |
| Ⓒ 032 | Multi-function output terminal 12 contact selection | | × | 00 | – |
| Ⓒ 036 | Relay output (AL2, AL1) contact selection | 00... NO contact at AL2, NC contact at AL1 01... NC contact at AL2, NO contact at AL1 | × | 01 | – |

You can also adjust the output with ON/OFF delays.

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------|--------------------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| Ⓒ 130 | Output 11 ON delay | Set range is 0.0 to 100.0 sec. | × | 0.0 | Sec. |
| Ⓒ 131 | Output 11 OFF delay | | × | 0.0 | Sec. |
| Ⓒ 132 | Output 12 ON delay | Set range is 0.0 to 100.0 sec. | × | 0.0 | Sec. |
| Ⓒ 133 | Output 12 OFF delay | | × | 0.0 | Sec. |
| Ⓒ 140 | Relay output ON delay | Set range is 0.0 to 100.0 sec. | × | 0.0 | Sec. |
| Ⓒ 141 | Relay output OFF delay | | × | 0.0 | Sec. |

Note If you are using the output terminal OFF delay feature (any of Ⓒ 145, Ⓒ 149 > 0.0 sec.), the [RS] (reset) terminal affects the ON-to-OFF transition slightly. Normally (with using OFF delays), the [RS] input causes the motor output and the logic outputs to turn OFF together, immediately. However, when any output uses an OFF delay, then after the [RS] input turns ON, that output will remain ON for an additional 1 sec. period (approximate) before turning OFF.

Output Function Summary Table - This table shows all functions for the logical outputs (terminals [11], [12] and [AL]) at a glance. Detailed descriptions of these functions, related parameters and settings, and example wiring diagrams are in *4-6 Using Intelligent Output Terminals* on page 225.

| Output Function Summary Table | | | | |
|-------------------------------|-----------------|-----------------------------------|-------------|--|
| Option Code | Terminal Symbol | Function Name | Description | |
| 00 | RUN | Signal during RUN | ON | When the inverter is in Run Mode |
| | | | OFF | When the inverter is in Stop Mode |
| 01 | FA1 | Constant speed arrival signal | ON | When output to motor is at the set frequency |
| | | | OFF | When output to motor is OFF, or in any acceleration or deceleration ramp |
| 02 | FA2 | Over set frequency arrival signal | ON | When output to motor is at or above the set freq., even if in accel (C042) or decel (C043) ramps |
| | | | OFF | When output to motor is OFF, or at a level below the set frequency |
| 03 | OL | Overload warning | ON | When output current is more than the set threshold (C041) for the overload signal |
| | | | OFF | When output current is less than the set threshold for the deviation signal |
| 04 | OD | Excessive PID deviation | ON | When PID error is more than the set threshold for the deviation signal |
| | | | OFF | When PID error is less than the set threshold for the deviation signal |
| 05 | AL | Alarm output | ON | When an alarm signal has occurred and has not been cleared |
| | | | OFF | When no alarm has occurred since the last cleaning of alarm(s) |
| 06 | FA3 | Set-frequency-only arrival signal | ON | When output to motor is at the set frequency, during accel (C042) and decel (C043). |
| | | | OFF | When output to motor is OFF, or is not at a level of the set frequency |
| 07 | OTQ | Overtorque | ON | Estimated motor torque exceeds the specified level |
| | | | OFF | Estimated motor torque is lower than the specified level |
| 09 | UV | Signal during undervoltage | ON | Inverter is in Undervoltage |
| | | | OFF | Inverter is not in Undervoltage |
| 10 | TRQ | Torque limit | ON | Torque limit function is executing |
| | | | OFF | Torque limit function is not executing |
| 11 | RNT | RUN time over | ON | Total running time of the inverter exceeds the specified value |
| | | | OFF | Total running time of the inverter does not exceed the specified value |
| 12 | ONT | Power ON time over | ON | Total power ON time of the inverter exceeds the specified value |
| | | | OFF | Total power ON time of the inverter does not exceed the specified value |
| 13 | THM | Thermal warning | ON | Accumulated thermal count exceeds the C061 set value |
| | | | OFF | Accumulated thermal count does not exceed the C061 set value |
| 19 | BRK | Brake release | ON | Output for brake release |
| | | | OFF | No action for brake |
| 20 | BER | Brake error | ON | Brake error has occurred |
| | | | OFF | Brake performance is normal |

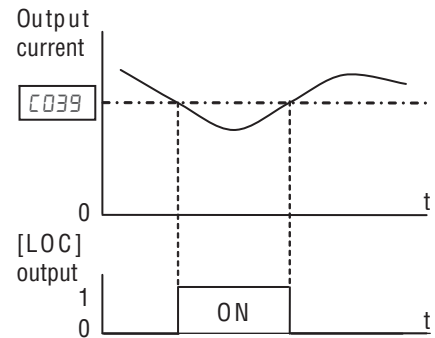
| Output Function Summary Table | | | | |
|-------------------------------|-----------------|-----------------------------------|-------------|--|
| Option Code | Terminal Symbol | Function Name | Description | |
| 21 | ZS | 0 Hz signal | ON | Output frequency falls below the threshold specified in C063 |
| | | | OFF | Output frequency is higher than the threshold specified in C063 |
| 22 | DSE | Excessive speed deviation | ON | Deviation of speed command and actual speed exceeds the specified value P027 . |
| | | | OFF | Deviation of speed command and actual speed does not exceed the specified value P027 . |
| 23 | POK | Position ready | ON | Positioning is completed |
| | | | OFF | Positioning is not completed |
| 24 | FA4 | Set frequency exceeded 2 | ON | When output to motor is at or above the set freq., even if in accel (C045) or decel (C046) ramps |
| | | | OFF | When output to motor is OFF, or at a level below the set frequency |
| 25 | FA5 | Set frequency only 2 | ON | When output to motor is at the set frequency, during accel (C045) and decel (C046). |
| | | | OFF | When output to motor is OFF, or is not at a level of the set frequency |
| 26 | OL2 | Overload warning 2 | ON | When output current is more than the set threshold (C111) for the overload signal |
| | | | OFF | When output current is less than the set threshold for the deviation signal |
| 27 | ODc | Analog O disconnection detection | ON | When the [O] input value < b070 setting (signal loss detected) |
| | | | OFF | When no signal loss is detected |
| 28 | OIDc | Analog OI disconnection detection | ON | When the [OI] input value < b071 setting (signal loss detected) |
| | | | OFF | When no signal loss is detected |
| 31 | FBV | PID FB status output | ON | Transitions to ON when the inverter is in RUN Mode and the PID Process Variable (PV) is less than the Feedback Low Limit (C053) |
| | | | OFF | Transitions to OFF when the PID Process Variable (PV) exceeds the PID High Limit (C052), and transitions to OFF when the inverter goes from Run Mode to Stop Mode |
| 32 | NDc | Network error | ON | When the communications watchdog timer (period specified by C077) has time out |
| | | | OFF | When the communications watchdog timer is satisfied by regular communications activity |
| 33 | LOG1 | Logic operation output 1 | ON | When the Boolean operation specified by C143 has a logical “1” result |
| | | | OFF | When the Boolean operation specified by C143 has a logical “0” result |
| 34 | LOG2 | Logic operation output 2 | ON | When the Boolean operation specified by C146 has a logical “1” result |
| | | | OFF | When the Boolean operation specified by C146 has a logical “0” result |
| 35 | LOG3 | Logic operation output 3 | ON | When the Boolean operation specified by C149 has a logical “1” result |
| | | | OFF | When the Boolean operation specified by C149 has a logical “0” result |
| 39 | WAC | Capacitor life warning signal | ON | Lifetime of internal capacitor has expired. |
| | | | OFF | Lifetime of internal capacitor has not expired. |
| 40 | WAF | Cooling fan life warning signal | ON | Lifetime of cooling fan has expired. |
| | | | OFF | Lifetime of cooling fan has not expired. |

| Output Function Summary Table | | | | |
|-------------------------------|-----------------|---|-------------|---|
| Option Code | Terminal Symbol | Function Name | Description | |
| 41 | FR | Starting contact signal | ON | Either FW or RV command is given to the inverter |
| | | | OFF | No FW or RV command is given to the inverter, or both are given to the inverter |
| 42 | OHF | Fin overheat warning | ON | Temperature of the heat sink exceeds a specified value (L064) |
| | | | OFF | Temperature of the heat sink does not exceed a specified value (L064) |
| 43 | LOC | Light load detection signal | ON | Motor current is less than the specified value (L039) |
| | | | OFF | Motor current is not less than the specified value (L039) |
| 44 | MO1 | Drive Programming output 1 | ON | General output 1 is ON |
| | | | OFF | General output 1 is OFF |
| 45 | MO2 | Drive Programming output 2 | ON | General output 2 is ON |
| | | | OFF | General output 2 is OFF |
| 46 | MO3 | Drive Programming output 3 | ON | General output 3 is ON |
| | | | OFF | General output 3 is OFF |
| 50 | IRDY | Operation ready signal | ON | Inverter can receive a run command |
| | | | OFF | Inverter cannot receive a run command |
| 51 | FWR | Forward run signal | ON | Inverter is driving the motor in forward direction |
| | | | OFF | Inverter is not driving the motor in forward direction |
| 52 | RVR | Reverse run signal | ON | Inverter is driving the motor in reverse direction |
| | | | OFF | Inverter is not driving the motor in reverse direction |
| 53 | MJA | Fatal fault signal | ON | Inverter is tripping with major failure |
| | | | OFF | Inverter is normal, or is not tripping with major failure |
| 54 | WCO | Window comparator O | ON | Analog voltage input value is inside of the window comparator |
| | | | OFF | Analog voltage input value is outside of the window comparator |
| 55 | WCOI | Window comparator OI | ON | Analog current input value is inside of the window comparator |
| | | | OFF | Analog current input value is outside of the window comparator |
| 58 | FREF | Frequency command source | ON | Frequency command is given from the operator |
| | | | OFF | Frequency command is not given from the operator |
| 59 | REF | Run command source | ON | Run command is given from the operator |
| | | | OFF | Run command is not given from the operator |
| 60 | SETM | 2nd motor Selection | ON | 2 nd motor is being selected |
| | | | OFF | 2 nd motor is not being selected |
| 62 | EDM | STO (Safe Torque Off) Performance Monitor (Output terminal 11 only) | ON | STO is being performed |
| | | | OFF | STO is not being performed |
| 63 | OPO | Option board output | ON | (output terminal for option card) |
| | | | OFF | (output terminal for option card) |
| 255 | no | Not used | ON | – |
| | | | OFF | – |

3-7-4 Low Load Detection Parameters

The following parameters work in conjunction with the intelligent output function, when configured. The output mode parameter (C03B) sets the mode of the detection at which the low load detection signal [LOC] turns ON. Two kinds of modes can be selected. The detection level parameter (C039) is to set the level of the low load.

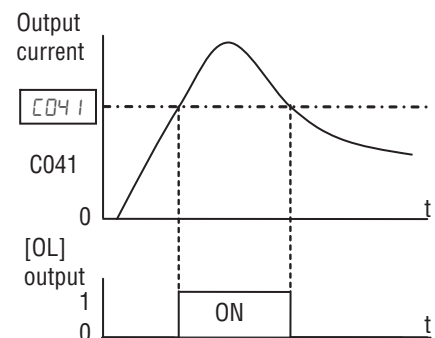
This function is for generating an early warning logic output, without causing either a trip event or a restriction of the motor current (those effects are available on other functions).



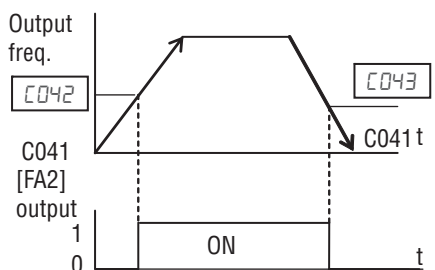
| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------------|--|---------------|---------------|-------|
| Func. Code | Name | Description | | EU | Units |
| C03B | Light load signal output mode | Two option codes: 00... ACC/DEC/CST (Enabled during acceleration/deceleration/constant speed) 01... Const (Enabled only during constant speed) | * | 01 | - |
| C039 | Light load detection level | Set the level of low load detection, range is 0.0 to 3.20 x Rated current | * | Rated current | A |

3-7-5 Output Function Adjustment Parameters

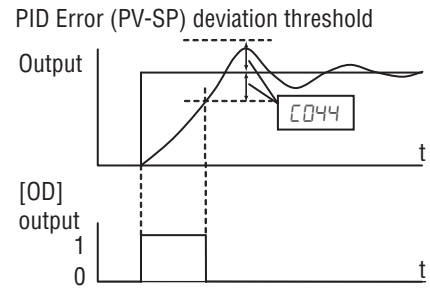
Overload Warning Output - The following parameters work in conjunction with the intelligent output function, when configured. The overload level parameter (C041) sets the motor current level at which the overload signal [OL] turns ON. The range of setting is from 0% to 200% of the rated current for the inverter. This function is for generating an early warning logic output, without causing either a trip event or a restriction of the motor current (those effects are available on other functions).



Frequency Arrival Output - The frequency arrival signal, [FA1] or [FA2], is intended to indicate when the inverter output has reached (arrived at) the target frequency. You can adjust the timing of the leading and trailing edges of the signal via two parameters specified to acceleration and deceleration ramps, C042 and C043. Refer also to SECTION 4 Operations and Monitoring on page 191.



PID FBV Output - The Error for the PID loop is the magnitude (absolute value) of the difference between the Set point (desired value) and Process Variable (actual value). The PID output deviation signal [OD] (output terminal function option code 04) indicates when the error magnitude has exceeded a magnitude you define.



Over/Under-torque Output - The inverter outputs the over/under-torque signal when it detects that the estimated motor output torque exceeds the specified level. To enable this function, assign parameter "07" (OTQ: over/under-torque signal) to an intelligent output terminal. Over-torque or under-torque can be selected by function C054.

This function is effective only when the V/F characteristic curve selection "A044" or "A244" is the sensorless vector control. With any other V/F characteristic curve selected the output of the OTQ signal is unpredictable. When using the inverter for a lift, use the OTQ signal as the trigger to stop braking. Use the frequency arrival signal as the trigger to start braking.

Electronic Thermal Warning Output - Please refer to page 237 for detailed information.

Zero speed detection Output - The inverter outputs the 0 Hz speed detection signal when the inverter output frequency falls below the threshold frequency specified in the zero speed detection level (C053).

To use this function, assign parameter "2 I" to one of the intelligent output terminals [11] to [12] (C021 to C022), or to the alarm relay output terminal (C025).

This function applies to the inverter output frequency when the V/F characteristic curve selection is based on the constant torque (VC), reduced torque (VP), free-V/F or sensorless vector control.

Heat Sink Overheat Warning Output - The inverter monitors the temperature of its heat sink, and outputs the heat sink overheat warning (OHF) signal when the temperature exceeds the heat sink overheat warning level specified in parameter C054.

| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------------------------|--|---------------|---------------|-------|
| Func. Code | Name | Description | | EU | Units |
| C040 | Overload warning signal output mode | Two option codes: 00... ACC/DEC/CST (Enabled during acceleration/deceleration/constant speed) 01... Const (Enabled only during constant speed) | * | 01 | - |
| C041 | Overload warning level | 0.0: Does not operate 0.1 x Rated current to 3.20 x Rated current | * | Rated current | A |
| C241 | Overload warning level, 2nd motor | 0.0: Does not operate 0.1 x Rated current to 3.20 x Rated current | * | Rated current | A |
| C042 | Arrival frequency during acceleration | Sets the frequency arrival setting threshold for the output frequency during acceleration, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| C043 | Arrival frequency during deceleration | Sets the frequency arrival setting threshold for the output frequency during deceleration, range is 0.00 to 400.00 Hz | * | 0.00 | Hz |

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|---------------|-------|
| Func. Code | Name | Description | | EU | Units |
| C044 | PID deviation excessive level | Sets the allowable PID loop error magnitude (absolute value), SP-PV, range is 0.0 to 100.0% | * | 3.0 | % |
| C045 | Arrival frequency during acceleration 2 | Set range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| C046 | Arrival frequency during deceleration 2 | Set range is 0.00 to 400.00 Hz | * | 0.00 | Hz |
| C047 | Pulse train input scale conversion for EO output | Sets the scale for the pulse input 0.01 to 99.99 | ✓ | 1.00 | |
| C052 | PID FB upper limit | When the PV exceeds this value, the PID loop turns OFF the PID second stage output, range is 0.0 to 100.0% | * | 100.0 | % |
| C053 | PID FB lower limit | When the PV goes below this value, the PID loop turns ON the PID second stage output, range is 0.0 to 100.0% | * | 0.0 | % |
| C054 | Over-torque/under-torque selection | Two option codes: 00... Over-torque 01... Under-torque | * | 00 | – |
| C055 | Overtorque level (Forward power running) | Set range is 0 to 200% | * | 100 | % |
| C056 | Overtorque level (Reverse regeneration) | Set range is 0 to 200% | * | 100 | % |
| C057 | Overtorque level (Reverse power running) | Set range is 0 to 200% | * | 100 | % |
| C058 | Overtorque level (Forward regeneration) | Set range is 0 to 200% | * | 100 | % |
| C059 | Signal output mode of Over/under torque | Two option codes: 00... ACC/DEC/CST (Enabled during acceleration/deceleration/constant speed) 01... Const (Enabled only during constant speed) | * | 01 | – |
| C061 | Thermal warning level | Set range is 0 to 100% Setting 0 means disabled. | * | 90 | % |
| C063 | 0 Hz detection level | Set range is 0.00 to 100.00 Hz | * | 0.00 | Hz |
| C064 | Fin overheat warning level | Set range is 0 to 110°C | * | 100 | °C |
| C111 | Overload warning level 2 | 0.0 to 3.20 x Rated current | * | Rated current | A |

3-7-6 Network Communications Settings

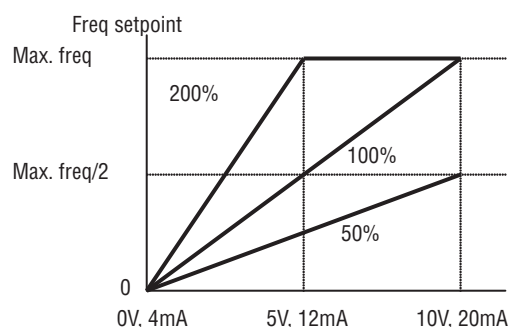
The following table lists parameters that configure the inverter's serial communications port. The settings affect how the inverter communication with a digital operator (such as 3G3AX-OP05), as well as a ModBus network (for networked inverter applications). The settings cannot be edited via the network, in order to ensure network reliability. Refer to *Appendix B ModBus Network Communications* on page 295 for more information on controlling any monitoring your inverter from a network.

| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|-------------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C071 | Communication speed selection | Eight option codes: 03... 2,400 bps 04... 4,800 bps 05... 9,600 bps 06... 19,200 bps 07... 38,400 bps 08... 57,600 bps 09... 76,800 bps 10... 115,200 bps | * | 05 | baud |
| C072 | Communication station No. Selection | Set the address of the inverter on the network. Range is 1 to 247 | * | 1 | – |
| C074 | Communication parity selection | Three option codes: 00... No parity 01... Even 02... Odd | * | 00 | – |
| C075 | Communication stop bit selection | Two option codes: 01... 1-bit 02... 2-bit | * | 01 | bit |
| C076 | Communication error selection | Selects inverter response to communications error. Five options: 00... Trip 01... Decel-Trip (Trip after deceleration stop) 02... Ignore 03... Free-RUN (Free-run stop) 04... Decel-Stop (Deceleration stop) | * | 02 | – |
| C077 | Communication error timeout | Sets the communications watchdog timer period. Range is 0.00 to 99.99 sec 0.00 = disabled | * | 0.00 | sec. |
| C078 | Communication wait time | Time the inverter waits after receiving a message before it transmits. Range is 0 to 1000 ms | * | 0 | msec. |

3-7-7 Analog Input Signal Calibration Settings

The functions in the following table configure the signals for the analog input terminals. Note that these settings do not change the current/voltage or sink/source characteristics - only the zero and span (scaling) of the signals.

These parameters are already adjusted before the shipment, and therefore it is not recommended to do the adjustment at the customer.



| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C081 | O adjustment | Scale factor between the external frequency command on terminals L-O (voltage input) and the frequency output, range is 0.0 to 200.0% | ✓ | 100.0 | % |
| C082 | OI adjustment | Scale factor between the external frequency command on terminals L-OI (current input) and the frequency output, range is 0.0 to 200.0% | ✓ | 100.0 | % |
| C085 | Thermistor adjustment | Scale factor of PTC input. Range is 0.0 to 200.0% | ✓ | 100.0 | % |

Note When you restore factory default settings, the values will change to those listed above. Be sure to manually reconfigure the values for your application, if needed, after restoring factory defaults.

3-7-8 Miscellaneous Functions

The following table contains miscellaneous functions not in other function groups.

| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C091 | Debug mode selection * | Use "00". Do not change. | ✗ | 00 | — |
| C101 | UP/DWN selection | Controls speed setpoint for the inverter after power cycle. Two option codes: 00... Not save (Do not store the frequency data) 01... Save (Store the frequency data) | ✗ | 00 | — |
| C102 | Reset selection | Determines response to Reset input [RS]. Four option codes: 00... ON-RESET (Trip reset at power-on) 01... OFF-RESET (Trip reset when the power is OFF) 02... ON in Trip (Enabled only during trip (Reset when the power is ON)) 03... Trip RESET (Trip reset only) | ✓ | 00 | — |

| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|------------------------------------|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C 103 | Reset frequency matching selection | Determines the restart mode after reset is given, three option codes: 00... 0 Hz start 01... f-match (Frequency matching start) 02... Actv.f-match (Active Frequency Matching restart) | * | 00 | – |
| C 104 | UP/DWN clear mode | Freq. set value when UDC signal is given to the input terminal, two option codes: 00... 0 Hz 01... Pow-ON data | * | 00 | – |

*1 Not only for Up/Down function, it also save the content of F001 when the reference is give by digital operator.

⚠ Caution Do not change the debug mode for safety reasons. Otherwise unexpected performances may occur.

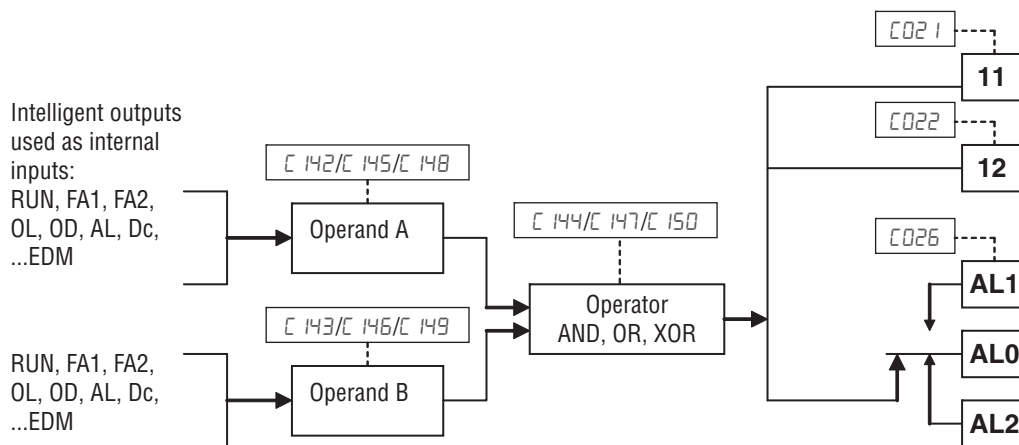
3-7-9 Analog Output Calibration Related Functions

These functions are for adjustment of analog output FM and AM. The outputs are adjusted at factory before the shipment, and therefore basically no need to adjust at the customer. But in case you need to change the gain depending on your system (i.e. analog meter specification), you can use these functions for the adjustment.

| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|-----------------|-------------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C 105 | EO gain setting | Set range is 50 to 200% | ✓ | 100 | % |
| C 106 | AM gain setting | Set range is 50 to 200% | ✓ | 100 | % |
| C 109 | AM bias setting | Set range is 0 to 100% | ✓ | 0 | % |

3-7-10 Output Logic and Timing

Logic Output Function - The inverter has a built-in logic output feature. Select any two operands out of all intelligent output options and their operator out of AND, OR, or XOR (exclusive OR). The terminal symbol for the new output is [LOG]. Use C021, C022 or C026 to route the logical result to terminal [11], [12] or the relay terminals. LOG1-LOG3, no, OPO cannot be the operand.



The following table shows all four possible input combinations with each of the three available logic operations.

| Operand | | Operator | | |
|---------|---|----------|----|-----|
| A | B | AND | OR | XOR |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 |

| "C" Function | | | Run Mode Edit | Defaults | |
|--------------|--|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| C 142 | Logic output signal 1 selection 1 | All the programmable functions available for logic (discrete) outputs except LOG1 to LOG3, OPO, no | * | 00 | - |
| C 143 | Logic output signal 1 selection 2 | | | | |
| C 144 | Logic output signal 1 operator selection | Applies a logic function to calculate [LOG] output state, Three options: 00... AND 01... OR 02... XOR | * | 00 | - |
| C 145 | Logic output signal 2 selection 1 | All the programmable functions available for logic (discrete) outputs except LOG1 to LOG3, OPO, no | * | 00 | - |
| C 146 | Logic output signal 2 selection 2 | | | | |
| C 147 | Logic output signal 2 operator selection | Applies a logic function to calculate [LOG] output state, Three options: 00... AND 01... OR 02... XOR | * | 00 | - |

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| Ⓒ 148 | Logic output signal 3 selection 1 | All the programmable functions available for logic (discrete) outputs except LOG1 to LOG3, OPO, no | * | 00 | – |
| Ⓒ 149 | Logic output signal 3 selection 2 | | | | |
| Ⓒ 150 | Logic output signal 3 operator selection | Applies a logic function to calculate [LOG] output state, Three options: 00... AND 01... OR 02... XOR | * | 00 | – |

3-7-11 Other Functions

| “C” Function | | | Run Mode Edit | Defaults | |
|--------------|--|--------------------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| Ⓒ 169 | Multi-step speed/position determination time | Set range is 0 to 200 (x 10ms) | * | 0 | ms |

To avoid the miss-input of the multi-speed due to the time rug, waiting time to fix the multi-speed can be set by Ⓒ 169. When input is detected, data is fixed after the time defined with Ⓒ 169.

3-8 “H” Group: Motor Constants Functions

The “H” Group parameters configure the inverter for the motor characteristics. You must manually set **H003** and **H004** values to match the motor. Parameter **H006** is factory-set. If you want to reset the parameters to the factory default settings, use the procedure in *6-3 Restoring Factory Default Settings* on page 279. Use **H044** to select the torque control algorithm as shown in the diagram.

Please refer to *3-8-3 Auto-tuning Function* on page 175 for detailed explanation of the auto-tuning.

| “H” Function | | | Run Mode Edit | Defaults | |
|--------------|---|---|---------------|--|------------------|
| Func. Code | Name | Description | | EU | Units |
| H001 | Auto-tuning selection | Option codes: 00... OFF (Disabled) 01... ON (STOP) 02... ON (Rotation) | * | 00 | – |
| H002 | Motor parameter selection | Option codes: | * | 00 | – |
| H202 | 2nd motor parameter selection | 00... Standard motor parameter 02... Auto tuning parameter | * | 00 | – |
| H003 | Motor capacity selection | Selections: 0.1/0.2/0.4/0.75/1.5/ 2.2/3.7/5.5/7.5/11/15/18.5 | * | Specified by the capacity of each inverter model | kW |
| H203 | 2nd motor capacity selection | | * | | kW |
| H004 | Motor pole number selection | Selections: 2/4/6/8/10/12/14/16/ 18/20/22/24/26/28/30/32/34/36/ 38/40/42/44/46/48 | * | 4 | poles |
| H204 | 2nd motor pole number selection | | * | 4 | poles |
| H005 | Speed response | Set range is 1 to 1000 | ✓ | 100 | % |
| H205 | 2nd speed response | | ✓ | 100 | % |
| H006 | Stabilization parameter | Motor constant (factory set), range is 0 to 255 | ✓ | 100 | – |
| H206 | 2nd stabilization parameter | | ✓ | 100 | – |
| H020 | Motor parameter R1 | 0.001~65.535 ohms | * | Depends on the motor capacity | Ohm |
| H220 | 2nd motor parameter R1 | | * | | Ohm |
| H021 | Motor parameter R2 | 0.001~65.535 ohms | * | Depends on the motor capacity | Ohm |
| H221 | 2nd motor parameter R2 | | * | | v |
| H022 | Motor parameter L | 0.01~655.35 mH | * | Depends on the motor capacity | mH |
| H222 | 2nd motor parameter L | | * | | mH |
| H023 | Motor parameter Io | 0.01~655.35 A | * | Depends on the motor capacity | A |
| H223 | 2nd motor parameter Io | | * | | A |
| H024 | Motor parameter J | 0.001~9999.000 kgm ² | * | Depends on the motor capacity | kgm ² |
| H224 | 2nd motor parameter J | | * | | kgm ² |
| H030 | Motor parameter R1 (auto-tuning data) | 0.001~65.535 ohms | * | Depends on the motor capacity | Ohm |
| H230 | 2nd motor parameter R1 (auto-tuning data) | | * | | Ohm |
| H031 | Motor parameter R2 (auto-tuning data) | 0.001~65.535 ohms | * | Depends on the motor capacity | Ohm |
| H231 | 2nd motor parameter R2 (auto-tuning data) | | * | | Ohm |
| H032 | Motor parameter L (auto-tuning data) | 0.01~655.35mH | * | Depends on the motor capacity | mH |
| H232 | 2nd motor parameter L (auto-tuning data) | | * | | mH |

| “H” Function | | | Run Mode Edit | Defaults | |
|--------------|---|---------------------------------|---------------|-------------------------------|------------------|
| Func. Code | Name | Description | | EU | Units |
| H033 | Motor parameter I _o (auto-tuning data) | 0.01~655.35A | × | Depends on the motor capacity | A |
| H233 | 2nd motor parameter I _o (auto-tuning data) | | × | | A |
| H034 | Motor parameter J (auto-tuning data) | 0.001~9999.000 kgm ² | × | Depends on the motor capacity | kgm ² |
| H234 | 2nd motor parameter J (auto-tuning data) | | × | | kgm ² |
| H050 | Slip compensation P gain for V/f control with FB | 0.00~10.00 | ✓ | 0.2 | - |
| H051 | Slip compensation I gain for V/f control with FB | 0~1000 | ✓ | 2 | - |

3-8-1 Motor Constants Selection

Adjust the motor constant settings to the motor to be driven by the inverter.

When using a single inverter to drive multiple motors in the control mode based on VC, VP, or free V/F characteristics, calculate the total capacity of the motors, and specify a value close to the total capacity for the motor capacity selection (**H003/H203**).

When the automatic torque boost function is used, the motor constant settings that do not match with the motor may result in a reduced motor torque, or unstable motor operation.

You can select the motor constants that are used when the control mode is the sensorless vector control (hereafter “SLV”) from the following three types.

1. Motor constants of standard induction motor
When **H002/H202=00**, motor constants in **H020/H220** to **H024/H224** are taken. The initial values in **H020/H220** to **H024/H224** are standard motor’s values.
2. Motor constants obtained by off-line auto-tuning
When **H002/H202=02**, motor constants in **H030/H230** to **H034/H234** are taken, which are obtained by off-line auto-tuning.
3. Arbitrarily set motor constants
In above (1) and (2) cases, motor constants can be adjusted manually. According to value of **H002/H202**, change motor constants in **H020/H220** to **H024/H224** or **H030/H230** to **H034/H234** if necessary.

*1) Convert the inertia (J) to the motor shaft value. Bigger J value will result in a quicker in motor response and quicker in torque increase. Smaller J value will result in the opposite way.

*2) In the SLV modes, inverter may give out reverse to given operation command in the low speed range as a nature of those controls. In case there is a specific inconvenience for example reverse rotation damages the machine, enable the reverse run protection (**b046**).

3-8-2 Sensorless Vector Control

This sensorless vector control enables the inverter to accurately operate the motor with a high starting torque, even at low speed. It estimates and controls the motor speed and output torque based on the inverter output voltage, output current, and the set motor constants on the inverter. To use this function, specify "03" for the V/F characteristic curve selection (R044/R244).

In prior to use this function, be sure to make optimum setting of the motor constants, which is described before.

When using this function, observe the following precautions:

1. If you use the inverter to drive a motor of which the capacity is two class lower than the maximum applicable capacity of the inverter, you may not be able to obtain adequate motor characteristics.
2. If you cannot obtain the desired characteristics from the motor driven under the SLV control, readjust the motor constants according to the symptom, as described in the table below.

| Status | Symptom | Adjustment method | Adjustment item |
|-------------------------|--|---|-----------------|
| Powering | Momentary speed variation is negative | Increase the motor constant R2 step by step from the set value up to 1.2 times of the set value | H021/H221 |
| | Momentary speed variation is positive | Decrease the motor constant R2 step by step from the set value up to 0.8 times of the set value | H021/H221 |
| Regeneration | Torque is insufficient at low speed (~ few Hz) | Increase the motor constant R1 step by step from the set value up to 1.2 times of the set value | H020/H220 |
| | | Increase the motor constant I0 step by step from the set value up to 1.2 times of the set value | H023/H223 |
| Starting | Motor generates an impact at start | Reduce the motor constant J from the set value | H024/H224 |
| | | Decrease the speed response factor | H005/H205 |
| | Motor runs backward for short moment at start | Set 01 (enable) on reverse run protection function (b046) | b046 |
| Decelerating | Motor runs unsteadily | Decrease the speed response factor | H005/H205 |
| | | Decrease the motor constant J from the set value | H024/H224 |
| Low frequency operation | Motor rotation is unstable | Increase the speed response factor | H024/H224 |
| | | Increase the motor constant J from the set value | H005/H205 |

Note Note 1) When driving a motor of which the capacity is one class lower than the inverter, adjust the torque limit (b041 to b044) so that the value "α" calculated by the expression below does not exceed 200%. Otherwise, the motor may not be burnt.

$$\alpha = \text{"torque limit"} \times (\text{inverter capacity}) / (\text{motor capacity})$$

(Example) When the inverter capacity is 0.75 kW and the motor capacity is 0.4 kW, the torque limit value is calculated as follows, based on the assumption that the value should be 200%:

$$\begin{aligned} \text{Torque limit (b041 to b044)} &= \alpha \times (\text{motor capacity}) / (\text{inverter capacity}) \\ &= 2.0 \times (0.4\text{kW}) / (0.75\text{kW}) = 106\% \end{aligned}$$

3-8-3 Auto-tuning Function

The MX2 inverter has auto-tuning function to get suitable motor control performance by measuring the motor constants automatically. Auto-tuning is effective only for sensorless vector control.

Auto-tuning with motor stop (H00 I=0 I)

Motor does not rotate while auto-tuning. If rotating motor could give harm to your application, use this mode. But the motor constant I0 (no-load current) and J (inertia) are not measured and remain unchanged. (I0 can be monitored in 50Hz of V/f operation.)

Auto-tuning with motor rotation (H00 I=02)

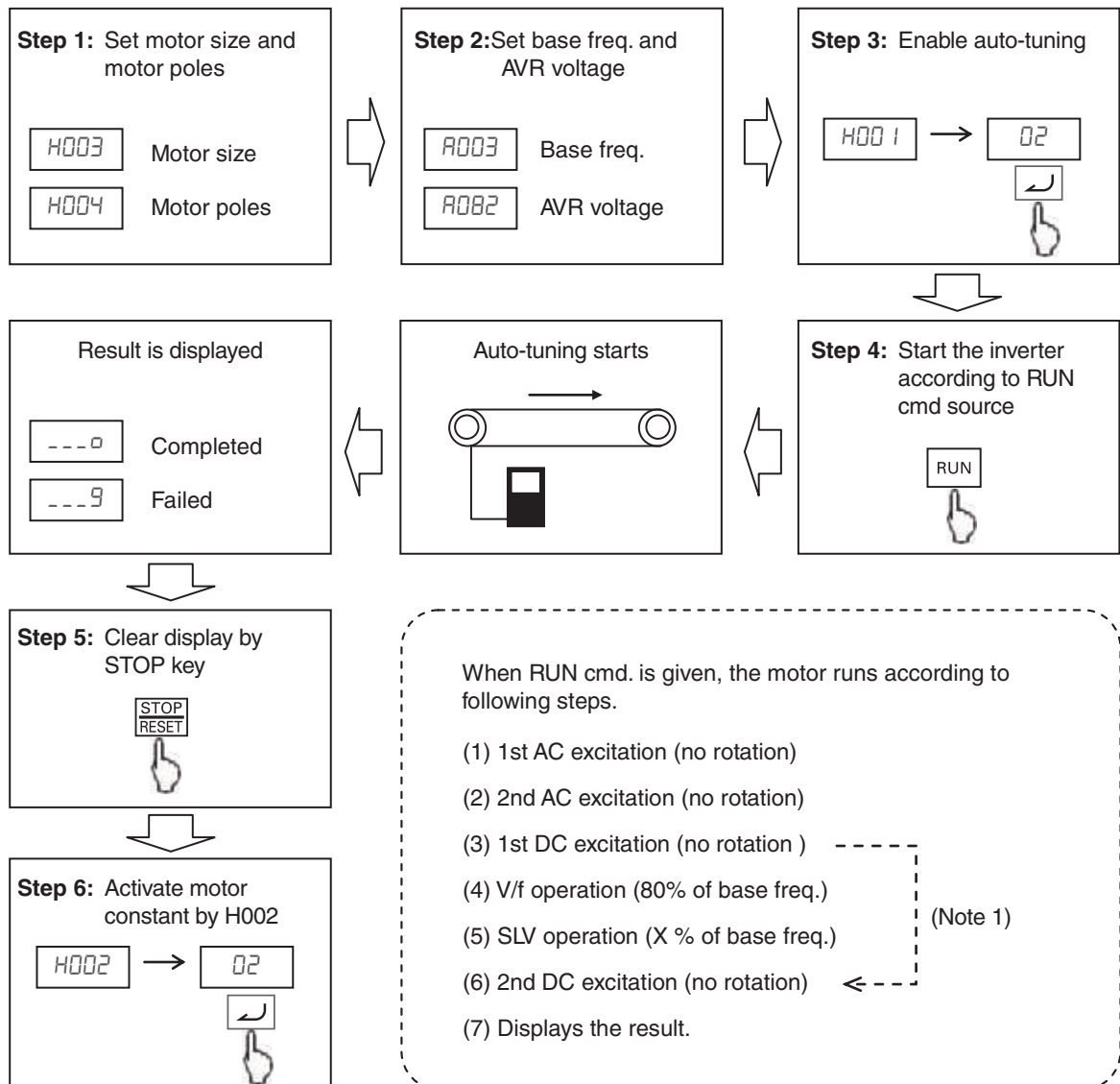
Motor rotates according to a special operation pattern while auto-tuning. However, the torque during auto-tuning is not sufficient, which may cause a problem in the load (for example, a lift may slide down). See below instruction 8.-d).

When using auto-tuning function, follow the instructions below.

1. When using a motor which constants are unknown, execute offline auto-tuning to obtain the constants.
2. When the motor constant selection (H002/H202) is standard motor (01), the initial values in H020/H220 to H024/H224 are standard motor's values.
3. The motor constant data is corresponding to one-phase of Y (star) connection for 50 Hz.
4. Set base frequency (A003) and AVR voltage (A0B2) according to the motor specifications. If the motor voltage is other than the alternatives, set V/f gain (A045) according to below formula.
 “motor voltage (A0B2)”x“output voltage gain (A045)”=“motor rated voltage”
5. Proper motor constants are obtained only when the same size or one size lower motor is used. If other size of motor is connected, proper values may not be obtained or auto-tuning operation may not be completed. In this case, press STOP/RESET key, then error code will be displayed.
6. Be sure to disable DC braking setting (A05 I=00) and simple positioning selection (P0 I2=00), otherwise motor constants are not measured properly.
7. Be sure to deactivate ATR terminal (52: Enable torque cmd. input), otherwise motor constants are not measured properly.
8. If auto-tuning with motor rotation (H00 I=02) is used, check the followings points.
 - a) The motor rotates up to 80% of base frequency. Check if it is no problem for the application.
 - b) The motor should not be driven by any other external force.
 - c) All the brakes should be released.
 - d) During auto-tuning, insufficient torque may cause a problem in the load (for example, a lift may slide down). In this case, remove the motor from the machine or other load, and perform auto-tuning with the motor alone. The measured inertia J is based on the motor alone. To apply the data, add the moment of inertia of the load machine to the measured J data after converting the moment of inertia to the motor shaft data.
 - e) If the application is with limitation (e.g. lift or boring machine), the allowable rotation limit may be exceeded in auto-tuning, and the machine may be damaged.
9. Even when “0 I (auto-tuning without motor rotation)” is selected, the motor could rotate slightly during auto-tuning.

10. When performing the auto-tuning with one lower size of motor, enable the overload restriction function, and set the overload restriction level to 150% of the rated current of the motor.
11. When deceleration over-voltage suppress integral time (**b134**) is small, auto-tuning may result in over-voltage trip. In this case, increase **b134** and retry the auto-tuning.
12. To execute auto-tuning, be sure to set the output frequency (**F001**) larger than starting frequency (**b002**) regardless with or without rotation.

Off-line auto-tuning procedure (with motor rotation)



- Note 1** When no-rotation setting (**H001=01**), (4) and (5) are skipped.
- Note 2** After auto-tuning is completed, be sure to set 02 in H002/H202, otherwise measured data is not effective.
- Note 3** Speed “X” of above (5) depends on accel/deceleration time.
 (T: Larger time of accel or deceleration time)
 0 < T < 50 [s] : X=40%
 50 ≤ T < 100 [s] : X=20%
 100 ≤ T [s] : X=10%
- Note 4** If auto-tuning is failed, try to execute again.

- Note 5** If the inverter trips during the auto-tuning, the auto-tuning is interrupted. After removing the cause of trip, retry auto-tuning from the beginning.
- Note 6** If inverter is stopped during auto-tuning by stop command (by STOP key or deactivate RUN input), measured constants could remain. Be sure to execute auto-tuning again.
- Note 7** If auto-tuning is attempted in free V/f setting, auto-tuning will fail with error display.

3-8-4 Permanent Magnet motor

When PM mode is selected on **b 17 I=03** and after initialization **b 180=0 1** new motor parameters appears on the “H” group replacing most of the standard IM parameters that disappears. Next table shows this new parameters that should be used to adjust the motor characteristics:

| Func. Code | “H” Function | | Run Mode Edit | Defaults | |
|------------|------------------------------------|---|---------------|------------------------------|-------------------|
| | Name | Description | | EU | Units |
| H102 | PM motor code selection | 00 Standard motor parameter 02 Auto-tuning parameter | * | 00 | – |
| H103 | PM motor capacity | 0.1 to 18.5 | * | According to inverter rating | – |
| H104 | PM motor pole number selection | 2/4/6/8/10/12/14/16/18/20/22/24/26/28/30/32/34/36/38/40/42/44/46/48 poles | * | | – |
| H105 | PM rated current | 0.00 x Rated current to 1.60 x Rated current | * | | A |
| H106 | PM parameter R | 0.001 to 65.535 Ω | * | | Ω |
| H107 | PM parameter Ld | 0.01 to 655.35 mH | * | | mH |
| H108 | PM parameter Lq | 0.01 to 655.35 mH | * | | mH |
| H109 | PM parameter Ke | 0.0001 to 6.5535 Vp/(rad/s) | * | | Vp/(rad/s) |
| H110 | PM parameter J | 0.001 to 9999.000 Kg/m ² | * | | Kg/m ² |
| H111 | PM parameter R (auto-tuning data) | 0.001 to 65.535 Ω | * | | Ω |
| H112 | PM parameter Ld (auto-tuning data) | 0.01 to 655.35 mH | * | | mH |
| H113 | PM parameter Lq (auto-tuning data) | 0.01 to 655.35 mH | * | mH | |
| H116 | PM speed response | 1 to 1000 | ✓ | 100 | % |
| H117 | PM starting current | 20.00 to 100.00% | ✓ | 70.00 | % |
| H118 | PM starting time | 0.01 to 60.00 s | ✓ | 1.00 | s |
| H119 | PM stabilization parameter | 0 to 120% | ✓ | 100 | % |
| H121 | PM minimum frequency | 0.0 to 25.5% | ✓ | 8.0 | % |
| H122 | PM No-Load current | 0.00 to 100.00% | ✓ | 10.00 | % |
| H123 | PM starting method | 00 Normal 01 IMPE | * | 00 | – |
| H131 | PM IMPE 0V wait | 0 to 255 | * | 10 | – |
| H132 | PM IMPE detect wait | 0 to 255 | * | 10 | – |
| H133 | PM IMPE detect | 0 to 255 | * | 30 | – |
| H134 | PM IMPE voltage gain | 0 to 200 | * | 100 | – |

Some parameters default setting also change when PM motor is selected. This table shows this parameters and the new default setting:

| Func. Code | Name | New default setting |
|------------|----------------------------------|---------------------|
| b027 | Overcurrent suppression function | 00 (OFF) |
| b083 | Carrier frequency | 10 KHz |
| b089 | Automatic carrier reduction | 00 (OFF) |

Permanent Magnet motor limitations.

When using a Permanent Magnet motor some limitations should be considered regarding application and functionality point of view.

From application point of view take this limitations in consideration:

1. Use always on reduced torque applications with a starting torque less than 50%.
2. MX2 in PM mode is not suitable for use in constant torque application where rapid acceleration/deceleration and low speed operation is need. Never use for transportation machine and specially for vertical loads such elevators.
3. Drive is able to control up to 50 times the motor moment of Inertia.
4. Two or more motors could not be driven with one inverter
5. Be careful not exceed the demagnetization current of the motor

From functionality point of view several functions and parameters are not available when PM mode is selected, next table show which ones.

| Function | Related Parameters | PM mode |
|---|--|---------------------|
| 2nd control | Intelligent input terminal SET08 | Non-display |
| | Intelligent output terminal SETM60 | Non-display |
| Torque monitor limit control | C027, C028 | Choices restriction |
| | d009, d010, d012, b040, b045, C054, C059, P033, P034, P036, P041 | Non-display |
| | Intelligent input terminal TL(40), TRQ1(41), TRQ2(42), ATR(52) | Non-display |
| | Intelligent output terminal OTQ(07), TRQ(10) | Non-display |
| Encoder feedback | P003 | Choices restriction |
| | d008, d029, d030, H050, H051, P004, P011, P012, P015, P026, P027, P060, P073, P075, P077 | Non-display |
| | Intelligent input terminal PCLR(47), CP1(66), CP3(68), ORL(69), ORG(70), SPD(73), EB(85) | Non-display |
| | Intelligent output terminal DES(22), POK(23) | Non-display |
| Jog | A038, A039 | Non-display |
| | Intelligent input terminal JG(06) | Non-display |
| IM control | A041, A044, A046, A047, b100, b113, H002, H006, H020, H024, H030, H034 | Non-display |
| V/f gain | A045 | Non-display |
| AVR | A081, A083, A084 | Non-display |
| Automatic energy-saving drive | A085, A086 | Non-display |
| Restarting with active matching frequency | b001, b008, b088, C103 | Choices restriction |
| | b028, b030 | Non-display |
| Overcurrent suppression | b027 | Non-display |
| Reduced voltage start | b036 | Non-display |
| Reverse run protection | b046 | Non-display |
| Brake control | b120, b127 | Non-display |
| | Intelligent input terminal BOK(44) | Non-display |
| | Intelligent output terminal BRK(19), BER(20) | Non-display |
| Offline auto-tuning | H001 | Choices restriction |
| Dual Rating | b049 | Non-display |
| Commercial power source switching | Intelligent input terminal CS14 | Non-display |
| LAD cancellation | Intelligent output terminal LAC46 | Non-display |

3-9 "P" Group: Other Parameters

P group parameters are for other functionality such as option error, encoder (pulse train input) settings, torque command, positioning command, Drive Programming and communication (CompoNet, DeviceNet, EtherCAT, Profi-Bus, CAN Open) related.

3-9-1 Option Card Error

You can select how the inverter reacts when an error results from a built-in option card.

| "P" Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| P001 | Operation selection at option 1 error | Two option codes: 00... Trip 01... Continues operation | * | 00 | – |

3-9-2 Encoder (Pulse Train Input) Related Settings

You can achieve speed control or simple positioning control by using pulse train input. Following table shows the related parameters of those function. Please refer to SECTION 4 Operations and Monitoring on page 191 for the detailed description.

| "P" Function | | | Run Mode Edit | Defaults | |
|--------------|---------------------------------------|--|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| P003 | EA terminal selection | Three option codes: 00... FQ set 01... Encoder FB 02... EzSQ | * | 00 | – |
| P004 | Pulse train input mode for feedback | Four option codes: 00... Single-ph. 01... 2-ph.1 02... 2-ph.2 03... Single+Dir | * | 00 | – |
| P011 | Encoder pulses | Sets the pulse number (ppr) of the encoder, set range is 32~1024 pulses | * | 512 | – |
| P012 | Simple positioning selection | Two option codes: 00... OFF 02... ON | * | 00 | – |
| P014 | Creep pulse ratio | 0.0 to 400.0 | * | 125.0 | % |
| P015 | Creep speed | Set range is start frequency (b082) ~10.00 Hz | * | 5.00 | Hz |
| P026 | Overspeed error detection level | Set range is 0.0~150.0% | * | 115.0 | % |
| P027 | Speed deviation error detection level | Set range is 0.00~120.00 Hz | * | 10.00 | Hz |

3-9-3 Speed control Related Settings

Set "15" in C027 and "00" in P003, then output frequency is controlled by single phase pulse train input to EA terminal.

| "P" Function | | | Run Mode Edit | Defaults | |
|--------------|--|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| P055 | Pulse train frequency scale | Sets the pulse numbers at max. frequency, set range is 1.0~32.0 kHz | * | 1.5 | kHz |
| P056 | Pulse train frequency filter time constant | Set range is 0.01~2.00 sec. | * | 0.10 | sec |
| P057 | Pulse train frequency bias amount | Set range is -100~100 % | * | 0 | % |
| P058 | Pulse train frequency limit | Set range is 0~100 % | * | 100 | % |
| P059 | Pulse input lower cut | 0.01 to 20.00 | * | 1.00 | % |

The P059 parameter works as a cut frequency for the pulse input so all the frequencies below it will be considered as zero. The percentage value is based on the maximum frequency on the input setting in P055.

3-9-4 Torque Command Related Settings

Torque control in open loop could be achieved with following parameters. 100% torque is referred to inverter rated current. Absolute torque value is up the motor to be combined.

| "P" Function | | | Run Mode Edit | Defaults | |
|--------------|---|---|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| P033 | Torque reference input selection | Six option codes: 00... O (Terminal O) 01... OI (Terminal OI) 03... OPE (Digital Operator) 06... Option | * | 00 | - |
| P034 | Torque reference setting | Set range is 0~200% | ✓ | 0 | % |
| P036 | Torque bias mode | Three option codes: 00... OFF (None) 01... OPE (Digital Operator) 05... Option 1 | * | 00 | - |
| P037 | Torque bias value | Range is -200~200% | ✓ | 0 | % |
| P038 | Torque bias polarity selection | Two option codes: 00... Sign (Signed) 01... Direction (Depends on the RUN direction) | * | 00 | - |
| P039 | Speed limit value in torque control (forward) | Set range is 0.00~120.00Hz | ✓ | 0.00 | Hz |
| P040 | Speed limit value in torque control (reverse) | Set range is 0.00~120.00Hz | ✓ | 0.00 | Hz |
| P041 | Speed/torque control switching time | Set range is 0 to 1000 ms | * | 0 | ms |

To enable the torque control is necessary to assign the "ATR" (Enable torque command input) to one of the multi-function inputs (that is, when "52" is specified for one of "C001" to "C007").

3-9-5 Simple Positioning

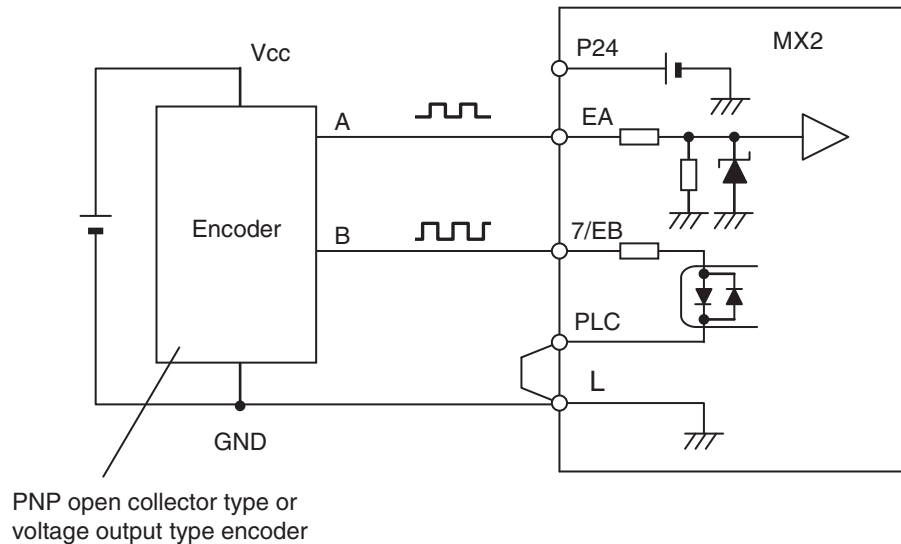
You can achieve simple positioning by simple encoder feedback control. Following pages shows the related parameters to be set for the positioning.

Encoder wiring - The hardware overview about pulse train input is shown below.

| Pulse input types | Max. Freq. | EA terminal (5 to 24 VDC) | EB terminal (24 VDC) |
|--------------------------------|---------------------------------|---|--|
| 90 ph. difference 2-ph. pulse | 32 kHz Phase A 2 kHz Phase B | Phase-A (PNP open collector or Voltage output type) | Phase-B (PNP open collector or Voltage output type) |
| Single phase pulse + direction | 32 kHz | Single phase pulse (PNP open collector or Voltage output type) | Direction (sink/source transistor or contactor) |
| Single phase pulse | 32 kHz | Single phase pulse (PNP open collector or Voltage output type) | - |

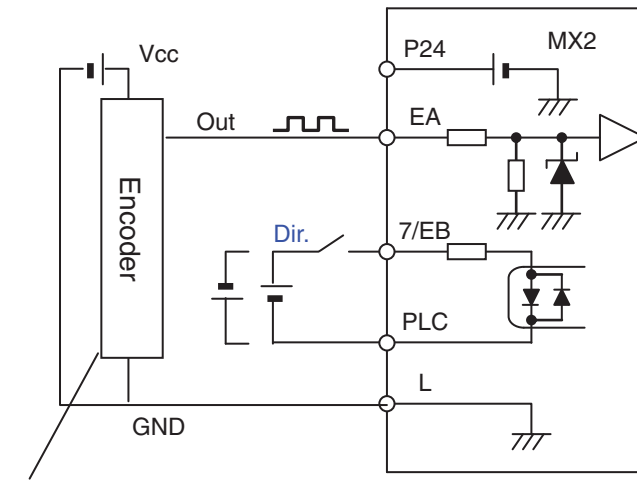
2-phase pulse input

Wire phase-A to EA terminal and phase-B to EB terminal. Since common terminal of EB is same as other inputs, use all the input terminals as source logic (PNP open collector or voltage output type). Voltage of EB should be 18 to 24 VDC. Assign EB in input terminal 7.

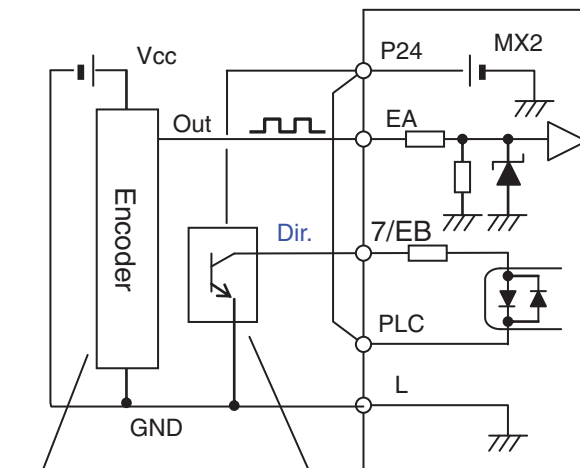


Single phase pulse input

Wire phase-A to EA terminal and direction signal to EB terminal. Both sink or source logic are available for EB terminal by changing position of the short bar. Assign EB in input terminal 7. ON input is forward and OFF input is reverse direction.

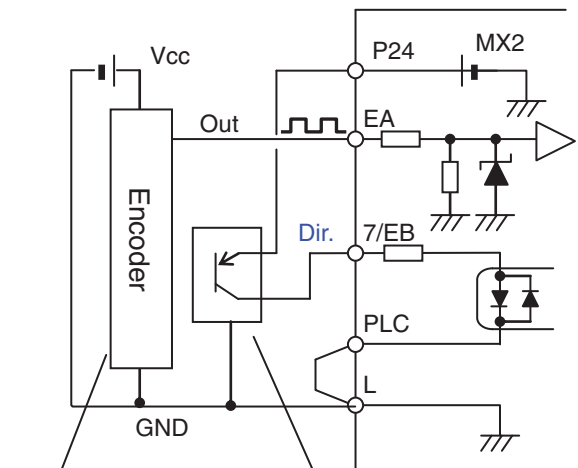


PNP open collector type or voltage output type encoder



Sink type transistor

PNP open collector type or voltage output type encoder



Source type transistor

PNP open collector type or voltage output type encoder

Simple positioning setting

- Set "01" in [EA] selection (P003), then pulse train input is used as feedback signal from encoder.
- Set "02" in simple positioning selection (P012), then simple positioning is enabled. (If "00" is set, "V/f control with FB" is enabled. Please refer to xx for further information.
- Up to 8 position data are commanded by combination of 3 input terminals configured as CP1 to CP3.
- Besides positioning input, RUN command (FW,RV) is necessary. Since rotation direction does not matter for positioning, both FW and RV work as RUN command.
- Positioning speed depends on frequency source (A001).

- More than four digits are required for positioning data, but only four higher digits are displayed.

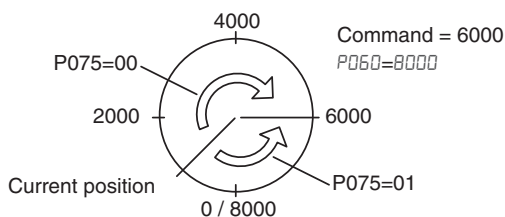
| Code | Item | Data or data range | Description |
|-------------------|--|--------------------------|--|
| P003 | EA terminal selection | 01 | Encoder feedback |
| P004 | Pulse train input mode for feedback | 00 | Single phase pulse train |
| | | 01 | 90 ph. difference 2-ph. pulse train 1 |
| | | 02 | 90 ph. difference 2-ph. pulse train 2 |
| | | 03 | Single phase pulse train + direction |
| PD11 | Encoder pulses | 32 to 1024 | |
| PD12 | Simple positioning selection | 02 | Simple positioning enabled |
| PD14 | Creep pulse ratio | 0.0 to 400.0 | Distance that will be use for the positioning sequence and the creep speed operation. 100.0% means one motor turn. |
| PD15 | Creep speed | Start freq. to 10.00 Hz | |
| PD26 | Overspeed error detection level | 0.0 to 150.0 % | |
| PD27 | Speed deviation error detection level | 0.00 to 120.00 Hz | |
| PD72 | Position range specification (forward) | 0 to +268435455 | Higher 4-digits displayed |
| PD73 | Position range specification (reverse) | -268435455 to 0 | Higher 4-digits displayed |
| PD75 | Positioning mode | 00 | With limitation |
| | | 01 | No limitation (shorter route) P004 is to be set 00 or 01 |
| PD77 | Encoder disconnection timeout | 0.0 to 10.0 s | |
| PO80 | Position restarting range | 0 to 10000 [pulses] | |
| PO81 | Save position at power off | 00: OFF 01: ON | |
| H050 | Slip compensation P gain for V/f control with FB | 0.00 to 10.00 | |
| H051 | Slip compensation I gain for V/f control with FB | 0 to 1000 s | |
| d029 | Position command monitor | -268435455 to +268435455 | |
| d030 | Current position monitor | | |
| C102 | Reset selection | 03 | Internal data is not cleared by reset |
| C001-C007 | Multi-function input 1 selection | 47 | PCLR: Position deviation clear |
| C021-C022 C026 | Multi-function output 11/12/AL selection | 22 | DSE: Excessive speed deviation |
| | | 23 | POK: Position ready |

Note 1 If 7/EB terminal is used (P004=01~03), set 85 (EB) in input 7 (C007). ON is forward and OFF is reverse direction.

Note 2 When 2-phase pulse is used, maximum frequency of phase-A and B are different (32kHz for A-phase, 2kHz for B-phase). In order to detect rotation direction over 2kHz, choose detection methods in P004.

| P004 | Item | Description |
|------|--|----------------------------------|
| 01 | 90° ph. difference 2-ph. pulse train 1 | Keep the last direction |
| 02 | 90° ph. difference 2-ph. pulse train 2 | Depend on RUN command (FW or RV) |

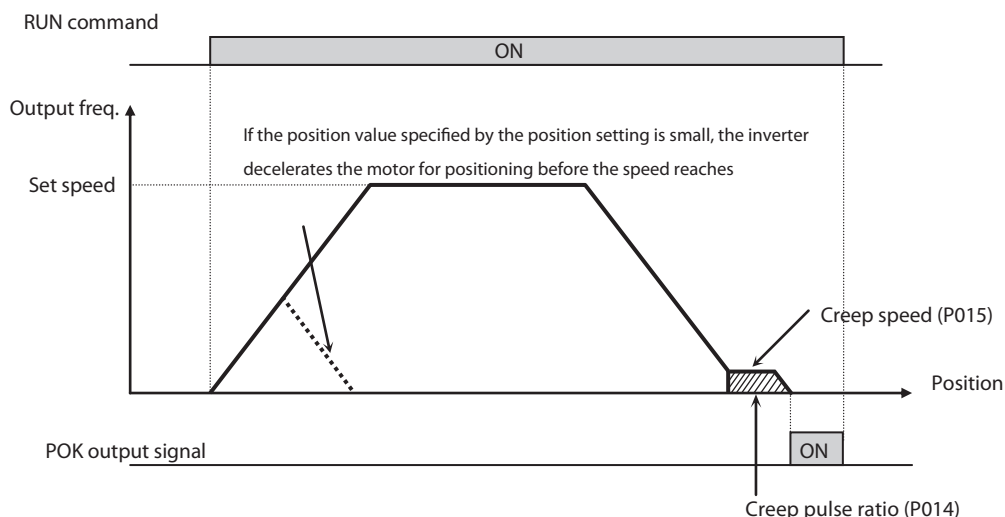
Note 3 For rotating coordinate system, if “0” is set in P075, the rotation direction of shorter routing is selected. In this case, set the number of pulse for one rotation in position-0 (P060). This value must be positive number.



Note 4 When “0” is set in P075, P004 should be set to 00 or 01.

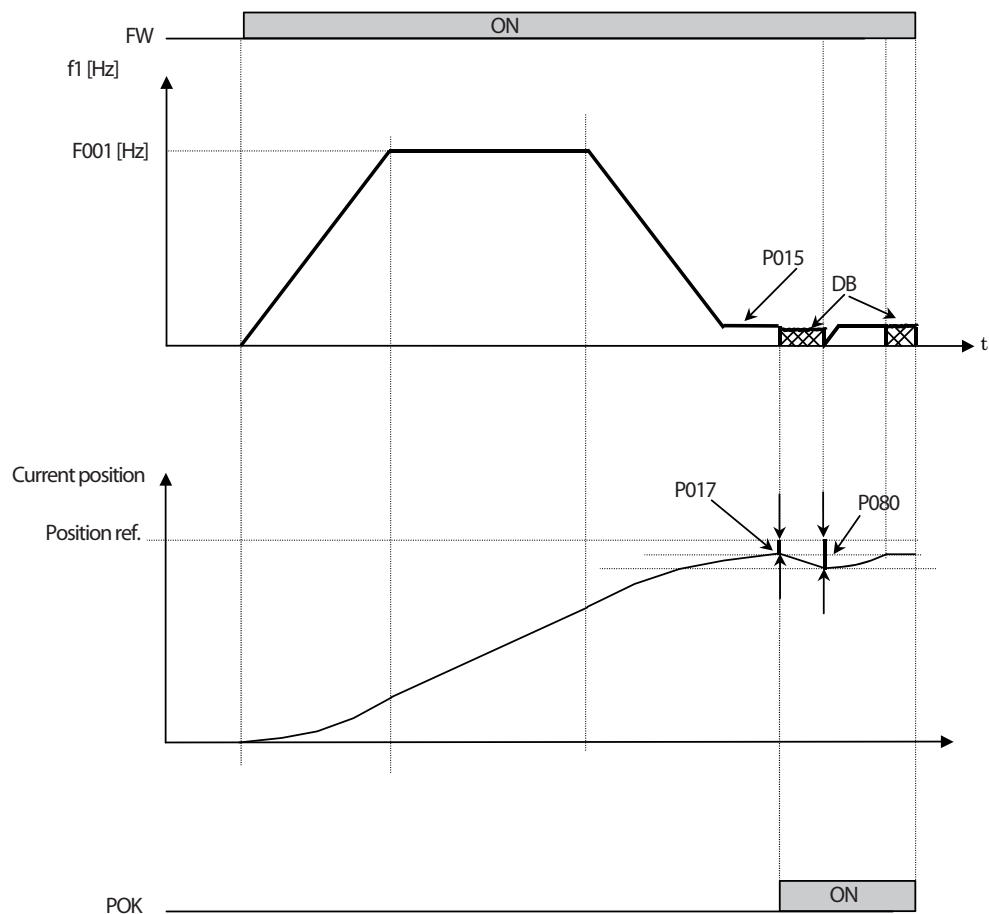
In the simple positioning mode, the inverter runs the motor until the machine reaches the target position according to the following settings, and then stops the motor with DC braking.

- <1> Position setting
 - <2> Speed setting (frequency setting)
 - <3> Acceleration and deceleration time
- (DC braking state is held until RUN command is turned off.)



- In simple positioning mode, the frequency and acceleration/deceleration are according to current settings as same as normal operation.
- Depending on DC braking and creep speed setting, positioning may go off the point.
- If the position value specified by the position setting is small, the inverter may decelerate the motor for positioning before its speed reaches the speed setting.
- In simple positioning mode, the rotation direction setting (FW or RV) of the operation command is ignored. The operation command simply functions as the signal to run or stop the motor. The motor runs in the forward direction when the value of “target position” -(minus) “current position” is positive, or in the reverse position when the value is negative.
- The position at power up is home position (Position data = 0). If power is removed, current position data is lost except when current position save at power off function is selected setting P081 = 1 that allows to keep the latest position before the power off.
- When the operation command is turned on with 0 specified as the position setting, positioning is completed (with DC braking) without running the motor.

- Specify "03 (only to reset a trip)" for reset mode selection (C 102). If a value other than "03" is specified to C 102, the current position counter will be cleared when the inverter reset terminal (or reset key) is turned on. Be sure to specify "03" for reset mode selection (C 102) if you intend to use the value of the current position counter for operation after recovering the inverter from tripping by turning on the reset terminal (or reset key).
- If the PCLR function is assigned to an input terminal, turning it on to clear the current position counter. (But note that the internal position deviation counter is also cleared at the same time.)
- In simple positioning mode, ATR terminal is invalid. (Torque control does not work.)
- If current position is out of the set range, inverter will be tripped (E83) and coasting status.
- If position error becomes bigger than the value on P080, the inverter will return automatically to set point while the Run signal keeps On. This function is disabled when P080 is set to 0.
- In case this function is used please remember to set $P080 > P017$.
- Both P017 and P080 are handled as edge counts so it is necessary to divide by 4 to transform into encoder pulses.
- If P080 parameter is not "0", when the condition "Position error" > P080 is true, the inverter cancel DB and restart position management.
- To avoid repetition of a stop and the restarting of the position management, please set parameter P080 so that condition $P080 > P017$ is true.



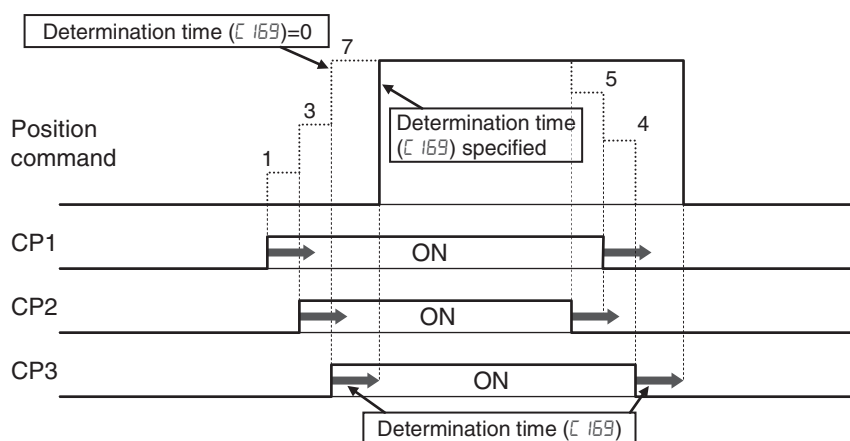
3-9-6 Multistage position switching function (CP1/CP2/CP3)

When functions "66 (CP1)" to "68 (CP3)" are assigned to input terminal [1] to [7] (C001 to C007), you can select multistage positions 0 to 7. Preset position data 0 to 7 in P060 to P067. If no assignment is set in terminals, position command will be position-0 (P060).

| Code | Item | Data or data range | Description |
|------|-------------------------------|--|--|
| P060 | Multi-step position command 0 | P073 to P072 (Displayed higher 4-digits only) | Defines the different positions that could be selected by digital inputs |
| P061 | Multi-step position command 1 | | |
| P062 | Multi-step position command 2 | | |
| P063 | Multi-step position command 3 | | |
| P064 | Multi-step position command 4 | | |
| P065 | Multi-step position command 5 | | |
| P066 | Multi-step position command 6 | | |
| P067 | Multi-step position command 7 | | |

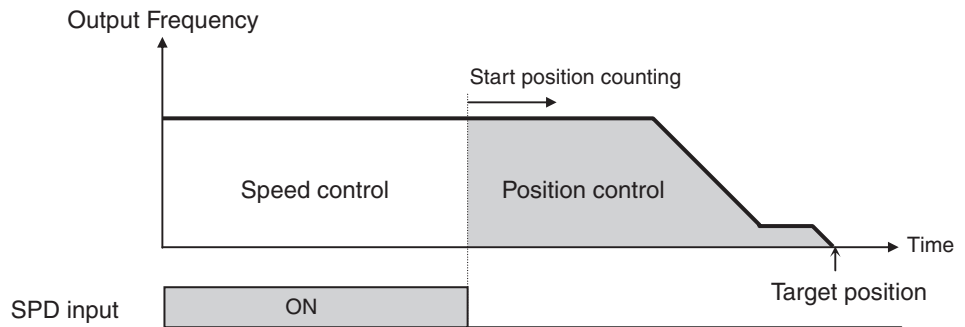
| Position setting | CP3 | CP2 | CP1 |
|--------------------------------------|-----|-----|-----|
| Multi-step position command 0 (P060) | 0 | 0 | 0 |
| Multi-step position command 1 (P061) | 0 | 0 | 1 |
| Multi-step position command 2 (P062) | 0 | 1 | 0 |
| Multi-step position command 3 (P063) | 0 | 1 | 1 |
| Multi-step position command 4 (P064) | 1 | 0 | 0 |
| Multi-step position command 5 (P065) | 1 | 0 | 1 |
| Multi-step position command 6 (P066) | 1 | 1 | 0 |
| Multi-step position command 7 (P067) | 1 | 1 | 1 |

To avoid misinput due to time lag of each input, you can adjust the determination time in (C169). The input status is taken the preset time (C169) after the last change of input status. (Note that a long determination time deteriorates the input response.)



3-9-7 Speed/positioning switching function (SPD)

- Set SPD terminal ON, then speed control is enabled in simple positioning mode.
- While SPD terminal is ON, current position counter is 0. When SPD is turned OFF, the inverter starts positioning operation.
- If positioning command data is 0 at SPD turning OFF, the inverter start deceleration immediately. (Depending on DC braking setting, motor could be hunting.)
- While SPD terminal is ON, rotating direction depends on RUN command. Be sure to check rotating direction after switching to positioning operation.



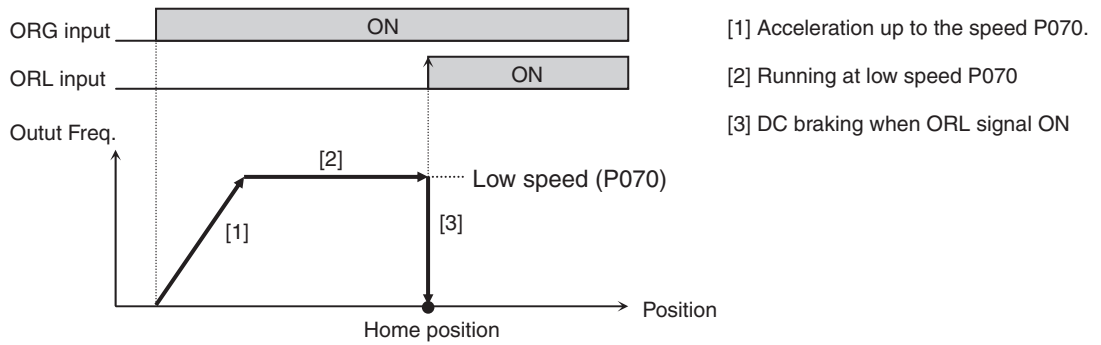
| Parameter | Item | Data | Description |
|-----------|---------------------------------------|------|-------------------------------|
| C001-C007 | Multi-function input 1 to 7 selection | 73 | SPD: Speed/position switching |

3-9-8 Homing function

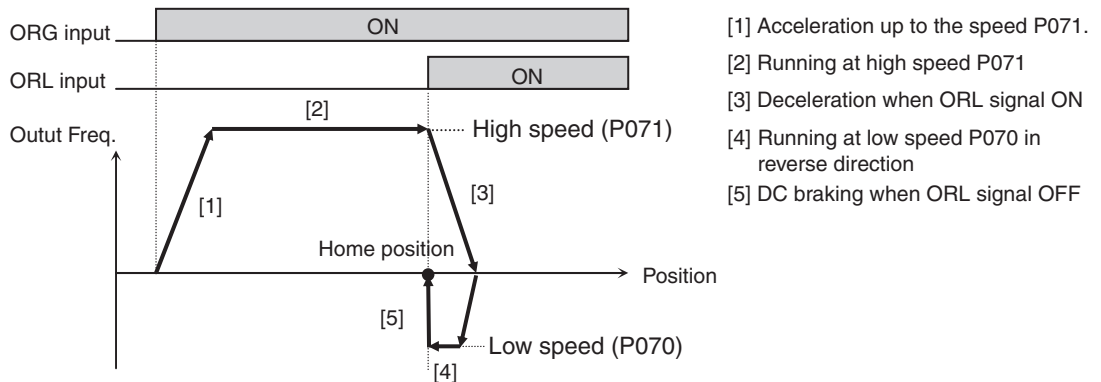
- Two different homing function are available by setting homing mode selection (P068).
- When trigger signal of homing (70: ORG), the inverter starts homing operation. When homing is completed, current position data is reset (0).
- Direction of homing is specified in P069.
- If homing is not operated, position at power up is regarded as home position (0).

| Code | Item | Data or data range | Description |
|-------------------|---------------------------------------|--------------------|---------------------------------|
| P068 | Zero return mode | 00 | Low speed |
| | | 01 | High speed 1 |
| P069 | Zero return direction selection | 00 | FWD (Forward side) |
| | | 01 | REV (Reverse side) |
| P070 | Low-speed zero return frequency | 0.00 to 10.00 Hz | |
| P071 | High-speed zero return frequency | 0.00 to 50.00 Hz | |
| C001 ~ C007 | Multi-function input 1 to 7 selection | 69 | ORL: Zero return limit signal |
| | | 70 | ORG: Zero return startup signal |

(1) Low speed homing (P068 = 00)



(2) High speed homing (P068 = 01)



3-9-9 Preset Position Function

If the P083 parameter is not 0, when Input terminal function, "PSET(91)" which added newly as a set range of C001 to C007" is ON. the inverter set a value of (P083x4) into a current position inside level.

Here, P083 is the value that is not 4 multiply like a position command.

This function is effective about P075 (Positioning Mode Selection) = 00, 01 both sides.

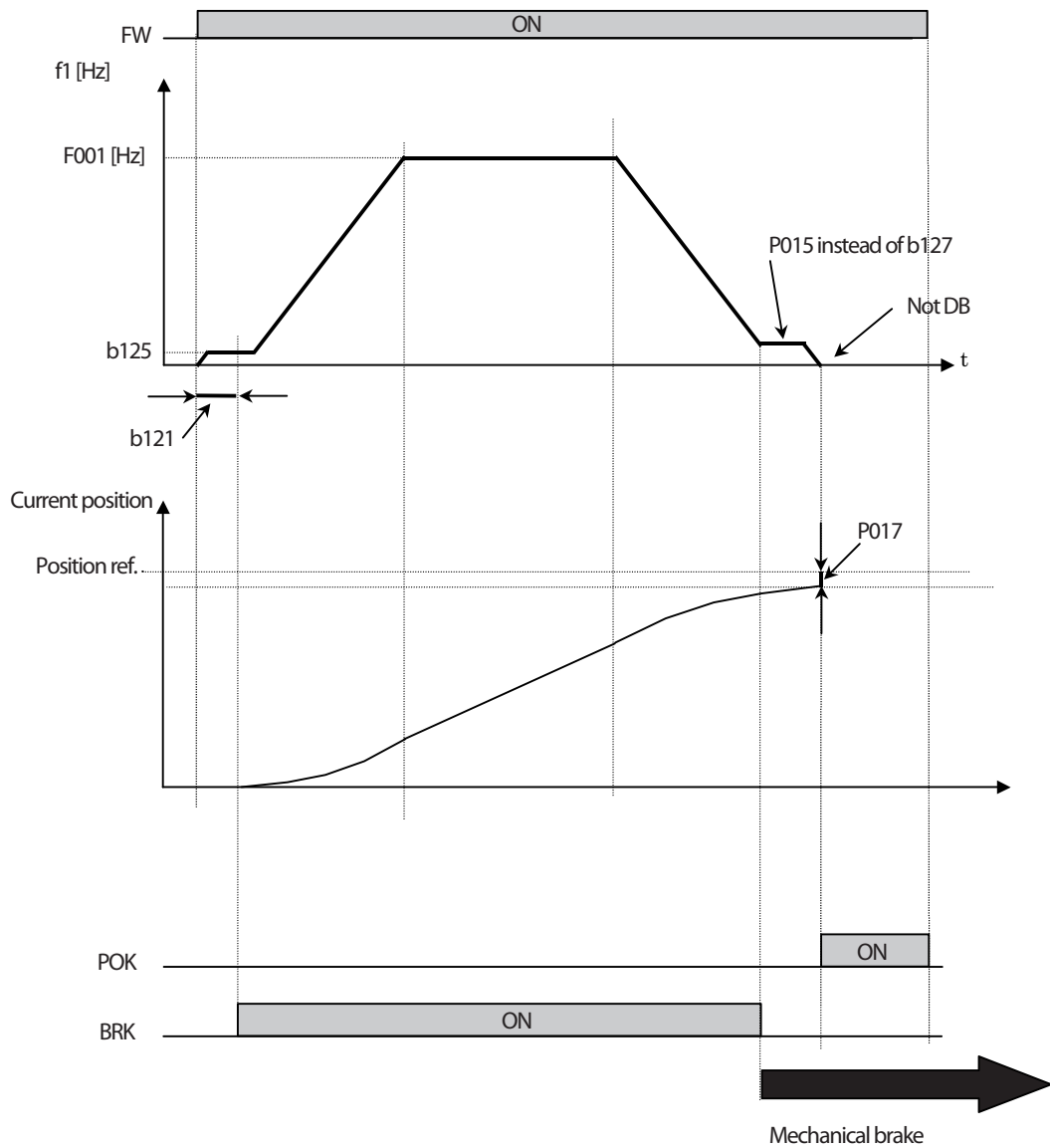
| "P" Function | | | Run Mode Edit | Defaults | |
|--------------|----------------------|-------------------------|---------------|----------|-------|
| Func. Code | Name | Setting Range | | EU | Units |
| P083 | Preset position data | -268435455 to 268435455 | ✓ | 0 | - |

3-9-10 Positioning with Brake Control

In the case of brake control significance (b120=01), close brakes with the position management end in simple position control significance (P012=02). Ignore b127 as brakes injection frequency then and apply P015 (creep speed-setting) automatically.

In the case of brake control function is enabled (b120=01) and simple positioning function is enabled (P012=02), the inverter turns Brake ON, when position management was terminated. At this time, the inverter automatically ignores (b127) and applies Creep sped setting (P015) as Brake on frequency.

In the case of the above, the DB does not operate at the time of the position management end.



3-9-11 Drive Programming User Parameter Related Settings

Please refer to SECTION 4 Operations and Monitoring on page 191 for the detailed description of the function.

| "P" Function | | | Run Mode Edit | Defaults | |
|---------------------|--|---------------------------|---------------|----------|-------|
| Func. Code | Name | Description | | EU | Units |
| P 100 ~ P 131 | Drive Program parameter U(00) to U(31) | Each set range is 0~65535 | ✓ | 0 | — |

SECTION 4

Operations and Monitoring

4-1 Introduction




The previous material in Chapter 3 gave a reference listing of all the programmable functions of the inverter. We suggest that you first scan through the listing of inverter functions to gain a general familiarity. This chapter will build on that knowledge in the following ways:

1. **Related functions** – Some parameters interact with or depend on the settings in other functions. This chapter lists “required settings” for a programmable function to serve as a cross-reference and an aid in showing how function interacts.
2. **Intelligent terminals** – Some functions rely on an input signal on a control logic connector terminal, or generate output signals in other cases.
3. **Electrical interfaces** – This chapter shows how to make connections between the inverter and other electrical devices.
4. **Auto Tuning Performance** – This chapter shows how to perform auto tuning so to achieve good performance of the motor control.
5. **Positioning Performance** – This chapter shows how to realize simple positioning by using encoder (PG) feedback.
6. **PID Loop Operation** – The MX2 has a built-in PID loop that calculates the optimal inverter output frequency to control an external process. This chapter shows the parameters and input/output terminals associated with PID loop operation.
7. **Multiple motors** – A single MX2 inverter may be used with two or more motors in some types of applications. This chapter shows the electrical connections and inverter parameters involved in multiple-motor applications.












The topics in this chapter can help you decide the features that are important to your application, and how to use them. The basic installation covered in Chapter 2 concluded with the powerup test and running the motor. Now, this chapter starts from that point and shows how to make the inverter part of a larger control or automation system.

4-1-1 Caution Messages for Operating Procedures

Before continuing, please read the following Caution messages.

-  **Caution** The heat sink fins will have a high temperature. Be careful not to touch them. Otherwise, there is the danger of getting burned.
-  **Caution** The operation of the inverter can be easily changed from low speed to high speed. Be sure to check the capability and limitations of the motor and machine before operating the inverter. Otherwise, it may cause injury to personnel.
-  **Caution** If you operate a motor at a frequency higher than the inverter standard default setting (50 Hz/60 Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage.

4-1-2 Warning Messages for Operating Procedures

-  **WARNING** Be sure to turn ON the input power supply only after closing the front case. While the inverter is energized, be sure not to open the front case. Otherwise, there is the danger of electric shock.
-  **WARNING** Be sure not to operate electrical equipment with wet hands. Otherwise, there is the danger of electric shock.
-  **WARNING** While the inverter is energized, be sure not to touch the inverter terminals even when the motor is stopped. Otherwise, there is the danger of electric shock.
-  **WARNING** If the retry mode is selected, the motor may suddenly restart after a trip stop. Be sure to stop the inverter before approaching the machine (be sure to design the machine so that safety for personnel is secure even if it restarts.) Otherwise, it may cause injury to personnel.
-  **WARNING** If the power supply is cut OFF for a short period of time, the inverter may restart operating after the power supply recovers if the Run command is active. If a restart may pose danger to personnel, so be sure to use a lock-out circuit so that it will not restart after power recovery. Otherwise, it may cause injury to personnel.
-  **WARNING** The Stop Key is effective only when the stop function is enabled. Be sure to enable the Stop Key separately from the emergency stop. Otherwise, it may cause injury to personnel.
-  **WARNING** During a trip event, if the alarm reset is applied and the Run command is present, the inverter will automatically restart. Be sure to apply the alarm reset only after verifying the Run command is OFF. Otherwise, it may cause injury to personnel.
-  **WARNING** Be sure not to touch the inside of the energized inverter or to put any conductive object into it. Otherwise, there is a danger of electric shock and/or fire.
-  **WARNING** If power is turned ON when the Run command is already active, the motor will automatically start and injury may result. Before turning ON the power, confirm that the RUN command is not present.
-  **WARNING** When the Stop key function is disabled, pressing the Stop key does not stop the inverter, nor will it reset a trip alarm.
-  **WARNING** Be sure to provide a separate, hard-wired emergency stop switch when the application warrants it.

4-2 Connecting to PLCs and Other Devices

Omron inverters (drives) are useful in many types of applications. During installation, the inverter keypad (or other programming device) will facilitate the initial configuration. After installation, the inverter will generally receive its control commands through the control logic connector or serial interface from another controlling device. In a simple application such as single-conveyor speed control, a Run/Stop switch and potentiometer will give the operator all the required control. In a sophisticated application, you may have a *programmable logic controller* (PLC) as the system controller, with several connections to the inverter.

It is not possible to cover all the possible types of application in this manual. It will be necessary for you to know the electrical characteristics of the devices you want to connect to the inverter. Then, this section and the following sections on I/O terminal functions can help you quickly and safely connect those devices to the inverter.

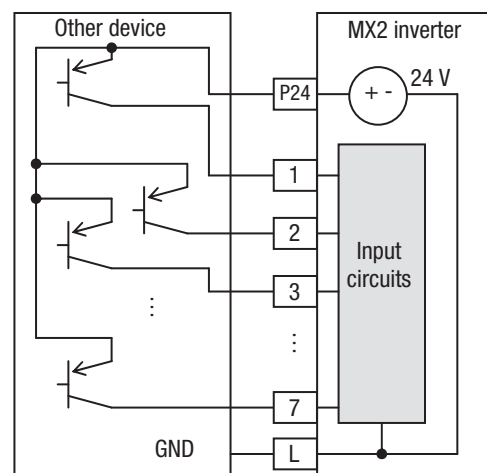
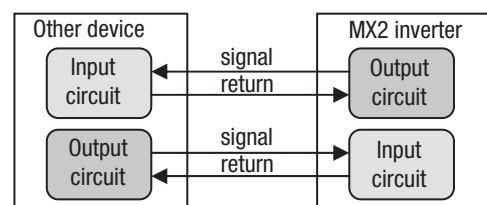
⚠ Caution It is possible to damage the inverter or other devices if your application exceeds the maximum current or voltage characteristics of a connection point.

The connections between the inverter and other devices rely on the electrical input/output characteristics at both ends of each connection, shown in the diagram to the right. The inverter's configurable inputs accept either a sourcing or sinking output from an external device (such as PLC). This chapter shows the inverter's internal electrical component(s) at each I/O terminal. In some cases, you will need to insert a power source in the interface wiring.

In order to avoid equipment damage and get your application running smoothly, we recommend drawing a schematic of each connection between the inverter and the other device. Include the internal components of each device in the schematic, so that it makes a complete circuit loop.

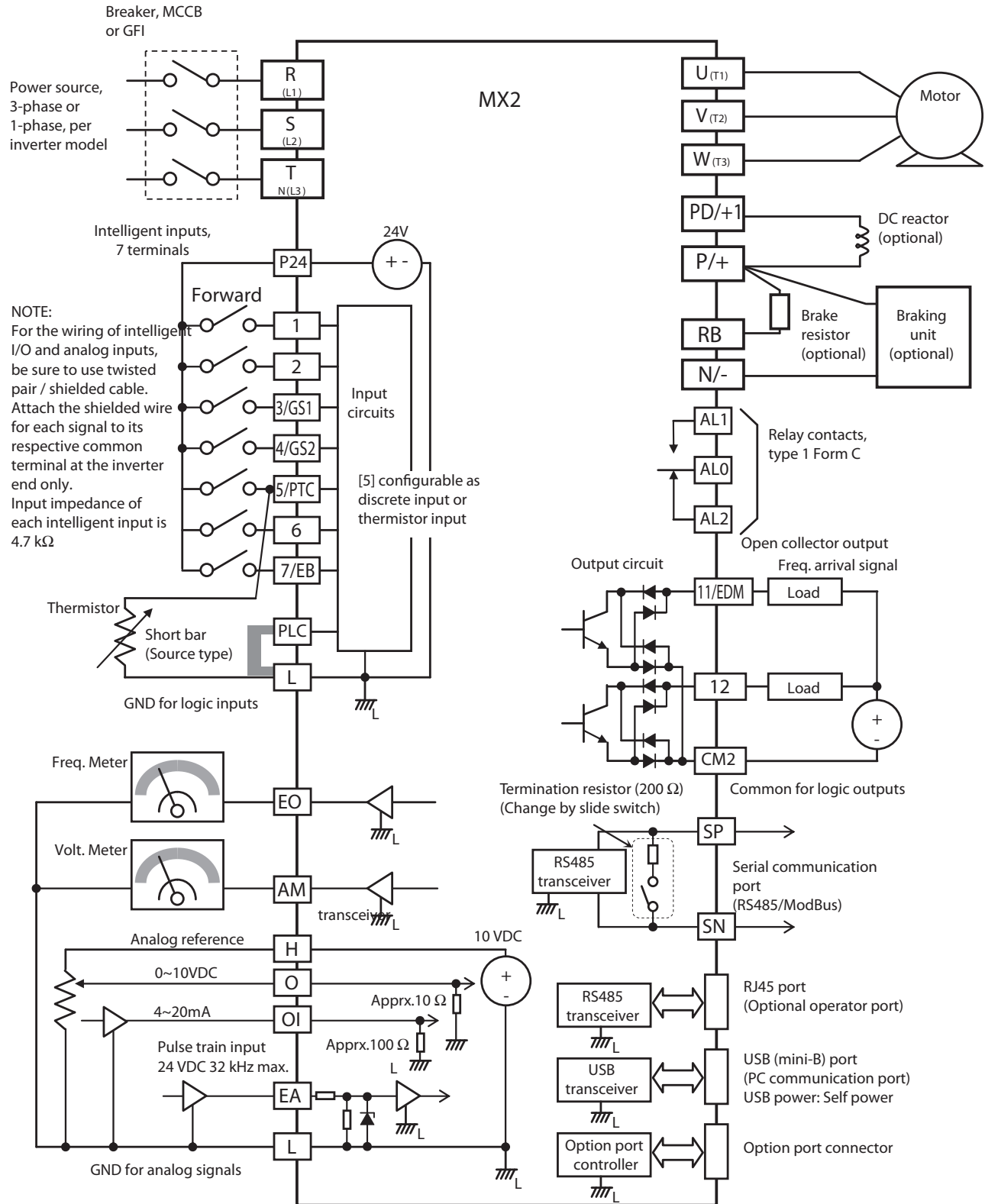
After making the schematic, then:

1. Verify that the current and voltage for each connection is within the operating limits of each device.
2. Make sure that the logic sense (active high or active low) of any ON/OFF connection is correct.
3. Check the zero and span (curve end points) for analog connections, and be sure the scale factor from input to output is correct.
4. Understand what will happen at the system level if any particular device suddenly loses power, or powers up after other devices.



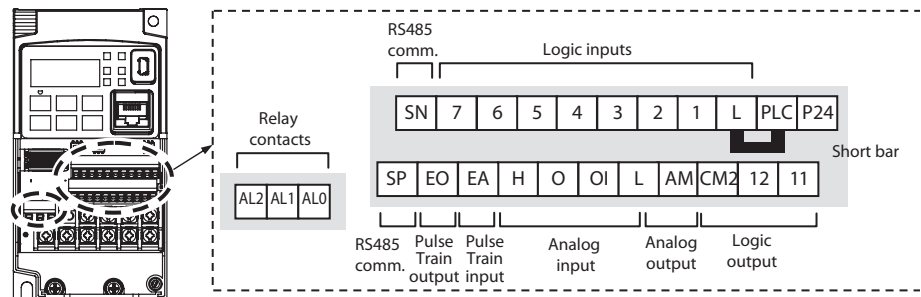
4-2-1 Example Wiring Diagram

The schematic diagram below provides a general example of logic connector wiring, in addition to basic power and motor wiring converted in Chapter 2. The goal of this chapter is to help you determine the proper connections for the various terminals shown below for your application needs.



4-3 Control Logic Signal Specifications

The control logic connectors are located just behind the front housing cover. The relay contacts are just to the left of the logic connectors. Connector labeling is shown below.



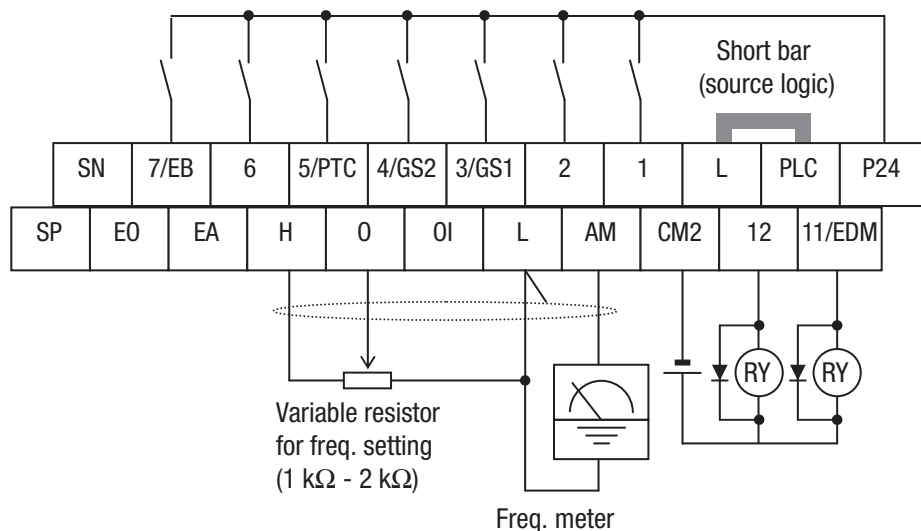
| Terminal Name | Description | Ratings |
|--|--|--|
| P24 | +24 V for logic inputs | 24 VDC, 100 mA including DI (5mA each). (do not short to terminal L) |
| PLC | Intelligent input common | Factory set: Source type (connecting [P24] to [1]~[7] turns each input ON). To change to sink type, remove the short bar between [PLC] and [L], and connect it between [P24] and [PLC]. In this case, connecting [L] to [1]~[7] makes each input ON. |
| 1 2 3/GS1 4/GS2 5/PTC 6 7/EB | Discrete logic inputs (Terminal [3],[4],[5] and [7] have dual function. See following description and related pages for the details.) | Voltage between each input and PLC ON voltage: 18 V min. OFF voltage: 3 V max. Allowable max. voltage: 27 VDC Load current: 5 mA (at 24 V) |
| GS1(3) | Safe stop input GS1 | Functionality is based on ISO13849-1 |
| GS2(4) | Safe stop input GS2 | See appendix for the details. |
| PTC(5) | Motor thermistor input | Connect motor thermistor between PTC and L terminal and assign [19:PTC] to detect the motor temperature by tripping when exceeding 3 kOhm. Set 19 in C005. |
| EB(7) | Pulse train input B | Input pulse 1.8 kHz max.* ON voltage: 18 V min. OFF voltage: 3 V max. Allowable max. voltage: 27 VDC Load current: 5 mA (at 24 V) |
| EA | Pulse train input A | Input pulse 32 kHz max. Voltage between input and L ON voltage: 4 V min. OFF voltage: 1 V max. Allowable max. voltage: 27 VDC |
| L (upper row) *1 | GND for logic inputs | Sum of input [1]~[7] currents (return) |
| 11/EDM | Discrete logic outputs [11] (Terminal [11] has dual function. See following description and related pages for the details.) | Open collector output Between each terminal and CM2 Allowable max. voltage: 27 V Allowable max. current: 50 mA |
| 12 | Discrete logic outputs [12] | Voltage drop when ON: 4 V max. In case the EDM is selected, the functionality is based on ISO13849-1 |
| CM2 | GND for logic output | 100 mA: [11], [12] current return |
| AM | Analog voltage output | 0~10 VDC 1 mA maximum |

| Terminal Name | Description | Ratings |
|----------------------|--------------------------------|---|
| EO | Pulse train output | Output pulse: 32 kHz max. Output voltage: 10 VDC Allowable max. current: 2 mA |
| L (bottom row) *2 | GND for analog signals | Sum of [OI], [O], and [H] currents (return) |
| OI | Analog current input | 0 to 20 mA range, 20 mA nominal, input impedance 100 Ω |
| O | Analog voltage input | 0 to 10 VDC range, 10 VDC nominal, input impedance 10 KΩ |
| H | +10 V analog reference | 10 VDC nominal Allowable max. current: 7 mA |
| SP, SN | Serial communication terminal | For RS485 Modbus communication Max. speed: 115.2 kbps Built-in Terminal Resistor: 200 Ω Slide switch selection |
| AL0 | Relay common contact | Max. contact capacity |
| AL1 *3 | Relay contact, normally open | AL1-AL0: 250 VAC, 2 A (resistance) 0.2 A (induction) |
| AL2 *3 | Relay contact, normally closed | AL2-AL0: 250 VAC, 1 A (resistance) 0.2 A (induction) Contact min. capacity: 100 VAC, 10 mA 5VDC, 100 mA |

* In combination with Pulse train input A it is used to check direction below 1.8 kHz.

- Note 1** The two terminals [L] are electrically connected together inside the inverter.
- Note 2** We recommend using [L] logic GND (to the right) for logic input circuits and [L] analog GND (to the left) for analog I/O circuits.
- Note 3** Default relay N.O./N.C. configuration is reversed. See 4-5-11 *Forced Operator* on page 214.

4-3-1 Wiring sample of control logic terminal (source logic)

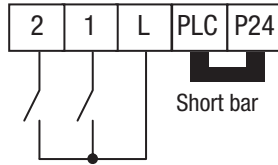


Note If relay is connected to intelligent output, install a diode across the relay coil (reverse-biased) in order to suppress the turn-off spike.

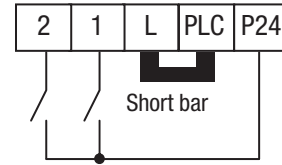
4-3-2 Sink/source logic of intelligent input terminals

Sink or source logic is switched by a short bar as below.

Sink logic

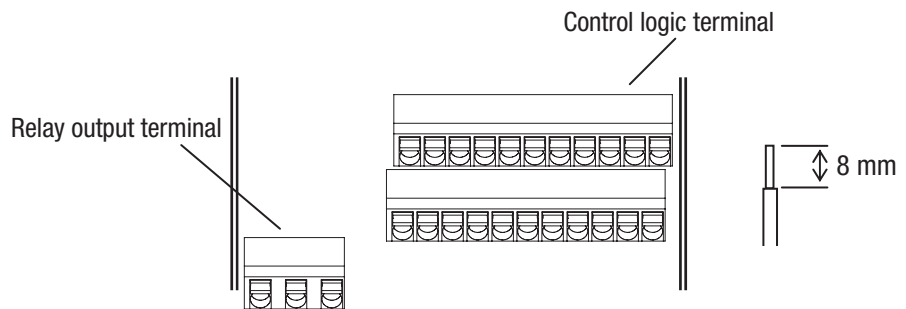


Source logic



4-3-3 Wire size for control and relay terminals

Use wires within the specifications listed below. For safe wiring and reliability, it is recommended to use ferrules, but if solid or stranded wire is used, stripping length should be 8 mm.



| | Solid mm ² (AWG) | Stranded mm ² (AWG) | Ferrule mm ² (AWG) |
|------------------------|--------------------------------|-----------------------------------|----------------------------------|
| Control logic terminal | 0.2 to 1.5 (AWG 24 to 16) | 0.2 to 1.0 (AWG 24 to 17) | 0.25 to 0.75 (AWG 24 to 18) |
| Relay terminal | 0.2 to 1.5 (AWG 24 to 16) | 0.2 to 1.0 (AWG 24 to 17) | 0.25 to 0.75 (AWG 24 to 18) |

4-3-4 Recommended ferrule

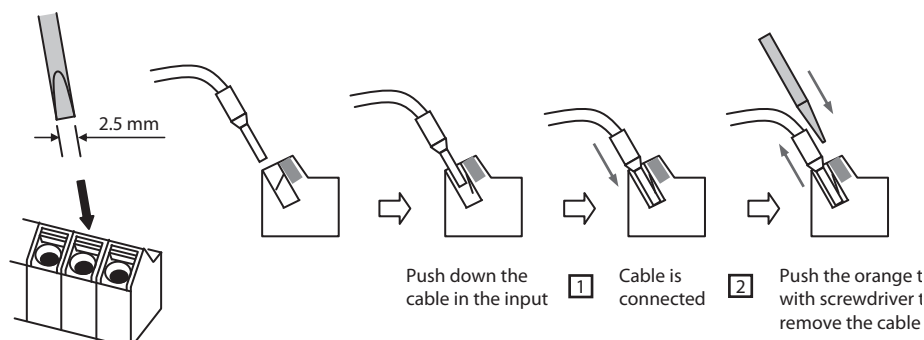
For safe wiring and reliability, it is recommended to use following ferrules.

| Wire size mm ² (AWG) | Model name of ferrule *1 | L [mm] | Φd [mm] | ΦD [mm] | |
|---------------------------------|--------------------------|--------|---------|---------|--|
| 0.25 (24) | AI 0.25-8YE | 12.5 | 0.8 | 2.0 | |
| 0.34 (22) | AI 0.34-8TQ | 12.5 | 0.8 | 2.0 | |
| 0.5 (20) | AI 0.5-8WH | 14 | 1.1 | 2.5 | |
| 0.75 (18) | AI 0.75-8GY | 14 | 1.3 | 2.8 | |

Note 1 Phoenix contact
Crimping pliers: CRIPMFOX UD 6-4 or CRIMPFOX ZA 3

4-3-5 How to connect?

1. Push down the cable in the input. Cable is connected.
2. To remove the wire push down the orange actuating lever by a slotted screwdriver (width 2.5 mm max.) Then pull out the cable while pressing the screwdriver.



4-4 Intelligent Terminal Listing

4-4-1 Intelligent Inputs

Use the following table to locate pages for intelligent input material in this chapter.

| Input Function Summary Table | | | |
|------------------------------|-------|-------------------------------------|------|
| Symbol | Code | Function Name | Page |
| FW | 00 | Forward Run/Stop | 205 |
| RV | 01 | Reverse Run/Stop | 205 |
| CF1 | 02 | Multi-step speed setting binary 1 | 96 |
| CF2 | 03 | Multi-step speed setting binary 2 | 96 |
| CF3 | 04 | Multi-step speed setting binary 3 | 96 |
| CF4 | 05 | Multi-step speed setting binary 4 | 96 |
| JG | 06 | Jogging | 99 |
| DB | 07 | External DC injection braking | 105 |
| SET | 08 | Set 2nd control | 206 |
| 2CH | 09 | 2-step acceleration/deceleration | 115 |
| FRS | 11 | Free-run stop | 207 |
| EXT | 12 | External trip | 208 |
| USP | 13 | Unattended start protection | 208 |
| CS | 14 | Commercial switch | 209 |
| SFT | 15 | Soft lock | 130 |
| AT | 16 | Analog input switching | 93 |
| RS | 18 | Reset | 210 |
| PTC | 19 | PTC thermistor Thermal Protection | 211 |
| STA | 20 | 3-wire start | 212 |
| STP | 21 | 3-wire stop | 212 |
| F/R | 22 | 3-wire forward/reverse | 212 |
| PID | 23 | PID enabled/disabled | 109 |
| PIDC | 24 | PID integral reset | 109 |
| UP | 27 | UP/DWN function accelerated | 213 |
| DWN | 28 | UP/DWN function decelerated | 213 |
| UDC | 29 | UP/DWN function data clear | 213 |
| OPE | 31 | Forced operator | 214 |
| SF1~SF7 | 32~38 | Multi-step speed setting bit 1 to 7 | 96 |

| Input Function Summary Table | | | |
|------------------------------|-------|--|----------|
| Symbol | Code | Function Name | Page |
| OLR | 39 | Overload limit switching | 128 |
| TL | 40 | Torque limit enabled | 137, 215 |
| TRQ1 | 41 | Torque limit switching 1 | 137, 215 |
| TRQ2 | 42 | Torque limit switching 2 | 137, 215 |
| BOK | 44 | Brake confirmation | 147, 215 |
| LAC | 46 | LAD cancel | 216 |
| PCLR | 47 | Position deviation clear | 157 |
| ADD | 50 | Frequency addition | 217 |
| F-TM | 51 | Forced terminal block | 218 |
| ATR | 52 | Torque command input permission | 180 |
| KHC | 53 | Integrated power clear | 142 |
| MI1~MI7 | 56~62 | Drive programming input 1 to 7 | 219 |
| AHD | 65 | Analog command held | 220 |
| CP1~CP3 | 66~68 | Position command selection 1 to 3 | 186, 221 |
| ORL | 69 | Zero return limit signal | 187, 222 |
| ORG | 70 | Zero return startup signal | 187, 222 |
| SPD | 73 | Speed/position switching | 187, 223 |
| GS1 | 77 | STO1 input (Safety related signal) | 223 |
| GS2 | 78 | STO2 input (Safety related signal) | 223 |
| 485 | 81 | Starting communication signal | 314 |
| PRG | 82 | Drive program start | 223 |
| HLD | 83 | Retain output frequency | 108, 224 |
| ROK | 84 | Permission of Run command | 224 |
| EB | 85 | Rotation direction detection (phase B) | 179 |
| DISP | 86 | Display limitation | 224 |
| NO | 255 | No allocation | - |

4-4-2 Intelligent Outputs

Use the following table to locate pages for intelligent output material in this chapter.

| Input Function Summary Table | | | |
|------------------------------|------|-----------------------------------|----------|
| Symbol | Code | Function Name | Page |
| RUN | 00 | Run Signal | 228 |
| FA1 | 01 | Constant speed arrival signal | 164, 229 |
| FA2 | 02 | Over set frequency arrival signal | 164, 229 |
| OL | 03 | Overload warning | 164, 231 |
| OD | 04 | Excessive PID deviation | 165, 232 |
| AL | 05 | Alarm output | 233 |
| FA3 | 06 | Set-frequency-only arrival signal | 229 |
| OTQ | 07 | Overtorque | 165, 235 |
| UV | 09 | Signal during undervoltage | 235 |
| TRQ | 10 | Torque limit | 138, 236 |
| RNT | 11 | RUN time over | 132, 236 |
| ONT | 12 | Power ON time over | 132, 236 |
| THM | 13 | Thermal warning | 127, 237 |
| BRK | 19 | Brake release | 148, 237 |
| BER | 20 | Brake error | 147, 237 |
| ZS | 21 | 0 Hz signal | 238 |
| DSE | 22 | Excessive speed deviation | 183, 239 |
| POK | 23 | Position ready | 183, 239 |

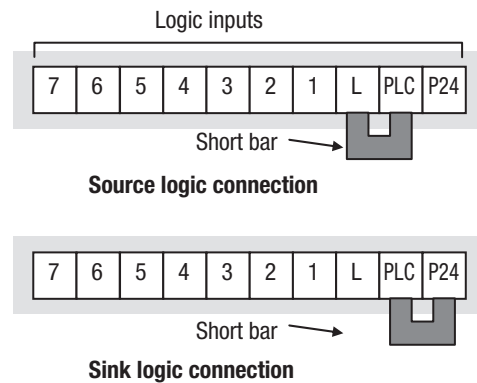
| Input Function Summary Table | | | |
|------------------------------|-------|--|----------|
| Symbol | Code | Function Name | Page |
| FA4 | 24 | Set frequency exceeded 2 | 229 |
| FA5 | 25 | Set frequency only 2 | 229 |
| OL2 | 26 | Overload warning 2 | 231 |
| ODc | 27 | Analog O disconnection detection | 240 |
| OIDc | 28 | Analog OI disconnection detection | 240 |
| FBV | 31 | PID FB status output | 241 |
| NDc | 32 | Network error | 243 |
| LOG1~3 | 33~35 | Logic operation output 1 to 3 | 170, 244 |
| WAC | 39 | Capacitor life warning signal | 245 |
| WAF | 40 | Cooling fan life warning signal | 245 |
| FR | 41 | Starting contact signal | 245 |
| OHF | 42 | Fin overheat warning | 165, 246 |
| LOC | 43 | Light load detection signal | 164, 246 |
| MO1~3 | 44~46 | Drive programming output 1 to 3 | 246 |
| IRDY | 50 | Operation ready signal | 247 |
| FWR | 51 | Forward run signal | 247 |
| RVR | 52 | Reverse run signal | 247 |
| MJA | 53 | Fatal fault signal | 248 |
| WCO | 54 | Window comparator O | 141, 248 |
| WCOI | 55 | Window comparator OI | 141, 248 |
| FREF | 58 | Frequency Command Source | 248 |
| REF | 59 | Run Command Source | 248 |
| SETM | 60 | 2nd motor in operation | 249 |
| EDM | 62 | STO (Safe Torque Off) Performance Monitor (Output terminal 11 only) | 249 |
| OPO | 63 | Option board output | - |
| no | 255 | Not used | - |

4-5 Using Intelligent Input Terminals

Terminals [1], [2], [3], [4], [5], [6] and [7] are identical, programmable inputs for general use. The input circuits can use the inverter's internal (isolated) +24 V field supply or an external power supply. This section describes input circuits operation and how to connect them properly to switches or transistor outputs on field devices.

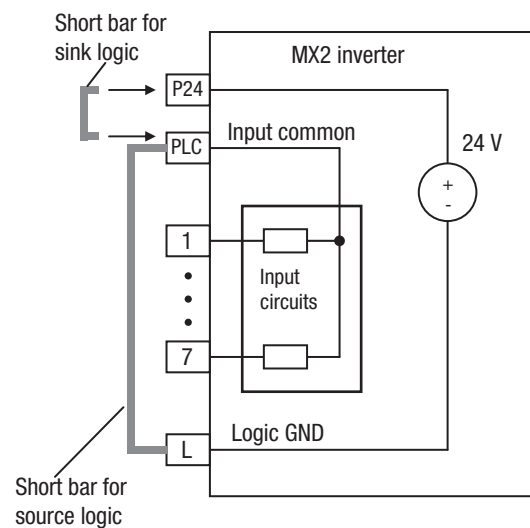
The MX2 inverter features selectable *sinking* or *sourcing* inputs. These terms refer to the connection to the external switching device—it either *sinks* current (from the input to GND) or *sources* current (from a power source) into the input. Note that the sink/source naming convention may be different in your particular country or industry. In any case, just follow the wiring diagrams in this section for your application.

The inverter has a short bar (jumper) for configuring the choice of sinking or sourcing inputs. To access it, you must remove the front cover of the inverter housing. In the figure to the top right, the short bar is shown as attached to the logic terminal block (connector). Originally is located as source type logic. If you need to change to the sink type connection, remove the short bar and connect it as shown in the figure at the bottom right.



Caution Be sure to turn OFF power to the inverter before changing the short circuit bar position. Otherwise, damage to the inverter circuitry may occur.

[PLC] Terminal Wiring – The [PLC] terminal (Programmable Logic Control terminal) is named to include various devices that can connect to the inverter's logic inputs. In the figure to the right, note the [PLC] terminal and the short bar (jumper). Locating the short bar between [PLC] and [L] sets the input logic source type, which is the default setting. In this case, you connect input terminal to [P24] to make it active. If instead you locate the short bar between [PLC] and [P24], the input logic will be sink type. In this case, you connect the input terminal to [L] to make it active.

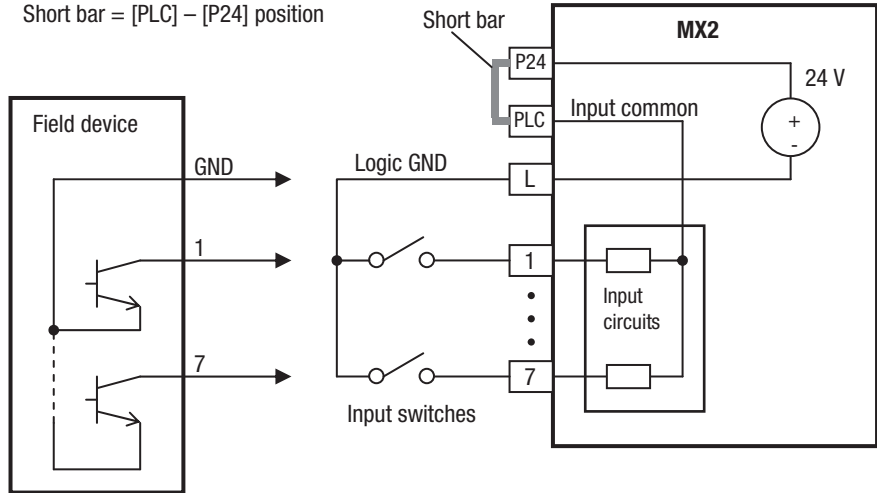


The wiring diagram on the following pages show the four combinations of using sourcing or sinking inputs, and using the internal or an external DC supply.

The two diagrams below input wiring circuits using the inverter's internal +24 V supply. Each diagram shows the connection for simple switches, or for a field device with transistor outputs. Note that in the lower diagram, it is necessary to connect terminal [L] only when using the field device with transistors. Be sure to use the correct connection of the short bar shown for each wiring diagram.

Sinking Inputs, Internal Supply

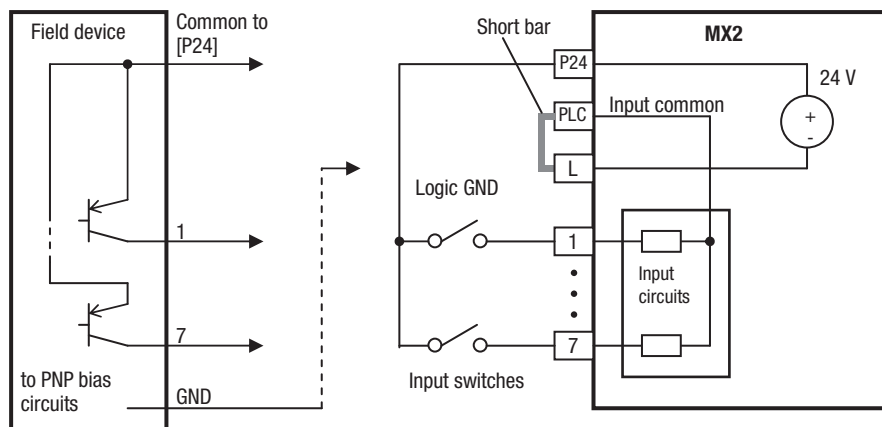
Short bar = [PLC] – [P24] position



Open collector outputs,
NPN transistors

Sourcing Inputs, Internal Supply

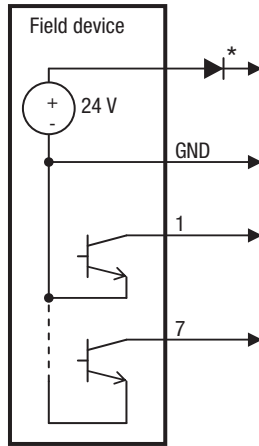
Short bar = [PLC] – [L] position



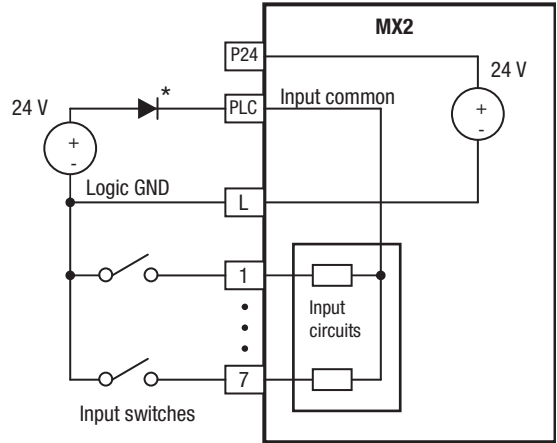
PNP transistor
sourcing outputs

The two diagrams below show input wiring circuits using an external supply. If using the “Sinking Inputs, External Supply” in below wiring diagram, be sure to remove the short bar, and use a diode (*) with the external supply. This will prevent a power supply contention in case the short bar is accidentally placed in the incorrect position. For the “Sourcing Inputs, External Supply”, please connect the short bar as drawn in the diagram below.

Sinking Inputs, External Supply
Short bar = Removed

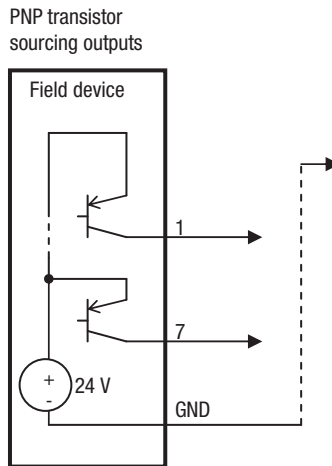


Open collector outputs, NPN transistors

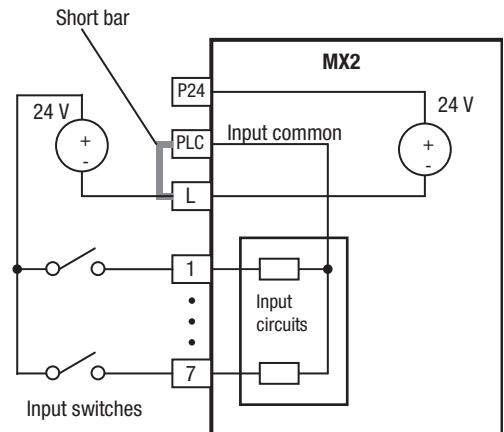


* Note: If the external power supply to GND is (optionally) connected to [L], then install the above diode.

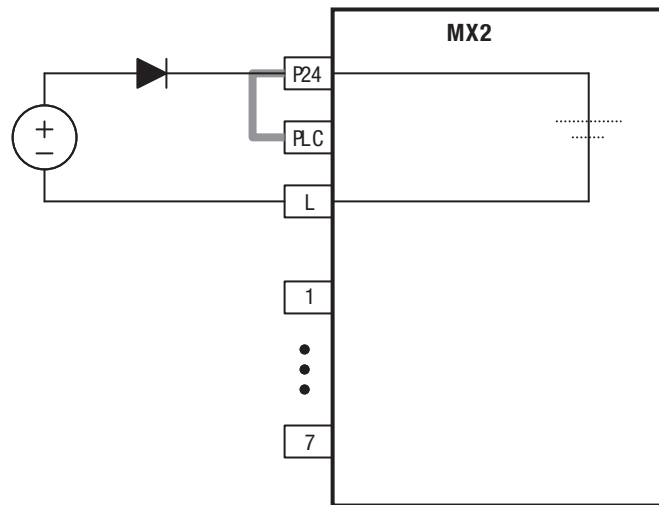
Sourcing Inputs, External Supply
Short bar = [PLC] – [L]



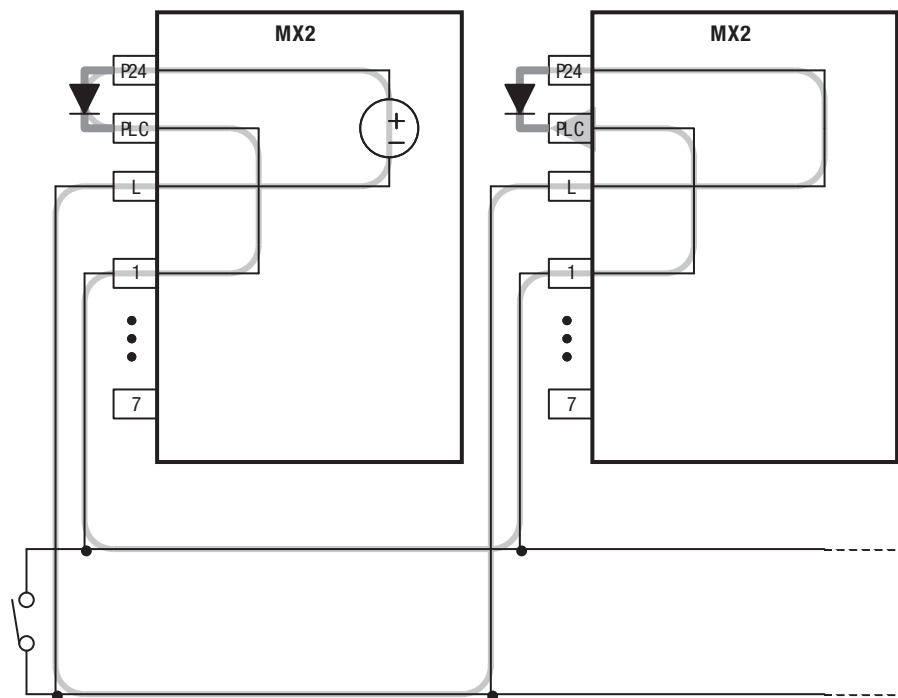
PNP transistor sourcing outputs



The power to the inverter control part can be supplied externally as shown below. Except driving motor, it is possible read and write the parameters by keypad and via communication even the drive itself is not powered.

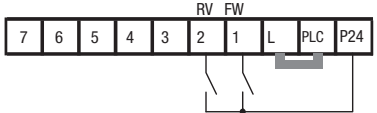


By having ability inverter doesn't block the current flowing into itself when it is not powered. This may cause the closed circuit when two or more inverters are connected to common I/O wiring as shown below to result in unexpected turning the on the input. To avoid this closed circuit, please put the diode (rated: 50 V/0.1 A) in the path as described below.



4-5-1 Forward Run/Stop and Reverse Run/Stop Commands:

When you input the Run command via the terminal [FW], the inverter executes the Forward Run command (high) or Stop command (low). When you input the Run command via the terminal [RV], the inverter executes the Reverse Run command (high) or Stop command (low).

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|------------------|-------|---|
| 00 | FW | Forward Run/Stop | ON | Inverter is in Run Mode, motor runs forward |
| | | | OFF | Inverter is in Stop Mode, motor stops |
| 01 | RV | Reverse Run/Stop | ON | Inverter is in Run Mode, motor runs reverse |
| | | | OFF | Inverter is in Stop Mode, motor stops |
| Valid for inputs: | | C001~C007 | | Example (default input configuration shown – see page 153) |
| Required settings: | | A002 = 01 | | |
| Notes: | | | |  <p>See I/O specs on page 195.</p> |
| <ul style="list-style-type: none"> When the Forward Run and Reverse Run commands are active at the same time, the inverter enters the Stop Mode. When a terminal associated with either [FW] or [RV] function is configured for <i>normally closed</i>, the motor starts rotation when that terminal is disconnected or otherwise has no input voltage. | | | | |

Note The parameter F004, Keypad Run Key Routing, determines whether the single Run key issues a Run FWD command or Run REV command. However, it has no effect on the [FW] and [RV] input terminal operation.

⚠ WARNING If the power is turned ON and the Run command is already active, the motor starts rotation and is dangerous! Before turning power ON, confirm that the Run command is not active.

4-5-2 Set Second Motor, Special Set

If you assign the [SET] function to an intelligent input terminal, you can select between two sets of motor parameters. The second parameters store an alternate set of motor characteristics. When the terminal [SET] is turned ON, the inverter will use the second set of parameters to generate the frequency output to the motor. When changing the state of the [SET] input terminal, the change will not take effect until the inverter is stopped.

When you turn ON the [SET] input, the inverter operates per the second set of parameters. When the terminal is turned OFF, the output function returns to the original settings (first set of motor parameters). Refer to “Configuring the Inverter for Multiple Motors” on page 172 for details.

| Parameters | SET | | Parameters | SET | |
|------------|------|-----|-------------------------|------|-----|
| | Stop | Run | | Stop | Run |
| F002/F202 | | | R093/R293 | ✓ | – |
| F003/F203 | ✓ | – | R094/R294 | ✓ | – |
| R001/R201 | ✓ | – | R095/R295 | ✓ | – |
| R002/R202 | ✓ | – | R096/R296 | ✓ | – |
| R003/R203 | ✓ | – | b012/b212 | ✓ | – |
| R004/R204 | ✓ | – | b013/b213 | ✓ | – |
| R020/R220 | ✓ | – | b021/b221 | ✓ | – |
| R041/R241 | ✓ | – | b022/b222 | ✓ | – |
| R042/R242 | ✓ | – | b023/b223 | ✓ | – |
| R043/R243 | ✓ | – | C041/C241 | ✓ | – |
| R044/R244 | ✓ | – | H002/H202 | ✓ | – |
| R045/R245 | ✓ | – | H003/H203 | ✓ | – |
| R046/R246 | ✓ | – | H004/H204 | ✓ | – |
| R047/R247 | ✓ | – | H005/H205 | ✓ | – |
| R061/R261 | ✓ | – | H006/H206 | ✓ | – |
| R062/R262 | ✓ | – | H020~H024/ H220~H224 | ✓ | – |
| R081/R281 | ✓ | – | | ✓ | – |
| R082/R282 | ✓ | – | H030~H034/ H230~H234 | ✓ | – |
| R092/R292 | ✓ | – | | ✓ | – |

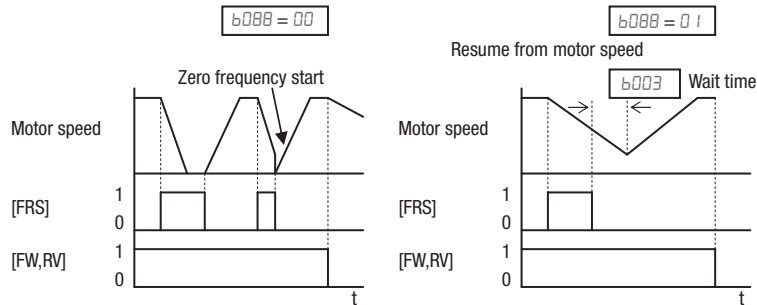
| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|--|
| 08 | SET | Set (2nd control) | ON | causes the inverter to use the 2nd set of motor parameters for generating the frequency output to motor |
| | | | OFF | causes the inverter to use the 1st (main) set of motor parameters for generating the frequency output to motor |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | (none) | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> If the terminal state is changed while the inverter is running, the inverter continues using the current set of parameters until the inverter is stopped. | | | | |

4-5-3 Free-run Stop

When the terminal [FRS] is turned ON, the inverter stops the output and the motor enters the free-run state (coasting). If terminal [FRS] is turned OFF, the output resumes sending power to the motor if the Run command is still active. The free-run stop feature works with other parameters to provide flexibility in stopping and starting motor rotation.

In the figure below, parameter *b088* selects whether the inverter resumes operation from 0 Hz (left graph) or the current motor rotation speed (right graph) when the [FRS] terminal turns OFF. The application determines the best setting.

Parameter *b003* specifies a delay time before resuming operation from a free-run stop. To disable this feature, use a zero delay time.

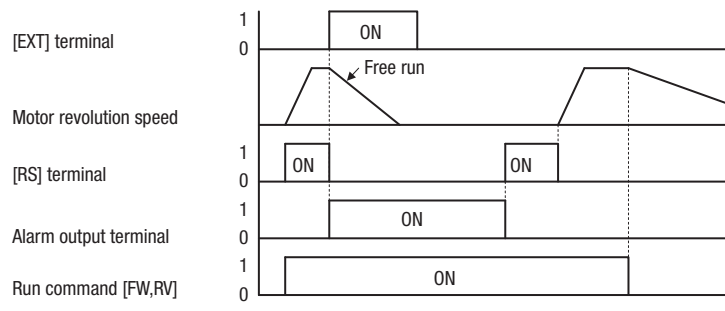


| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|----------------------------|-------|---|
| 11 | FRS | Free-run stop | ON | Causes output to turn OFF, allowing motor to free run (coast) to stop |
| | | | OFF | Output operates normally, so controlled deceleration and stops motor |
| Valid for inputs: | | C00 1~C00 7 | | |
| Required settings: | | b003, b088, C0 11 to C0 17 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> When you want the [FRS] terminal to be active low (normally closed logic), change the setting (C0 11 to C0 17) that corresponds to the input (C00 1 to C00 7) that is assigned the [FRS] function. | | | | |

4-5-4 External Trip

When the terminal [EXT] is turned ON, the inverter enters the trip state, indicates error code $E\ i2$, and stops the output. This is a general purpose interrupt type feature, and the meaning of the error depends on what you connect to the [EXT] terminal. Even if the [EXT] input is turned OFF, the inverter remains in the trip state. You must reset the inverter or cycle power to clear the error, returning the inverter to the Stop Mode.

In the graph below, the [EXT] input turns ON during normal Run Mode operation. The inverter lets the motor free-run to a stop, and the alarm output turns ON immediately. When the operator initiates a Reset command, the alarm and error are cleared. When the Reset is turned OFF, the motor begins rotation since the Run command is already active.



| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---------------|-------|---|
| $i2$ | EXT | External trip | ON | When assigned input transitions OFF to ON, inverter latches trip event and displays $E\ i2$ |
| | | | OFF | No trip event for ON to OFF, any recorded trip events remain in history until Reset. |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | (none) | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> If the USP (Unattended Start Protection) feature is in use, the inverter will not automatically restart after canceling the EXT trip event. In that case, it must receive either another Run command (OFF-to- ON transition), a keypad Reset command, or an [RS] intelligent terminal input signal. | | | | |

4-5-5 Unattended Start Protection

If the Run command is already set when power is turned ON, the inverter starts running immediately after powerup. The Unattended Start Protection (USP) function prevents that automatic startup, so that the inverter will not run without outside intervention. When USP is active and you need to reset an alarm and resume running, either turn the Run command OFF, or perform a reset operation by the terminal [RS] input or the keypad Stop/reset key.

In the figure below, the [USP] feature is enabled. When the inverter power turns ON, the motor does not start, even though the Run command is already active. Instead, it enters the USP trip state, and displays $E\ i3$ error code. This requires outside intervention to reset the alarm by turning OFF the Run com-

mand per this example (or applying a reset). Then the Run command can turn ON again and start the inverter output.



| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-----------------------------|-------|--|
| E13 | USP | Unattended Start Protection | ON | On powerup, the inverter will not resume a Run command |
| | | | OFF | On powerup, the inverter will resume a Run command that was active before power loss |
| Valid for inputs: | | E001~E007 | | |
| Required settings: | | (none) | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> Note that when a USP error occurs and it is canceled by a reset from a [RS] terminal input, the inverter restarts running immediately. Even when the trip state is canceled by turning the terminal [RS] ON and OFF after an under voltage protection E09 occurs, the USP function will be performed. When the running command is active immediately after the power is turned ON, a USP error will occur. When this function is used, wait for at least 3 seconds after the powerup to generate a Run command. | | | | |

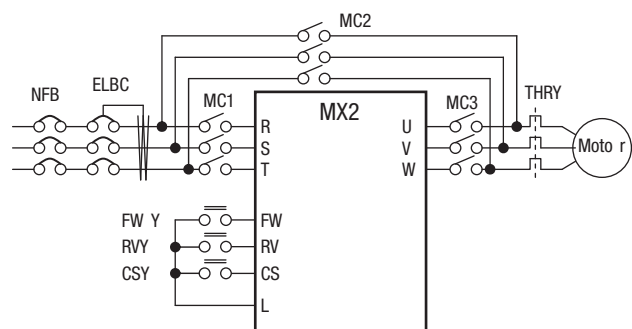
4-5-6 Commercial switch

The commercial power source switching function allows you to switch the power supply (between the inverter and commercial power supply) to your system of which the load causes a considerable moment of inertia. You can use the inverter to accelerate and decelerate the motor in the system and the commercial power supply to drive the motor for constant speed operation.

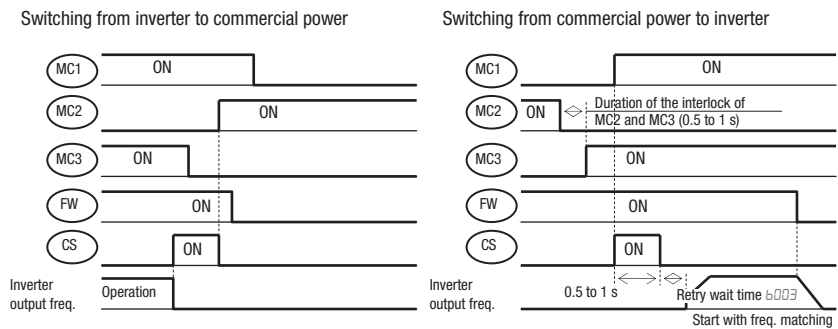
To use this function, assign parameter "14 (CS)" to one of the intelligent input terminal [1] to [7] (E001 to E007). When the CS is turned OFF with an operation command is being given, the inverter waits for the retry wait time before motor starts (b003), adjusts the output frequency to the speed of the free-running motor, and then accelerates the motor with the adjusted frequency.

Mechanically interlock the MC3 and MC2 contacts with each other. Otherwise you may damage the drive.

If the earth leakage breaker (ELB) trips because of a ground fault, the commercial power will be disabled. Therefore, contact a backup power supply from the commercial power line circuit (ELBC) to your system if needed.



Use weak-current type relays for FWY, RVY, and CSY. The figures below show the sequence and timing of operations for reference.



If the inverter trips because of overcurrent when it starts the motor with frequency matching, increase the retry wait time before motor starts (b003).

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|-------------|
| 14 | CS | Commercial switch | ON | |
| | | | OFF | |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | b003, b007 | | |
| Notes: | | | | |
| inverter may start the motor with 0 Hz if: | | | | |
| <ul style="list-style-type: none"> the motor speed is no more than half of the base frequency, or the voltage induced on the motor is attenuated quickly. | | | | |

4-5-7 Reset

The [RS] terminal causes the inverter to execute the reset operation. If the inverter is in Trip Mode, the reset cancels the Trip state. When the signal [RS] is turned ON and OFF, the inverter executes the reset operation.

⚠ WARNING After the Reset command is given and the alarm reset occurs, the motor will restart suddenly if the Run command is already active. Be sure to set the alarm reset after verifying that the Run command is OFF to prevent injury to personnel.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------|-------|---|
| 18 | RS | Reset | ON | The motor output is turned OFF, the Trip Mode is cleared (if it exists), and powerup reset is applied |
| | | | OFF | Normal power ON operation |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | (none) | | |

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---------------|-------|-------------|
| Notes: | | | | |
| <ul style="list-style-type: none"> While the control terminal [RS] input is ON, the keypad displays alternating segments. After RS turns OFF, the display recovers automatically. Pressing the Stop/Reset key of the digital operator can generate a reset operation only when an alarm occurs. A terminal configured with the [RS] function can only be configured for normally open operation. The terminal cannot be used in the normally closed contact state. When input power is turned ON, the inverter performs the same reset operation as it does when a pulse on the [RS] terminal occurs. The Stop/Reset key on the inverter is only operational for a few seconds after inverter powerup when a hand-held remote operator is connected to the inverter. If the [RS] terminal is turned ON while the motor is running, the motor will be free running (coasting). If you are using the output terminal OFF delay feature (any of $\text{C } 145, \text{C } 147, \text{C } 149 > 0.0 \text{ sec.}$), the [RS] terminal affects the ON-to-OFF transition slightly. Normally (without using OFF delays), the [RS] input causes the motor output and the logic outputs to turn OFF together, immediately. However, when any output uses an OFF delay, then after the [RS] input turns ON, that output will remain ON for an additional 1 sec. period (approximate) before turning OFF. | | | | |

4-5-8 Thermistor Thermal Protection

Motors that are equipped with a thermistor can be protected from overheating. Input terminal [5] has the unique ability to sense a thermistor resistance. When the resistance value of the thermistor connected to terminal [PTC] (5) and [L] is more than $3 \text{ k}\Omega \pm 10\%$, the inverter enters the Trip Mode, turns OFF the output to the motor, and indicates the trip status $\text{E}35$. Use this function to protect the motor from overheating.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|-------------------------------|-------|---|
| 19 | PTC | Thermistor Thermal Protection | ON | When a thermistor is connected to terminals [5] and [L], the inverter checks for over-temperature and will cause trip ($\text{E}35$) and turn OFF the output to the motor |
| | | | OFF | An open circuit in the thermistor causes a trip, and the inverter turns OFF the output |
| Valid for inputs: | | C001 only | | Example (requires input configuration – see page 153): |
| Required settings: | | (none) | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> Be sure the thermistor is connected to terminals [5] and [L]. If the resistance is above the threshold the inverter will trip. When the motor cools down enough, the thermistor resistance will change enough to permit you to clear the error. Press the STOP/Reset key to clear the error. | | | | |

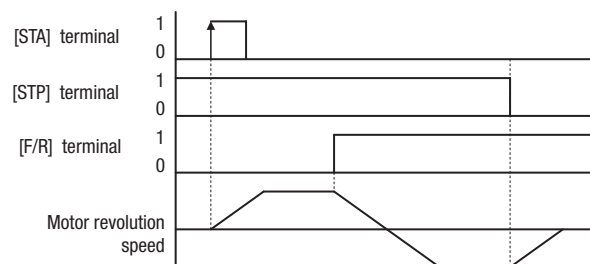
4-5-9 Three-wire Interface Operation

The 3-wire interface is an industry standard motor control interface. This function uses two inputs for momentary contact start/stop control, and a third for selecting forward or reverse direction. To implement the 3-wire interface, assign 20 [STA] (Start), 21 [STP] (Stop), and 22 [F/R] (Forward/Reverse) to three of the intelligent input terminals. Use a momentary contact for Start and Stop. Use a selector switch, such as SPST for the Forward/Reverse input. Be sure to set the operation command selection $ADD2=01$ for input terminal control of motor.

If you have a motor control interface that needs logic-level control (rather than momentary pulse control), use the [FW] and [RV] inputs instead.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|------------------------|-------|---|
| 20 | STA | 3-wire start | ON | Start motor rotation on momentary contact (uses acceleration profile) |
| | | | OFF | No change to motor operation |
| 21 | STP | 3-wire stop | ON | No change to motor operation |
| | | | OFF | Stop motor rotation on momentary contact (use deceleration profile) |
| 22 | F/R | 3-wire forward/reverse | ON | Select reverse direction of rotation |
| | | | OFF | Select forward direction of rotation |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | $ADD2 = 01$ | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The STP logic is inverted. Normally the switch will be closed, so you open the switch to stop. In this way, a broken wire causes the motor to stop automatically (safe design). When you configure the inverter for 3-wire interface control, the dedicated [FW] terminal is automatically disabled. The [RV] intelligent terminal assignment is also disabled. | | | | |

The diagram below shows the use of 3-wire control. STA (Start Motor) is an edge-sensitive input; an OFF-to-ON transition gives the Start command. The control of direction is level-sensitive, and the direction may be changed at any time. STP (Stop Motor) is also a level-sensitive input.

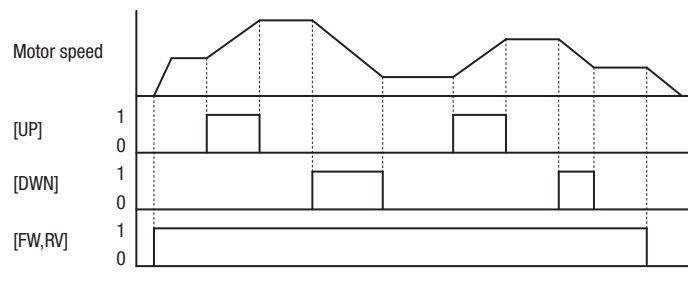


4-5-10 Remote Control Up and Down Functions

The [UP] [DWN] terminal functions can adjust the output frequency for remote control while the motor is running. The acceleration time and deceleration time of this function is same as normal operation ACC1 and DEC1 (2ACC1, 2DEC1). The input terminals operate according to these principles:

- Acceleration - When the [UP] contact is turned ON, the output frequency accelerates from the current value. When it is turned OFF, the output frequency maintains its current value at that moment.
- Deceleration - When the [DWN] contact is turned ON, the output frequency decelerates from the current value. When it is turned OFF, the output frequency maintains its current value at that moment.

In the graph below, the [UP] and [DWN] terminals activate while the Run command remains ON. The output frequency responds to the [UP] and [DWN] commands.



It is possible for the inverter to retain the frequency set from the [UP] and [DWN] terminals through a power loss. Parameter $C101$ enables/disables the memory. If disabled, the inverter retains the last frequency before an UP/DWN adjustment. Use the [UDC] terminal to clear the memory and return to the original set output frequency.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-----------------------------|-------|---|
| 27 | UP | UP/DWN function accelerated | ON | Accelerates (increases output frequency) motor from current frequency |
| | | | OFF | Output to motor operates normally |
| 28 | DWN | UP/DWN function decelerated | ON | Decelerates (decreases output frequency) motor from current frequency |
| | | | OFF | Output to motor operates normally |
| 29 | UDC | UP/DWN function data clear | ON | Clears the Up/Down frequency memory |
| | | | OFF | No effect on Up/Down memory |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | A001 = 02 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> • This feature is available only when the frequency command source is programmed for operator control. Confirm A001 is set to 02. • This function is not available when [JG] is in use. • The range of output frequency is 0 Hz to the value in A004 (maximum frequency setting). • This setting modifies the inverter speed from using F001 output frequency setting as a starting point. | | | | |

4-5-11 Forced Operator

This function permits a digital operator interface to override the following two settings in the inverter:

- *ADD 1* - Frequency reference selection
- *ADD 2* - RUN command selection

When using the [OPE] terminal input, typically *ADD 1* and *ADD 2* are configured for sources other than the digital operator interface for the output frequency and Run command sources, respectively. When the [OPE] input is ON, then user has immediate command of the inverter, to start or stop the motor and to set the speed.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|--|-------|---|
| 31 | OPE | Forced operator | ON | Forces the operator interface to override: <i>ADD 1</i> – Frequency Source Setting, and <i>ADD 2</i> – Run Command Source Setting |
| | | | OFF | Parameters <i>ADD 1</i> and <i>ADD 2</i> are in effect again, for the frequency source and the Run command source, respectively |
| Valid for inputs: | | <i>COO 1</i> ~ <i>COO 7</i> | | |
| Required settings: | | <i>ADD 1</i> (set not equal to 00) <i>ADD 2</i> (set not equal to 02) | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> • When changing the [OPE] state during Run Mode (inverter is driving the motor), the inverter will stop the motor before the new [OPE] state takes effect. • If the [OPE] input turns ON and the digital operator gives a Run command while the inverter is already running, the inverter stops the motor. Then the digital operator can control the motor. | | | | |

4-5-12 Overload Limit Switching

The inverter monitors the motor current during acceleration or constant speed operation and lowers output frequency automatically when the motor current reaches to the overload limit level.

This function prevents an overcurrent trip caused by excessive moment of inertia during acceleration, or caused by sporadic load fluctuations during constant speed operation.

You can set 2 types of overload limit functions in b021/b022/b023 and b024/b025/b026.

To switch between b021/b022/b023 and b024/b025/b026, allocate “39: OLR” to a multi-function input terminal and then turn it ON/OFF.

The overload limit level sets a current value for this function to work.

The overload limit parameter sets a time of deceleration from the maximum frequency to 0 Hz.

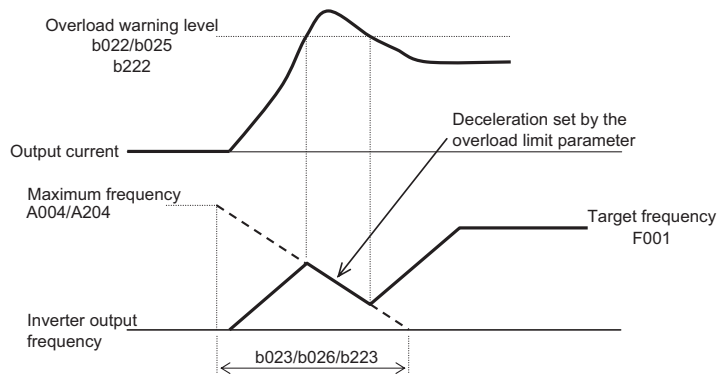
When this function operates while the Inverter is accelerating, the acceleration time becomes longer than the set time.

When the selected control method is sensorless vector control and “03: Enabled during acceleration/constant speed (accelerated during regeneration)” is selected for b021/b024, the frequency will increase if current exceeding the overload limit level flows during regeneration operation.

If the setting of Overload Limit Parameter b023/b026 is too small, an overvoltage trip may occur because of regenerative energy from the motor even during acceleration. This is due to automatic deceleration under this function.

Make the following adjustments if this function operates during acceleration and the frequency doesn't reach the target level.

- Increase the acceleration time.
- Increase the overload limit level (b022/b025).



| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--------------------------|-------|------------------------------|
| 39 | OLR | Overload limit switching | ON | Perform overload restriction |
| | | | OFF | Normal operation |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | b02 1~b026, b22 1~b223 | | |

4-5-13 Torque Limit Enabled

This function is to select the torque limit mode. (Please refer to chapter 3 for the detailed description of the function.)

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|----------------------|-------|---------------------------------|
| 40 | TL | Torque limit enabled | ON | b040 value is enabled as torque |
| | | | OFF | b040 value is disabled |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | b040~b044 | | |

4-5-14 Torque Limit Switching

This function is to select the torque limit mode. (Please refer to chapter 3-6 for the detailed description of the function.)

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|------------------------|-------|--|
| 41 42 | TRQ1 | Torque limit switching | ON | Torque limit value of b04 1 to b044 will be selected by the combination of the switches. |
| | TRQ2 | | OFF | |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | b04 1~b044 | | |

4-5-15 Brake Confirmation

This function is for brake performance. Please refer to chapter 3 for the detailed description of the function.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-------------------------|-------|--|
| 44 | BOK | Brake confirmation | ON | Brake confirmation signal is being given |
| | | | OFF | Brake confirmation signal is not given |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | b 120~b 127, C02 1~C022 | | |

4-5-16 LAD Cancel

This function is for canceling the set ramp time and changes the output speed immediately according to the set speed. (Please refer to chapter 3 for the detailed description of the function.)

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------|-------|--|
| 46 | LAD | LAD cancel | ON | Disabling the set ramp time and inverter output immediately follows the speed command. |
| | | | OFF | Accelerates and decelerates according to the set ramp time |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

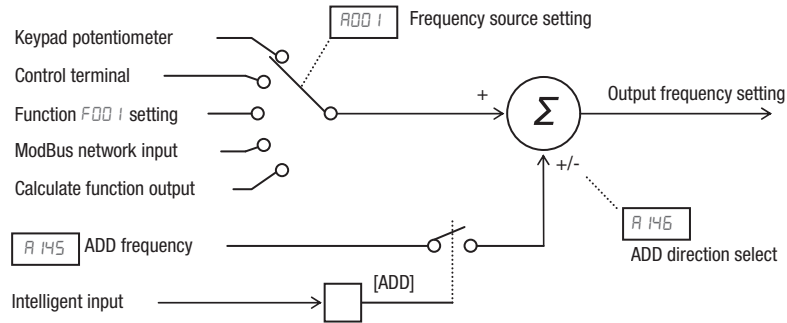
4-5-17 Position Deviation Clear

This function is for clearing the accumulated pulse numbers in case of positioning. (Please refer to chapter 3 for the detailed description of the function.)

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--------------------------|-------|---------------------------------------|
| 47 | PCLR | Position deviation clear | ON | Clears the accumulated pulse numbers. |
| | | | OFF | Does not clear the pulse numbers. |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-18 Frequency Addition

The inverter can add or subtract an offset value to the output frequency setting which is specified by *ADD 1* (will work with any of the five possible sources). The ADD Frequency is a value you can store in parameter *A 145*. The ADD Frequency is summed with or subtracted from the output frequency setting only when the [ADD] terminal is ON. Function *A 146* selects whether to add or subtract. By configuring an intelligent input as the [ADD] terminal, your application can selectively apply the fixed value in *A 145* to offset (positively or negatively) the inverter output frequency in real time.



| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|----------------------------|-------|---|
| 50 | ADD | Frequency addition | ON | Applies the <i>A 145</i> Add Frequency value to the output frequency |
| | | | OFF | Does not apply the Add frequency. The output frequency retains its normal value |
| Valid for inputs: | | <i>C00 1~C00 7</i> | | |
| Required settings: | | <i>ADD 1, A 145, A 146</i> | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> <i>ADD 1</i> may specify any source; the Add Frequency will be added to or subtracted from that value to yield output frequency value. | | | | |

4-5-19 Forced Terminal Block

The purpose of this intelligent input is to allow a device to force the inverter to allow control of the following two parameters via the control terminals:

- **ADD1** – Frequency source setting (01 = control terminals [O] or [OI])
- **ADD2** – Run command source setting (01 = control terminals [FW] and [RW])

Some applications will require one or both settings above to use a source other than the terminals. You may prefer to normally use the inverter's keypad and potentiometer, or to use the ModBus network for control, for example. However, an external device can turn ON the [F-TM] input to force the inverter to (temporarily) allow control (frequency source and Run command) via control terminals. When the [F-TM] input is OFF, then the inverter uses the regular sources specified by **ADD1** and **ADD2** again.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|-----------------------|-------|---|
| 51 | F-TM | Forced terminal block | ON | Forces ADD1=01 (frequency source setting = control terminal), and ADD2=01 (Run command source setting = control terminal) |
| | | | OFF | Inverter applies the user setting for ADD1 and ADD2 normally |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> • When changing the [F-TM] state during Run Mode (inverter is driving the motor), the inverter will stop the motor before the new [F-TM] state takes effect. | | | | |

4-5-20 Torque Command Input Permission

This function is to permit the torque command input. (Please refer to chapter 3 for the detailed description of the function.)

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------------------------|-------|---|
| 52 | ATR | Torque command input permission | ON | Inverter is ready to accept the torque command. |
| | | | OFF | Inverter is in a normal mode. |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-21 Integrated Power Clear

This function is to clear the cumulative input power data.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|------------------------|-------|---------------------------------|
| 53 | KHC | Integrated power clear | ON | Clear the cumulative power data |
| | | | OFF | Does not clear the data |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | | | |

4-5-22 Drive Programming Input 1 to 7

These functions are used with Drive Programming function. Refer to a description of Drive Programming for the details.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--------------------------------|-------|-----------------------------------|
| 55~62 | MI1~MI7 | Drive programming input 1 to 7 | ON | General purpose input is made ON |
| | | | OFF | General purpose input is made OFF |
| Valid for inputs: | | C00 1~C007 | | |
| Required settings: | | | | |

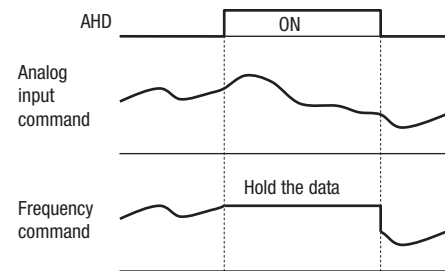
4-5-23 Analog Command Held

This function allows you to make the inverter hold the analog command input via the external analog input terminal when the AHD terminal is made ON.

While the AHD is turned ON, the up/down function can be used based on the analog signal held by this function as reference data.

When "01" is specified for Up/down memory mode selection (C101), the result of up/down processing can be stored in memory.

If the inverter power is turned on or the RS terminal turned off with the AHD terminal left turned on, the data held immediately before power on or turning off the RS terminal will be used.



Note Set frequency remains when the inverter is switched with SET terminal with AHD on. Turn AHD terminal off to re-hold the set frequency.

Note Frequent use of this function may result in a shorter in memory component of the inverter.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------------|-------|--------------------------------------|
| 65 | AHD | Analog command held | ON | Hold the analog input value |
| | | | OFF | Does not hold the analog input value |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-24 Position Command Selection 1 to 3

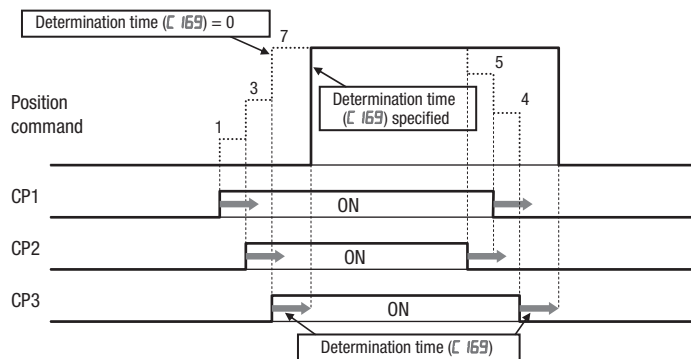
When “65 (CP1)” to “68 (CP3)” are assigned to input terminals, you can select position settings from multistage positions 0 to 7.

Use multistage position settings 0 to 7 (P060 to P067) for the position settings. If no position settings are assigned to terminals, multistage position 0 (P060) is assumed.

| Position setting | Parameter | CP3 | CP2 | CP1 |
|-------------------------------|-----------|-----|-----|-----|
| Multi-step position command 0 | P060 | 0 | 0 | 0 |
| Multi-step position command 1 | P061 | 0 | 0 | 1 |
| Multi-step position command 2 | P062 | 0 | 1 | 0 |
| Multi-step position command 3 | P063 | 0 | 1 | 1 |
| Multi-step position command 4 | P064 | 1 | 0 | 0 |
| Multi-step position command 5 | P065 | 1 | 0 | 1 |
| Multi-step position command 6 | P066 | 1 | 1 | 0 |
| Multi-step position command 7 | P067 | 1 | 1 | 1 |

You can specify a delay to be applied at multistage position setting input, until the relevant terminal input is determined. Use this specification to prevent the application of fluctuating terminal input before it is determined.

You can adjust the determination time with the multistage speed/position determination time setting (C159). The input data is finally determined when the terminal input becomes stable after the delay set as C159. (Note that a long determination time deteriorates the input terminal response.)



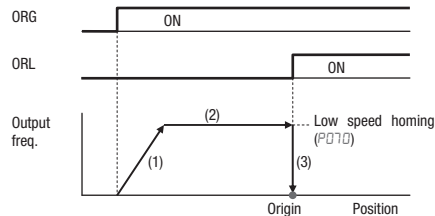
| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-----------------------------------|-------|--|
| 65-68 | CP1~CP3 | Position command selection 1 to 3 | ON | Multistage position is defined by combination of the inputs. |
| | | | OFF | |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | P060~P067 | | |

4-5-25 Limit signal of homing, Trigger signal of zero-return

These functions are used for homing performance.

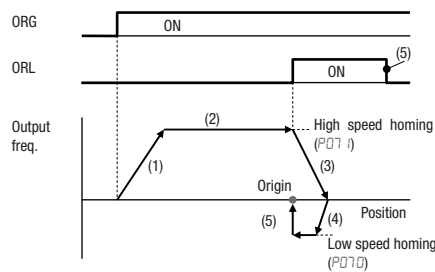
One of three types of homing operations can be selected by homing mode selection (P068). When a homing operation ends, the current position counter is cleared (to 0). Use homing direction selection (P069) to select the direction of homing operation. If homing operation is not performed, position control is performed based on the assumption that the motor position detected at power-on is the origin.

<1> Low speed homing (P068=00)



1. The inverter accelerates the motor for the specified ramp time to the low speed homing.
2. It runs the motor at the low speed homing.
3. It performs positioning when the ORL signal is given.

<2> High speed homing (P068=01)



1. The inverter accelerates the motor for the specified ramp time to the high speed homing.
2. It runs the motor at the high speed homing.
3. It starts deceleration when the ORL signal is turned on.
4. It runs the motor in the reverse direction at the low speed homing.
5. It performs positioning when the ORL signal is turned off.

4-5-26 Speed/position switching

To perform speed control operation in absolute position control mode, turn on the SPD terminal. While the SPD terminal is off, the current position count remains at 0. Therefore if the SPD terminal is turned off during operation, the control operation is switched to position control operation based on the position where the terminal is turned off. (Speed control operation is switched to position control operation.)

If the position setting is 0 at this time, the inverter stops the motor at that position. (Hunting may occur if a certain position loop gain value has been set.)

While the SPD terminal is on, the rotating direction depends on the operation command. When switching from speed control to position control, pay attention to the sign of the value set in the operation command.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--------------------|-----------------|---------------------------------|-------|--|
| 73 | SPD | Speed/ position switching | ON | Inverter is in a speed control mode |
| | | | OFF | Inverter is in a position control mode |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-27 Safe Stop Related Signals

| Option Code | Terminal Symbol | Function Name | State | Description |
|-----------------------------|-----------------|------------------------------|-------|-------------|
| 77 | GS1 | Safety related signals | ON | |
| 78 | GS2 | | OFF | |
| Refer to Safety in Appendix | | | | |

4-5-28 Drive Program Start

| Option Code | Terminal Symbol | Function Name | State | Description |
|------------------------------------|-----------------|---------------------------|-------|-------------|
| 82 | PRG | Drive program start | ON | |
| | | | OFF | |
| Refer to Drive Programming section | | | | |

4-5-29 Retain output frequency

This function allows you to retain output frequency.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-------------------------|-------|-------------|
| B3 | HLD | Retain output frequency | ON | |
| | | | OFF | |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-30 Permission of Run command

This function allows you to accept run command.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------------------|-------|-----------------------------|
| B4 | ROK | Permission of Run command | ON | Run command can be accepted |
| | | | OFF | Run command is ignored |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-31 Rotation direction detection

Input terminal (7) is for inputting "B pulse", which is used for detecting the rotation direction.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|------------------------------|-------|-------------|
| B5 | EB | Rotation direction detection | ON | |
| | | | OFF | |
| Valid for inputs: | | C007 | | |
| Required settings: | | | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> EB input terminal is dedicated terminal (7). Maximum allowable input frequency is 2kHz. | | | | |

4-5-32 Display limitation

This function is to show only the contents of d001 display.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--------------------|-------|-------------|
| B6 | DISP | Display limitation | ON | |
| | | | OFF | |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-5-33 Preset position

P0B3 value is set to current position.

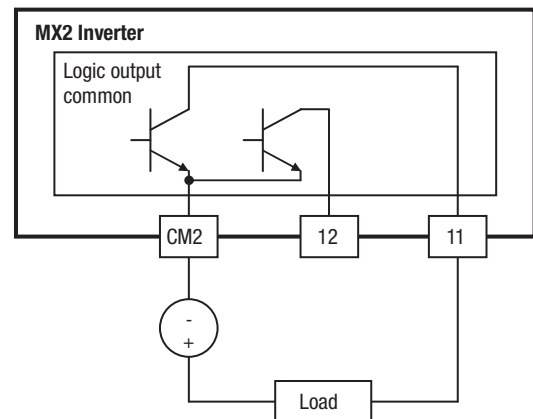
| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-----------------|-------|-------------|
| 91 | PSET | Preset position | ON | |
| | | | OFF | |
| Valid for inputs: | | C001~C007 | | |
| Required settings: | | | | |

4-6 Using Intelligent Output Terminals

The intelligent output terminals are programmable in a similar way to the intelligent input terminals. The inverter has several output functions that you can assign individually to two physical logic outputs. One of the outputs is an open-collector transistor, and the other output is the alarm relay (form C – normally open and normally closed contacts). The relay is assigned the alarm function by default, but you can assign it to any of the functions that the open-collector output uses.

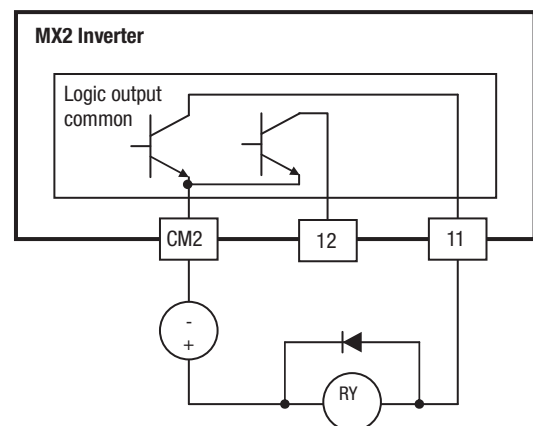
4-6-1 Sinking Outputs, Open Collector

The open-collector transistor output can handle up to 50 mA. We highly recommend that you use an external power source as shown at the right. It must be capable of providing at least 50 mA to drive the output at full load. To drive loads that require more than 50 mA, use external relay circuits as shown below right.



4-6-2 Sinking Outputs, Open Collector

If you need output current greater than 50 mA, use the inverter output to drive a small relay. Be sure to use a diode across the coil of the relay as shown (reverse-biased) in order to suppress the turn-off spike, or use a solid-state relay.



4-6-3 Internal Relay Output

The inverter has an internal relay output with normally open and normally closed contacts (Type 1 form C). The output signal that controls the relay is configurable; the Alarm Signal is the default setting. Thus, the terminals are labeled [AL0], [AL1], [AL2], as shown to the right. However, you can assign any one of the nine intelligent outputs to the relay. For wiring purposes, the general terminal functions are:

- [AL0] – Common contact
- [AL1] – Normally open contact
- [AL2] – Normally closed contact

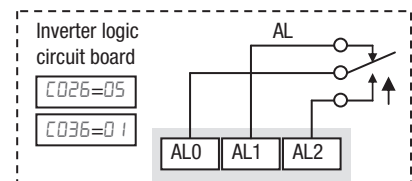
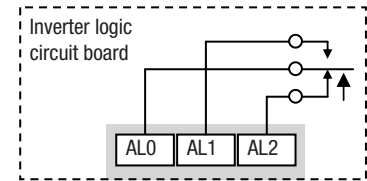
The relay itself can be configured as “normally open or closed.” Parameter C036, Alarm Relay Active State, is the setting. This setting determines whether or not the relay coil is energized when its output signal is OFF:

- C036=00 – “Normally open” (relay coil is de-energized when output signal is OFF)
- C036=01 – “Normally closed” (relay coil is energized when the output signal is OFF)

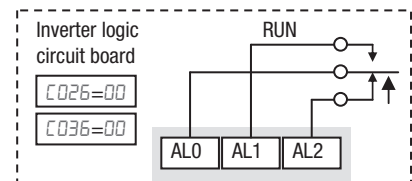
Since the relay already has normally open [AL1] and normally closed [AL2] contacts, the purpose of the ability to invert the relay coil's active state may not be obvious. It allows you to determine whether or not an inverter power loss causes the relay to change state. The default relay configuration is the Alarm Signal (C026=05), as shown to the right. And, C036=01 sets the relay to “normally closed” (relay coil normally energized). The reason for this is that a typical system design will require an inverter power loss to assert an alarm signal to external devices.

The relay can be used for other intelligent output signals, such as the Run Signal (set C026=00). For these remaining output signal types, the relay coil typically must NOT change state upon inverter power loss (set C036=00). The figure to the right shows the relay settings for the Run Signal output.

If you assign the relay an output signal other than the Alarm Signal, the inverter can still have an Alarm Signal output. In this case, you can assign it to terminal [11], providing an open collector output.



Relay shown with inverter power ON, Alarm Signal OFF



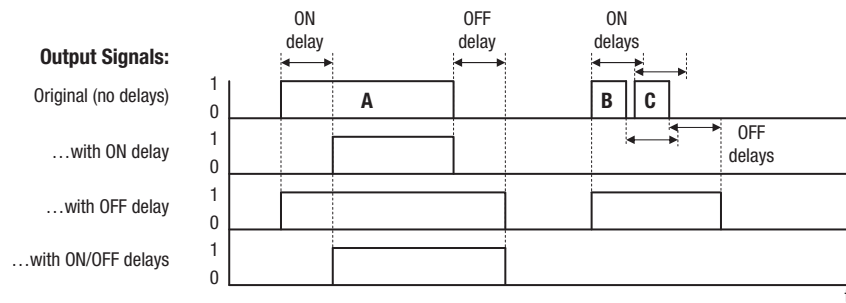
Relay shown with inverter power ON, Run Signal OFF

4-6-4 Output Signal ON/OFF Delay Function

Intelligent outputs including terminals [11], and the output relay, have configurable signal transition delays. Each output can delay either the OFF-to-ON or ON-to-OFF transitions, or both. Signal transition delays are variable from 0.1 to 100.0 seconds. This feature is useful in applications that must tailor inverter output signals to meet timing requirements of certain external devices.

The timing diagram below shows a sample output signal (top line) and the results of various ON/OFF delay configurations.

- **Original signal** – This example signal waveform consists of three separate pulses named “A,” “B,” and “C.”
- **...with ON delay** – Pulse A is delayed by the duration of the ON delay time. Pulses B and C do not appear at the output, because they are shorter than the ON delay.
- **...with OFF delay** – Pulse A is lengthened by the amount of the OFF delay time. The separation between pulses B and C does not appear at the output, because it is shorter than the OFF delay time.
- **...with ON/OFF delays** – Pulse A is delayed on both leading and trailing edges by the amounts of the ON and OFF delay times, respectively. Pulses B and C do not appear at the output, because they are shorter than the ON delay time.

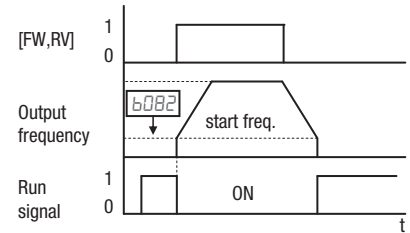


| Func. | Description | Range | Default |
|-------|------------------------|-------------------|---------|
| C 130 | Output 11 ON delay | 0.0 to 100.0 sec. | 0.0 |
| C 131 | Output 11 OFF delay | 0.0 to 100.0 sec. | 0.0 |
| C 132 | Output 12 ON delay | 0.0 to 100.0 sec. | 0.0 |
| C 133 | Output 12 OFF delay | 0.0 to 100.0 sec. | 0.0 |
| C 140 | Relay output ON delay | 0.0 to 100.0 sec. | 0.0 |
| C 141 | Relay output OFF delay | 0.0 to 100.0 sec. | 0.0 |

Use of the ON/OFF signal delay functions are optional. Note that any of the intelligent output assignments in this section can be combined with ON/OFF signal timing delay configurations.

4-6-5 Run Signal

When the [RUN] signal is selected as an intelligent output terminal, the inverter outputs a signal on that terminal when it is in Run Mode. The output logic is active low, and is the open collector type (switch to ground).



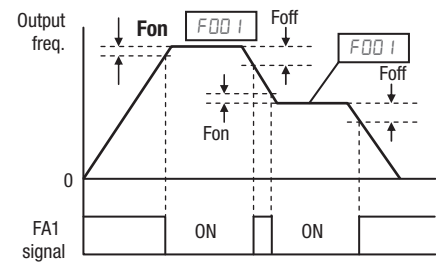
| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|--|
| 00 | RUN | Run Signal | ON | when inverter is in Run Mode |
| | | | OFF | when inverter is in Stop Mode |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | Example for terminal [11] (default output configuration shown – see page 158): |
| Required settings: | | (none) | | |
| <p>Notes:</p> <ul style="list-style-type: none"> The inverter outputs the [RUN] signal whenever the inverter output exceeds the start frequency specified by parameter b002. The start frequency is the initial inverter output frequency when it turns ON. The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |
| <p>Example for terminal [AL0], [AL1], [AL2] (requires output configuration – see page 226 and page 158):</p> <p>See I/O specs on page 195</p> | | | | |

4-6-6 Frequency Arrival Signals

The *Frequency Arrival* group of outputs helps coordinate external systems with the current velocity profile of the inverter. As the name implies, output [FA1] turns ON when the output *frequency arrives* at the standard set frequency (parameter F001). Output [FA2] relies on programmable accel/ decel thresholds for increased flexibility. For example, you can have an output turn ON at one frequency during acceleration, and have it turn OFF at a different frequency during deceleration. All transitions have hysteresis to avoid output chatter if the output frequency is near one of the thresholds.

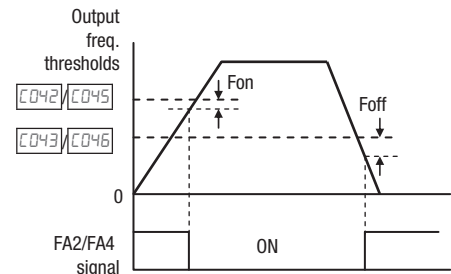
| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|-----------------------------------|-------|--|
| 01 | FA1 | Constant speed arrival signal | ON | when output to motor is at the constant frequency |
| | | | OFF | when output to motor is OFF, or in any acceleration or deceleration ramp |
| 02 | FA2 | Over set frequency arrival signal | ON | when output to motor is at or above the set frequency thresholds for, even if in acceleration or decel ramps |
| | | | OFF | when output to motor is OFF, or during accel or decel before the respective thresholds are crossed |
| 06 | FA3 | Set-frequency-only arrival signal | ON | when output to motor is at the set frequency |
| | | | OFF | when output to motor is OFF, or in any acceleration or deceleration ramp |
| 24 | FA4 | Set frequency exceeded 2 | ON | when output to motor is at or above the set frequency thresholds for, even if in acceleration or decel ramps |
| | | | OFF | when output to motor is OFF, or during accel or decel before the respective thresholds are crossed |
| 25 | FA5 | Set frequency only 2 | ON | when output to motor is at the set frequency |
| | | | OFF | when output to motor is OFF, or in any acceleration or deceleration ramp |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | [042, [043, [045, [046 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> • For most applications you will need to use only one type of frequency arrival outputs (see examples). However, it is possible assign both output terminals to output functions [FA1] and [FA2] • For each frequency arrival threshold, the output anticipates the threshold (turns ON early) by 1.5 Hz • The output turns OFF as the output frequency moves away from the threshold, delayed by 0.5 Hz • The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative going turn-off spike generated by the coil from damaging the inverter's output transistor | | | | |

Frequency arrival output [FA1] uses the standard output frequency (parameter F001) as the threshold for switching. In the figure to the right, Frequency Arrival [FA1] turns ON when the output frequency gets within *Fon* Hz below or *Fon* Hz above the target constant frequency, where *Fon* is 1% of the set maximum frequency and *Foff* is 2% of the set maximum frequency. This provides hysteresis that prevents output chatter near the threshold value. The hysteresis effect causes the output to turn ON slightly *early* as the speed approaches the threshold. Then the turn-OFF point is slightly *delayed*. Note the active low nature of the signal, due to the open collector output.



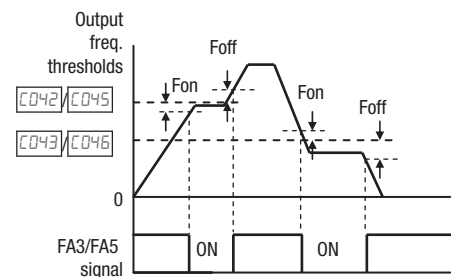
Fon = 1% of max. frequency
 Foff = 2% of max. frequency

Frequency arrival output [FA2/FA4] works the same way; it just uses two separate thresholds as shown in the figure to the right. These provide for separate acceleration and deceleration thresholds to provide more flexibility than for [FA1]. [FA2/FA4] uses C042/C045 during acceleration for the ON threshold, and C043/C046 during deceleration for the OFF threshold. This signal also is active low. Having different accel and decel thresholds provides an asymmetrical output function. However, you can use equal ON and OFF thresholds, if desired.



Fon = 1% of max. frequency
 Foff = 2% of max. frequency

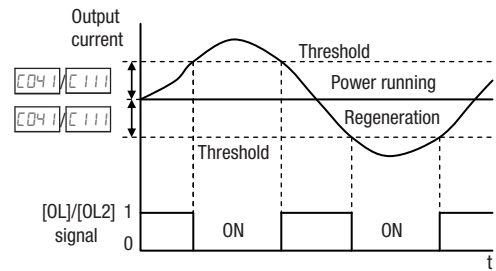
Frequency arrival output [FA3/FA5] works also the same way, only difference is arriving at set frequency.



Fon = 1% of max. frequency
 Foff = 2% of max. frequency

4-6-7 Overload Advance Notice Signal

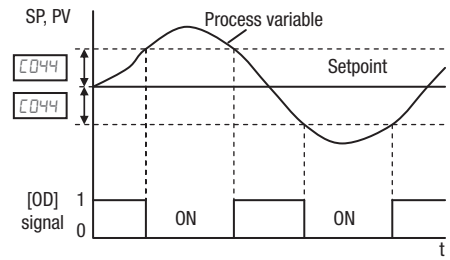
When the output current exceeds a preset value, the [OL] terminal signal turns ON. The parameter C041 and C111 sets the overload threshold. (Two thresholds can be set.) The overload detection circuit operates during powered motor operation and during regenerative braking. The output circuits use open-collector transistors, and are active low.



| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------------------|-------|--|
| 03 | OL | Overload warning | ON | when output current is more than the set threshold for the overload signal |
| | | | OFF | when output current is less than the set threshold for the overload signal |
| 25 | OL2 | Overload warning 2 | ON | (Same as above) |
| | | | OFF | (Same as above) |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C041 , C111 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The default value is 100%. To change the level from the default, set C041 (overload level) and/or C111 (overload level (2)). The accuracy of this function is the same as the function of the output current monitor on the [FM] terminal (see <i>Analog Output Operation</i> on page 252). The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-8 Excessive PID deviation

The PID loop error is defined as the magnitude (absolute value) of the difference between the Setpoint (target value) and the Process Variable (actual value). When the error magnitude exceeds the preset value for $\square\square44$, the [OD] terminal signal turns ON. Refer to "PID Loop Operation" on page 109.

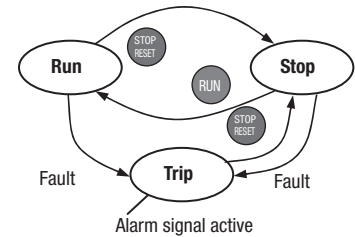


| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------------|-------|--|
| $\square4$ | OD | Excessive PID deviation | ON | when PID error is more than the set threshold for the deviation signal |
| | | | OFF | when PID error is less than the set threshold for the deviation signal |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | $\square\square44$ | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The default difference value is set to 3%. To change this value, change parameter $\square\square44$ (deviation level). The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-9 Alarm Output

The inverter alarm signal is active when a fault has occurred and it is in the Trip Mode (refer to the diagram at right). When the fault is cleared the alarm signal becomes inactive.

We must make a distinction between the alarm *signal* AL and the alarm relay *contacts* [AL0], [AL1] and [AL2]. The signal AL is a logic function, which you can assign to the open collector output terminals [11], [12], or the relay outputs.



The most common (and default) use of the relay is for AL, thus the labeling of its terminals. Use an open collector output (terminal [11] or [12]) for a low-current logic signal interface or to energize a small relay (50 mA maximum). Use the relay output to interface to higher voltage and current devices (10 mA minimum).

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|-------------------|-------|--|
| 05 | AL | Alarm output | ON | when an alarm signal has occurred and has not been cleared |
| | | | OFF | when no alarm has occurred since the last clearing of alarm(s) |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C031, C032, C036 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> By default, the relay is configured as normally closed (C036=01). Refer to the next page for an explanation. In the default relay configuration, an inverter power loss turns ON the alarm output. the alarm signal remains ON as long as the external control circuit has power. When the relay output is set to normally closed, a time delay of less than 2 seconds occurs after powerup before the contact is closed. Terminals [11] and [12] are open collector outputs, so the electric specifications of [AL] are different from the contact output terminals [AL0], [AL1], [AL2]. This signal output has the delay time (300 ms nominal) from the fault alarm output. The relay contact specifications are in 4-3 <i>Control Logic Signal Specifications</i> on page 195. The contact diagrams for different conditions are on the next page. | | | | |

The alarm relay output can be configured in two main ways:

- Trip/Power Loss Alarm - The alarm relay is configured as normally closed (C036=01) by default, shown below (left). An external alarm circuit that detects broken wiring also as an alarm connects to [AL0] and [AL1]. After powerup and short delay (< 2 seconds), the relay energizes and the alarm circuit is OFF. Then, either an inverter trip event or an inverter power loss will de-energize the relay and open the alarm circuit
- Trip Alarm - Alternatively, you can configure the relay as normally open (C036=00), shown below (right). An external alarm circuit that detects broken wiring also as an alarm connects to [AL0] and [AL2]. After powerup, the relay energizes only when an inverter trip event occurs, opening the alarm circuit. However, in this configuration, an inverter power loss does not open the alarm circuit.

Be sure to use the relay configuration that is appropriate for your system design. Note that the external circuits shown assume that a closed circuit = no alarm condition (so that a broken wire also causes an alarm). However, some systems may require a closed circuit = alarm condition. In that case, then use the opposite terminal [AL1] or [AL2] from the ones shown.

| N.C. contacts (C036=01) | | | | N.O. contacts (C036=00) | | | |
|-------------------------|----------|---|---------|--|----------|----------------------|---------|
| During normal operation | | When an alarm occurs or when power is OFF | | During normal operation or when power is OFF | | When an alarm occurs | |
| | | | | | | | |
| Power | Run Mode | AL0-AL1 | AL0-AL2 | Power | Run Mode | AL0-AL1 | AL0-AL2 |
| ON | Normal | Closed | Open | ON | Normal | Open | Closed |
| ON | Trip | Open | Closed | ON | Trip | Closed | Open |
| OFF | - | Open | Closed | OFF | - | Open | Closed |

4-6-10 Overtorque

The inverter outputs the over torque signal when it detects that the estimated motor output torque exceeds the specified level.

To enable this function, assign “07 (OTQ)” to an intelligent output terminal.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|--------------------------|-------|--|
| 07 | OTQ | Overtorque | ON | when the estimated output torque > C055~C058 |
| | | | OFF | when no over torque is detected |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | R044=03 or 04, C055~C058 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> This function is effective only when the V/F characteristic curve selection R044 is set to “03 (SLV mode)”. With any other V/F characteristic curve selection, the output of the OTQ signal is unpredictable. When using the inverter for a lift, use the OTQ signal as the trigger to stop braking. Use the frequency arrival signal as the trigger to start braking. The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-11 Signal during Undervoltage

The inverter outputs the undervoltage signal when it detects that the inverter is in undervoltage situation.

To enable this function, assign “09 (UV)” to an intelligent output terminal.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|----------------------------|-------|---------------------------------|
| 09 | UV | Signal during undervoltage | ON | Inverter is in undervoltage |
| | | | OFF | Inverter is in normal condition |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-12 Torque Limit

The inverter outputs the torque limited signal when it is in torque limit operation.

To enable this function, assign “*I0* (TRQ)” to an intelligent output terminal.

Refer to SECTION 3 *Configuring Drive Parameters* on page 69 for detailed explanation.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---------------------------|-------|---|
| <i>I0</i> | TRQ | Torque limit | ON | Inverter is in torque limiting mode |
| | | | OFF | Inverter is not in torque limiting mode |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | <i>R044=03, b040-b044</i> | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-13 Running Time and Power On Time Over Signal

The inverter outputs the operation time expiration signal and power on time expiration signal.

To enable this function, assign “*I1* (RNT)”, and/or “*I2* (ONT)” to intelligent output terminals.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|--------------------|-------|---|
| <i>I1</i> | RNT | RUN time over | ON | Accumulated operation time of the inverter exceeds the set value of <i>b034</i> |
| | | | OFF | Accumulated operation time of the inverter does not exceed the set value of <i>b034</i> |
| <i>I2</i> | ONT | Power ON time over | ON | Accumulated power on time of the inverter exceeds the set value of <i>b034</i> |
| | | | OFF | Accumulated power on time of the inverter does not exceed the set value of <i>b034</i> |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | <i>b034</i> | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-14 Thermal Warning

You can configure this function so that the inverter outputs a warning signal before the electronic thermal protection operates against motor overheat. You can also set the threshold level to output a warning signal with the electronic thermal warning level setting (C05 I).

To output the warning signal, assign function “13 (THM)” to one of the intelligent output terminals [11] to [12], or to the relay output terminal.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|--|
| 13 | THM | Thermal warning | ON | Accumulated thermal level exceeds the electronic thermal warning level (C05 I) |
| | | | OFF | Accumulated thermal level does not exceed the electronic thermal warning level (C05 I) |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C05 I | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-15 External Brake Related Output Signals

These signals are used with brake control function.

To output the warning signals, assign function “19 (BRK)” and “20 (BER)” to the intelligent output terminals [11] and [12], or to the relay output terminal.

Refer to SECTION 3 *Configuring Drive Parameters* on page 69 detailed explanation of the brake control function.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|-----------------------------------|
| 19 | BRK | Brake release | ON | Brake is ready to be released |
| | | | OFF | Brake is not ready to be released |
| 20 | BER | Brake error | ON | Brake error has occurred |
| | | | OFF | Brake is working properly |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | b I20~b I27 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-16 0 Hz Signal

The inverter outputs the 0Hz speed detection signal when the inverter output frequency falls below the threshold level (C063).

To use this function, assign "21 (ZS)" to one of the intelligent output terminals.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|--|
| 21 | ZS | 0 Hz signal | ON | Output frequency is less than C063 |
| | | | OFF | Output frequency is not less than C063 |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C063 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-17 Excessive Speed Deviation

The inverter outputs the detection signal when the deviation between the set speed and actual motor speed becomes less the threshold level (*P027*). This function is valid when connecting the encoder feedback to the inverter.

To use this function, assign “22 (DSE)” to one of the intelligent output terminals.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---------------------------|-------|--|
| 22 | DSE | Excessive speed deviation | ON | Deviation between the speed command and motor speed is less than <i>P027</i> |
| | | | OFF | Deviation between the speed command and motor speed exceeds <i>P027</i> |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | <i>P027</i> | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-18 Position Ready

Inverter gives out the positioning signal when positioning performance is done.

To use this function, assign “23 (POK)” to one of the intelligent output terminals.

Refer to chapter 4 for the details of the performance.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|---------------------|-------|--|
| 23 | POK | Position ready | ON | Positioning performance is completed |
| | | | OFF | Positioning performance is not completed |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | <i>PO 103~PO 15</i> | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-19 Analog Input Disconnection Detection

This feature is useful when the inverter receives a speed reference from an external device. Upon input signal loss at either the [O] or [OI] terminal, the inverter normally just decelerates the motor to a stop. However, the inverter can use the intelligent output terminal [Dc] to signal other devices that a signal loss has occurred.

Voltage signal loss at [O] terminal – Parameter **b002** is the Start Frequency Adjustment. It sets the beginning (minimum) output frequency when the speed reference source is greater than zero. If the analog input at terminal [O] is less than the Start Frequency, the inverter turns ON the [Dc] output to indicate a signal loss condition.

Current signal loss at [OI] terminal – The [OI] terminal accepts a 4 mA to 20 mA signal, with 4 mA representing the beginning of the input range. If the input current falls below 4 mA, the inverter applies a threshold to detect signal loss.

Note that a signal loss is not an inverter trip event. When the analog input value is again above the **b002** value, the [Dc] output turns OFF. There is no error condition to clear.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-----------------------------------|-------|---|
| 27 | ODc | Analog O disconnection detection | ON | when signal loss is detected on [O] input |
| | | | OFF | when no signal loss is detected on [O] input |
| 28 | OIDc | Analog OI disconnection detection | ON | when signal loss is detected on [OI] input |
| | | | OFF | when no signal loss is detected on [OI] input |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | R00 I=0 I, b002 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The [Dc] output can indicate an analog signal disconnect when the inverter is in Stop Mode, as well as Run Mode. The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-20 PID FB Status Output

The inverter has a built-in PID loop feature for *two-stage control*, useful for certain applications such as building ventilation or heating and cooling (HVAC). In an ideal control environment, a single PID loop controller (stage) would be adequate. However, in certain conditions, the maximum output energy from the first stage is not enough to maintain the Process Variable (PV) at or near the Setpoint (SP). And, the output of the first stage is in saturation. A simple solution is to add a second stage, which puts an additional and constant amount of energy into the system under control. When sized properly, the boost from the second stage brings the PV toward the desired range, allowing the first stage PID control to return to its linear range of operation.

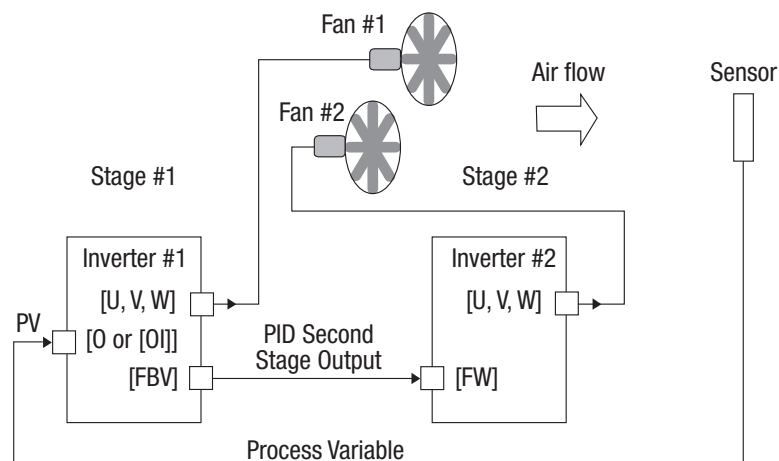
The two-stage method of control has some advantages for particular applications.

- The second stage is only ON in adverse conditions, so there is an energy savings during normal conditions.
- Since the second stage is simple ON/OFF control, it is less expensive to add than just duplicating the first stage.
- At powerup, the boost provided by the second stage helps the process variable reach the desired setpoint sooner than it would if the first stage acted alone.
- Even though the second stage is simple ON/OFF control, when it is an inverter you can still adjust the output frequency to vary the boost it provides.

Refer to the example diagram below. Its two stages of control are defined as follows:

- Stage 1 - Inverter #1 operating in PID loop mode, with motor driving a fan
- Stage 2 - Inverter #2 operating as an ON/OFF controller, with motor driving a fan

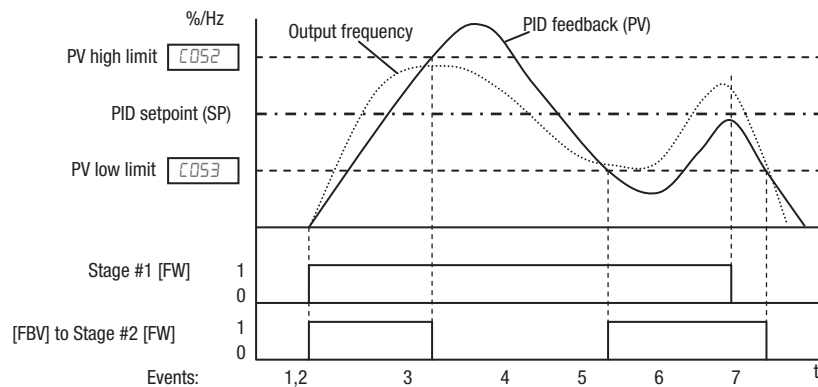
Stage #1 provides the ventilation needs in a building most of the time. On some days, there is a change in the building's air volume because large warehouse doors are open. In that situation, Stage #1 alone cannot maintain the desired air flow (PV sags under SP). Inverter #1 senses the low PV and its PID Second Stage Output at [FBV] terminal turns ON. This gives a Run FWD command to Inverter #2 to provide the additional air flow.



To use the PID Second Stage Output feature, you will need to choose upper and lower limits for the PV, via $C053$ and $C052$ respectively. As the timing diagram below shows, these are the thresholds Stage #1 inverter uses to turn ON or OFF Stage #2 inverter via the [FBV] output. The vertical axis units are percent (%) for the PID setpoint, and for the upper and lower limits. The output frequency, in Hz, is superimposed onto the same diagram.

When the system control begins, the following events occur (in sequence in the timing diagram):

1. Stage #1 inverter turns ON via the [FW] Run command.
2. Stage #1 inverter turns ON the [FBV] output, because the PV is below the PV low limit $C053$. So, Stage #2 is assisting in loop error correction from the beginning.
3. The PV rises and eventually exceeds the PV high limit $C052$. Stage #1 inverter then turns OFF the [FBV] output to Stage #2, since the boost is no longer needed.
4. When the PV begins decreasing, only Stage #1 is operating, and it is in the linear control range. This region is where a properly configured system will operate most often.
5. The PV continues to decrease until it crosses under the PV low limit (apparent external process disturbance). Stage #1 inverter turns ON the [FBV] output, and Stage #2 inverter is assisting again.
6. After the PV rises above the PV low limit, the [FW] Run command to Stage #1 inverter turns OFF (as in a system shutdown).
7. Stage #1 inverter enters Stop Mode and automatically turns OFF the [FBV] output, which causes Stage #2 inverter to also stop.



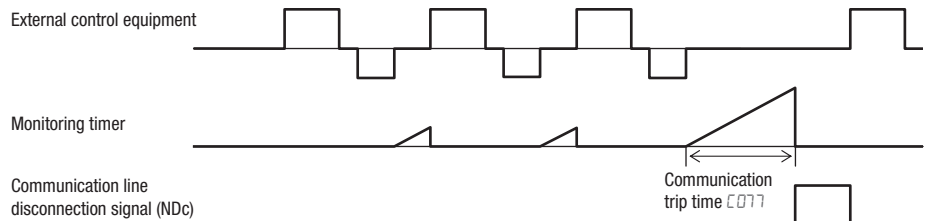
The terminal [FBV] configuration table is on the following page.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|----------------------|-------|---|
| 31 | FBV | PID FB status output | ON | <ul style="list-style-type: none"> Transitions to ON when the inverter is in RUN Mode and the PID Process Variable (PV) is less than the Feedback Low Limit (C053) |
| | | | OFF | <ul style="list-style-type: none"> Transitions to OFF when the PID Feedback Value (PV) exceeds the PID High Limit (C052) Transitions to OFF when the inverter goes from Run Mode to Stop Mode |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | A076, C052, C053 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The [FBV] is designed for implementing two-stage control. The PV high limit and PV low limit parameters, C052 and C053, do not function as process alarm thresholds. Terminal [FBV] does not provide a PID alarm function. The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-21 Network Error

This signal function is enabled only when ModBus-RTU has been selected for the communication. If a reception timeout occurs, the inverter continues to output the communication line disconnection signal until it receives the next data.

Specify the limit time for reception timeout by setting the communication trip time (C077).

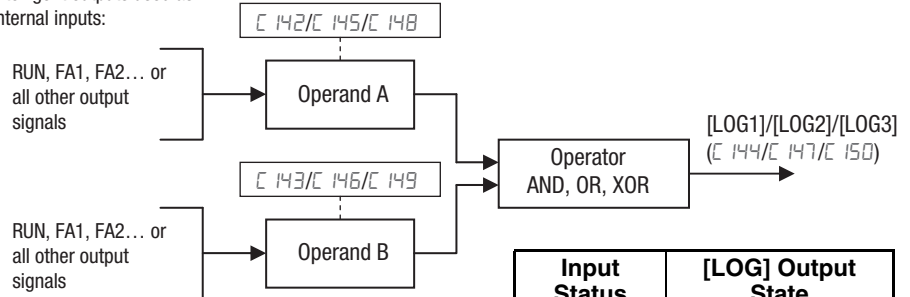


| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|-------------------|-------|---|
| 32 | NDc | Network error | ON | When there is a disconnection in communication |
| | | | OFF | When there is no disconnection in communication |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C077 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The example circuit for terminal [11] drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor. | | | | |

4-6-22 Logic Operation Outputs

The inverter has a built-in logic output feature. Select any two operands out of all intelligent output options except LOG1~LOG3 and their operator out of AND, OR, or XOR (exclusive OR). The terminal symbol for the new output is [LOG]. Use C021, C022 or C026 to route the logical result to terminal [11], [12] or the relay terminals.

Intelligent outputs used as internal inputs:



| Input Status | | [LOG] Output State | | |
|--------------|---|--------------------|----|-----|
| A | B | AND | OR | XOR |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 |

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-------------------------|-------|--|
| 33 | LOG1 | Logic operation outputs | ON | when the Boolean operation specified by C144 /C145/C147 has a logical "1" result |
| 34 | LOG2 | | OFF | when the Boolean operation specified by C144 /C145/C147 has a logical "0" result |
| 35 | LOG3 | | | |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C141~C150 | | |

4-6-23 Life time Warning Output Function

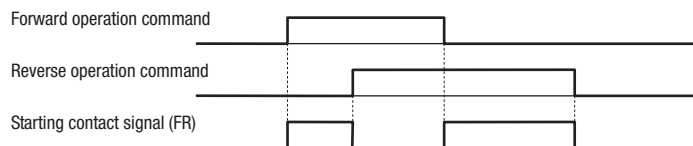
Capacitor life warning signal – The inverter checks the operating life of the capacitors on the internal circuit board on the basis of the internal temperature and cumulative power on time. You can also monitor the state of the capacitor life warning signal (WAC) in #022. If the WAC signal is given out, it is recommended to replace the main PCB and control PCB.

Cooling fan warning signal – If the signal is given out, check the cooling fan cover for clogging. You can also monitor the state of WAF signal in #022.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------------------------|-------|--|
| 39 | WAC | Capacitor life warning signal | ON | Calculated lifetime of the electrolytic capacitor is expired |
| | | | OFF | Electrolytic capacitor is normal |
| 40 | WAF | Cooling fan life warning signal | ON | Calculated lifetime of the cooling fan is expired |
| | | | OFF | Cooling fan is normal |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |

4-6-24 Starting Contact Signal

The inverter gives out the starting contact signal (FR) while it is receiving an operational command. The FR signal is given out, regardless the setting of the run command source setting (#002). If the forward operation (FW) and reverse operation (RV) are given at the same time, the inverter stops the motor operation.



| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-------------------------|-------|--|
| 41 | FR | Starting contact signal | ON | Either FW or RV is given, or no operation command is given |
| | | | OFF | Both FW and RV is given at the same time |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |

4-6-25 Fin Overheat Warning

The inverter monitors the temperature of its internal heatsink, and gives out the heat sink overheat warning signal (OHF) when the temperature exceeds the overheat warning level (C064).

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|----------------------------|-------|--|
| 42 | OHF | Fin over-heat warn- ing | ON | Heat sink temperature exceeds the C064 set level |
| | | | OFF | Heat sink temperature does not exceed the C064 set level |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C064 | | |

4-6-26 Light Load Detection Signal

The low load detection signal output indicates the general status of the inverter output current. When the output current becomes less than the value specified by C039, the LOC output turns ON.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|-----------------------------|-------|---|
| 43 | LOC | Light load detection signal | ON | When the output current becomes less than the value specified by C039 |
| | | | OFF | When the output current is more than the value specified by C039 |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C038, C039 | | |

4-6-27 Drive Programming Output 1 to 3

The functions are for Drive Programming. Refer to a manual of Drive Programming for detailed description.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|----------------------------|-------|-----------------------------------|
| 44 | MO1 | Drive programming output 1 | ON | Each general output is turned on |
| | | | OFF | Each general output is turned off |
| 45 | MO2 | Drive programming output 2 | | |
| 46 | MO3 | Drive programming output 3 | | |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> Refer to a manual of Drive Programming for detailed explanation. | | | | |

4-6-28 Operation Ready Signal

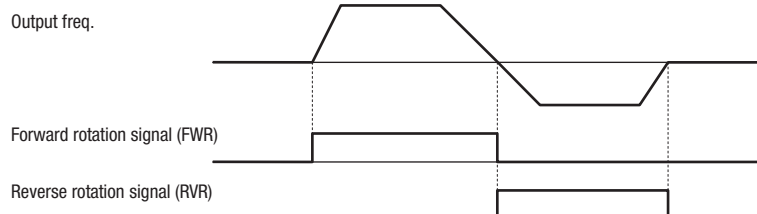
The inverter outputs the inverter ready signal (IRDY) when it is ready for operation (i.e. when it can receive an operational command).

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|------------------------|-------|---|
| 50 | IRDY | Operation ready signal | ON | The inverter is ready to accept the operation command |
| | | | OFF | The inverter is not ready to accept the operation command |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | C038, C039 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The inverter can recognize only the operation command if given while the IRDY signal is given out If the IRDY signal is not given out, check whether the input power supply voltage (connect to the R, S, and T terminals) is within the range of specification | | | | |

4-6-29 Forward and Reverse Run Signals

Forward Rotation signal – The inverter continues to output the forward rotation signal (FWR) while it is driving the motor for forward operation. The FWR signal is turned off while the inverter is driving the motor for reverse operation or stopping the motor.

Reverse Rotation signal – The inverter continues to output the reverse rotation signal (RVR) while it is driving the motor for reverse operation. The RVR signal is turned off while the inverter is driving the motor for forward operation or stopping the motor.



| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--------------------|-------|--|
| 51 | FWR | Forward run signal | ON | Inverter is driving the motor for forward operation |
| | | | OFF | Inverter is driving the motor for reverse operation, or the motor is stopped |
| 52 | RVR | Reverse run signal | ON | Inverter is driving the motor for reverse operation |
| | | | OFF | Inverter is driving the motor for forward operation, or the motor is stopped |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |

4-6-30 Fatal Fault Signal

The inverter gives out the major failure signal in addition to an alarm signal when it trips because of one of the errors listed in note down below.

| Option Code | Terminal Symbol | Function Name | State | Description |
|---|-----------------|--------------------|-------|-------------|
| 53 | MJA | Fatal fault signal | ON | |
| | | | OFF | |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> The output applies to the tripping caused by hardware as shown below. | | | | |

4-6-31 Window Comparator for Analog Inputs

The window comparator function outputs signals when the value of analog inputs [O] and [OI] are within the maximum and minimum limits specified for the window comparator. You can monitor analog inputs with reference to arbitrary levels (to find input terminal disconnection and other errors).

Refer to SECTION 3 *Configuring Drive Parameters* on page 69 for detailed information.

| Option Code | Terminal Symbol | Function Name | State | Description |
|--|-----------------|-----------------------|-------|--|
| 54 | WCO | Window comparator O | ON | [O] input is inside of the window comparator |
| | | | OFF | [O] input is outside of the window comparator |
| 55 | WCOI | Window comparator OI | ON | [OI] input is inside of the window comparator |
| | | | OFF | [OI] input is outside of the window comparator |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | b060~b065, b070, b071 | | |
| Notes: | | | | |
| <ul style="list-style-type: none"> Output values of ODc and OIDc are the same as those of WCO and WCOI, respectively. | | | | |

4-6-32 Frequency Command Source, Run Command Source

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|--------------------------|-------|-------------|
| 58 | FREF | Frequency command source | ON | |
| | | | OFF | |
| 59 | REF | Run command source | ON | |
| | | | OFF | |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |

4-6-33 2nd Motor Selection

This function allows you to switch the inverter setting to control two different types of motors. To use this function, assign function "DB" to one of the input terminal and make it on or off. When 2nd motor parameters are selected, output signal SETM turns on.

| No. | Codes | Description | No. | Codes | Description |
|-----|-------|---|-----|-------|--|
| 1 | F202 | 2nd acceleration time 1 | 22 | A295 | Acc1 to Acc2 frequency transition point, 2nd motor |
| 2 | F203 | 2nd deceleration time 1 | 23 | A296 | Dec1 to Dec2 frequency transition point, 2nd motor |
| 3 | A201 | Frequency reference selection 2nd motor | 24 | C241 | Overload warning level, 2nd motor |
| 4 | A202 | RUN command selection 2nd motor | 25 | H202 | 2nd motor parameter selection |
| 5 | A203 | 2nd set base frequency | 26 | H203 | 2nd motor capacity selection |
| 6 | A204 | 2nd maximum frequency | 27 | H204 | 2nd motor pole number selection |
| 7 | A220 | 2nd multi-step speed reference 0 | 28 | H205 | 2nd speed response |
| 8 | A241 | 2nd torque boost selection | 29 | H206 | 2nd stabilization parameter |
| 9 | A242 | 2nd manual torque boost voltage | 30 | H220 | 2nd motor parameter R1 |
| 10 | A243 | 2nd manual torque boost frequency | 31 | H221 | 2nd motor parameter R2 |
| 11 | A244 | 2nd v/f characteristics selection | 32 | H222 | 2nd motor parameter L |
| 12 | A245 | Output voltage gain, 2nd motor | 33 | H223 | 2nd motor parameter Io |
| 13 | A246 | 2nd automatic torque boost voltage compensation gain | 34 | H224 | 2nd motor parameter J |
| 14 | A247 | 2nd automatic torque boost slip compensation gain | 35 | H230 | 2nd motor parameter R1 (auto-tuning data) |
| 15 | A261 | 2nd frequency upper limit | 36 | H231 | 2nd motor parameter R2 (auto-tuning data) |
| 16 | A262 | 2nd frequency lower limit | 37 | H232 | 2nd motor parameter L (auto-tuning data) |
| 17 | A281 | AVR selection 2nd motor | 38 | H233 | 2nd motor parameter Io (auto-tuning data) |
| 18 | A282 | AVR voltage selection 2nd motor | 39 | H234 | 2nd motor parameter J (auto-tuning data) |
| 19 | A292 | 2nd acceleration time 2 | | | |
| 20 | A293 | 2nd deceleration time 2 | | | |
| 21 | A294 | Select method to switch to Acc2/Dec2 profile, 2nd motor | | | |

| Option Code | Terminal Symbol | Function Name | State | Description |
|---------------------------|-----------------|---------------------|-------|---|
| 60 | SETM | 2nd motor selection | ON | 2 nd motor parameter sets are selected |
| | | | OFF | 1 st motor parameter sets are selected |
| Valid for inputs: | | 11, 12, AL0 - AL2 | | |
| Required settings: | | | | |

4-6-34 STO (Safe Torque Off) Performance Monitor

This signal is specific for Safe Stop function.

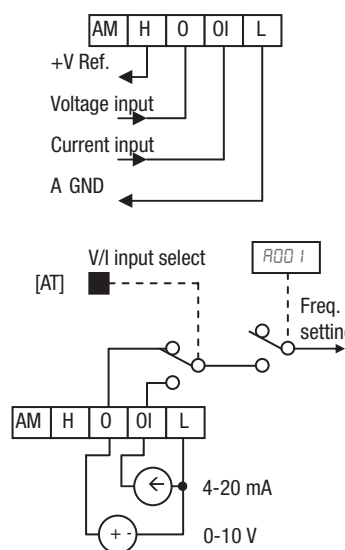
| Option Code | Terminal Symbol | Function Name | State | Description |
|-------------|-----------------|---|-------|-------------|
| 62 | EDM | STO (Safe Torque Off) Performance Monitor (Output terminal 11 only) | ON | |
| | | | OFF | |

| Option Code | Terminal Symbol | Function Name | State | Description |
|-------------|-----------------|--------------------|-------|-----------------------------|
| | | Valid for inputs: | 11 | Dedicated to terminal [11]: |
| | | Required settings: | | |
| | | | | |

4-7 Analog Input Operation

The MX2 inverters provide for analog input to command the inverter frequency output value. The analog input terminal group includes the [L], [OI], [O], and [H] terminals on the control connector, which provide for Voltage [O] or Current [OI] input. All analog input signals must use the analog ground [L].

If you use either the voltage or current analog input, you must select one of them using the logic input terminal function [AT] analog type. Refer to the table on next page showing the activation of each analog input by combination of *ADD5* set parameter and [AT] terminal condition. The [AT] terminal function is covered in “Analog Input Current/Voltage Select” in section 4. Remember that you must also set *ADD1 = 01* to select analog input as the frequency source.

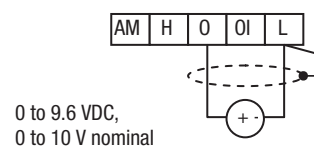
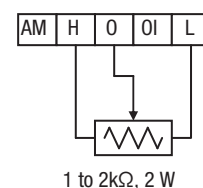


Note If no logic input terminal is configured for the [AT] function, then inverter recognizes that [AT]=OFF and MCU recognizes [O]+[OI] as analog input. In case either (O) or (OI) is to be referred, please ground the other.

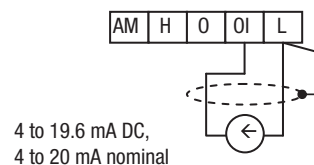
Using an external potentiometer is a common way to control the inverter output frequency (and a good way to learn how to use the analog inputs). The potentiometer uses the built-in 10 V reference [H] and the analog ground [L] for excitation, and the voltage input [O] for the signal. By default, the [AT] terminal selects the voltage input when it is OFF.

Take care to use the proper resistance for the potentiometer, which is 1~2 kΩ, 2 Watts.

Voltage Input – The voltage input circuit uses terminals [L] and [O]. Attach the signal cable's shield wire only to terminal [L] on the inverter. Maintain the voltage within specifications (do not apply negative voltage).



Current Input – The current input circuit uses terminals [OI] and [L]. The current comes from a *sourcing* type transmitter; a *sinking* type will not work! This means the current must flow into terminal [OI], and terminal [L] is the return back to the transmitter. The input impedance from [OI] to [L] is 100 Ohms. Attach the cable shield wire only to terminal [L] on the inverter.



See I/O specs on page 195.

The following table shows the available analog input settings. Parameter *ADDS* and the input terminal [AT] determine the External Frequency Command input terminals that are available, and how they function. The analog inputs [O] and [OI] use terminal [L] as the reference (signal return).

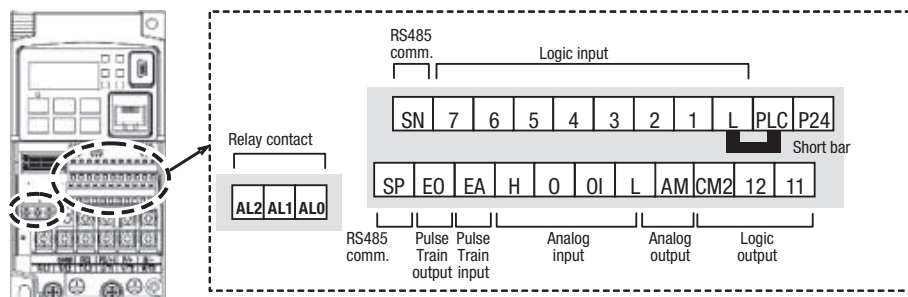
| <i>ADDS</i> | [AT] Input | Analog Input Configuration |
|-------------|------------|----------------------------------|
| 00 | ON | [O] |
| | OFF | [OI] |
| 02 | ON | [O] |
| | OFF | Integrated POT on external panel |
| 03 | ON | [OI] |
| | OFF | Integrated POT on external panel |

4-7-1 Other Analog Input-related topics:

- “Analog Input Settings”
- “Additional Analog Input Settings”
- “Analog Signal Calibration Settings”
- “Analog Input Current/Voltage Select”
- “ADD Frequency Enable”
- “Analog Input Disconnect Detect”

4-7-2 Pulse Train Input Operation

The MX2 inverter is capable of accepting pulse train input signals, that are used for frequency command, process variable (feedback) for PID control, and simple positioning. The dedicated terminal is called “EA” and “EB”. Terminal “EA” is a dedicated terminal, and the terminal “EB” is an intelligent terminal, that has to be changed by a parameter setting.



| Terminal Name | Description | Ratings |
|--------------------------|---|---|
| EA | Pulse train input A | For frequency command, 32 kHz max. Common is [L] |
| EB (Input terminal 7) | Pulse train input B (Set [007] to B5) | 27 VDC max. For frequency command, 2 kHz max. Common is [PLC] |

1. Frequency Command by pulse train input

When using this mode, you should set **A001** to **06**. In this case the frequency is detected by input-capture, and calculated based on the ratio of designated max. frequency (under 32 kHz). Only an input terminal “EA” will be used in this case.

2. Using for process variable of PID control

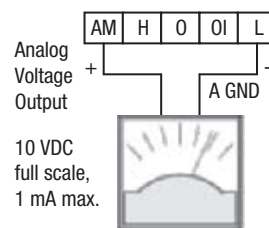
You can use the pulse train input for process variable (feedback) of PID control. In this case you need to set **A016** to **03**. Only “EA” input terminal is to be used.

3. Simple positioning by pulse train input

This is to use the pulse train input like an encoder signal. You can select three types of operation.

4-8 Analog Output Operation

In inverter applications it is useful to monitor the inverter operation from a remote location or from the front panel of an inverter enclosure. In some cases, this requires only a panel-mounted volt meter. In other cases, a controller such as a PLC may provide the inverter's frequency command, and require inverter feedback data (such as output frequency or output current) to confirm actual operation. The analog output terminal [AM] serves these purposes.



See I/O specs on page 195

The inverter provides an analog voltage output on terminal [AM] with terminal [L] as analog GND reference. The [AM] can output inverter frequency or current output value. Note that the voltage range is 0 to +10 V (positive-going only), regardless of forward or reverse motor rotation. Use **C028** to configure terminal [AM] as indicated below.

| Func. | Code | Description |
|-------------|-----------|-------------------------|
| C028 | 00 | Output frequency |
| | 01 | Output current |
| | 02 | Output torque |
| | 04 | Output voltage |
| | 05 | Power |
| | 06 | Thermal load rate |
| | 07 | LAD frequency |
| | 10 | Fin temperature |
| | 11 | Output torque <signed> |
| | 13 | YA1 (Drive Programming) |
| | 16 | Option |

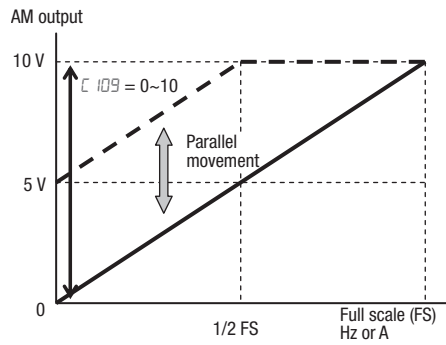
The [AM] signal offset and gain are adjustable, as indicated below.

| Func. | Description | Range | Default |
|-------------|-----------------|--------|---------|
| C106 | AM gain setting | 50~200 | 100 |
| C109 | AM bias setting | 0~100 | 0 |

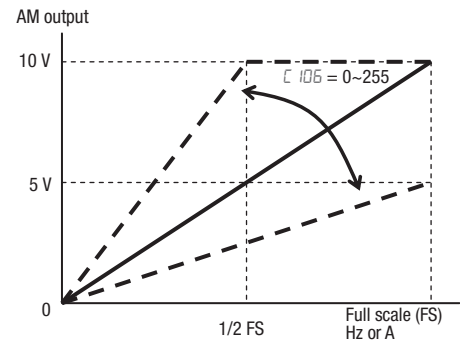
The graph below shows the effect of the gain and offset setting. To calibrate the [AM] output for your application (analog meter), follow the steps below:

1. Run the motor at the full scale speed, or most common operating speed.
 - a) If the analog meter represents output frequency, adjust offset (C 109) first, and then use C 106 to set the voltage for full scale output.
 - b) If [AM] represents motor current, adjust offset (C 109) first, and then use C 106 to set the voltage for full scale output. Remember to leave room at the upper end of the range for increased current when the motor is under heavier loads.

AM output offset adjustment



AM output gain adjustment



Note As mentioned above, first adjust the offset, and then adjust the gain. Otherwise the required performance cannot be obtained because of the parallel movement of the offset adjustment.

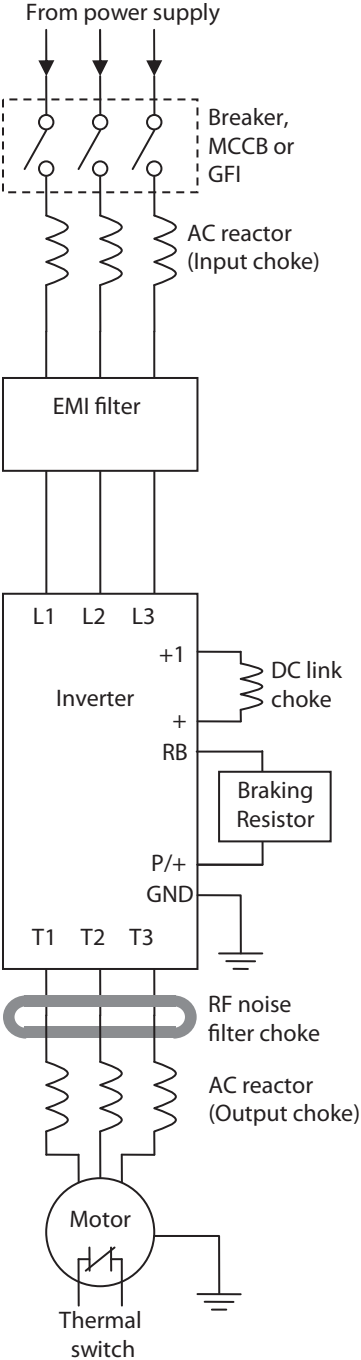
SECTION 5

Inverter System Accessories

5-1 Introduction

5-1-1 Introduction

A motor control system will obviously include a motor and inverter, as well as fuses for safety. If you are connecting a motor to the inverter on a test bench just to get started, that's all you may need for now. But a fully developed system can also have a variety of additional components. Some can be for noise suppression, while others may enhance the inverter's braking performance. The figure below shows a system with several possible optional components, and the table gives part number information.



| Name | Part No. Series | See page |
|------------------------------------|-------------------|----------|
| | | |
| AC reactor, input side | AX-RAIxxxxxxxx-DE | 256 |
| EMC filter (for CE) | AX-FIMxxxx-RE | 259 |
| DC reactor | AX-RCxxxxxxxx-RE | 261 |
| Braking resistor | AX-REMxxxxxxxx-IE | 263 |
| RF noise filter choke, output side | AX-FERxxxx-RE | 259 |
| AC reactor, output side | AX-RAOxxxxxxxx-DE | 258 |

5-2 Component Descriptions

5-2-1 AC Reactors, Input Side

This is useful in suppressing harmonics induced on the power supply lines, or when the main power voltage imbalance exceeds 3% (and power source capacity is more than 500 kVA), or to smooth out line fluctuations. It also improves the power factor.

In the following cases for a general-purpose inverter, a large peak current flows on the main power supply side, and is able to destroy the inverter module:

- If the unbalanced factor of the power supply is 3% or higher
- If the power supply capacity is at least 10 times greater than the inverter capacity (the power supply capacity is 500 kVA or more)
- If abrupt power supply changes are expected

Examples of these situations include:

1. Several inverters are connected in parallel, sharing the same power bus
2. A thyristor converter and an inverter are connected in parallel, sharing the same power bus
3. An installed phase-advance (power factor correction) capacitor opens and closes

Where these conditions exist or when the connected equipment must be highly reliable, you MUST install an input-side AC reactor of 3% (at a voltage drop at rated current) with respect to the supply voltage on the power supply side. Also, where the effects of an indirect lightning strike are possible, install a lightning conductor.

Example calculation:

$$V_{RS} = 205 \text{ V}, V_{ST} = 203 \text{ V}, V_{TR} = 197 \text{ V},$$

where V_{RS} is R-S line voltage, V_{ST} is S-T line voltage, V_{TR} is T-R line voltage

Unbalance factor of voltage =

$$\frac{\text{Max. line voltage (min.)} - \text{Mean Line voltage}}{\text{Meanline voltage}} \times 100$$

$$= \frac{V_{RS} - (V_{RS} + V_{ST} + V_{TR}) / 3}{(V_{RS} + V_{ST} + V_{TR}) / 3} \times 100 = \frac{205 - 202}{202} \times 100 = 1.5 \%$$

Please refer to the documentation that comes with the AC reactor for installation instructions.

Fig. 1

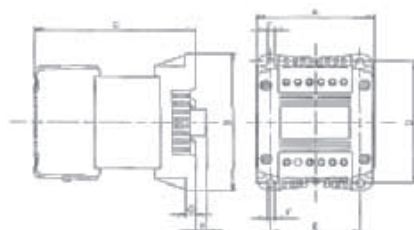


Fig. 2

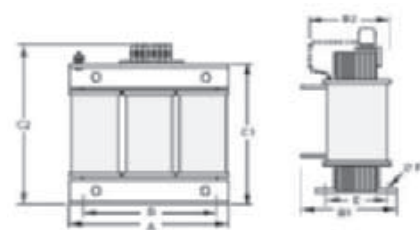
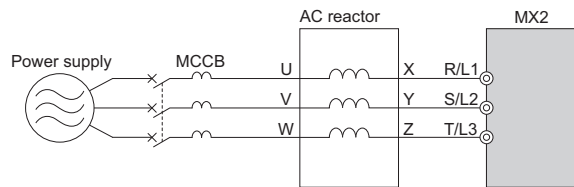


Fig. 1 (single-phase input AC reactor)

| Voltage | Reference | Dimensions (mm) | | | | | | | | Weight kg | Max. motor output kW | Current value A | Inductance mH |
|---------|-------------------|-----------------|-----|-----|-----|----|---|-----|---|-----------|----------------------|-----------------|---------------|
| | | A | B | C | D | E | F | G | H | | | | |
| 200 V | AX-RAI02000070-DE | 84 | 113 | 96 | 101 | 66 | 5 | 7.5 | 2 | 1.22 | 0.4 | 7.0 | 2.0 |
| | AX-RAI01700140-DE | | | 116 | | | | | | 1.95 | 0.75 | 14.0 | 1.7 |
| | AX-RAI01200200-DE | | | 131 | | | | | | 2.55 | 1.5 | 20.0 | 1.2 |
| | AX-RAI00630240-DE | | | 116 | | | | | | 1.95 | 2.2 | 24.0 | 0.63 |

Fig. 2 (three-phase input AC reactor)

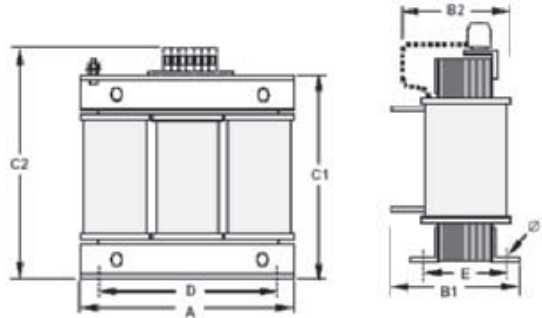
| Voltage | Reference | Dimensions (mm) | | | | | | Weight kg | Max. motor output kW | Current value A | Inductance mH |
|---------|-------------------|-----------------|----|-----|-----|----|-----|-----------|----------------------|-----------------|---------------|
| | | A | B2 | C2 | D | E | F | | | | |
| 200 V | AX-RAI02800080-DE | 120 | 70 | 120 | 80 | 52 | 5.5 | 1.78 | 1.5 | 8.0 | 2.8 |
| | AX-RAI00880200-DE | | 80 | | | 62 | | 2.35 | 3.7 | 20.0 | 0.88 |
| | AX-RAI00350335-DE | 180 | 85 | 190 | 140 | 55 | 6 | 5.5 | 7.5 | 33.5 | 0.35 |
| | AX-RAI00180670-DE | | | | | | | | 15 | 67.0 | 0.18 |
| 400 V | AX-RAI07700050-DE | 120 | 70 | 120 | 80 | 52 | 5.5 | 1.78 | 1.5 | 5.0 | 7.7 |
| | AX-RAI03500100-DE | | 80 | | | 62 | | 2.35 | 4.0 | 10.0 | 3.5 |
| | AX-RAI01300170-DE | 180 | 85 | 190 | 140 | 55 | 6 | 5.5 | 7.5 | 17.0 | 1.3 |
| | AX-RAI00740335-DE | | | | | | | | 15 | 33.5 | 0.74 |



| Voltage | Inverter model | DC reactor model |
|-----------------|----------------------------|-------------------|
| 1-phase 200 VAC | 3G3MX2-AB002/-AB004 | AX-RAI02000070-DE |
| | 3G3MX2-AB007 | AX-RAI01700140-DE |
| | 3G3MX2-AB015 | AX-RAI01200200-DE |
| | 3G3MX2-AB022 | AX-RAI00630240-DE |
| 3-phase 200 VAC | 3G3MX2-A2002/-A2004/-A2007 | AX-RAI02800080-DE |
| | 3G3MX2-A2015/-A2022/-A2037 | AX-RAI00880200-DE |
| | 3G3MX2-A2055/-A2075 | AX-RAI00350335-DE |
| | 3G3MX2-A2110/-A2150 | AX-RAI00180670-DE |
| 3-phase 400 VAC | 3G3MX2-A4004/-A4007/-A4015 | AX-RAI07700050-DE |
| | 3G3MX2-A4022/-A4030/-A4040 | AX-RAI03500100-DE |
| | 3G3MX2-A4055/-A4075 | AX-RAI01300170-DE |
| | 3G3MX2-A4110/-A4150 | AX-RAI00740335-DE |

5-2-2 AC Reactors, Output Side

This reactor reduces the vibrations in the motor caused by the inverter's switching waveforms, by smoothing the waveforms to approximate commercial power quality. It is also useful to reduce the reflected voltage wave phenomenon when wiring from the inverter to the motor is more than 10 m in length. Please refer to the documentation that comes with the AC reactor for installation instructions.



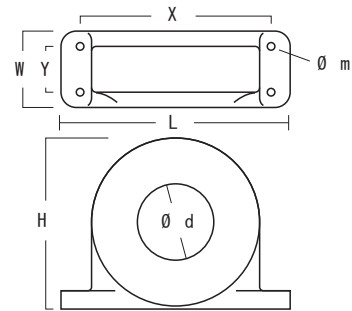
| Voltage | Reference | Dimensions (mm) | | | | | | Weight kg | Max. motor output kW | Current value A | Inductance mH |
|---------|-------------------|-----------------|-----|-----|-----|----|-----|-----------|----------------------|-----------------|---------------|
| | | A | B2 | C2 | D | E | F | | | | |
| 200 V | AX-RAO11500026-DE | 120 | 70 | 120 | 80 | 52 | 5.5 | 1.78 | 0.4 | 2.6 | 11.50 |
| | AX-RAO07600042-DE | | 80 | | | 62 | | | 0.75 | 4.2 | 7.60 |
| | AX-RAO04100075-DE | | | | | | | | | 1.5 | 7.5 |
| | AX-RAO03000105-DE | | | | | | | 2.2 | 10.5 | 3.00 | |
| | AX-RAO01830160-DE | 180 | 85 | 190 | 140 | 55 | 6 | 5.5 | 3.7 | 16.0 | 1.83 |
| | AX-RAO01150220-DE | | | | | | | | | 5.5 | 22.0 |
| | AX-RAO00950320-DE | | | | | | | 6.5 | 7.5 | 32.0 | 0.95 |
| | AX-RAO00630430-DE | | 95 | 205 | | 65 | | 9.1 | 11 | 43.0 | 0.63 |
| | AX-RAO00490640-DE | | | | | | | | | | 15 |
| 400 V | AX-RAO16300038-DE | 120 | 70 | 120 | 80 | 52 | 5.5 | 1.78 | 1.5 | 3.8 | 16.30 |
| | AX-RAO11800053-DE | | 80 | | | 62 | | | 2.2 | 5.3 | 11.80 |
| | AX-RAO07300080-DE | | | | | | | | | 4.0 | 8.0 |
| | AX-RAO04600110-DE | 180 | 85 | 190 | 140 | 55 | 6 | 5.5 | 5.5 | 11.0 | 4.60 |
| | AX-RAO03600160-DE | | | | | | | 6.5 | 7.5 | 16.0 | 3.60 |
| | AX-RAO02500220-DE | | 95 | 205 | | 85 | | 9.1 | 11 | 22.0 | 2.50 |
| | AX-RAO02000320-DE | | 105 | | | | | 11.7 | 15 | 32.0 | 2.00 |

| Voltage | Inverter model | DC reactor model |
|-----------------|----------------------------|-------------------|
| 1-phase 200 VAC | 3G3MX2-AB001/-AB002/-AB004 | AX-RAO11500026-DE |
| | 3G3MX2-AB007 | AX-RAO07600042-DE |
| | 3G3MX2-AB015 | AX-RAO04100075-DE |
| | 3G3MX2-AB022 | AX-RAO03000105-DE |
| 3-phase 200 VAC | 3G3MX2-A2001/-A2002/-A2004 | AX-RAO11500026-DE |
| | 3G3MX2-A2007 | AX-RAO07600042-DE |
| | 3G3MX2-A2015 | AX-RAO04100075-DE |
| | 3G3MX2-A2022 | AX-RAO03000105-DE |
| | 3G3MX2-A2037 | AX-RAO01830160-DE |
| | 3G3MX2-A2055 | AX-RAO01150220-DE |
| | 3G3MX2-A2075 | AX-RAO00950320-DE |
| | 3G3MX2-A2110 | AX-RAO00630430-DE |
| | 3G3MX2-A2150 | AX-RAO00490640-DE |

| Voltage | Inverter model | DC reactor model |
|-----------------|----------------------------|-------------------|
| 3-phase 400 VAC | 3G3MX2-A4004/-A4007/-A4015 | AX-RAO16300038-DE |
| | 3G3MX2-A4022 | AX-RAO11800053-DE |
| | 3G3MX2-A4030/-A4040 | AX-RAO07300080-DE |
| | 3G3MX2-A4055 | AX-RAO04600110-DE |
| | 3G3MX2-A4075 | AX-RAO03600160-DE |
| | 3G3MX2-A4110 | AX-RAO02500220-DE |
| | 3G3MX2-A4150 | AX-RAO02000320-DE |

5-2-3 Zero-phase Reactor (RF Noise Filter)

The zero-phase reactor helps reduce radiated noise from the inverter wiring. It can be used on the input or output side of the inverter. The example zero-phase reactor shown to the right comes with a mounting bracket. The wiring must go through the opening to reduce the RF component of the electrical noise. Loop the wires three times (four turns) to attain the full RF filtering effect. For larger wire sizes, place multiple zero-phase reactors (up to four) side-by-side for a greater filtering effect.



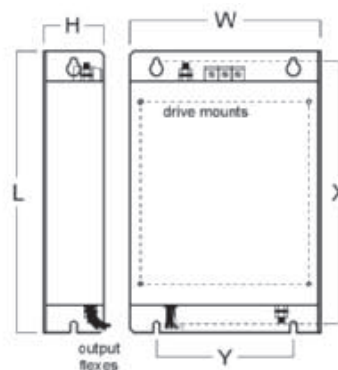
| Reference | D diameter | Dimensions (mm) | | | | | Weight kg | Description | |
|---------------|------------|-----------------|----|-----|-----|----|-----------|-------------|----------------------------|
| | | L | W | H | X | Y | | | |
| AX-FER2102-RE | 21 | 85 | 22 | 46 | 70 | - | 5 | 0.1 | For 2.2 kW motors or below |
| AX-FER2515-RE | 25 | 105 | 25 | 62 | 90 | - | | 0.2 | For 15 kW motors or below |
| AX-FER5045-RE | 50 | 150 | 50 | 110 | 125 | 30 | | 0.7 | For 45 kW motors or below |

5-2-4 EMC Filter

The EMC filter reduces the conducted noise on the power supply wiring generated by the inverter. Connect the EMC filter to the inverter primary (input side). Filter is required for compliance to the EMC Class A directive (Europe) and C-TICK (Australia). See D-1 *CE-EMC Installation Guidelines* on page 373.

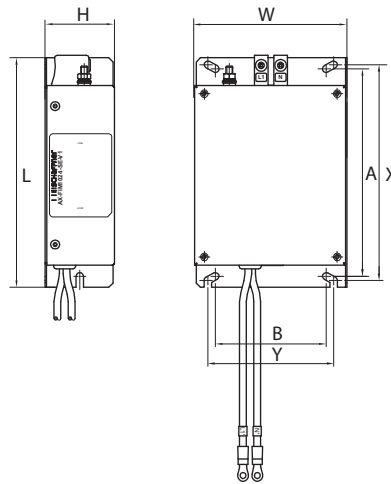
⚠ WARNING The EMC filter has high internal leakage current from power wiring to the chassis. Therefore, connect the chassis ground of the EMC filter before making the power connections to avoid danger of shock or injury.

Rasmi footprint filters



| Voltage | Reference | Dimensions (mm) | | | | | | Model 3G3MX2-□ | Current (A) |
|-----------|---------------|-----------------|----|-----|-----|---------------|----|-------------------------------|----------------|
| | | W | H | L | X | Y | M | | |
| 1 x 200 V | AX-FIM1010-RE | 71 | 45 | 169 | 156 | 51 | M4 | AB001 / AB002 / AB004 | 10 |
| | AX-FIM1014-RE | 111 | 50 | | | 91 | | AB007 | 14 |
| | AX-FIM1024-RE | | | | | AB015 / AB022 | | 24 | |
| 3 x 200 V | AX-FIM2010-RE | 82 | 50 | 194 | 181 | 62 | M4 | A2001 / A2002 / A2004 / A2007 | 10 |
| | AX-FIM2020-RE | 111 | | 169 | 156 | 91 | | A2015 / A2022 | 20 |
| | AX-FIM2030-RE | 144 | | 174 | 161 | 120 | | A2037 | 30 |
| | AX-FIM2060-RE | 150 | 52 | 320 | 290 | 122 | M5 | A2055 / A2075 | 60 |
| | AX-FIM2080-RE | 188 | 62 | 362 | 330 | 160 | | A2110 | 80 |
| | AX-FIM2100-RE | 220 | | 415 | 380 | 192 | M6 | A2150 | 100 |
| 3 x 400 V | AX-FIM3005-RE | 114 | 46 | 169 | 156 | 91 | M4 | A4004 / A4007 | 5 |
| | AX-FIM3010-RE | | | | | | | A4015 / A4022 / A4030 | 10 |
| | AX-FIM3014-RE | 144 | 50 | 174 | 161 | 120 | | A4040 | 14 |
| | AX-FIM3030-RE | 150 | 52 | 306 | 290 | 122 | M5 | A4055 / A4075 | 30 |
| | AX-FIM3050-RE | 182 | 62 | 357 | 330 | 160 | | A4110 / A4150 | 50 |

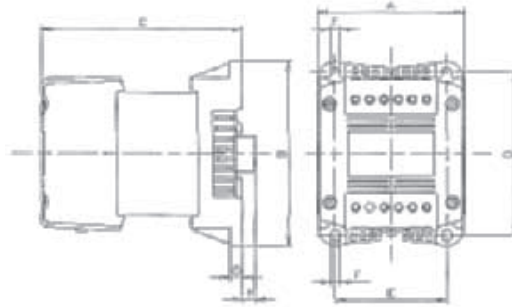
Schaffner footprint filters



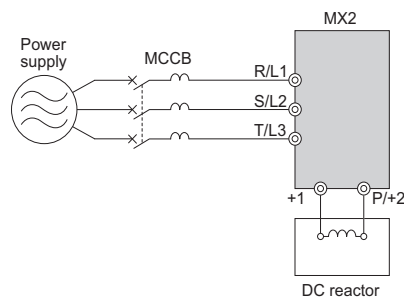
| Voltage | Reference | Dimensions (mm) | | | | | | | | Model 3G3MX2-□ | Current (A) | |
|-----------|------------------|-----------------|-----|-----|-----|-----|-----|---------------|----|-------------------------------|-----------------------|----|
| | | W | H | L | X | Y | A | B | M | | | |
| 1 x 200 V | AX-FIM1010-SE-V1 | 70 | 40 | 166 | 156 | 51 | 150 | 50 | M5 | AB001 / AB002 / AB004 | 8 | |
| | AX-FIM1024-SE-V1 | 110 | 50 | | | 91 | | | | 80 | AB007 / AB015 / AB022 | 27 |
| 3 x 200 V | AX-FIM2010-SE-V1 | 80 | 40 | 191 | 181 | 62 | 150 | 50 | M5 | A2001 / A2002 / A2004 / A2007 | 7.8 | |
| | AX-FIM2020-SE-V1 | 110 | 50 | 160 | 156 | 91 | | | | 80 | A2015 / A2022 | 16 |
| | AX-FIM2030-SE-V1 | 142 | | 171 | 161 | 120 | | | | A2037 | 25 | |
| | AX-FIM2060-SE-V1 | 140 | 55 | 304 | 290 | 122 | 286 | 112 | | A2055 / A2075 | 50 | |
| | AX-FIM2080-SE-V1 | 180 | | 344 | 330 | 160 | 323 | 140 | | A2110 | 75 | |
| | AX-FIM2100-SE-V1 | 220 | 65 | 394 | 380 | 192 | 376 | 180 | | A2150 | 100 | |
| 3 x 400 V | AX-FIM3005-SE-V1 | 110 | 50 | 166 | 156 | 91 | 150 | 80 | M5 | A4004 / A4007 | 6 | |
| | AX-FIM3010-SE-V1 | | | | | | | | | A4015 / A4022 / A4030 | 12 | |
| | AX-FIM3014-SE-V1 | 142 | 171 | 161 | 120 | 112 | | A4040 | | 15 | | |
| | AX-FIM3030-SE-V1 | 140 | 55 | 304 | 290 | 122 | 286 | A4055 / A4075 | | 29 | | |
| | AX-FIM3050-SE-V1 | 180 | | 344 | 330 | 160 | 323 | 140 | | A4110 / A4150 | 48 | |

5-2-5 DC Reactor

The DC Reactor suppresses harmonics generated by the inverter. It attenuates the high-frequency components on the inverter's internal DC bus (link). However, note that it does not protect the diode rectifiers in the inverter input circuit.



| Voltage | Reference | Dimensions (mm) | | | | | | | | Weight kg | Max. motor output kW | Current value A | Inductance mH | |
|------------------|------------------|------------------|-----|-------|------|-----|-----|-----|------|-----------|----------------------|-----------------|---------------|------|
| | | A | B | C | D | E | F | G | H | | | | | |
| 200 V | AX-RC21400016-DE | 84 | 113 | 96 | 101 | 66 | 5 | 7.5 | 2 | 1.22 | 0.2 | 1.6 | 21.4 | |
| | AX-RC10700032-DE | | | 0.4 | | | | | | | 3.2 | 10.7 | | |
| | AX-RC06750061-DE | | | 105 | | | | | | | 0.7 | 6.1 | 6.75 | |
| | AX-RC03510093-DE | | | 116 | | | | | | | 1.5 | 9.3 | 3.51 | |
| | AX-RC02510138-DE | 108 | 135 | 124 | 120 | 82 | 6.5 | 9.5 | 3.20 | 3.7 | 22.3 | 1.60 | | |
| | AX-RC01600223-DE | 120 | 152 | 136 | 135 | 94 | 7 | 9.5 | - | 5.20 | 5.5 | 30.9 | 1.11 | |
| | AX-RC00840437-DE | | | 146 | | | | | - | 6.00 | 7.5 | 43.7 | 0.84 | |
| | AX-RC00590614-DE | 150 | 177 | 160 | 160 | 115 | 7 | 2 | - | 11.4 | 11.0 | 61.4 | 0.59 | |
| | AX-RC00440859-DE | | | 182.6 | | | | | - | 14.3 | 15.0 | 85.9 | 0.44 | |
| | 400 V | AX-RC43000020-DE | 84 | 113 | 96 | 101 | 66 | 5 | 7.5 | 2 | 1.22 | 0.4 | 2.0 | 43.0 |
| AX-RC27000030-DE | | 105 | | | 0.7 | | | | | | | 3.0 | 27.0 | |
| AX-RC14000047-DE | | 116 | | | 1.5 | | | | | | | 4.7 | 14.0 | |
| AX-RC10100069-DE | | 131 | | | 1.95 | | | | | | | 2.2 | 6.9 | 10.1 |
| AX-RC08250093-DE | | 131 | | | 2.65 | | | | | | | 3.0 | 9.3 | 8.25 |
| AX-RC06400116-DE | | 108 | 135 | 133 | 120 | 82 | 6.5 | 9.5 | 3.70 | 4.0 | 11.6 | 6.40 | | |
| AX-RC04410167-DE | | 120 | 152 | 136 | 135 | 94 | 7 | 9.5 | - | 5.20 | 5.5 | 16.7 | 4.41 | |
| AX-RC03350219-DE | | | | 146 | | | | | - | 6.00 | 7.5 | 21.9 | 3.35 | |
| AX-RC02330307-DE | | 150 | 177 | 160 | 160 | 115 | 7 | 2 | - | 11.4 | 11.0 | 30.7 | 2.33 | |
| AX-RC01750430-DE | | | | 182.6 | | | | | - | 14.3 | 15.0 | 43.0 | 1.75 | |



| Voltage | Inverter model | DC reactor model |
|-----------------|------------------|------------------|
| 1-phase 200 VAC | 3G3MX2-AB001 | AX-RC10700032-DE |
| | 3G3MX2-AB002 | |
| | 3G3MX2-AB004 | AX-RC06750061-DE |
| | 3G3MX2-AB007 | AX-RC03510093-DE |
| | 3G3MX2-AB015 | AX-RC02510138-DE |
| | 3G3MX2-AB022 | AX-RC01600223-DE |
| 3-phase 200 VAC | 3G3MX2-A2001 | AX-RC21400016-DE |
| | 3G3MX2-A2002 | |
| | 3G3MX2-A2004 | AX-RC10700032-DE |
| | 3G3MX2-A2007 | AX-RC06750061-DE |
| | 3G3MX2-A2015 | AX-RC03510093-DE |
| | 3G3MX2-A2022 | AX-RC02510138-DE |
| | 3G3MX2-A2037 | AX-RC01600223-DE |
| | 3G3MX2-A2055 | AX-RC01110309-DE |
| | 3G3MX2-A2075 | AX-RC00840437-DE |
| | 3G3MX2-A2110 | AX-RC00590614-DE |
| 3G3MX2-A2150 | AX-RC00440859-DE | |
| 3-phase 400 VAC | 3G3MX2-A4004 | AX-RC43000020-DE |
| | 3G3MX2-A4007 | AX-RC27000030-DE |
| | 3G3MX2-A4015 | AX-RC14000047-DE |
| | 3G3MX2-A4022 | AX-RC10100069-DE |
| | 3G3MX2-A4030 | AX-RC08250093-DE |
| | 3G3MX2-A4040 | AX-RC06400116-DE |
| | 3G3MX2-A4055 | AX-RC04410167-DE |
| | 3G3MX2-A4075 | AX-RC03350219-DE |
| | 3G3MX2-A4110 | AX-RC02330307-DE |
| | 3G3MX2-A4150 | AX-RC01750430-DE |

5-3 Dynamic Braking

5-3-1 Introduction

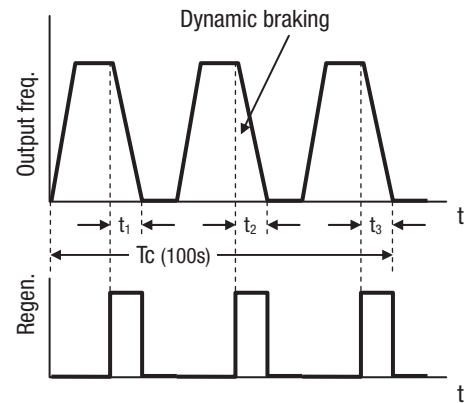
- The purpose of dynamic braking is to improve the ability of the inverter to stop (decelerate) the motor and load. This becomes necessary when an application has some or all of the following characteristics:
 - High load inertia compared to the available motor torque
 - The application requires frequent or sudden changes in speed
 - System losses are not great enough to slow the motor as needed

When the inverter reduces its output frequency to decelerate the load, the motor can temporarily become a generator. This occurs when the motor rotation frequency is higher than the inverter output frequency. This condition can cause the inverter DC bus voltage to rise, resulting in an over-voltage trip. In many applications, the over-voltage condition serves as a warning signal that we have exceeded the deceleration capabilities of the system. The MX2 inverters have a built-in braking chopper, which sends the regenerative energy from the motor during deceleration to the optional braking resistor(s). external braking units may also be used if higher braking torques and/or duty cycles are required. The dynamic braking resistor serves as a load, developing heat to stop the motor just as brakes on an automobile develop heat during braking.

The braking resistor is the main component of a braking resistor assembly, it includes a fuse and a thermal relay for safety. And switching circuit and power resistor are the main components of the dynamic braking unit that includes a fuse and thermally activated alarm relay for safety. However, be careful to avoid overheating its resistor. The fuse and thermal relay are safeguards for extreme conditions, but the inverter can maintain braking usage in a safe zone.

5-3-2 Dynamic Braking Usage

The inverter controls braking via a duty cycle method (percent of the time braking is ON versus total time). Parameter `b090` sets the dynamic braking usage ratio. In the graph to the right, the example shows three uses of dynamic braking in a 100-second period. The inverter calculates the average percentage usage in that time (T%). The percentage of usage is proportional to the heat dissipated. If T% is greater than the `b090` parameter setting, the inverter enters the trip mode and turns off the frequency output.



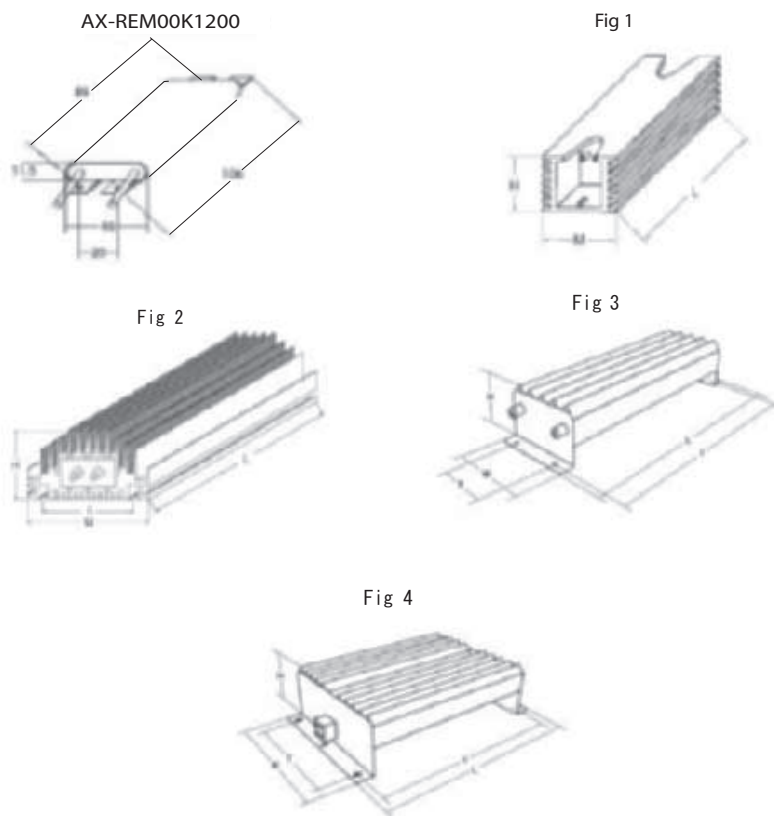
$$b090 \quad T\% = \frac{t_1 + t_2 + t_3}{100 \text{ sec}} \times 100$$

Please note the following:

- When `b090` is set for 0%, dynamic braking is not performed
- When the T% value exceeds the limit set by `b090`, dynamic braking ends.
- When mounting an external dynamic braking unit, set the usage ratio (`b090`) to 0.0 and remove the external resistors.
- The cable from the external resistor to the inverter must not exceed 5 m length.
- The individual wires from the resistor to the inverter must not be bundled together.

5-3-3 Braking Resistor Selection Tables

The MX2 series inverters have integrated braking units (chopper). Stopping torque is available by adding external resistors. The required braking torque depends on your particular application. Next table helps you to choose the right resistor for 3% and 10% braking duty applications (ocasional braking). To achieve higher duty cycles, external braking units (separate chopper with higher capacity) are required. Check with your supplier.



| Type | Fig. | Dimensions (mm) | | | | | Weight kg | | | | |
|------------------|------|-----------------|-----|-----|-----|-----|-----------|-----|------|------|----|
| | | L | H | M | I | T | | | | | |
| AX-REM00K1400-IE | 1 | 105 | 27 | 36 | 94 | - | 0.2 | | | | |
| AX-REM00K2070-IE | | | | | 189 | | | | | | |
| AX-REM00K2120-IE | | | | | 249 | | | | | | |
| AX-REM00K2200-IE | | 260 | | 27 | 36 | | 309 | - | 0.58 | | |
| AX-REM00K4075-IE | | | | | | | 320 | | 0.73 | | |
| AX-REM00K4035-IE | | | | | | | 200 | | 62 | 100 | 74 |
| AX-REM00K4030-IE | | 2 | | 200 | 62 | | 100 | 74 | - | 1.41 | |
| AX-REM00K5120-IE | | | | | | | | | | | |
| AX-REM00K6100-IE | | 3 | | 365 | 73 | | 105 | 350 | 70 | 4 | |
| AX-REM00K6035-IE | | | | | | | | | | | |
| AX-REM00K9070-IE | | | | | | | | | | | |
| AX-REM00K9020-IE | 4 | 310 | 100 | 240 | 295 | 210 | 7 | | | | |
| AX-REM01K9070-IE | | | | | 350 | | 8 | | | | |
| AX-REM01K9017-IE | | 365 | | | 310 | | 73 | 105 | 350 | 70 | 4 |
| AX-REM02K1070-IE | | | | | | | | | | | |
| AX-REM02K1017-IE | 365 | 310 | 73 | 105 | 350 | 70 | 4 | | | | |
| AX-REM03K5035-IE | | | | | | | | | | | |
| AX-REM03K5010-IE | 8 | | | | | | | | | | |

| Inverter | | | | | Braking resistor unit | | |
|-----------------------------|---------------|-------------------|---------|-------------------------------|---|---------------|-----|
| Voltage | Max. motor kW | Inverter 3G3MX2-□ | | Connectable min. resistance Ω | Inverter mounted type (3 %ED, 10 sec max) | | |
| | | 3-phase | 1-phase | | Type AX- | Resist Ω | |
| 200 V (single-/three-phase) | 0.12 | 2001 | B001 | 100 | REM00K1400-IE | 400 | |
| | 0.25 | 2002 | B002 | | 50 | REM00K1200-IE | 200 |
| | 0.55 | 2004 | B004 | | | REM00K2070-IE | 70 |
| | 1.1 | 2007 | B007 | 35 | REM00K4075-IE | 75 | |
| | 1.5 | 2015 | B015 | | REM00K4035-IE | 35 | |
| | 2.2 | 2022 | B022 | 20 | REM00K6035-IE | 35 | |
| | 4.0 | 2040 | - | | REM00K9017-IE | 17 | |
| | 5.5 | 2055 | - | 17 | REM00K1400-IE | 400 | |
| | 7.5 | 2075 | - | | REM00K1200-IE | 200 | |
| | 11 | 2110 | - | | REM00K2200-IE | 200 | |
| 400 V (three-phase) | 15 | 2150 | - | 100 | REM00K2120-IE | 120 | |
| | 0.55 | 4004 | - | | 70 | REM00K4075-IE | 75 |
| | 1.1 | 4007 | - | 35 | | REM00K6100-IE | 100 |
| | 1.5 | 4015 | - | | REM00K9070-IE | 70 | |
| | 2.2 | 4022 | - | 180 | REM00K1400-IE | 400 | |
| | 3.0 | 4030 | - | | REM00K1200-IE | 200 | |
| | 4.0 | 4040 | - | 100 | REM00K2200-IE | 200 | |
| | 5.5 | 4055 | - | | REM00K2120-IE | 120 | |
| | 7.5 | 4075 | - | 70 | REM00K4075-IE | 75 | |
| | 11 | 4110 | - | | REM00K6100-IE | 100 | |
| 15 | 4150 | - | 35 | REM00K9070-IE | 70 | | |

| Inverter | | | | | Braking resistor unit | | | |
|-----------------------------|---------------|-------------------|---------|-------------------------------|---|---------------|------------------|-----|
| Voltage | Max. motor kW | Inverter 3G3MX2-□ | | Connectable min. resistance Ω | Inverter mounted type (10%ED, 10 sec max) | | Braking torque % | |
| | | 3-phase | 1-phase | | Type AX- | Resist Ω | | |
| 200 V (single-/three-phase) | 0.12 | 2001 | B001 | 100 | REM00K1400-IE | 400 | 200 | |
| | 0.25 | 2002 | B002 | | 50 | REM00K1200-IE | 200 | 180 |
| | 0.55 | 2004 | B004 | | | REM00K2070-IE | 70 | 200 |
| | 1.1 | 2007 | B007 | 35 | REM00K4075-IE | 75 | 130 | |
| | 1.5 | 2015 | B015 | | REM00K4035-IE | 35 | 180 | |
| | 2.2 | 2022 | B022 | 20 | REM00K6035-IE | 35 | 100 | |
| | 4.0 | 2040 | - | | REM00K9020-IE | 20 | 150 | |
| | 5.5 | 2055 | - | 17 | REM01K9017-IE | 17 | 110 | |
| | 7.5 | 2075 | - | | REM02K1017-IE | 17 | 75 | |
| | 11 | 2110 | - | | REM03K5010-IE | 10 | 95 | |
| 400 V (three-phase) | 15 | 2150 | - | 100 | REM00K1400-IE | 400 | 200 | |
| | 0.55 | 4004 | - | | 70 | REM00K1200-IE | 200 | 200 |
| | 1.1 | 4007 | - | 35 | | REM00K2200-IE | 200 | 190 |
| | 1.5 | 4015 | - | | REM00K5120-IE | 120 | 200 | |
| | 2.2 | 4022 | - | 180 | REM00K6100-IE | 100 | 160 | |
| | 3.0 | 4030 | - | | REM00K9070-IE | 70 | 150 | |
| | 4.0 | 4040 | - | 100 | REM01K9070-IE | 70 | 110 | |
| | 5.5 | 4055 | - | | REM02K1070-IE | 70 | 75 | |
| | 7.5 | 4075 | - | 70 | REM03K5035-IE | 35 | 110 | |
| | 11 | 4110 | - | | 35 | | | |
| 15 | 4150 | - | 35 | | | | | |


SECTION 6


Troubleshooting and Maintenance


6-1 Troubleshooting

6-1-1 Safety Messages

Please read the following safety messages before troubleshooting or performing maintenance on the inverter and motor system.

 **WARNING** Wait at least ten (10) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, there is a danger of electric shock.

 **WARNING** Make sure that only qualified personnel will perform maintenance, inspection, and part replacement. Before starting to work, remove any metallic objects from your person (wristwatch, bracelet, etc.). Be sure to use tools with insulated handles. Otherwise, there is a danger of electric shock and/or injury to personnel.

 **WARNING** Never remove connectors by pulling on its wire leads (wires for cooling fan and logic P.C.board). Otherwise, there is a danger of fire due to wire breakage and/or injury to personnel.

6-1-2 General Precautions and Notes

- Always keep the unit clean so that dust or other foreign matter does not enter the inverter.
- Take special care in regard to breaking wires or making connection mistakes.
- Firmly connect terminals and connectors.
- Keep electronic equipment away from moisture and oil. Dust, steel filings and other foreign matter can damage insulation, causing unexpected accidents, so take special care.

6-1-3 Inspection Items

This chapter provides instructions or checklists for these inspection items:

- Daily inspection
- Periodical inspection (approximately once a year)
- Insulation resistance (Megger) test (approximately once two years)

6-1-4 Troubleshooting Tips

The table below lists typical symptoms and the corresponding solution(s).

1. Inverter does not power up.

| Possible Cause(s) | Corrective Action |
|--|---|
| Power cable is incorrectly wired. | Check input wiring |
| Short bar or DCL between [P] and [PD] is disconnected. | Install short bar or DCL between [P] and [PD] terminal. |
| Power cable is broken. | Check input wiring. |

2. Motor does not start.

| Possible Cause(s) | Corrective Action |
|---|--|
| Incorrect RUN command source is selected. | Check RUN command selection (A002) for correct source. Ex. Terminal (digital input) : 01 Operator (RUN key) : 02 |
| Incorrect frequency source is selected. | Check frequency reference selection (A001) for correct source. Ex. Terminal (analog input) : 01 Operator (F001) : 02 |
| Frequency setting is 0 Hz. | If frequency reference selection is terminal (A001=01), check analog voltage or current signal at [O] or [OI] terminals. If frequency reference selection is operator (A001=02), set frequency in F001 . Depending on frequency source, input proper frequency reference. If frequency reference selection is multi-speed operation, set frequency in A020 to A035 and A220 . |
| RUN command is not set to input terminal. | If RUN command selection is terminal (A002=01), set "forward" (00:FW) or "reverse" (01:RV) to any input terminals. In case of 3-wire control, set "3-wire start" (20:STA), "3-wire stop" (21:STP) and "3-wire FW/RV" (22:F/R) to any input terminals. |
| "Multi-step speed reference" (02 to 05:CF1 to CF4) is (are) set to input terminal(s) and active. | Deactivate the input(s), or check the frequency reference parameters associated (A021 to A035). |
| Both FWD and REV input are active. | If RUN command source is FWD/REV input, activate either FWD or REV input. |
| Rotation direction limit selection (b035) is enabled. | Check b035 . |
| Incorrect input wiring or short bar position | Wire inputs correctly and/or install short bar. (ON/OFF status of inputs are monitored in d005 .) |
| Incorrect analog input or variable resistor wiring | Wire correctly. In case of analog voltage or variable resistor input, check voltage between [O] and [L] terminal. In case of analog current, check current between current source and [OI] terminal. |
| RUN command source is operator, but input terminal is set to "Force terminal" and active. | Deactivate the input. |
| RUN command source is terminal, but input terminal is set to "Force operator" and active. | Deactivate the input. |
| Inverter is in trip status. (With ALARM LED and "Exxx" indication) | Reset inverter by STOP/RESET key and check error code. |

| Possible Cause(s) | Corrective Action |
|--|---|
| Safety function is enabled and either GS1 or GS2 input is inactive. | If safety function is used, activate both GS1 and GS2. If not, disable safety function by dip switch. |
| "1B:RS", "14:CS" or "11:FRS" is set to input terminal and the input is inactive. | Deactivate the input. |
| "04:ROK" is set to input terminal and the input is active. | Activate the input. |
| Cable between inverter and motor or internal cable of motor is breaking. | Check the wiring. |
| Excess load. | Remove excess load. |
| Motor is locked. | Unlock the motor. |

3. Motor does not accelerate to command speed.

| Possible Cause(s) | Corrective Action |
|--|--|
| Bad connection of analog wiring. | Check the wiring. In case of analog voltage or variable resistor input, check voltage between [O] and [L] terminal. In case of analog current, check current between current source and [OI] terminal. |
| Overload restriction or OC suppression function works. | Check the function level. |
| Max. frequency (A004) or upper limit (A05 I/A25 I) is lower than as expected. | Check the value. |
| Acceleration time is excessive. | Change acceleration time (F002/A092/A292). |
| "Multi-speed input(s) (02 to 05:CF1 to CF4)" is (are) set to input terminal(s) and active. | Deactivate the input(s). |
| "06:JG" is set to input terminal and the input is active. | Deactivate the input. |
| Excess load. | Remove excess load. |
| Motor is locked. | Unlock the motor. |

4. Inverter does not respond to changes in frequency setting from operator.

| Possible Cause(s) | Corrective Action |
|--|---|
| Incorrect frequency source is selected. | Check frequency reference selection (A00 I=02). |
| "5 I:F-TM" is set to input terminal and the input is active. | Deactivate the input. |

5. A part of function codes is not displayed.

| Possible Cause(s) | Corrective Action |
|---|------------------------------------|
| "Display selection" (b037) is enabled. | Set 00 (complete display) to b037. |
| "06:DISP" is set to input terminal and the input is active. | Deactivate the input. |

6. Operator (keypad) does not respond.

| Possible Cause(s) | Corrective Action |
|---|-----------------------|
| "06:DISP" is set to input terminal and the input is active. | Deactivate the input. |

7. Parameter data does not change.

| Possible Cause(s) | Corrective Action |
|---|---|
| Inverter is in RUN status. | Stop the inverter, make sure the motor stops and try again. If "RUN mode edit" is enabled, a part of function codes can be changed in RUN status. |
| Soft lock selection (b03 l) is enabled. | Disable software lock function. |

8. Motor rotates reverse direction with forward command.

| Possible Cause(s) | Corrective Action |
|--|---|
| Incorrect power wiring. | Exchange any two of U/T1, V/T2 or W/T3. |
| Incorrect logic of direction signal in 3-wire operation. | Check the logic of input set as "22:F/R". |

9. Motor rotates reverse direction with RUN key of keypad.

| Possible Cause(s) | Corrective Action |
|--|-------------------|
| Operator rotation direction selection (F004) is incorrectly set. | Check F004. |

10. Overcurrent trip (E03)

| Possible Cause(s) | Corrective Action |
|--|--|
| Acceleration time is short. | Change acceleration time (F002/A092/A292). Enable "acceleration stop" function (A069, A070) |
| Excess load. | Remove excess load. Enable torque boost function. Set free V/f in V/F characteristics selection (A044/A244=02) |
| Overload limit selection (b02 l) is disabled (00). | Enable overload limit selection (b02 l=0 l/02/03). |

Despite overload restriction is enabled, the inverter trips due to Overcurrent (E03).

| | |
|--|--|
| Overload limit level (b022/b025) is high. | Set overload limit level (b022/b025) lower. |
| Overload limit parameter (b023/b026) is too short. | Set overload limit parameter (b023/b026) longer. |

11. STOP/RESET key does not respond.

| Possible Cause(s) | Corrective Action |
|---|---|
| STOP/RESET key disabled. | Check "STOP key selection" function. (b087) |
| Overvoltage protection function selection during deceleration (b 130) or selection of non-stop function at momentary power interruption (b050) function is enabled. | Check b 130 and b050. |

12. Sound noise of motor or machine.

| Possible Cause(s) | Corrective Action |
|--|---|
| Carrier frequency is low. | Set carrier frequency (b083) higher. (This could cause electric noise and leak current higher.) |
| Machine frequency and motor frequency are resonated. | Change output frequency slightly. If resonating in accel/deceleration, use jump frequency function (A063-68) to avoid machine frequency. |
| Over excitation | Set base frequency (A003/A203) and AVR voltage selection (A082/A282) according to motor rating. If not improved, reduce output voltage gain (A045/A245) slightly or change V/f characteristics selection (A044/A244) as free V/f. |

13. Motor overload trip (E05).

| Possible Cause(s) | Corrective Action |
|--|--|
| Improper electronic thermal level | Check electronic thermal level (b0 12/b0 13-b9 10-b9 11-b9 12) |
| The application needs frequent strong accelerations with high peak currents. | Check if the application can accept softer acceleration time to minimize peak currents F002/F202/A092/A292). Motor parameters are forcing too high unnecessary current to the motor (H020 to H034 or H005), depending in motor control method (A044/A244). If the inverter really can not deliver the current, change inverter to a higher power. |

14. Over voltage trip (E07).

| Possible Cause(s) | Corrective Action |
|---|---|
| Short deceleration time | Change deceleration time. (F003/F203/A093/A293) |
| Overvoltage protection function selection during deceleration (b 130) is disabled (00). | Enable overvoltage suppression (b 130=0 1/02). |

In case the inverter trips due to over voltage, despite over voltage suppression is enabled.

| | |
|--|---|
| Overvoltage protection integral time setting (b 134) or integral time (b 135). | Check overvoltage protection integral time setting (b 134) and integral time (b 135). |
| Overvoltage protection level during deceleration (b 13 1) is high. | Set Overvoltage protection level during deceleration (b 13 1) lower. |

15. Thermal trip (E21)

| Possible Cause(s) | Corrective Action |
|-------------------|---------------------|
| Heat sink is clog | Clean the Heat sink |

16. Drive Error (E30)

| Possible Cause(s) | Corrective Action |
|---------------------------------|-----------------------------------|
| Short circuit in output circuit | Check the output cables |
| Ground fault | Check the output cables and motor |
| Main circuit element damage | Check the IGBT's |

17. Thermistor error trip (E35).

| Possible Cause(s) | Corrective Action |
|---|---|
| Thermistor is set to input [5] and DC24V is supplied. | Check setting of input terminal [5] (C005). |

18. Unstable output frequency.

| Possible Cause(s) | Corrective Action |
|---------------------------------------|--|
| Improper parameters | Set output frequency slightly smaller or bigger value than power source frequency. |
| | Change motor stabilization parameter (H006/H203). |
| Load variation is excessive. | Change motor and inverter to one size bigger. |
| Power voltage variation is excessive. | Check power source. |

19. Output torque is not sufficient.

| Possible Cause(s) | Corrective Action |
|------------------------------------|--|
| Improper parameters [Acceleration] | Increase manual torque boost (A042/A242-A043/A243). |
| | Reduce AVR filter time constant (A083). |
| | Change V/f characteristics selection (A044/A244) to SLV. |
| | Change torque boost selection (A041/A241) to automatic. |
| Improper parameters [Deceleration] | Increase deceleration time (F003/F203/A093/A293). |
| | Disable AVR selection (A081/A281). |
| | Install dynamic braking resistor or regenerative braking unit. |

20. If cable to operator is disconnected, inverter will trip or stop.

| Possible Cause(s) | Corrective Action |
|---------------------------|---|
| Improper setting of b165. | Set ex.operator com loss action (b165) to 02. |

21. No response over Modbus communication.

| Possible Cause(s) | Corrective Action |
|---|--|
| New parameter is not updated. | If C071, C074 or C075 is changed, cycle power or reset inverter by turning RS terminal ON and OFF. |
| Incorrect setting of RUN command selection (A002/A202). | Set RUN command selection (A002/A202) to 03. |
| Incorrect setting of Frequency reference selection (A001/A201). | Set frequency reference selection (A001/A201) to 03. |
| Incorrect setting of com. speed. | Check communication speed (A071). |
| Incorrect setting or duplication of Modbus address. | Check Modbus address (A072). |
| Incorrect setting of com. parity. | Check communication parity (A074). |
| Incorrect setting of com. stop bit. | Check communication stop bit (A075). |
| Incorrect wiring. | Check communication wiring at SP,SN terminals. |

22. When inverter starts, ECB (Earth leakage Circuit Breaker) trips.

| Possible Cause(s) | Corrective Action |
|--|--|
| Leak current of inverter is excessive. | Reduce carrier frequency (A083). |
| | Increase current sensor level of ECB or replace ECB with another one having higher current sensor level. |

23. PM troubleshooting information.

| Operation status | Symptom | Adjustment method | Adjustment item |
|---|--|--|-----------------|
| Starting | Trouble is caused when reverse run. | Enable to the initial magnet position estimation function. | H123 |
| | Generate out-of-step. Generate overcurrent trip. | Increase the starting current. | H117 |
| | | Increase the starting time. | H118 |
| | Need for early starting. | Enable to the initial magnet position estimation function, and reduce the starting time. | H118, H123 |
| Running under minimum frequency (H121) | Motor runs unsteadily. | Increase the starting current. | H117 |
| Running around minimum frequency (H121) | Motor generates an impact. Generate overcurrent trip. | Adjust the speed response. | H116 |
| | | Adjust the minimum frequency when a load change. | H121 |

| Operation status | Symptom | Adjustment method | Adjustment item |
|--------------------------------------|---------------------------|---|-----------------|
| Runing over minimum frequency (H121) | Motor generate a hunting. | Adjust the speed response. | H116 |
| | | Reduce the stabilization constant. (When value is too small, you may not be able to obtain motor torque and motor will generate incompact or overcurrent trip near H121) | H119 |
| | | Increase the no-load current. | H122 |

6-2 Monitoring Trip Events, History, & Conditions

6-2-1 Fault Detection and Clearing

The microprocessor in the inverter detects a variety of fault conditions and captures the event, recording it in a history table. The inverter output turns OFF, or “trips” similar to the way a circuit breaker trips due to an over-current condition. Most faults occur when the motor is running (refer to the diagram to the right). However, the inverter could have an internal fault and trip in Stop Mode.

In either case, you can clear the fault by pressing the Stop/Reset key. Additionally, you can clear the inverter's cumulative trip history by performing the procedure 6-3 *Restoring Factory Default Settings* on page 279 (setting **b0B4=00** will clear the trip history but leave inverter settings intact).

6-2-2 Error Codes










An error code will appear on the display automatically when a fault causes the inverter to trip. The following table lists the cause associated with the error.

| Erro Code | Name | Cause(s) |
|------------|--|--|
| E01 | Over-current event while at constant speed | The inverter output was short-circuited, or the motor shaft is locked or has a heavy load. These conditions cause excessive current for the inverter, so the inverter output is turned OFF. The dual-voltage motor is wired incorrectly. |
| E02 | Over-current event during deceleration | |
| E03 | Over-current event during acceleration | |
| E04 | Over-current event during other conditions | |
| E05 | Motor overload protection | When a motor overload is detected by the electronic thermal function, the inverter trips and turns OFF its output. Check that the thermal model is properly set in parameter b012 , b013 , b910 , b911 and b912 . Check if the application can accept softer acceleration rates to minimize peak currents F002/F202/R092/R292 . Check if motor parameters are not correctly set (H020 to H034 or H005), depending in motor control method (R044/R244). |
| E06 | Braking resistor overload protection | When the BRD operation rate exceeds the setting of “ b090 ”, this protective function shuts off the inverter output and displays the error code. |
| E07 | Over-voltage protection | When the DC bus voltage exceeds a threshold, due to regenerative energy from the motor. |
| E08 | EEPROM error | When the built-in EEPROM memory has problems due to noise or excessive temperature, the inverter trips and turns OFF its output to the motor. |

| Erro Code | Name | Cause(s) |
|-----------|-------------------------------|--|
| E09 | Under-voltage error | A decrease of internal DC bus voltage below a threshold results in a control circuit fault. This condition can also generate excessive motor heat or cause low torque. The inverter trips and turns OFF its output. |
| E10 | Current detection error | If an error occurs in the internal current detection system, the inverter will shut off its output and display the error code. |
| E11 | CPU error | A malfunction in the built-in CPU has occurred, so the inverter trips and turns OFF its output to the motor. |
| E12 | External trip | A signal on an intelligent input terminal configured as EXT has occurred. The inverter trips and turns OFF the output to the motor. |
| E13 | USP | When the Unattended Start Protection (USP) is enabled, an error occurred when power is applied while a Run signal is present. The inverter trips and does not go into Run Mode until the error is cleared. |
| E14 | Ground fault | The inverter is protected by the detection of ground faults between the inverter output and the motor upon during powerup tests. This feature protects the inverter, and does not protect humans. |
| E15 | Input over-voltage | The inverter tests for input over-voltage after the inverter has been in Stop Mode for 100 seconds. If an over-voltage condition exists, the inverter enters a fault state. After the fault is cleared, the inverter can enter Run Mode again. |
| E21 | Inverter thermal trip | When the inverter internal temperature is above the threshold, the thermal sensor in the inverter module detects the excessive temperature of the power devices and trips, turning the inverter output OFF. |
| E22 | CPU communication error | When communication between two CPU fails, inverter trips and displays the error code. |
| E25 | Main circuit error (*3) | The inverter will trip if the power supply establishment is not recognized because of a malfunction due to noise or damage to the main circuit element. |
| E30 | Driver error | If instantaneous overcurrent occurs the Inverter will shut off IGBT's output to protect the main circuit element. After tripping due this protective function the inverter cannot retry the operation. |
| E35 | Thermistor | When a thermistor is connected to terminals [5] and [L] and the inverter has sensed the temperature is too high, the inverter trips and turns OFF the output. |
| E36 | Braking error | When "0 P" has been specified for the Brake Control Selection (b120), the inverter will trip if it cannot receive the braking confirmation signal within the Brake Wait Time for Confirmation (b124) after the output of the brake release signal. Or when the output current doesn't reach the brake release current (b125) during the brake wait time for release (b121) |
| E37 | Safe Stop | Safe stop signal is given.* |
| E38 | Low-speed overload protection | If overload occurs during the motor operation at a very low speed, the inverter will detect the overload and shut off the inverter output. |
| E40 | Operator connection | When the connection between inverter and operator keypad failed, inverter trips and displays the error code. |

| Erro Code | Name | Cause(s) |
|------------|---|---|
| E41 | Modbus communication error | When "trip" is selected (C076=00) as a behavior in case of communication error, inverter trips when timeout happens. |
| E43 | Drive Programming invalid instruction | The program stored in inverter memory has been destroyed, or the PRG terminal was turned on without a program downloaded to the inverter. |
| E44 | Drive Programming nesting count error | Subroutines, if-statement, or for-next loop are nested in more than eight layers |
| E45 | Drive Programming instruction error | Inverter found the command which cannot be executed. |
| E50 to E59 | Drive Programming user trip (0 to 9) | When user -defined trip happens, inverter trips and displays the error code. |
| E60 to E69 | Option errors (error in connected option board, the meanings change upon the connected option). | These errors are reserved for the option board. Each option board can show the errors for a different meaning .. To check the specific meaning, please refer to the corresponding option board user manual and documentation. |
| E80 | Encoder disconnection | If the encoder wiring is disconnected, an encoder connection error is detected, the encoder fails, or an encoder that does not support line driver output is used, the inverter will shut off its output and display the error code shown on the right. |
| E81 | Excessive speed | If the motor speed rises to "maximum frequency (A004) x overspeed error detection level (P026)" or more, the inverter will shut off its output and display the error code shown on the right. |
| E83 | Positioning range error | If current position exceeds the position range specification (P072-P073), the inverter will shut off its output and display the error code. |

* E37.X only can be reset by digital input (18: RS).

| Error Code | Name | Descriptions |
|--|------------------------------|---|
|  Rotating | Reset | RS input is ON or STOP/RESET key is pressed. |
|  | Undervoltage | If input voltage is under the allowed level, inverter shuts off output and wait with this indication. |
|  | Waiting to restart | This indication is displayed after tripping before restarting. |
|  | Restricted operation command | Commanded Rotation direction limit selection is restricted in b035 . |
|  | Trip history initializing | Trip history is being initialized. |
|  | No data (Trip monitor) | No trip/warning data exists. |
|  Blinking | Communication error | Communication between inverter and digital operator fails. |
|  | Auto-tuning completed | Auto-tuning is completed properly. |
|  | Auto-tuning error | Auto-tuning fails. |

Note Reset is not allowed in 10 second after trip.

Note When error E08, E14 and E30 occur, reset operation by RS terminal or STOP/RESET key is not accepted. In this case, reset by cycling power. If still same error occurs, perform initialization.

6-2-3 Parameter Warning Codes

If set parameter is conflicted to other parameters, warning code is displayed as follows.

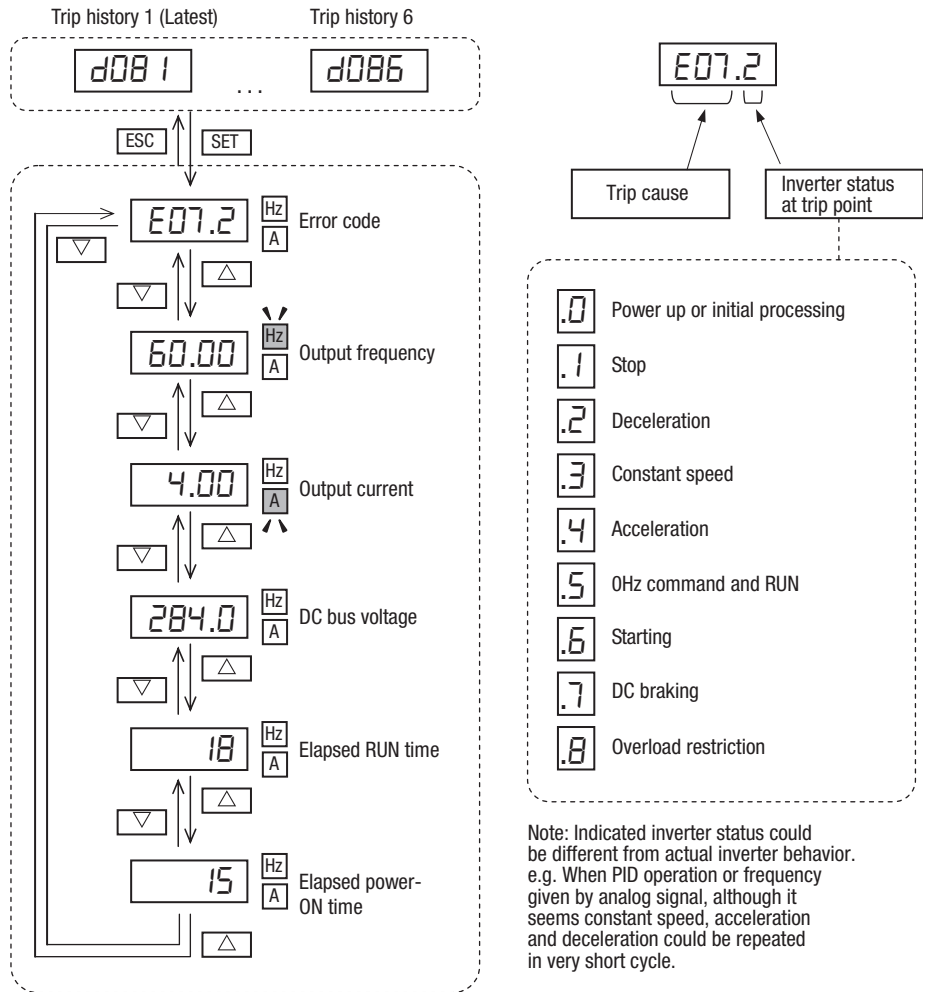
| Warning code | Warning conditions | | |
|--------------|---|---|---|
| 001 | Frequency upper limit (A061) | > | Maximum Frequency (A004) |
| 002 | Frequency lower limit (A062) | > | Maximum Frequency (A004) |
| 005 | Output frequency setting/monitor (F001) Multi-step speed reference 0 (A020) | > | Maximum Frequency (A004) |
| 015 | Output frequency setting (F001) Multi-step speed reference 0 (A020) | > | Frequency upper limit (A061) |
| 025 | Frequency lower limit (A062) | > | Output frequency setting (F001) Multi-step speed reference 0 (A020) |
| 031 | Starting frequency (b082) | > | Frequency upper limit (A061) |
| 032 | Starting frequency (b082) | > | Frequency lower limit (A062) |
| 035 | Starting frequency (b082) | > | Output frequency setting (F001) Multi-step speed reference 0 (A020) |
| 036 | Starting frequency (b082) | > | Multi-step speed reference 1 to 15 (A021-A035) |
| 037 | Starting frequency (b082) | > | Jogging frequency (A038) |

| Warning code | Warning conditions | | |
|--------------|--|---|--|
| 085 | Output frequency setting (F00 I) Multi-step speed reference 0 (A020) | = | Jump frequency (A063/A063/A063±A064/A066/A068) |
| 086 | Multi-step speed reference 1 to 15 (A02 I-A035) | | |
| 09 I | Free setting V/f frequency 7 | > | Frequency upper limit (A06 I) |
| 092 | Free setting V/f frequency 7 | > | Frequency lower limit (A062) |
| 095 | Free setting V/f frequency 7 | > | Output frequency setting/monitor (F00 I) Multi-step speed reference 0 (A020) |
| 20 I | Frequency upper limit (A26 I) | > | 2nd maximum Frequency (A204) |
| 202 | Frequency lower limit (A262) | > | 2nd maximum Frequency (A204) |
| 205 | Output frequency setting/monitor (F00 I) 2nd multi-step speed reference 0 (A220) | > | 2nd maximum Frequency (A204) |
| 2 I5 | Output frequency setting/monitor (F00 I) 2nd multi-step speed reference 0 (A220) | > | Frequency upper limit (A26 I) |
| 225 | Frequency lower limit (A262) | > | Output frequency setting/monitor (F00 I) 2nd multi-step speed reference 0 (A220) |
| 23 I | Starting frequency (b082) | > | Frequency upper limit (A26 I) |
| 232 | Starting frequency (b082) | > | Frequency lower limit (A262) |
| 235 | Starting frequency (b082) | > | Output frequency setting/monitor (F00 I) 2nd multi-step speed reference 0 (A220) |
| 285 | Output frequency setting/monitor (F00 I) 2nd multi-step speed reference 0 (A220) | = | Jump frequency (A063/A063/A063±A064/A066/A068) |
| 29 I | Free setting V/f frequency 7 | > | Frequency upper limit (A26 I) |
| 292 | Free setting V/f frequency 7 | > | Frequency lower limit (A262) |
| 295 | Free setting V/f frequency 7 | > | Output frequency setting/monitor (F00 I) 2nd multi-step speed reference 0 (A220) |

6-2-4 Trip History and Inverter Status

We recommend that you first find the cause of the fault before clearing it. When a fault occurs, the inverter stores important performance data at the moment of the fault. To access the data, use the monitor function (dxxx) and select **d001** details about the present fault. The previous 5 faults are stored in **d002** to **d006**. Each error shifts **d001-d005** to **d002-d006**, and writes the new error to **d001**.

The following Monitor Menu map shows how to access the error codes. When fault(s) exist, you can review their details by first selecting the proper function: **d001** is the most recent, and **d006** is the oldest.

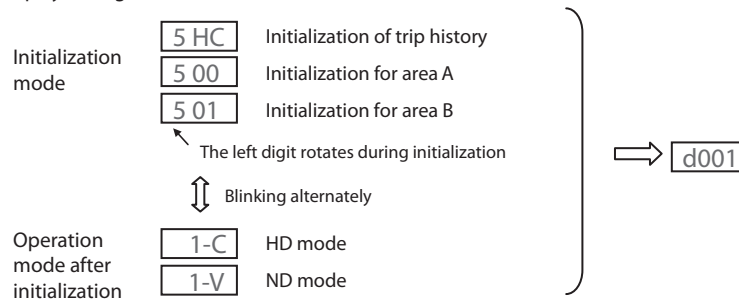


6-3 Restoring Factory Default Settings

You can restore all inverter parameters to the original factory (default) settings according to area of use. After initializing the inverter, use the powerup test in Chapter 2 to get the motor running again. If operation mode is changed, inverter must be initialized to activate new mode. To initialize the inverter, follow the steps below.

1. Select initialization mode in **b084**.
2. If **b084=02, 03** or **04**, select initialization target data in **b094**.
3. If **b084=02, 03** or **04**, select country code in **b085**.
4. Set **01** in **b180**.
5. The following display appears for a few seconds, and initialization is completed with **d001** displayed.

Display during initialization



| "B" Function | | |
|--------------|------------------------------------|--|
| Func. Code | Name | Description |
| b084 | Initialization selection | Select initialized data, five option codes: <ul style="list-style-type: none"> • 00 no (Clears the trip monitor) • 01 Trip data (Initializes data) • 02 Parameters (Clears the trip monitor and initializes data) • 03 Trip+Param (Clears the trip monitor and parameters) • 04 Trp+Prm+EzSQ (Clears the trip monitor, parameters and Drive program) |
| b094 | Initialization target data | Select initialized parameters, four option codes: <ul style="list-style-type: none"> • 00 ALL • 01 Exp.COM, TERM • 02 Onlu U*** • 03 All exp.U*** |
| b085 | Initialization parameter selection | Select initial data for initialization: <ul style="list-style-type: none"> • 00 JPN • 01 EUR |
| b180 | Initialize trigger | This is to perform initialization by parameter input with b084 , b085 and b094 . Two option codes: 00 No action 01 Initialize |

Data of **b084** is not saved in EEPROM to avoid unintentional initializing.

6-4 Maintenance and Inspection

6-4-1 Daily and Yearly Inspection Chart

| Item Inspected | | Check for... | Inspection Cycle | | Inspection Method | Criteria |
|-----------------|----------------------|---------------------------------|------------------|------|---|--|
| | | | Daily | Year | | |
| Overall | Ambient environment | Extreme temperatures & humidity | ✓ | | Thermometer, hygrometer | Ambient temperature between -10 to 50°C, Humidity 90% or less non-condensing |
| | Major devices | Abnormal noise & vib. | ✓ | | Visual and aural | Stable environment for electronic controls |
| | Power supply voltage | Voltage tolerance | ✓ | | Digital volt meter, measure between inverter terminals [L1], [L2], [L3] | 200 V class: 50/60 Hz 200 to 240 V (-15/+10%) 400 V class: 50/60 Hz 380 to 460 V (-15/+10%) |
| Main circuit | Ground Insulation | Adequate resistance | | ✓ | Refer to P6-16 | 5 MΩ or greater |
| | Mounting | No loose screws | | ✓ | Torque wrench | M3.5: 1.0 Nm M4: 1.4 Nm M5: 3.0 M6: 3.9 to 5.1 Nm M8: 5.9 to 8.8 Nm |
| | Components | Overheating | | ✓ | Thermal trip events | No trip events |
| | IGBT | Resistance value | | ✓ | Refer to P6-17 | |
| | Terminal block | Secure connections | | ✓ | Visual | No abnormalities |
| | Smoothing capacitors | Leaking, swelling | ✓ | | Visual | No abnormalities |
| | Relay(s) | Chattering | | ✓ | Aural | Single click when switching ON or OFF |
| Control circuit | Function | Voltage balance between phases | | ✓ | Measure voltage between U, V, W | Difference must be 2% or less. |
| | | Protection circuit | | ✓ | e.g. Input Ex.trip signal and check inverter behavior and alarm signal. | Functions properly. |
| | Overall | No odor, discoloring, corrosion | | ✓ | Visual | No abnormalities |
| | Capacitor | Leaking, swelling | ✓ | | Visual | Undistorted appearance |
| Cooling | Cooling fan | Noise | ✓ | | Power down, manually rotate | Rotation must be smooth |
| | | Dust | ✓ | | Visual | Vacuum to clean |
| | | Mounting | ✓ | | Visual | Mounted firmly |
| | Heat sink | Dust | ✓ | | Visual | Vacuum to clean |
| Display | LEDs | Legibility | ✓ | | Visual | All LED segments work |

Note 1 The life of a capacitor is affected by the ambient temperature. See page 286.

Note 2 Designed life of a cooling fan is 10 years. However, it is affected by the ambient temperature and other environmental conditions.

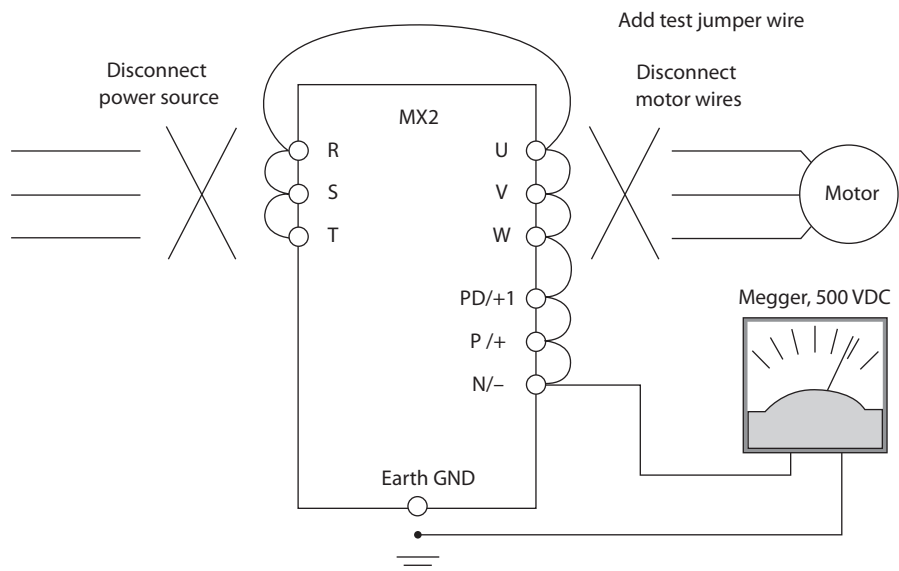
Note 3 The inverter must be cleaned periodically. If dust accumulates on the fan and heat sink, it can cause overheating of the inverter.

6-4-2 Megger test

The megger is a piece of test equipment that uses a high voltage to determine if an insulation degradation has occurred. For inverters, it is important that the power terminals be isolated from the Earth GND terminal via the proper amount of insulation.

The circuit diagram below shows the inverter wiring for performing the megger test. Just follow the steps to perform the test:

1. Remove power from the inverter and wait at least 5 minutes before proceeding.
2. Open the front housing panel to access the power wiring.
3. Remove all wires to terminals [R, S, T, PD/+1, P/+, N/-, U, V, and W]. Most importantly, the input power and motor wires will be disconnected from the inverter.
4. Use a bare wire and short terminals [R, S, T, PD/+1, P/+, N/-, U, V, and W] together as shown in the diagram.
5. Connect the megger to the inverter Earth GND and to the shorted power terminals as shown. Then perform the megger test at 500 VDC and verify 5 M Ω or greater resistance.



6. After completing the test, disconnect the megger from the inverter.
7. Reconnect the original wires to terminals [R, S, T, PD/+1, P/+, N/-, U, V, and W].

⚠ Caution Do not connect the megger to any control circuit terminals such as intelligent I/O, analog terminals, etc. Doing so could cause damage to the inverter.

⚠ Caution Never test the withstand voltage (HIPOT) on the inverter. The inverter has a surge protector between the main circuit terminals above and the chassis ground.

⚠ Caution Power terminal assignment is different compared to old models such as L100, L200 series, etc.,. Pay attention when wiring the power cable.

6-4-3 IGBT Test Method

The following procedure will check the inverter transistors (IGBTs) and diodes:

1. Disconnect input power to terminals [R, S, and T] and motor terminals [U, V, and W].
2. Disconnect any wires from terminals [+] and [-] for regenerative braking.
3. Use a Digital Volt Meter (DVM) and set it for 1 Ω resistance range. You can check the status of the charging state of terminals [R, S, T, U, V, W, +, and -] of the inverter and the probe of the DVM by measuring the charging state.

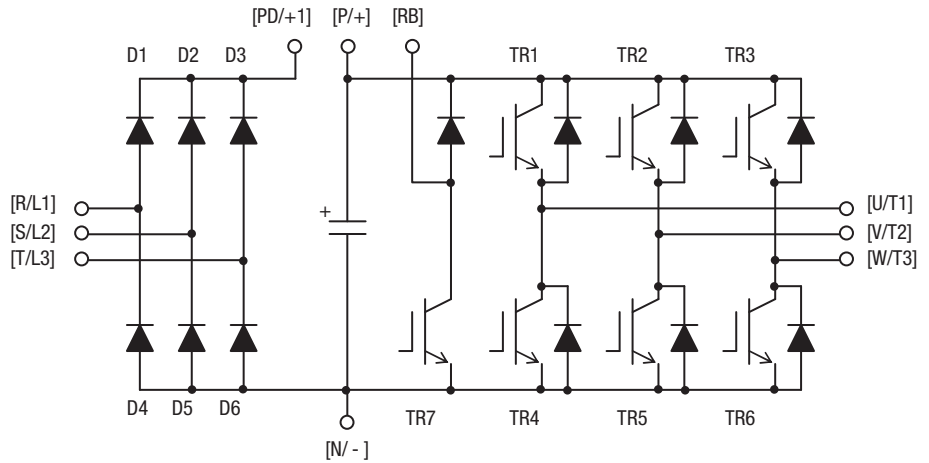


Table Legend

Almost infinite resistance: $\cong \infty \Omega$

Almost zero resistance: $\cong 0 \Omega$

| Part | DVM | | Measured Value | Part | DVM | | Measured Value | Part | DVM | | Measured Value |
|------|------|------|-----------------------|------|------|-----------------------|-----------------------|------|------|-----------------------|-----------------------|
| | - | + | | | - | + | | | - | + | |
| D1 | [R] | [+1] | $\cong \infty \Omega$ | D5 | [S] | [-] | $\cong 0 \Omega$ | TR4 | [U] | [-] | $\cong 0 \Omega$ |
| | [+1] | [R] | $\cong 0 \Omega$ | | [-] | [S] | $\cong \infty \Omega$ | | [-] | [U] | $\cong \infty \Omega$ |
| D2 | [S] | [+1] | $\cong \infty \Omega$ | D6 | [T] | [-] | $\cong 0 \Omega$ | TR5 | [V] | [-] | $\cong 0 \Omega$ |
| | [+1] | [S] | $\cong 0 \Omega$ | | [-] | [T] | $\cong \infty \Omega$ | | [-] | [V] | $\cong \infty \Omega$ |
| D3 | [T] | [+1] | $\cong \infty \Omega$ | TR1 | [U] | [+] | $\cong \infty \Omega$ | TR6 | [W] | [-] | $\cong 0 \Omega$ |
| | [+1] | [T] | $\cong 0 \Omega$ | | [+] | [U] | $\cong 0 \Omega$ | | [-] | [W] | $\cong \infty \Omega$ |
| D4 | [R] | [-] | $\cong 0 \Omega$ | TR2 | [V] | [+] | $\cong \infty \Omega$ | TR7 | [RB] | [+] | $\cong \infty \Omega$ |
| | [-] | [R] | $\cong \infty \Omega$ | | [+] | [V] | $\cong 0 \Omega$ | | [+] | [RB] | $\cong 0 \Omega$ |
| TR3 | [W] | [+] | $\cong \infty \Omega$ | [RB] | [-] | $\cong \infty \Omega$ | [-] | | [RB] | $\cong \infty \Omega$ | |
| | [+] | [W] | $\cong 0 \Omega$ | [-] | [RB] | $\cong \infty \Omega$ | | | | | |

Note The resistance values for the diodes or the transistors will not be exactly the same, but they will be close. If you find a significance difference, a problem may exist.

Note Before measuring the voltage between [+] and [-] with the DC current range, confirm that the smoothing capacitor is discharged fully, then execute the tests.

6-4-4 General Inverter Electrical Measurements

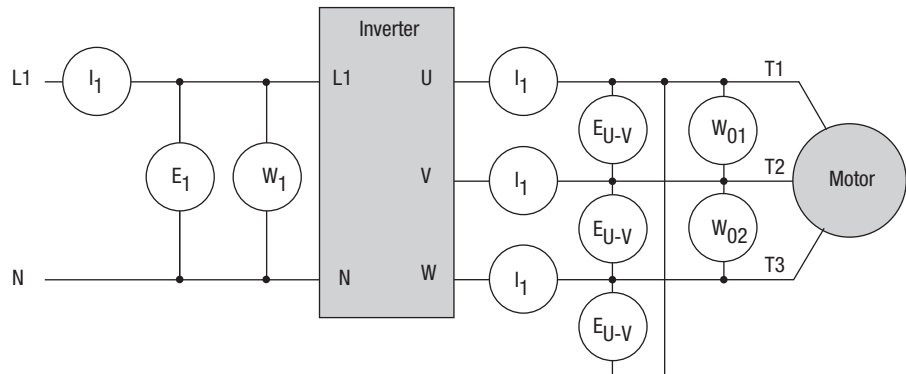
The following table specifies how to measure key system electrical parameters. The diagrams on the next page show inverter-motor systems and the location of measurement points for these parameters.

| Parameter | Circuit location of measurement | Measuring instrument | Notes | Reference Value |
|----------------------------|--|--|----------------------------------|---|
| Supply voltage E_1 | E_R – across L1 and L2 E_S – across L2 and L3 E_T – across L3 and L1 | Moving-coil type voltmeter or rectifier type voltmeter | Fundamental wave effective value | Commercial supply voltage 200 V class: 200-240 V, 50/60 Hz 400 V class: 380-460 V, 50/60 Hz |
| Supply current I_1 | I_r - L1 I_s - L2 I_t - L3 | | Total effective value | – |
| Supply power W_1 | W_{11} – across L1 and L2 W_{12} – across L2 and L3 | | Total effective value | – |
| Supply power factor Pf_1 | $Pf_1 = \frac{W_1}{\sqrt{3} \times E_1 \times I_1} \times 100\%$ | | | – |
| Output voltage E_O | E_U – across U and V E_V – across V and W E_W – across W and U | Rectifier type voltmeter | Total effective value | – |
| Output current I_O | I_U - U I_V - V I_W - W | Moving-coil type ammeter | Total effective value | – |
| Output power W_O | W_{O1} – across U and V W_{O2} – across V and W | Electronic type wattmeter | Total effective value | – |
| Output power factor Pf_O | Calculate the output power factor from the output voltage E, output current I, and output power W. $Pf_O = \frac{W_1}{\sqrt{3} \times E_O \times I_O} \times 100\%$ | | | – |

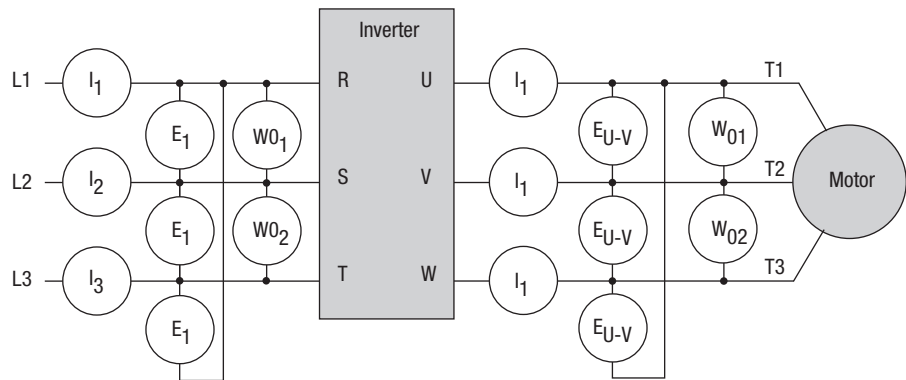
- Note 1** Use a meter indicating a fundamental wave effective value for voltage, and meters indicating total effective values for current and power.
- Note 2** The inverter output has a distorted waveform, and low frequencies may cause erroneous readings. However, the measuring instruments and methods listed above provide comparably accurate results.
- Note 3** A general-purpose digital volt meter (DVM) is not usually suitable to measure a distorted waveform (not pure sinusoid).

The figures below show measurement locations for voltage, current, and power measurements listed in the table on the previous page. The voltage to be measured is the fundamental wave effective voltage. The power to be measured is the total effective power.

Single-phase Measurement Diagram

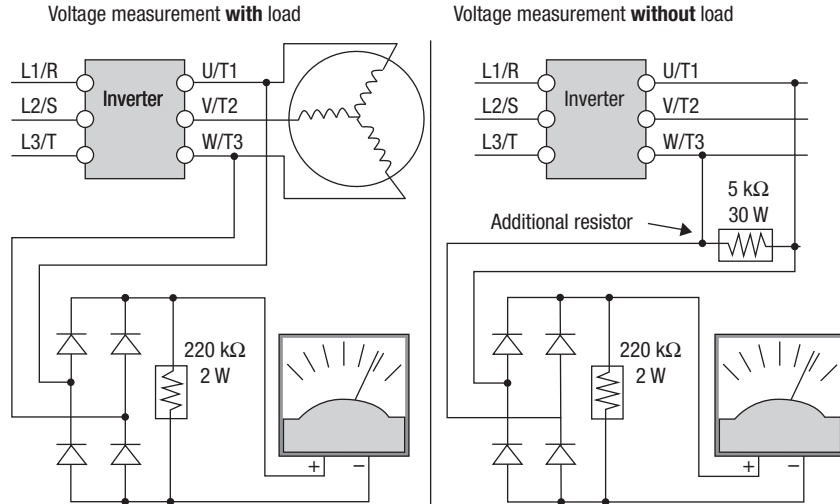


Three-phase Measurement Diagram



6-4-5 Inverter Output Voltage Measurement Techniques

Taking voltage measurements around drives equipment requires the right equipment and a safe approach. You are working with high voltages and high-frequency switching waveforms that are not pure sinusoids. Digital voltmeters will not usually produce reliable readings for these waveforms. And, it is usually risky to connect high voltage signals to oscilloscopes. The inverter output semiconductors have some leakage, and no-load measurements produce misleading results. So, we highly recommend using the following circuits to measure voltage for performing the equipment inspections.

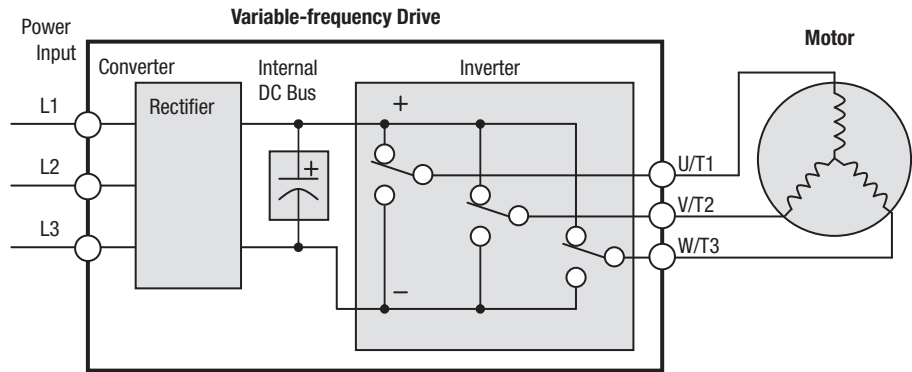


| V Class | Diode Bridge | Voltmeter | V Class | Diode Bridge | Voltmeter |
|--------------|----------------------|-------------|-------------|----------------------|-------------|
| 200 V Class | 600 V 0.01 A min. | 300 V range | 200 V Class | 600 V 0.01 A min. | 300 V range |
| 400 V Classs | 100 V 0.1 A min. | 600 V range | 400 C Class | 100 V 0.1 A min. | 600 V range |

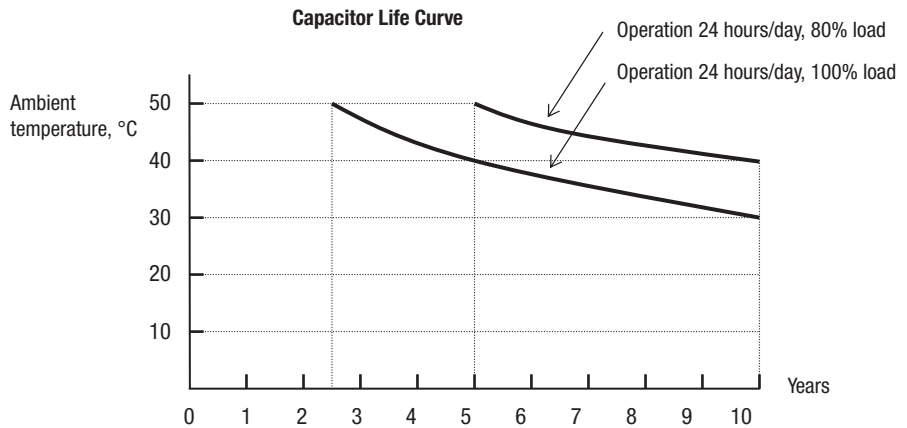
⚠ HIGH VOLTAGE Be careful not to touch wiring or connector terminals when working with the inverters and taking measurements. Be sure to place the measurement circuitry components above in an insulated housing before using them.

6-4-6 Capacitor Life Curves

The DC bus inside the inverter uses a large capacitor as shown in the diagram below. The capacitor handles high voltage and current as it smooths the power for use by the inverter. So, any degradation of the capacitor will affect the performance of the inverter.



Capacitor life is reduced in higher ambient temperatures, as the graph below demonstrates. Under the condition of average ambient temperature 40°C, 80% load, 24 hours operation, the lifetime is 10 years. Be sure to keep the ambient temperature at acceptable levels, and perform maintenance inspections on the fan, heat sink, and other components. If the inverter is installed on a cabinet, the ambient temperature is the temperature inside the cabinet.



6-5 Warranty

6-5-1 Warranty Terms

The warranty period under normal installation and handling conditions is two (2) years from the date of manufacture, or one (1) year from the date of installation, whichever occurs first. The warranty shall cover the repair or replacement, at Omron's sole discretion, of **ONLY** the inverter that was installed.

1. Service in the following cases, even within the warranty period, shall be charged to the purchaser:
 - a) Malfunction or damage caused by mis-operation or modification or improper repair
 - b) Malfunction or damage caused by a drop after purchase and transportation
 - c) Malfunction or damage caused by fire, earthquake, flood, lightning, abnormal input voltage, contamination, or other natural disasters
2. When service is required for the product at your work site, all expenses associated with field repair shall be charged to the purchaser.
3. Always keep this manual handy; please do not lose it. Please contact your Omron distributor to purchase replacement or additional manuals.

Appendix A

Glossary and Bibliography

A-1 Glossary

| | |
|----------------------------|---|
| Ambient Temperature | The air temperature in the chamber containing a powered electronic unit. A unit's heat sinks rely on a lower ambient temperature in order to dissipate heat away from sensitive electronics. |
| Arrival Frequency | The arrival frequency refers to the set output frequency of the inverter for the constant speed setting. The arrival frequency feature turns on an output when the inverter reaches the set constant speed. The inverter has various arrival frequencies and pulsed or latched logic options. |
| Auto-tuning | The ability of a controller to execute a procedure that interacts with a load to determine the proper coefficients to use in the control algorithm. Auto-tuning is a common feature of process controllers with PID loops. Omron inverters feature auto tuning to determine motor parameters for optimal commutation. Auto-tuning is available as a special command from a digital operator panel. See also <i>Digital Operator Panel</i> . |
| Base Frequency | The power input frequency for which an AC induction motor is designed to operate. Most motors will specify a 50 to 60 Hz value. The Omron Omron inverters have a programmable base frequency, so you must ensure that parameter matches the attached motor. The term <i>base frequency</i> helps differentiate it from the carrier frequency. See also <i>Carrier Frequency</i> and <i>Frequency Setting</i> . |
| Braking Resistor | An energy-absorbing resistor that dissipates energy from a decelerating load. Load inertia causes the motor to act as a generator during deceleration. For the MX2 inverter models, the braking unit and braking resistor are optional (external) components. See also <i>Four-quadrant Operation</i> and <i>Dynamic Braking</i> . |
| Break-away Torque | The torque a motor must produce to overcome the static friction of a load, in order to start the load moving. |
| Carrier Frequency | The frequency of the constant, periodic, switching waveform that the inverter modulates to generate the AC output to the motor. See also <i>PWM</i> . |
| CE | A regulatory agency for governing the performance of electronic products in Europe. Drive installations designed to have CE approval must have particular filter(s) installed in the application. |
| Choke | An inductor that is tuned to react at radio frequencies is called a "choke," since it attenuates (chokes) frequencies above a particular threshold. Tuning is often accomplished by using a movable magnetic core. In variable-frequency drive systems, a choke positioned around high-current wiring can help attenuate harmful harmonics and protect equipment. See also <i>Harmonics</i> . |
| DC Braking | The inverter DC braking feature stops the AC commutation to the motor, and sends a DC current through the motor windings in order to stop the motor. Also called "DC injection braking," it has little effect at high speed, and is used as the motor is nearing a stop. |
| Deadband | In a control system, the range of input change for which there is no perceptible change in the output. In PID loops, the error term may have a dead band associated with it. Deadband may or may not be desirable; it depends on the needs of the application. |

| | |
|--------------------------------|---|
| Digital Operator Panel | For Omron inverters, “digital operator panel” (DOP) refers first to the operator keypad on the front panel of the inverter. It also includes hand-held remote keypads, which connect to the inverter via a cable. Finally, the DOP Professional is a PC-based software simulation of the keypad devices. |
| Diode | A semiconductor device that has a voltage-current characteristic that allows current to flow only in one direction, with negligible leakage current in the reverse direction. See also <i>Rectifier</i> . |
| Duty Cycle | <ol style="list-style-type: none">1. The percent of time a square wave of fixed frequency is ON (high) versus OFF (low).2. The ratio of operating time of a device such as a motor to its resting time. This parameter usually is specified in association with the allowable thermal rise for the device. |
| Dynamic Braking | For the MX2 inverter models, the braking unit and braking resistor are optional (external) components. The dynamic braking feature shunts the motor-generated EMF energy into a special braking resistor. The added dissipation (braking torque) is effective at higher speeds, having a reduced effect as the motor nears a stop. |
| Error | In process control, the error is the difference between the desired value or set-point (SP) and the actual value of a the process variable (PV). See also <i>Process Variable</i> and <i>PID Loop</i> . |
| EMI | Electromagnetic Interference – In motor/drive systems, the switching of high currents and voltages creates the possibility of generating radiated electrical noise that may interfere with the operation of nearby sensitive electrical instruments or devices. Certain aspects of an installation, such as long motor lead wire lengths, tend to increase the chance of EMI. Omron provides accessory filter components you can install to decrease the level of EMI. |
| Four-quadrant operation | Referring to a graph of torque versus direction, a four-quadrant drive can turn the motor either forward or reverse, as well as decelerate in either direction (see also reverse torque). A load that has a relatively high inertia and must move in both directions and change directions rapidly requires four-quadrant capability from its drive. |
| Free-run Stop | A method of stopping a motor, caused when the inverter simply turns OFF its motor output connections. This may allow the motor and load to coast to a stop, or a mechanical brake may intervene and shorten the deceleration time. |
| Frequency Setting | While frequency has a broad meaning in electronics, it typically refers to motor speed for variable-frequency drives (inverters). This is because the output frequency of the inverter is variable, and is proportional to the attained motor speed. For example, a motor with a base frequency of 60 Hz can be speed controlled with an inverter output varying from 0 to 60 Hz. See also <i>Base Frequency</i> , <i>Carrier Frequency</i> , and <i>Slip</i> . |
| Harmonics | A <i>harmonic</i> is a whole number multiple of a base of fundamental frequency. The square waves used in inverters produce high frequency harmonics, even though the main goal is to produce lower-frequency sine waves. These harmonics can be harmful to electronics (including motor windings) and cause radiated energy that interferes with nearby electronic devices. Chokes, line reactors, and filters are sometimes used to suppress the transmission of harmonics in an electrical system. See also <i>Choke</i> . |
| Horsepower | A unit of physical measure to quantify the amount of work done per unit of time. You can directly convert between horsepower and Watts as measurements of power. |

| | |
|-------------------------------|--|
| IGBT | Insulated Gate Bipolar Transistor (IGBT) – A semiconductor transistor capable of conducting very large currents when in saturation and capable of withstanding very high voltages when it is OFF. This high-power bipolar transistor is the type used in Omron inverters. |
| Inertia | The natural resistance a stationary object to being moved by an external force. See also <i>Momentum</i> . |
| Intelligent Terminal | A configurable input or output logic function on the Omron inverters. Each terminal may be assigned one of several functions. |
| Inverter | A device that electronically changes DC to AC current through an alternating process of switching the input to the output, inverted and non-inverted. It contains three inverter circuits to generate 3-phase output to the motor. |
| Isolation Transformer | A transformer with 1:1 voltage ratio that provides electrical isolation between its primary and secondary windings. These are typically used on the power input side of the device to be protected. An isolation transformer can protect equipment from a ground fault or other malfunction of nearby equipment, as well as attenuate harmful harmonics and transients on the input power. |
| Jogging Operation | Usually done manually, a jog command from an operator's panel requests the motor/drive system to run indefinitely in a particular direction, until the machine operator ends the jog operation. |
| Jump Frequency | A jump frequency is a point on the inverter output frequency range that you want the inverter to skip around. This feature may be used to avoid a resonant frequency, and you can program up to three jump frequencies in the inverter. |
| Line Reactor | A three-phase inductor generally installed in the AC input circuit of an inverter to minimize harmonics and to limit short-circuit current. |
| Momentum | The physical property of a body in motion that causes it to remain in motion. In the case of motors, the rotor and attached load are rotating and possesses angular momentum. |
| Multi-speed Operation | The ability of a motor drive to store preset discrete speed levels for the motor, and control motor speed according to the currently selected speed preset. The Omron inverters have 16 preset speeds. |
| Motor Load | In motor terminology, motor load consists of the inertia of the physical mass that is moved by the motor and the related friction from guiding mechanisms. See also <i>Inertia</i> . |
| NEC | The National Electric Code is a regulatory document that governs electrical power and device wiring and installation in the United States. |
| NEMA | The National Electric Manufacturer's Association. NEMA Codes are a published series of device ratings standards. Industry uses these to evaluate or compare the performance of devices made by various manufacturers to a known standard. |
| Open-collector Outputs | A common logic-type discrete output that uses an NPN transistor that acts as a switch to a power supply common, usually ground. The transistor's collector is open for external connection (not connected internally). Thus, the output sinks external load current to ground. |
| Power Factor | A ratio that expresses a phase difference (timing offset) between current and voltage supplied by a power source to a load. A perfect power factor = 1.0 (no phase offset). Power factors less than one cause some energy loss in power transmission wiring (source to load). |

| | |
|----------------------------------|--|
| PID Loop | Proportional – Integral-Derivative – A mathematical model used for process control. A process controller maintains a process variable (PV) at a setpoint (SP) by using its PID algorithm to compensate for dynamic conditions and vary its output to drive the PV toward the desired value. For variable-frequency drives, the process variable is the motor speed. See also <i>Error</i> . |
| Process Variable | A physical property of a process that is of interest because it affects the quality of the primary task accomplished by the process. For an industrial oven, temperature is the process variable. See also <i>PID Loop</i> and <i>Error</i> . |
| PWM | Pulse-width modulation: A type of AC adjustable frequency drive that accomplishes frequency and voltage control at the output section (inverter) of the drive. The drive output voltage waveform is at a constant amplitude, and by “chopping” the waveform (pulsewidth- modulating), the average voltage is controlled. The chopping frequency is sometimes called the <i>Carrier Frequency</i> . |
| Reactance | The impedance of inductors and capacitors has two components. The resistive part is constant, while the reactive part changes with applied frequency. These devices have a complex impedance (complex number), where the resistance is the real part and the reactance is the imaginary part. |
| Rectifier | An electronic device made of one or more diodes that converts AC power into DC power. Rectifiers are usually used in combination with capacitors to filter (smooth) the rectified waveform to closely approximate a pure DC voltage source. |
| Regenerative Braking | A particular method of generating reverse torque to a motor, an inverter will switch internally to allow the motor to become a generator and will either store the energy internally, deliver the braking energy back to the main power input, or dissipate it with a resistor. |
| Regulation | The quality of control applied to maintain a parameter of interest at a desired value. Usually expressed as a percent (\pm) from the nominal, motor regulation usually refers to its shaft speed. |
| Reverse Torque | The torque applied in the direction opposite to motor shaft rotation. As such, reverse torque is a decelerating force on the motor and its external load. |
| Rotor | The windings of a motor that rotate, being physically coupled to the motor shaft. See also <i>Stator</i> . |
| Saturation Voltage | For a transistor semiconductor device, it is in saturation when an increase in input current no longer results in an increase in the output current. The saturation voltage is the voltage drop across the device. The ideal saturation voltage is zero. |
| Sensorless Vector Control | A technique used in some variable-frequency drives (featured in some other Omron inverter model families) to rotate the force vector in the motor without the use of a shaft position sensor (angular). Benefits include an increase in torque at the lowest speed and the cost savings from the lack of a shaft position sensor. |
| Setpoint (SP) | The setpoint is the desired value of a process variable of interest. See also <i>Process Variable (PV)</i> and <i>PID Loop</i> . |
| Single-phase power | An AC power source consisting of Hot and Neutral wires. An Earth Ground connection usually accompanies them. In theory, the voltage potential on Neutral stays at or near Earth Ground, while Hot varies sinusoidally above and below Neutral. This power source is named Single Phase to differentiate it from three-phase power sources. Some Omron inverters can accept single phase input power, but they all output three-phase power to the motor. See also <i>Three-phase</i> . |

| | |
|--------------------------|---|
| Slip | The difference between the theoretical speed of a motor at no load (determined by its inverter output waveforms) and the actual speed. Some slip is essential in order to develop torque to the load, but too much will cause excessive heat in the motor windings and/or cause the motor to stall. |
| Squirrel Cage | A “nick-name” for the appearance of the rotor frame assembly for an AC induction motor. |
| Stator | The windings in a motor that are stationary and coupled to the power input of the motor. See also <i>Rotor</i> . |
| Tachometer | <ol style="list-style-type: none">1. A signal generator usually attached to the motor shaft for the purpose of providing feedback to the speed controlling device of the motor.2. A speed-monitoring test meter that may optically sense shaft rotation speed and display it on a readout. |
| Thermal Switch | An electromechanical safety device that opens to stop current flow when the temperature at the device reaches a specific temperature threshold. Thermal switches are sometimes installed in the motor in order to protect the windings from heat damage. The inverter can use thermal switch signals to trip (shut down) if the motor overheats. See also <i>Trip</i> . |
| Thermistor | A type of temperature sensor that changes its resistance according to its temperature. The sensing range of thermistors and their ruggedness make them ideal for motor overheating detection. Omron inverters have built-in thermistor input circuits, which can detect an overheated motor and shut off (trip) the inverter output. |
| Three-phase power | An AC power source with three Hot connections that have phase offsets of 120 degrees is a 3-phase power source. Usually, Neutral and Earth Ground wires accompany the three Hot connections. Loads may be configured in a delta or Y configuration. A Y-connected load such as an AC induction motor will be a balanced load; the currents in all the Hot connections are the same. Therefore, the Neutral connection is theoretically zero. This is why inverters that generate 3-phase power for motors do not generally have a Neutral connection to the motor. However, the Earth Ground connection is important for safety reasons, and is provided. |
| Torque | The rotational force exerted by a motor shaft. The units of measurement consist of the distance (radius from shaft center axis) and force (weight) applied at that distance. Units are usually given as pound-feet, ounce-inches, or Newton-meters. |
| Transistor | A solid state, three-terminal device that provides amplification of signals and can be used for switching and control. While transistors have a linear operating range, inverters use them as high-powered switches. Recent developments in power semiconductors have produced transistors capable of handling high voltages and currents, all with high reliability. The saturation voltage has been decreasing, resulting in less heat dissipation. Omron inverters use state-of-the-art semiconductors to provide high performance and reliability in a compact package. See also <i>IGBT</i> and <i>Saturation Voltage</i> . |
| Trip Event | An event that causes the inverter to stop operation is called a “trip” event (as in <i>tripping</i> a circuit breaker). The inverter keeps a history log of trip events. They also require an action to clear. |
| Watt Loss | A measure of the internal power loss of a component, the difference between the power it consumes and what its output delivers. An inverter's watt loss is the input power minus the power delivered to the motor. The watt loss is typically highest when an inverter is delivering its maximum output. Therefore, watt loss is usually specified for a particular output level. Inverter watt loss specifications are important when designing enclosures. |

A-2 Bibliography

| Title | Author and Publisher |
|--|--|
| Variable Speed Drive Fundamentals, 2nd Ed. | Phipps, Clarence A. The Fairmont Press, Inc./Prentice-Hall, Inc. 1997 |
| Electronic Variable Speed Drives | Brumbach, Michael E. Delmar Publishers 1997 ISBN 0-8273-6937-9 |

Appendix B

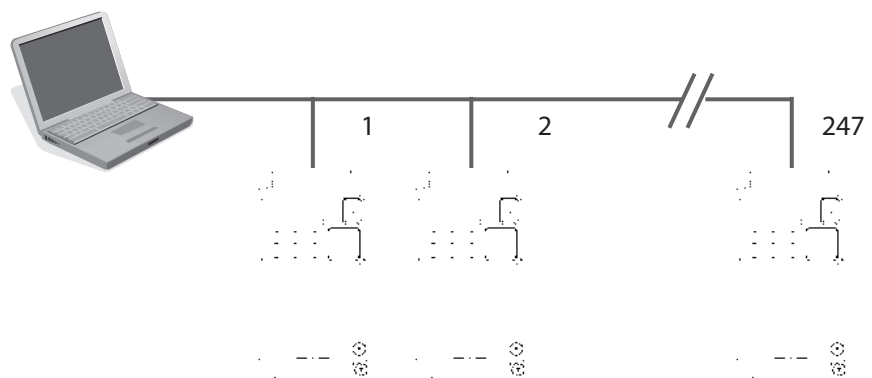
ModBus Network Communications

B-1 Introduction

MX2 Series inverters have built-in RS-485 serial communications, featuring the ModBus RTU protocol. The inverters can connect directly to existing factory networks or work with new networked applications, without any extra interface equipment. The specifications are in the following table.

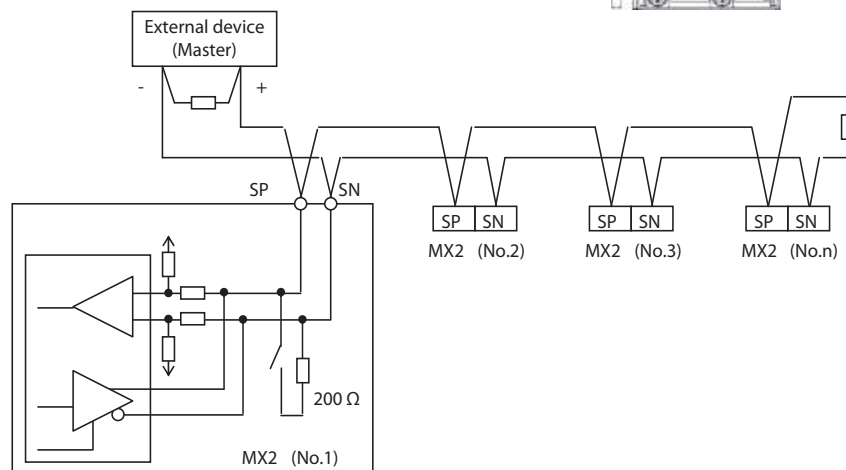
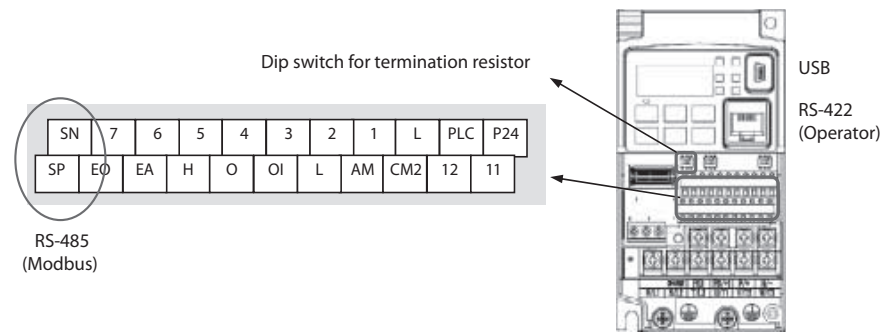
| Item | Specifications | User-selectable |
|------------------------|---|-----------------|
| Transmission speed | 2400/4800/9600/19.2 k/38.4 k/ 57.6 k/76.8 k/115.2 k bps | ✓ |
| Communication mode | Asynchronous | ✗ |
| Character code | Binary | ✗ |
| LSB placement | Transmits LSB first | ✗ |
| Electrical interface | RS-485 differential transceiver | ✗ |
| Data bits | 8-bit (ModBus RTU mode) | ✗ |
| Parity | None/even/odd | ✓ |
| Stop bits | 1 or 2 bits | ✓ |
| Startup convention | One-way start from host device | ✗ |
| Wait time for response | 0 to 1000 msec. | ✓ |
| Connections | Station address numbers from 1 to 247 | ✓ |
| Connector | Terminal connector | – |
| Error check | Overrun, Framing block check code, CRC-16, or horizontal parity | – |
| Cable length | 500m maximum | – |

The network diagram below shows a series of inverters communicating with a host computer. Each inverter must have a unique address, from 1 to 247, on the network. In a typical application, a host computer or controller is the master and each of the inverter(s) or other devices is a slave.



B-2 Connecting the Inverter to ModBus

Modbus connector is in control terminal block as below. Note that RJ45 connector (RS-422) is used for external operator only.



Terminate Network Wiring – The RS-485 wiring must be terminated at each physical end to suppress electrical reflections and help decrease transmission errors. MX2 has a built-in 200 resistor activated by a dip switch. Select termination resistors that match the characteristic impedance of the network cable. The diagram above shows a network with the needed termination resistor at each end.

Inverter Parameter Setup – The inverter has several settings related to ModBus communications. The table below lists them together. The *Required* column indicates which parameters must be set properly to allow communications. You may need to refer to the host computer documentation in order to match some of its settings.

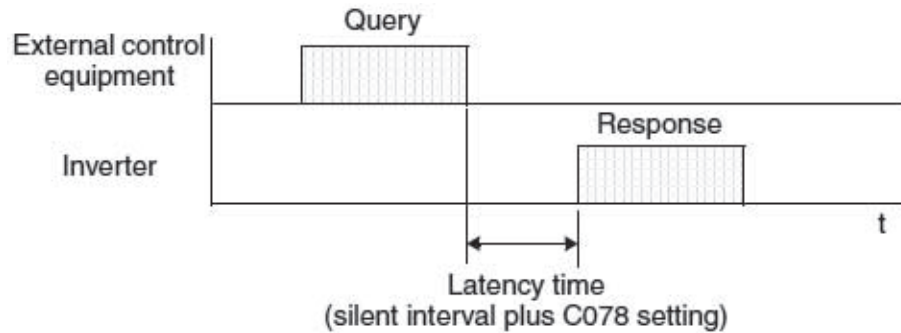
| Func. Code | Name | Required | Settings |
|-----------------|--|----------|--|
| A001 | Frequency reference selection | ✓ | 00 Digital operator 01 Terminal 02 Operator 03 ModBus communication 10 Operation function result |
| A002 | Run command selection | ✓ | 01 Terminal 02 Operator 03 ModBus communication |
| C071 | Communication speed selection (Baud rate selection) | ✓ | 03 2400 bps 04 4800 bps 05 9600 bps 06 19.2 k bps 07 38.4 k bps 08 57.6 k bps 09 76.8 k bps 10 115.2 k bps |
| C072 | Communication station No. Selection | ✓ | Network address, range is 1 to 247 |
| C074 | Communication parity selection | ✓ | 00 No parity 01 Even 02 Odd |
| C075 | Communication stop bit selection | ✓ | Range is 1 or 2 |
| C076 | Communication error selection | – | 00 Trip 01 Decel-Trip (Trip after deceleration stop) 02 Ignore 03 Free-RUN (Free-run stop) 04 Decel-Stop (Deceleration stop) |
| C077 | Communication error timeout | – | Comm. Watchdog timer period, range is 0.00 to 99.99 sec. |
| C078 | Communication wait time | ✓ | Time the inverter waits after receiving a message before it transmits. Range is 0 to 1000 ms |
| P200 | Serial comms mode | ✓ | 00 Standard 01 Free mapping |
| P201 to P210 | Modbus external register 1 to 10 | ✓ | Range is 0000h to FFFFh |
| P211 to P220 | Modbus register format 1 to 10 | ✓ | 00 Unsigned 01 Signed |
| P221 to P230 | Modbus register scaling 1 to 10 | ✓ | Range is 0.001 to 65.535 |
| P301 to P310 | Modbus internal register 1 to 10 | ✓ | Range is 0000h to FFFFh |
| P400 | Big/Little endian selection | ✓ | 00 Big endian 01 Little endian 02 Special endian |

Note When you change any of the parameters above, the inverter power must be rebooted in order to activate new parameters. Instead of rebooting, turning ON/OFF of reset terminal works as same.

B-3 Network Protocol Reference

B-3-1 Transmission procedure

The transmission between the external control equipment and the inverter takes the procedure below.



- Query - A frame sent from the external control equipment to the inverter
- Response - A frame returned from inverter to the external control equipment

The inverter returns the response only after the inverter receives a query from the external control equipment and does not output the response positively. Each frame is formatted (with commands) as follows:

| Frame Format |
|---------------------------|
| Header (silent interval) |
| Slave address |
| Function code |
| Data |
| Error check |
| Trailer (silent interval) |

B-3-2 Message Configuration: Query

Slave address:

- This is a number of 1 to 32 assigned to each inverter (slave). (Only the inverter having the address given as a slave address in the query can receive the query.)
- When slave address “0” is specified, the query can be addressed to all inverters simultaneously. (Broadcasting)
- In broadcasting, you cannot call and loop back data.
- Slave Address 1-247 in Modbus specification. When master address the slave 250-254, broadcast toward specific slave address. Slave doesn't answer back. And this function is valid for the write command (05h, 06h, 0Fh, 10h)

| Slave address | Broadcast to |
|---------------|--------------------------------------|
| 250 (FAh) | Broadcast to Slave address 01 to 09 |
| 251 (FBh) | Broadcast to Slave address 10 to 19 |
| 252 (FCh) | Broadcast to Slave address 20 to 29 |
| 253 (FDh) | Broadcast to Slave address 30 to 39 |
| 254 (FEh) | Broadcast to Slave address 40 to 247 |

Data:

- A function command is set here.
- The data format used in the MX2 series is corresponding to the Modbus data format below.

| Name of Data | Description |
|------------------|---|
| Coil | Binary data that can be referenced and changed (1 bit long) |
| Holding Register | 16-bit data that can be referenced and changed |

Function code:

Specify a function you want to make the inverter execute. Function codes available to the MX2 series are listed below.

| Function Code | Function | Maximum data size (bytes available per message) | Maximum number of data elements available per message |
|---------------|-----------------------------|---|---|
| 01h | Read Coil Status | 4 | 32 coils (in bits) |
| 03h | Read Holding Register | 32 | 16 registers (in bytes) |
| 05h | Write in Coil | 2 | 1 coil (in bits) |
| 06h | Write in Holding Register | 2 | 1 register (in bytes) |
| 08h | Loopback Test | – | – |
| 0Fh | Write in Coils | 4 | 32 coils (in bits) |
| 10h | Write in Registers | 32 | 16 registers (in bytes) |
| 17h | Read/Write Holding Register | 32 | 16 registers (in bytes) |

Error check:

Modbus-RTU uses CRC (Cyclic Redundancy Check) for error checking.

- The CRC code is 16-bit data that is generated for 8-bit blocks of arbitrary length.
- The CRC code is generated by a generator polynomial CRC-16 ($X^{16} + X^{15} + X^2 + 1$).

Header and trailer (silent interval):

Latency is the time between the reception of a query from the master and transmission of a response from the inverter.

- 3.5 characters (24 bits) are always required for latency time. If the latency time shorter than 3.5 characters, the inverter returns no response.
- The actual transmission latency time is the sum of silent interval (3.5 characters long) + C078 (transmission latency time).

B-3-3 Message Configuration: Response

Transmission time required:

- A time period between reception of a query from the master and transmission of a response from the inverter is the sum of the silent interval (3.5 characters long) + C078 (transmission latency time).
- The master must provide a time period of the silent interval (3.5 characters long or longer) before sending another query to an inverter after receiving a response from the inverter.

Normal response:

- When receiving a query that contains a function code of Loopback (08h), the inverter returns a response of the same content of the query.
- When receiving a query that contains a function code of Write in Register or Coil (05h, 06h, 0Fh, or 10h), the inverter directly returns the query as a response.
- When receiving a query that contains a function code of Read Register or Coil (01h or 03h), the inverter returns, as a response, the read data together with the same slave address and function code as those of the query.

Response when an error occurs:

- When finding any error in a query (except for a transmission error), the inverter returns an exception response without executing anything.
- You can check the error by the function code in the response. The function code of the exception response is the sum of the function code of the query and 80h.
- The content of the error is known from the exception code.

| Field Configuration |
|---------------------|
| Slave address |
| Function code |
| Exception code |
| CRC-16 |

| Exception Code | Description |
|----------------|---|
| 01h | The specified function is not supported. |
| 02h | The specified function is not found. |
| 03h | The format of the specified data is not acceptable. |
| 21h | The data to be written in a holding register is outside the inverter. |
| 22h | The specified functions are not available to the inverter. <ul style="list-style-type: none"> • Function to change the content of a register that cannot be changed while the inverter is in service • Function to submit an ENTER command during running (UV) • Function to write in a register during tripping (UV) • Function to change the I/O terminal configuration which is not allowed. • Function to change active state of RS (reset) terminal • Function to write in a register during auto-tuning • Function to write in a register locked by password |
| 23h | <ul style="list-style-type: none"> • The register (or coil) to be written in is read-only |

No response occurs:

In the cases below, the inverter ignores a query and returns no response.

- When receiving a broadcasting query
- When detecting a transmission error in reception of a query
- When the slave address set in the query is not equal to the slave address of the inverter
- When a time interval between data elements constituting a message is shorter than 3.5 characters
- When the data length of the query is invalid
- When broadcast message received.

Note Provide a timer in the master and make the master retransmit the same query when no response is made within a preset time period after the preceding query was sent.

B-3-4 Explanation of function codes

Read Coil Status [01h]:

This function reads the status (ON/OFF) of selected coils. An example follows below.

- Read intelligent input terminals [1] to [5] of an inverter having a slave address “8.”
- This example assumes the intelligent input terminals have terminal states listed below.

| Item | Data | | | | |
|----------------------------|------|-----|-----|-----|-----|
| Intelligent input terminal | [1] | [2] | [3] | [4] | [5] |
| Coil number | 7 | 8 | 9 | 10 | 11 |
| Coil Status | ON | OFF | ON | OFF | OFF |

Query:

| No. | Field Name | Example (Hex) |
|-----|------------------------------------|---------------|
| 1 | Slave address *1 | 08 |
| 2 | Function code | 01 |
| 3 | Coil start address *4 (high order) | 00 |
| 4 | Coil start address *4 (low order) | 06 |
| 5 | Number of coils (high order *2) | 00 |
| 6 | Number of coils (low order *2) | 05 |
| 7 | CRC-16 (high order) | 1C |
| 8 | CRC-16 (low order) | 91 |

Response:

| No. | Field Name | Example (Hex) |
|-----|----------------------|---------------|
| 1 | Slave address | 08 |
| 2 | Function code | 01 |
| 3 | Data size (in bytes) | 01 |
| 4 | Coil data *3 | 05 |
| 5 | CRC-16 (high order) | 92 |
| 6 | CRC-16 (low order) | 17 |

- Note 1** Broadcasting is disabled.
- Note 2** When 0 or more than 31 is specified as a number of coils, error code “03h” is returned.
- Note 3** Data is transferred by the specified number of data bytes (data size).
- Note 4** The PDU Coils are addressed starting at zero. Therefore coils numbered 1-31 are addressed as 0-30. Coil address value (transmitted on Modbus line) is 1 less than the Coil Number.

- The data set in the response shows terminal state of coils 0007h~000Dh.
- Data “05h=00000101b” indicates the following assuming coil 7 is the LSB.

| Item | Data | | | | | | | |
|-------------|------|-----|-----|-----|-----|----|-----|----|
| Coil Number | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 |
| Coil Status | OFF | OFF | OFF | OFF | OFF | ON | OFF | ON |

- When a read coil is outside the defined coils, the final coil data to be transmitted contains “0” as the status of the coil outside the range.
- When the Read Coil Status command cannot be executed normally, see the exception response.

Read Holding Register [03h]:

This function reads the contents of the specified number of consecutive holding registers (of specified register addresses). An example follows below.

- Reading Trip monitor 1 factor and trip frequency, current, and voltage from an inverter having a slave address “1”
- This example assumes the previous three trip factors are as follows:

| MX2 Command | d081 (factor) | d081 (frequency) | d081 (output current) | d081 (DC-bus Voltage) |
|-----------------|--------------------|------------------|-----------------------|-----------------------|
| Register Number | 0012h | 0014h | 0016h | 0017h |
| Trip factor | Over-Current (E03) | 9.9Hz | 3.0A | 284V |

Query:

| No. | Field Name | Example (Hex) |
|-----|--|---------------|
| 1 | Slave address *1 | 01 |
| 2 | Function code | 03 |
| 3 | Register start address *3 (high order) | 00 |
| 4 | Register start address *3 (low order) | 11 |
| 5 | Number of holding registers (high order) | 00 |
| 6 | Number of holding registers (low order) | 06 |
| 7 | CRC-16 (high order) | 95 |
| 8 | CRC-16 (low order) | CD |

Response:

| No. | Field Name | Example (Hex) |
|-----|------------------------------|---------------|
| 1 | Slave address | 01 |
| 2 | Function code | 03 |
| 3 | Data size (in bytes) *2 | 0C |
| 4 | Register data 1 (high order) | 00 |
| 5 | Register data 1 (high order) | 03 |
| 6 | Register data 2 (high order) | 00 |
| 7 | Register data 2 (low order) | 00 |
| 8 | Register data 3 (high order) | 00 |
| 9 | Register data 3 (low order) | 63 |
| 10 | Register data 4 (high order) | 00 |
| 11 | Register data 4 (low order) | 00 |
| 12 | Register data 5 (high order) | 00 |
| 13 | Register data 5 (low order) | 1E |
| 14 | Register data 6 (high order) | 01 |
| 15 | Register data 6 (low order) | 1C |
| 16 | CRC-16 (high order) | AF |
| 17 | CRC-16 (low order) | 6D |

Note 1 Broadcasting is disabled.

Note 2 Data is transferred by the specified number of data bytes (data size). In this case, 6 bytes are used to return the content of three holding registers.

Note 3 The PDU Register Number are addressed starting at zero. Therefore register numbered “0012h” are addressed as “0011h”. Register address value (transmitted on Modbus line) is 1 less than the Register Number.

The data set in the response is as follows:

| Response Buffer | 4-5 | | 6-7 | | 8-9 | |
|-----------------|----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|
| Register Number | 12+0 (high order) | 12+0 (low order) | 12+1 (high order) | 12+1 (low order) | 12+2 (high order) | 12+2 (low order) |
| Register Data | 0003h | | 00h | 00h | 0063h | |
| Trip data | Trip factor (E03) | | Not used | | Frequency (9.9Hz) | |
| Response Buffer | 10-11 | | 12-13 | | 14-15 | |
| Register Number | 12+3 (high order) | 12+3 (low order) | 12+4 (high order) | 12+4 (low order) | 12+5 (high order) | 12+5 (low order) |
| Register Data | 00h | 00h | 001Eh | | 011Ch | |
| Trip data | Not used | | Output current (3.0A) | | DC-bus voltage (284V) | |

When the Read Holding Register command cannot be executed normally, refer to the exception response.

Write in Coil [05h]:

This function writes data in a single coil. Coil status changes are as follows:

| Data | Coil Status | |
|--------------------------|-------------|-----------|
| | OFF to ON | ON to OFF |
| Change data (high order) | FFh | 00h |
| Change data (low order) | 00h | 00h |

An example follows (note that to command the inverter, set A002=03):

- Sending a RUN command to an inverter having slave address “8”
- This example writes in coil number “1.”

Query:

| No. | Field Name | Example (Hex) |
|-----|---------------------------------------|---------------|
| 1 | Slave address *1 | 08 |
| 2 | Function code | 05 |
| 3 | Coil start address *2 (high order) | 00 |
| 4 | Coil start address *2 (low order) | 00 |
| 5 | Change data (high order) | FF |
| 6 | Change data (low order) | 00 |
| 7 | CRC-16 (high order) | 8C |
| 8 | CRC-16 (low order) | A3 |

Response:

| No. | Field Name | Example (Hex) |
|-----|---------------------------------------|---------------|
| 1 | Slave address | 08 |
| 2 | Function code | 05 |
| 3 | Coil start address *2 (high order) | 00 |
| 4 | Coil start address *2 (low order) | 00 |
| 5 | Change data (high order) | FF |
| 6 | Change data (low order) | 00 |
| 7 | CRC-16 (high order) | 8C |
| 8 | CRC-16 (low order) | A3 |

Note 1 No response is made for a broadcasting query.

Note 2 The PDU Coils are addressed starting at zero. Therefore coils numbered 1-31 are addressed as 0-30. Coil address value (transmitted on Modbus line) is 1 less than the Coil Number.

When writing in a selected coil fails, see the exception response.

Write in Holding Register [06h]:

This function writes data in a specified holding register. An example follows:

- Write “50 Hz” as the first Multi-speed 0 (A020) in an inverter having slave address “5.”
- This example uses change data “500 (1F4h)” to set “50 Hz” as the data resolution of the register “1029h” holding the first Multi-speed 0 (A020) is 0.1 Hz

Query:

| No. | Field Name | Example (Hex) |
|-----|--|---------------|
| 1 | Slave address *1 | 08 |
| 2 | Function code | 06 |
| 3 | Register start address *2 (high order) | 10 |
| 4 | Register start address *2 (low order) | 28 |
| 5 | Change data (high order) | 01 |
| 6 | Change data (low order) | F4 |
| 7 | CRC-16 (high order) | 0D |
| 8 | CRC-16 (low order) | 8C |

Response:

| No. | Field Name | Example (Hex) |
|-----|--|---------------|
| 1 | Slave address | 08 |
| 2 | Function code | 06 |
| 3 | Register start address *2 (high order) | 10 |
| 4 | Register start address *2 (low order) | 28 |
| 5 | Change data (high order) | 01 |
| 6 | Change data (low order) | F4 |
| 7 | CRC-16 (high order) | 0D |
| 8 | CRC-16 (low order) | 8C |

Note 1 No response is made for a broadcasting query.

Note 2 The PDU Register Number are addressed starting at zero. Therefore register numbered “1029h” are addressed as “1028h”. Register address value (transmitted on Modbus line) is 1 less than the Register Number.

When writing in a selected holding register fails, see the exception response.

Loopback Test [08h]:

This function checks a master-slave transmission using any test data. An example follows:

- Send test data to an inverter having slave address “1” and receiving the test data from the inverter (as a loopback test).

Query:

| No. | Field Name | Example (Hex) |
|-----|---------------------------|---------------|
| 1 | Slave address *1 | 01 |
| 2 | Function code | 08 |
| 3 | Test subcode (high order) | 00 |
| 4 | Test subcode (low order) | 00 |
| 5 | Data (high order) | Any |
| 6 | Data (low order) | Any |
| 7 | CRC-16 (high order) | CRC |
| 8 | CRC-16 (low order) | CRC |

Response:

| No. | Field Name | Example (Hex) |
|-----|---------------------------|---------------|
| 1 | Slave address *1 | 01 |
| 2 | Function code | 08 |
| 3 | Test subcode (high order) | 00 |
| 4 | Test subcode (low order) | 00 |
| 5 | Data (high order) | Any |
| 6 | Data (low order) | Any |
| 7 | CRC-16 (high order) | CRC |
| 8 | CRC-16 (low order) | CRC |

Note 1 Broadcasting is disabled.

When test subcode is for echo (00h, 00h) only and not available to the other commands.

Write in Coils [0Fh]:

This function writes data in consecutive coils. An example follows:

- Change the state of intelligent input terminal [1] to [5] of an inverter having a slave address “8.”
- This example assumes the intelligent input terminals have terminal states listed below.

| Item | Data | | | | |
|----------------------------|------|-----|-----|-----|-----|
| Intelligent input terminal | [1] | [2] | [3] | [4] | [5] |
| Coil Number | 7 | 8 | 9 | 10 | 11 |
| Terminal status | ON | ON | ON | OFF | ON |

Query:

| No. | Field Name | Example (Hex) |
|-----|------------------------------------|---------------|
| 1 | Slave address *1 | 08 |
| 2 | Function code | 0F |
| 3 | Coil start address *3 (high order) | 00 |
| 4 | Coil start address *3 (low order) | 06 |
| 5 | Number of coils (high order) | 00 |
| 6 | Number of coils (low order) | 05 |
| 7 | Byte number *2 | 02 |
| 8 | Change data (high order) | 17 |
| 9 | Change data (low order) | 00 |
| 10 | CRC-16 (high order) | 83 |
| 11 | CRC-16 (low order) | EA |

Response:

| No. | Field Name | Example (Hex) |
|-----|------------------------------------|---------------|
| 1 | Slave address | 08 |
| 2 | Function code | 0F |
| 3 | Coil start address *3 (high order) | 00 |
| 4 | Coil start address *3 (low order) | 06 |
| 5 | Number of coils (high order) | 00 |
| 6 | Number of coils (low order) | 05 |
| 7 | CRC-16 (high order) | 75 |
| 8 | CRC-16 (low order) | 50 |

Note 1 Broadcasting is disabled.

Note 2 The change data is a set of high-order data and low-order data. So when the size (in bytes) of data to be changed is an odd start coil number (“7”), add “1” to the data size (in bytes) to make it an even number.

Note 3 The PDU Coils are addressed starting at zero. Therefore coils numbered 1-31 are addressed as 0-30. Coil address value (transmitted on Modbus line) is 1 less than the Coil Number.

Write in Holding Registers [10h]:

This function writes data in consecutive holding registers. An example follows:

- Write “3000 seconds” as the first acceleration time 1 (F002) in an inverter having a slave address “8.”
- This example uses change data “300000 (493E0h)” to set “3000 seconds” as the data resolution of the registers “1014h” and “1015h” holding the first acceleration time 1 (F002) is 0.01 second.

| No. | Field Name | Example (Hex) |
|-----|--|---------------|
| 1 | Slave address *1 | 08 |
| 2 | Function code | 10 |
| 3 | Start address *3 (high order) | 10 |
| 4 | Start address *3 (low order) | 13 |
| 5 | Number of holding registers (high order) | 00 |
| 6 | Number of holding registers (low order) | 02 |
| 7 | Byte number *2 | 04 |
| 8 | Change data 1 (high order) | 00 |
| 9 | Change data 1 (low order) | 04 |
| 10 | Change data 2 (high order) | 93 |
| 11 | Change data 2 (low order) | E0 |
| 12 | CRC-16 (high order) | 7D |
| 13 | CRC-16 (low order) | 53 |

| No. | Field Name | Example (Hex) |
|-----|--|---------------|
| 1 | Slave address | 08 |
| 2 | Function code | 10 |
| 3 | Start address *3 (high order) | 10 |
| 4 | Start address *3 (low order) | 13 |
| 5 | Number of holding registers (high order) | 00 |
| 6 | Number of holding registers (low order) | 02 |
| 7 | CRC-16 (high order) | B4 |
| 8 | CRC-16 (low order) | 54 |

- Note 1** Broadcasting is disabled.
- Note 2** This is not the number of holding registers. Specify the number of bytes of data to be changed.
- Note 3** The PDU Register Number are addressed starting at zero. Therefore register numbered “1014h” are addressed as “1013h”. Register address value (transmitted on Modbus line) is 1 less than the Register Number.

When writing in selected holding registers fails, see the exception response.

Write in Holding Registers [17h]:

This function is to read and write data in consecutive holding registers. An example follows:

- Write “50.0 Hz” as the set frequency (F001) in an inverter having a slave address “1” and then to read out the output frequency (d001).

| No. | Field Name | Example (Hex) |
|-----|---|---------------|
| 1 | Slave address *1 | 01 |
| 2 | Function code | 17 |
| 3 | Start address to read *3 (high order) | 10 |
| 4 | Start address to read *3 (low order) | 00 |
| 5 | Number of holding registers to read (high order) | 00 |
| 6 | Number of holding registers to read (low order) | 02 |
| 7 | Start address to write *3 (high order) | 00 |
| 8 | Start address to write *3 (low order) | 00 |
| 9 | Number of holding registers to write (high order) | 00 |
| 10 | Number of holding registers to write (low order) | 02 |
| 11 | Byte number to write*2 | 04 |
| 12 | Change data 1 (high order) | 00 |
| 13 | Change data 1 (low order) | 00 |
| 14 | Change data 2 (high order) | 13 |
| 15 | Change data 2 (low order) | 88 |
| 16 | CRC-16 (high order) | F4 |
| 17 | CRC-16 (low order) | 86 |

| No. | Field Name | Example (Hex) |
|-----|------------------------------|---------------|
| 1 | Slave address | 01 |
| 2 | Function code | 17 |
| 3 | Byte number n | 04 |
| 4 | Register Data 1 (high order) | 00 |
| 5 | Register Data 1 (low order) | 00 |
| 6 | Register Data 2 (high order) | 13 |
| 7 | Register Data 2 (low order) | 88 |
| 8 | CRC-16 (high order) | F4 |
| 9 | CRC-16 (low order) | 71 |

Note 1 Register address value (transmitted on Modbus line) is 1 less than the Register Number.

When writing in selected holding registers fails, see the exception response.

Exception Response:

When sending a query (excluding a broadcasting query) to an inverter, the master always requests a response from the inverter. Usually, the inverter returns a response according to the query. However, when finding an error in the query, the inverter returns an exception response. The exception response consists of the fields shown below.

| Field Configuration |
|---------------------|
| Slave address |
| Function code |
| Exception code |
| CRC-16 |

The content of each field is explained below. The function code of the exception response is the sum of the function code of the query and 80h. The exception code indicates the factor of the exception response.

| Function Code | |
|---------------|--------------------|
| Query | Exception Response |
| 01h | 81h |
| 03h | 83h |
| 05h | 85h |
| 06h | 86h |
| 0Fh | 8Fh |
| 10h | 90h |

| Exception Code | |
|----------------|--|
| Code | Description |
| 01h | The specified function is not supported. |
| 02h | The specified function is not found. |
| 03h | The format of the specified data is not acceptable. |
| 21h | The data to be written in a holding register is outside the inverter. |
| 22h | <ul style="list-style-type: none"> • The specified functions are not available to the inverter. • Function to change the content of a register that cannot be changed while the inverter is in service • Function to submit an ENTER command during running (UV) • Function to write in a register during tripping (UV) • Function to write in a read-only register (or coil) |

B-3-5 Store New Register Data (ENTER Command)

After being written in a selected holding register by the Write in Holding Register command (06h) or in selected holding registers by the Write in Holding Registers command (10h), new data is temporary and still outside the storage element of the inverter. If power to the inverter is shut off, this new data is lost and the previous data returns. The ENTER command is used to store this new data in the storage element of the inverter. Follow the instructions below to submit the ENTER command.

Submitting an ENTER Command:

- Write any data in all memory (of a holding register at 0900h) by the Write in Holding Register command [06h].

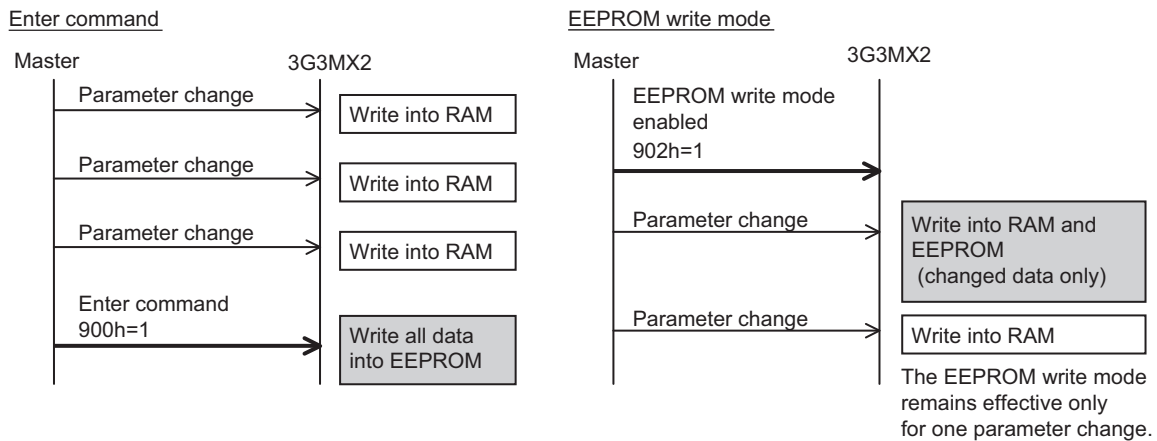
Note The ENTER command takes much time to run. You can check its progress by monitoring the Data Writing signal (of a coil at 0049h).

Note The service life of the storage element of the inverter is limited (to about 100,000 write operations). Frequent use of the ENTER command may shorten its service life.

EEPROM Write Mode

- If the holding register write command (06h), etc. is used to write “1” into the holding register for EEPROM write mode (0902h), the EEPROM write mode is cancelled.

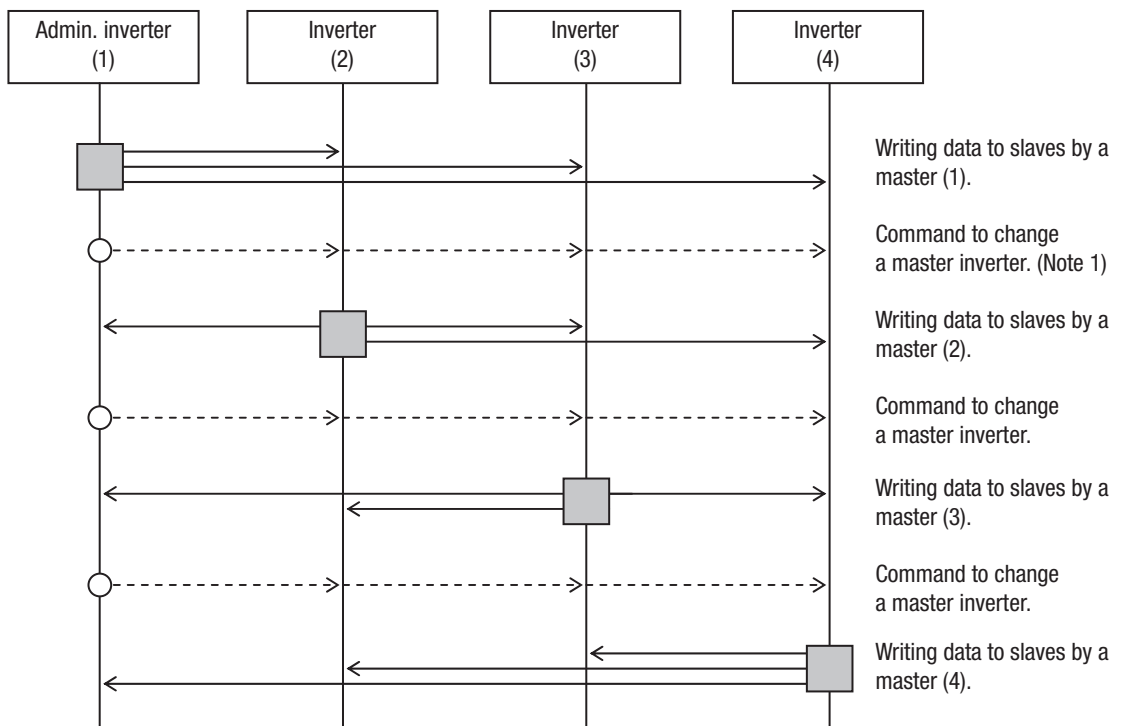
Difference between ENTER Command and EEPROM Write Mode



B-3-6 EzCOM (Peer-to-Peer communication)

- Besides standard Modbus-RTU communication (slave), MX2 supports Peer-to-Peer communication between multiple inverters.
- The max. number of inverter in the network is up to 247 (32 without repeater).
- One administrator inverter is necessary in the network, and the other inverters behave as master or slave.
- Be sure to set station No.1 as an administrator inverter, which controls master inverter according to user setting. The others will be slave inverters. An admin. inverter is fixed, but a master inverter always turns by rotation. For this reason, an admin. inverter can be a master or a slave.
- A master inverter is able to write data to any holding register of designated slave inverter. The max. number of holding register is up to 5. After writing data completed, a master inverter will be shift to the next inverter.

The max. number of master inverter is 8.



 : Master inverter

- Note 1** The command to change a master is issued by an admin. inverter automatically, which users do not have to take care.
- Note 2** The command to change a master from 01 to 02 is issued after the data is sent from master inverter 01 to slave and communication wait time (C078) passed.
- Note 3** Administrator inverter issues the next command to change a master after the data from master inverters is sent and communication wait time (C078) passed. In case the data from master inverter cannot be received within the communication error timeout (C077), then the inverter timeouts and the behaves according to the communication error selection.

Note 4 Please set the communication error timeout as it is valid (C077=0.01~99.99). If it is disabled (C077=0.0), EzCOM function is interrupted in case the data from master inverter was not received. In case it is interrupted, please turn on/off the power or reset (reset terminal on/off).

| Func. code | Name | Data/Range | For | Description |
|---------------|-------------------------------------|--------------|-----|------------------------------|
| C072 | Communication station No. Selection | 1 to 247 | ALL | Network address |
| C076 | Communication error selection | 00 | ALL | Trip |
| | | 01 | ALL | Trip after deceleration stop |
| | | 02 | ALL | Ignore |
| | | 03 | ALL | Free-run stop |
| | | 04 | ALL | Deceleration stop |
| C077 | Communication error timeout | 0.00 | ALL | Disabled |
| | | 0.01~99.99 | ALL | [sec.] |
| C078 | Communication wait time | 0~1000 | ALL | [ms] |
| C096 | Communication selection | 00 | – | Modbus-RTU |
| | | 01 | B | EzCOM |
| | | 02 | A | EzCOM (admin) |
| C098 | EzCOM start adr. of master | 1 to 8 | A | |
| C099 | EzCOM end adr. of master | 1 to 8 | A | |
| C100 | EzCOM starting trigger | 00 | A | 485 input |
| | | 01 | A | Always ON |
| P140 | EzCOM number of data | 1 to 5 | M | |
| P141 | EzCOM destination 1 address | 1 to 247 | M | (Note 3) |
| P142 | EzCOM destination 1 register | 0000 to FFFF | M | |
| P143 | EzCOM source 1 register | 0000 to FFFF | M | |
| P144 | EzCOM destination 2 address | 1 to 247 | M | |
| P145 | EzCOM destination 2 register | 0000 to FFFF | M | |
| P146 | EzCOM source 2 register | 0000 to FFFF | M | |
| P147 | EzCOM destination 3 address | 1 to 247 | M | |
| P148 | EzCOM destination 3 register | 0000 to FFFF | M | |
| P149 | EzCOM source 3 register | 0000 to FFFF | M | |
| P150 | EzCOM destination 4 address | 1 to 247 | M | |
| P151 | EzCOM destination 4 register | 0000 to FFFF | M | |
| P152 | EzCOM source 4 register | 0000 to FFFF | M | |
| P153 | EzCOM destination 5 address | 1 to 247 | M | |
| P154 | EzCOM destination 5 register | 0000 to FFFF | M | |
| P155 | EzCOM source 5 register | 0000 to FFFF | M | |
| C001~ C007 | Multi-function input 1 selection | 81 | A | 485: start EzCOM |

Which parameters to be set?

ALL : Set all inverters in the network.

A : Set admin. inverter (address=1) only.

B : Set all inverters except admin. inverter.

M : Set master inverters configured in C098 to C099 of admin. inverter.

Note 5 Address of Administrative inverter is to be set 01 (C072=01).

Note 6 When selection of operation after communication error is set other than "ignoring errors (C076=02)", EzCOM function is interrupted in case of com-

munication timeout on administrative inverter. In this case, please power off/on or reset (on/off RES terminal) to recover.

- Note 7** If EzCOM starting trigger is set as input terminal (C100=00), be sure to configure 81 in one of input terminals.
- Note 8** If EzCOM starting trigger is set as always (C100=01), administrative inverter starts to send the data immediately after power on. In case the establishment of the inverter to be assigned as master of delays and fail to receive the command to change the master, the data cannot be sent from master and administrative inverter time-outs. When C100=01 selected, please be sure to power up the administrative inverter at last after reconfirming the establishment of inverters other than administrative inverters.
- Note 9** Although slave addresses are set in a master inverter, data is sent as broadcast address (00). If a slave inverter receives data to another slave, it will be ignored.
- Note 10** As EzCOM source and destination register, please set the number minus one from the value listed in the table in "modbus data listing".
- Note 11** Just 0901h should be mention.
- Note 12** If above parameter is changed, the inverter power must be rebooted in order to activate new parameters. Instead of rebooting, turning ON/OFF of reset terminal works as same.

Basic function (in case the number of data is 1 (P140=1))

- A master inverter sends data in holding register P143 of the master to a slave inverter of address P141 and overwrites on holding register P142.
- A master inverter is changed to the next inverter, and repeats same procedure according to setting of new master inverter.

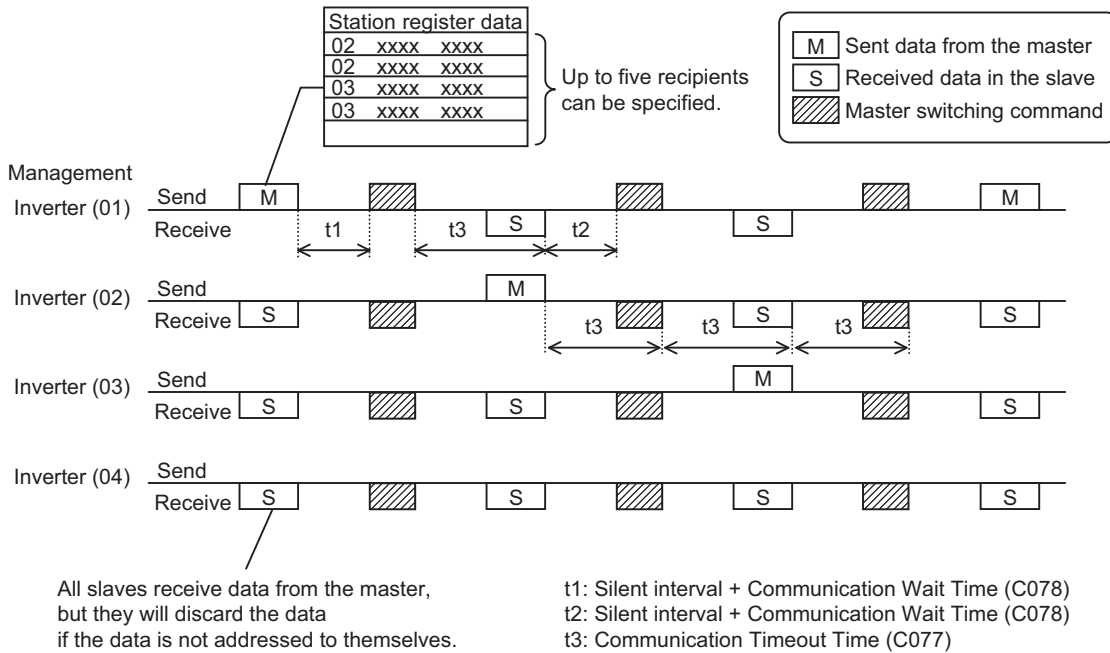
Inverter-Inverter Communication Operation

1. The Master Inverter sends data to each slave inverter according to the items set in the Master Inverter.
2. The Management Inverter sends a master switching command and the Master Inverter changes.
3. The next Master Inverter sends data to each slave inverter in the same manner as in 1st point.
4. The 2nd and the 3st points are repeated.

Note Since the Inverter communication is performed in the form of broadcasting (station number: 00), all communication data are sent to all stations. Accordingly, while a slave not specified as the recipient of the Master also receives data, if the data is not addressed to that slave the data will be discarded in the slave.

Example of Inverter-Inverter Communications Sequence

Shown below is a communication sequence involving a total of four inverters from station numbers 01 to 04, where the Master Inverter is one of 01 to 03.



- For the Management Inverter, be sure to set a value other than 0 (1 second or more is recommended) in Communication Error Timeout (C077). When 0 is set, the Co-inverter communication function will stop if the data sent from the Master Inverter cannot be received. If the function has stopped, reconnect the Management Inverter or perform a reset (by turning the RS terminal ON and then turning it OFF).
- The communication timeout timer starts counting when the recipient starts waiting for data. If data reception is not completed within the set time, a timeout occurs (t3 in the above figure) and the operation specified by Operation Selection on Communication Error (C076) takes place.
- If the Management Inverter is the master, the master switching command is sent after an elapse of the silent interval + Communication Wait Time (C078) following the sending of data by the Master Inverter (t1 in the above figure).
- If an Inverter other than the Management Inverter is the master, the master switching command is sent after an elapse of the silent interval + Communication Wait Time (C078) following the receiving of data from the Master Inverter (t2 in the above figure).
- If "01: Always started" is selected for Co-inverter Communication Start Selection, the Management Inverter starts sending the moment the power is turned on. Accordingly, any delay in the power-on timing of the other Inverter prevents normal communication and the Management Inverter experiences a communication timeout. If "Always started" is selected, confirm starting of all other Inverters and then start the Management Inverter at the end.
- Do not set 08FFh (EEPROM write) or 0901h (EEPROM write mode selection) in the recipient register.
- If any one of C096 to C100 is changed, the change will not be reflected until the power is reconnected or a reset is performed (by turning the RS terminal ON and then turning it OFF).

B-4 ModBus Data Listing

B-4-1 ModBus Coil List

The following tables list the primary coils for the inverter interface to the network. The table legend is given below.

- **Coil Number** – The network register address offset for the coil. The coil data is a single bit (binary) value.
- **Name** – The functional name of the coil
- **R/W** – The read-only (R) or read-write (R/W) access permitted to the inverter data
- **Description** – The meaning of each of the states of the coils

| Coil No. | Item | R/W | Setting |
|----------|---------------------------------------|-----|--|
| 0000h | unused | – | (Inaccessible) |
| 0001h | Operation command | R/W | 1: Run, 0: Stop (valid when A002 = 03) |
| 0002h | Rotation direction command | R/W | 1: Reverse rotation, 0: Forward rotation (valid when A002 = 03) |
| 0003h | External trip (EXT) | R/W | 1: Trip |
| 0004h | Trip reset (RS) | R/W | 1: Reset |
| 0005h | (Reserved) | – | – |
| 0006h | (Reserved) | – | – |
| 0007h | Intelligent input terminal [1] | R/W | 1: ON, 0: OFF (*1) |
| 0008h | Intelligent input terminal [2] | R/W | 1: ON, 0: OFF (*1) |
| 0009h | Intelligent input terminal [3] | R/W | 1: ON, 0: OFF (*1) |
| 000Ah | Intelligent input terminal [4] | R/W | 1: ON, 0: OFF (*1) |
| 000Bh | Intelligent input terminal [5] | R/W | 1: ON, 0: OFF (*1) |
| 000Ch | Intelligent input terminal [6] | R/W | 1: ON, 0: OFF (*1) |
| 000Dh | Intelligent input terminal [7] | R/W | 1: ON, 0: OFF (*1) |
| 000Eh | (Reserved) | – | – |
| 000Fh | Operation status | R | 1: Run, 0: Stop (interlocked to “d003”) |
| 0010h | Rotation direction | R | 1: Reverse rotation, 0: Forward rotation (interlocked to “d003”) |
| 0011h | Inverter ready | R | 1: Ready, 0: Not ready |
| 0012h | (Reserved) | – | – |
| 0013h | RUN (running) | R | 1: Running, 0: Not Running |
| 0014h | FA1 (constant-speed reached) | R | 1: ON, 0: OFF |
| 0015h | FA2 (set frequency overreached) | R | 1: ON, 0: OFF |
| 0016h | OL (overload advance notice (1)) | R | 1: ON, 0: OFF |
| 0017h | OD (output deviation for PID control) | R | 1: ON, 0: OFF |
| 0018h | AL (alarm signal) | R | 1: ON, 0: OFF |
| 0019h | FA3 (set frequency reached) | R | 1: ON, 0: OFF |
| 001Ah | OTQ (over-torque) | R | 1: ON, 0: OFF |
| 001Bh | (Reserved) | – | – |
| 001Ch | UV (undervoltage) | R | 1: ON, 0: OFF |
| 001Dh | TRQ (torque limited) | R | 1: ON, 0: OFF |
| 001Eh | RNT (operation time over) | R | 1: ON, 0: OFF |
| 001Fh | ONT (plug-in time over) | R | 1: ON, 0: OFF |
| 0020h | THM (thermal alarm signal) | R | 1: ON, 0: OFF |
| 0021h | (Reserved) | – | – |
| 0022h | (Reserved) | – | – |
| 0023h | (Reserved) | – | – |
| 0024h | (Reserved) | – | – |
| 0025h | (Reserved) | – | – |
| 0026h | BRK (brake release) | R | 1: ON, 0: OFF |
| 0027h | BER (brake error) | R | 1: ON, 0: OFF |
| 0028h | ZS (0 Hz detection signal) | R | 1: ON, 0: OFF |
| 0029h | DSE (speed deviation maximum) | R | 1: ON, 0: OFF |
| 002Ah | POK (positioning completed) | R | 1: ON, 0: OFF |
| 002Bh | FA4 (set frequency overreached 2) | R | 1: ON, 0: OFF |
| 002Ch | FA5 (set frequency reached 2) | R | 1: ON, 0: OFF |

| Coil No. | Item | R/W | Setting |
|----------|---|-----|--|
| 002Dh | OL2 (overload notice advance (2)) | R | 1: ON, 0: OFF |
| 002Eh | Odc: Analog O disconnection detection | – | 1: ON, 0: OFF |
| 002Fh | OIdc: Analog OI disconnection detection | – | 1: ON, 0: OFF |
| 0030h | (Reserved) | – | – |
| 0031h | (Reserved) | – | – |
| 0032h | FBV (PID feedback comparison) | R | 1: ON, 0: OFF |
| 0033h | NDc (communication train disconnection) | R | 1: ON, 0: OFF |
| 0034h | LOG1 (logical operation result 1) | R | 1: ON, 0: OFF |
| 0035h | LOG2 (logical operation result 2) | R | 1: ON, 0: OFF |
| 0036h | LOG3 (logical operation result 3) | R | 1: ON, 0: OFF |
| 0037h | (Reserved) | – | – |
| 0038h | (Reserved) | – | – |
| 0039h | (Reserved) | – | – |
| 003Ah | WAC (capacitor life warning) | R | 1: ON, 0: OFF |
| 003Bh | WAF (cooling-fan speed drop) | R | 1: ON, 0: OFF |
| 003Ch | FR (starting contact signal) | R | 1: ON, 0: OFF |
| 003Dh | OHF (heat sink overheat warning) | R | 1: ON, 0: OFF |
| 003Eh | LOC (low-current indication signal) | R | 1: ON, 0: OFF |
| 003Fh | M01 (general output 1) | R | 1: ON, 0: OFF |
| 0040h | M02 (general output 2) | R | 1: ON, 0: OFF |
| 0041h | M03 (general output 3) | R | 1: ON, 0: OFF |
| 0042h | (Reserved) | – | – |
| 0043h | (Reserved) | – | – |
| 0044h | (Reserved) | – | – |
| 0045h | IRDY (inverter ready) | R | 1: ON, 0: OFF |
| 0046h | FWR (forward rotation) | R | 1: ON, 0: OFF |
| 0047h | RVR (reverse rotation) | R | 1: ON, 0: OFF |
| 0048h | MJA (major failure) | R | 1: ON, 0: OFF |
| 0049h | Data writing in progress | R | 1: Writing in progress, 0: Normal status |
| 004Ah | CRC error | R | 1: Error detected, 0: No error (*2) |
| 004Bh | Overrun | R | 1: Error detected, 0: No error (*2) |
| 004Ch | Framing error | R | 1: Error detected, 0: No error (*2) |
| 004Dh | Parity error | R | 1: Error detected, 0: No error (*2) |
| 004Eh | Sum check error | R | 1: Error detected, 0: No error (*2) |
| 004Fh | (Reserved) | – | – |
| 0050h | WCO (window comparator O) | R | 1: ON, 0: OFF |
| 0051h | WCOI (window comparator OI) | R | 1: ON, 0: OFF |
| 0052h | (Reserved) | – | – |
| 0053h | OPDc (option disconnection) | R | 1: ON, 0: OFF |
| 0054h | FREF (FQ command source) | R | 1: Operator, 0: Others |
| 0055h | REF (RUN command source) | R | 1: Operator, 0: Others |
| 0056h | SETM (2nd motor selected) | R | 1: 2nd motor selected, 0: 1st motor selected |
| 0057h | (Reserved) | – | – |
| 0058h | EDM (Gate suppress monitor) | R | 1: ON, 0: OFF |
| 0059h- | unused | R | inaccessible |

Note 1 Normally, this coil is turned on when the corresponding intelligent input terminal on the control circuit terminal block is turned on or the coil itself is set to on. In this regard, the operation of the intelligent input terminal has priority over the operation of the coil. If disconnection of the communication train has disabled the master system from turning off the coil, turn the corresponding intelligent input terminal on the control circuit block on and off. This operation turns off the coil.

Note 2 Communication error data is retained until an error reset command is input. (The data can be reset during the inverter operation.)

B-4-2 ModBus Holding Registers

The following tables list the holding registers for the inverter interface to the network. The table legend is given below.

- **Function Code** – The inverter's reference code for the parameter or function (same as inverter keypad display)
- **Name** – The standard functional name of the parameter or function for the inverter
- **R/W** – The read-only(R) or read-write access(R/W) permitted to the data in the inverter
- **Description** – How the parameter or setting works (same as Chapter 3 description).
- **Reg.** – The network register address offset for the value. Some values have a high-byte and low-byte address.
- **Range** – The numerical range for the network value that is sent and/or received



Tip

The network values are binary integers. Since these values cannot have an embedded decimal point, for many parameters it represents the actual value (in engineering units) multiplied by a factor of 10 or 100. Network communications must use the listed range for network data. The inverter automatically divides received values by the appropriate factor in order to establish the decimal point for internal use. Likewise, the network host computer must apply the same factor when it needs to work in engineering units. However, when sending data to the inverter, the network host computer must scale values to the integer range listed for network communications.

- **Resolution** – This is the quantity represented by the LSB of the network value, in engineering units. When the network data range is greater than the inverter's internal data range, this 1-bit resolution will be fractional.

| Register No. | Function name | Function code | R/W | Monitoring and setting items | | Data resolution |
|----------------|----------------------------------|---------------|-----|---|--|-----------------|
| 0000h | unused | – | – | Inaccessible | | |
| 0001h | Output frequency setting/monitor | F001 (high) | R/W | 0 to 40000 (valid when A001 = 03) | | 0.01 [Hz] |
| 0002h | | F001 (low) | R/W | | | |
| 0003h | Inverter status A | – | R | 0: Initial status 2: Stopping 3: Running 4: Free-run stop 5: Jogging | 6: DC braking 7: Retrying 8: Tripping 9: Undervoltage (UV), | – |
| 0004h | Inverter status B | – | R | 0: Stopping, 1: Running, 2: Tripping | | – |
| 0005h | Inverter status C | – | R | 0: – 1: Stopping 2: Decelerating 3: Constant-speed operation 4: Accelerating 5: Forward rotation | 6: Reverse rotation 7: Switching from fwd. to rev. rotation, 8: Switching from rev. to fwd. rotation, 9: Starting fwd. 10: Starting rev. | – |
| 0006h | PID feedback | – | R/W | 0 to 10000 | | 0.01 [%] |
| 0007h to 0010h | (Reserved) | – | R | – | – | |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution | | |
|--------------|--|--------------------------------------|----------|---|-----------------|---|---|
| 0011h | Fault frequency monitor | d080 | R | 0 to 65535 | 1 [time] | | |
| 0012h | Fault monitor 1 (factor) | d081 | R | See the list of inverter trip factors below | – | | |
| 0013h | Fault monitor 1 (inverter status) | | | See the list of inverter trip factors below | – | | |
| 0014h | Fault monitor 1 (frequency) (high) | | | 0 to 40000 | 0.01[Hz] | | |
| 0015h | Fault monitor 1 (frequency) (low) | | | | | | |
| 0016h | Fault monitor 1 (current) | | | Output current at tripping | 0.01[A] | | |
| 0017h | Fault monitor 1 (voltage) | | | DC input voltage at tripping | 1[V] | | |
| 0018h | Fault monitor 1 (running time) (high) | | | Cumulative running time at tripping | 1[h] | | |
| 0019h | Fault monitor 1 (running time) (low) | | | | | | |
| 001Ah | Fault monitor 1 (power-on time) (high) | | | Cumulative power-on time at tripping | 1[h] | | |
| 001Bh | Fault monitor 1 (power-on time) (low) | | | | | | |
| 001Ch | Fault monitor 2 (factor) | | | d082 | R | See the list of inverter trip factors below | – |
| 001Dh | Fault monitor 2 (inverter status) | | | | | See the list of inverter trip factors below | – |
| 001Eh | Fault monitor 2 (frequency) (high) | 0 to 40000 | 0.01[Hz] | | | | |
| 001Fh | Fault monitor 2 (frequency) (low) | | | | | | |
| 0020h | Fault monitor 2 (current) | Output current at tripping | 0.01[A] | | | | |
| 0021h | Fault monitor 2 (voltage) | DC input voltage at tripping | 1[V] | | | | |
| 0022h | Fault monitor 2 (running time) (high) | Cumulative running time at tripping | 1[h] | | | | |
| 0023h | Fault monitor 2 (running time) (low) | | | | | | |
| 0024h | Fault monitor 2 (power-on time) (high) | Cumulative power-on time at tripping | 1[h] | | | | |
| 0025h | Fault monitor 2 (power-on time) (low) | | | | | | |
| 0026h | Fault monitor 3 (factor) | d083 | R | | | See the list of inverter trip factors below | – |
| 0027h | Fault monitor 3 (inverter status) | | | | | See the list of inverter trip factors below | – |
| 0028h | Fault monitor 3 (frequency) (high) | | | 0 to 40000 | 0.01[Hz] | | |
| 0029h | Fault monitor 3 (frequency) (low) | | | | | | |
| 002Ah | Fault monitor 3 (current) | | | Output current at tripping | 0.01[A] | | |
| 002Bh | Fault monitor 3 (voltage) | | | DC input voltage at tripping | 1[V] | | |
| 002Ch | Fault monitor 3 (running time) (high) | | | Cumulative running time at tripping | 1[h] | | |
| 002Dh | Fault monitor 3 (running time) (low) | | | | | | |
| 002Eh | Fault monitor 3 (power-on time) (high) | | | Cumulative power-on time at tripping | 1[h] | | |
| 002Fh | Fault monitor 3 (power-on time) (low) | | | | | | |
| 0030h | Fault monitor 4 (factor) | | | d084 | R | See the list of inverter trip factors below | – |
| 0031h | Fault monitor 4 (inverter status) | | | | | See the list of inverter trip factors below | – |
| 0032h | Fault monitor 4 (frequency) (high) | 0 to 40000 | 0.01[Hz] | | | | |
| 0033h | Fault monitor 4 (frequency) (low) | | | | | | |
| 0034h | Fault monitor 4 (current) | Output current at tripping | 0.01[A] | | | | |
| 0035h | Fault monitor 4 (voltage) | DC input voltage at tripping | 1[V] | | | | |
| 0036h | Fault monitor 4 (running time) (high) | Cumulative running time at tripping | 1[h] | | | | |
| 0037h | Fault monitor 4 (running time) (low) | | | | | | |
| 0038h | Fault monitor 4 (power-on time) (high) | Cumulative power-on time at tripping | 1[h] | | | | |
| 0039h | Fault monitor 4 (power-on time) (low) | | | | | | |
| 003Ah | Fault monitor 5 (factor) | d085 | R | | | See the list of inverter trip factors below | – |
| 003Bh | Fault monitor 5 (inverter status) | | | | | See the list of inverter trip factors below | – |
| 003Ch | Fault monitor 5 (frequency) (high) | | | 0 to 40000 | 0.01[Hz] | | |
| 003Dh | Fault monitor 5 (frequency) (low) | | | | | | |
| 003Eh | Fault monitor 5 (current) | | | Output current at tripping | 0.01[A] | | |
| 003Fh | Fault monitor 5 (voltage) | | | DC input voltage at tripping | 1[V] | | |
| 0040h | Fault monitor 5 (running time) (high) | | | Cumulative running time at tripping | 1[h] | | |
| 0041h | Fault monitor 5 (running time) (low) | | | | | | |
| 0042h | Fault monitor 5 (power-on time) (high) | | | Cumulative power-on time at tripping | 1[h] | | |
| 0043h | Fault monitor 5 (power-on time) (low) | | | | | | |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|--|-----------------|
| 0044h | Fault monitor 6 (factor) | d086 | R | See the list of inverter trip factors below | – |
| 0045h | Fault monitor 6 (inverter status) | | | See the list of inverter trip factors below | – |
| 0046h | Fault monitor 6 (frequency) (high) | | | 0 to 40000 | 0.01[Hz] |
| 0047h | Fault monitor 6 (frequency) (low) | | | | |
| 0048h | Fault monitor 6 (current) | | | Output current at tripping | 0.01[A] |
| 0049h | Fault monitor 6 (voltage) | | | DC input voltage at tripping | 1[V] |
| 004Ah | Fault monitor 6 (running time) (high) | | | Cumulative running time at tripping | 1[h] |
| 004Bh | Fault monitor 6 (running time) (low) | | | | |
| 004Ch | Fault monitor 6 (power-on time) (high) | | | Cumulative power-on time at tripping | 1[h] |
| 004Eh | Warning monitor | d090 | R | Warning code: 0 to 385 | – |
| 004Fh to 006Ch | (reserved) | – | – | – | – |
| 006Dh to 008Eh | (reserved) | – | – | – | – |
| 0900h | Writing to EEPROM | – | W | 0: Motor constant recalculation 1: Save all data in EEPROM Other: Motor constant recalculation and save all data in EEPROM | – |
| 0901h | Unused | – | – | Inaccessible | – |
| 0902h | EEPROM write mode | – | W | 0 (invalid) / 1 (valid) | |
| 0903h to 1000h | Unused | – | – | Inaccessible | – |

Note 1 Assume that the rated current of the inverter is “1000”.

Note 2 If a number not less than “1000” (100.0 seconds) is specified, the second value after the decimal point will be ignored.

Note 3 0902h setting is referred for one time when following 06h command is executed

List of inverter trip factors

| Upper part of trip factor code (indicating the factor) | | Lower part of trip factor code (indicating the inverter status) | |
|---|----------|--|------|
| Name | Code | Name | Code |
| No trip factor | 0 | Resetting | 0 |
| Over-current event while at constant speed | 1 | Stopping | 1 |
| Over-current event during deceleration | 2 | Decelerating | 2 |
| Over-current event during acceleration | 3 | Constant-speed operation | 3 |
| Over-current event during other conditions | 4 | Accelerating | 4 |
| Overload protection | 5 | Operating at zero frequency | 5 |
| Braking resistor overload protection | 6 | Starting | 6 |
| Overvoltage protection | 7 | DC braking | 7 |
| EEPROM error | 8 | Overload restricted | 8 |
| Undervoltage protection | 9 | | |
| Current detection error | 10 | | |
| CPU error | 11 | | |
| External trip | 12 | | |
| USP error | 13 | | |
| Ground-fault protection | 14 | | |
| Input overvoltage protection | 15 | | |
| Inverter thermal trip | 21 | | |
| CPU error | 22 | | |
| Main circuit error | 25 | | |
| Driver error | 30 | | |
| Thermistor error | 35 | | |
| Braking error | 36 | | |
| Safe Stop | 37 | | |
| Low-speed overload protection | 38 | | |
| Operator connection | 40 | | |
| Modbus communication error | 41 | | |
| Easy sequence error (invalid instruction) | 43 | | |
| Easy sequence error (invalid nesting count) | 44 | | |
| Easy sequence execution error 1 | 45 | | |
| Easy sequence user trip 0 to 9 | 50 to 59 | | |
| Option error 0 to 9 | 60 to 69 | | |
| Encoder disconnection | 80 | | |
| Excessive speed | 81 | | |
| Position control range trip | 83 | | |

(iii) List of registers (monitoring)

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|-------------------|---|---------------|-----|--|-----------------|
| 1001h | Output frequency monitor | d001 (high) | R | 0 to 40000 | 0.01 [Hz] |
| 1002h | | d001 (low) | | | |
| 1003h | Output current monitor | d002 | R | 0 to 999900 | 0.01 [A] |
| 1004h | Rotation direction monitor | d003 | R | 0: Stopping, 1: Forward rotation, 2: Reverse rotation | 0.1 [Hz] |
| 1005h | PID feedback value monitor | d004 (high) | R | 0 to 1000000 | 0.1 |
| 1006h | | d004 (low) | | | |
| 1007h | Multi-function input monitor | d005 | R | 2 ⁰ : Terminal 1 to 2 ⁶ : Terminal 7 | 1 bit |
| 1008h | Multi-function output monitor | d006 | R | 2 ⁰ : Terminal 11 to 2 ¹ : Terminal 12/ 2 ² : Relay Terminal | 1 bit |
| 1009h | Output frequency monitor (after conversion) | d007 (high) | R | 0 to 4000000 | 0.01 |
| 100Ah | | d007 (low) | | | |
| 100Bh | Real frequency monitor | d008 (high) | R | -40000 to +40000 | 0.01 [Hz] |
| 100Ch | | d008 (low) | R | | |
| 100Dh | Torque reference monitor | d009 | R | -200 to +200 | 1 [%] |
| 100Eh | Torque bias monitor | d010 | R | -200 to +200 | 1 [%] |
| 100Fh | (Reserved) | – | – | – | – |
| 1010h | Output torque monitor | d012 | R | -200 to +200 | 1 [%] |
| 1011h | Output voltage monitor | d013 | R | 0 to 6000 | 0.1 [V] |
| 1012h | Input power monitor | d014 | R | 0 to 1000 | 0.1 [kW] |
| 1013h | Watt-hour monitor | d015 (high) | R | 0 to 9999000 | 0.1 |
| 1014h | | d015 (low) | | | |
| 1015h | Total RUN time | d016 (high) | R | 0 to 999900 | 1 [h] |
| 1016h | | d016 (low) | | | |
| 1017h | Power ON time monitor | d017 (high) | R | 0 to 999900 | 1 [h] |
| 1018h | | d017 (low) | | | |
| 1019h | Fin temperature monitor | d018 | R | -200 to 1500 | 0.1 [°C] |
| 101Ah to 101Ch | (Reserved) | – | – | – | – |
| 101Dh | Life assessment monitor | d022 | R | 2 ⁰ : Capacitor on main circuit board 2 ¹ : cooling-fan | 1 bit |
| 101Eh | Program counter | d023 | R | 0~1024 | |
| 101Fh | Program number | d024 | R | 0~9999 | |
| 1020h~1 025h | (Reserved) | – | – | – | – |
| 1026h | DC voltage monitor | d102 | R | 0 to 10000 | 0.1 [V] |
| 1027h | Regenerative braking load rate monitor | d103 | R | 0 to 1000 | 0.1 [%] |
| 1028h | Electronic thermal monitor | d104 | R | 0 to 1000 | 0.1 [%] |
| 1029h to 102Dh | (Reserved) | – | – | – | – |
| 102Eh | Drive programming monitor (UM0) | d025(HIGH) | R | -2147483647 to 2147483647 | 1 |
| 102Fh | | d025(LOW) | R | | |
| 1030h | Drive programming monitor (UM1) | d026(HIGH) | R | -2147483647 to 2147483647 | 1 |
| 1031h | | d026(LOW) | R | | |
| 1032h | Drive programming monitor (UM2) | d027(HIGH) | R | -2147483647 to 2147483647 | 1 |
| 1033h | | d027(LOW) | R | | |
| 1034h to 1035h | (Reserved) | – | – | – | – |
| 1036h | Position command monitor | d029(HIGH) | R | -268435455 to 268435455 | 1 |
| 1037h | | d029(LOW) | R | | |
| 1038h | Current position monitor | d030(HIGH) | R | -268435455 to 268435455 | 1 |
| 1039h | | d030(LOW) | R | | |
| 103Ah to 1056h | (reserved) | – | – | – | – |
| 1057h | Inverter mode | d060 | R | 0 (IM CT) 1 (IM VT) 2 (Reserved) | |
| 1058h | unused | – | – | Inaccessible | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|--------------|---------------------------|---------------|-----|---|-----------------|
| 1059h | Frequency source monitor | d062 | R | 0: Operator 1 to 15: Multi-speed freq. 1 to 15 16: Jog frequency 18: Modbus network 19: Option 21: Potentiometer 22: Pulse train 23: Calculated function output 24: EzSQ (Drive Programming) 25: [O] input 26: [OI] input 27: [O] + [OI] | — |
| 105Ah | Run source monitor | d063 | R | 1: Terminal 2: Operator 3: Modbus network 4: Option | — |
| 10A1h | Analog input O monitor | d130 | R | 0 to 1023 | — |
| 10A2h | Analog input OI monitor | d131 | R | 0 to 1023 | — |
| 10A4h | Pulse train input monitor | d133 | R | 0.00 to 100.00 | % |
| 10A6h | PID deviation monitor | d153 | R | -327.68 to 327.67 -9999.00 to 9999.00 | % |
| 10A8h | PID output monitor | d155 | R | 0.00 to 9999.00 if (A071: 01) -9999.00 to 9999.00 if (A071: 02) | % |

(iv) List of registers

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---------------------------------------|---------------|-----|--|-----------------|
| 1103h | Acceleration time 1 | F002 (high) | R/W | 0 to 360000 | 0.01 [sec.] |
| 1104h | | F002 (low) | | | |
| 1105h | Deceleration time 1 | F003 (high) | R/W | 0 to 360000 | 0.01 [sec.] |
| 1106h | | F003 (low) | | | |
| 1107h | Operator rotation direction selection | F004 | R/W | 00 (forward rotation), 01 (reverse rotation) | – |
| 1108h to 1200h | Unused | – | – | Inaccessible | – |

(v) List of registers (function modes)

Parameter group A

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|------------------------------------|---------------|-----|--|-----------------|
| 1201h | Frequency reference selection | A001 | R/W | 00 (digital operator), 01 (terminal), 02 (operator), 03 (Modbus communication), 04 (option), 06 (pulse train frequency), 7 (drive programming), 10 (operation function result) | – |
| 1202h | Run command selection (*) | A002 | R/W | 01 (terminal), 02 (operator), 03 (Modbus communication), 04 (option) | – |
| 1203h | Base frequency | A003 | R/W | 300 to “maximum frequency” | 0.1 [Hz] |
| 1204h | Maximum frequency | A004 | R/W | 300 to 4000 | 0.1 [Hz] |
| 1205h | O/OI selection | A005 | R/W | 00 (switches between O/OI via terminal AT), 02 (switches between O/FREQ adjuster via terminal AT), 03 (switches between OI/FREQ adjuster via terminal AT) | – |
| 1206h to 120Ah | (Reserved) | – | – | – | – |
| 120Bh | O start frequency | A011 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 120Ch | | A011 (low) | | | |
| 120Dh | O end frequency | A012 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 120Eh | | A012 (low) | | | |
| 120Fh | O start ratio | A013 | R/W | 0 to “O end ratio” | 1 [%] |
| 1210h | O end ratio | A014 | R/W | “O start ratio” to 100 | 1 [%] |
| 1211h | O start selection | A015 | R/W | 00 (start FQ), 01 (0 Hz) | – |
| 1212h | O, O2, OI sampling | A016 | R/W | 1 to 30 or 31 (500 ms filter ± 0.1 Hz with hysteresis) | 1 |
| 1213h | Drive Programming (EzSQ) selection | A017 | R/W | 00 (disable), 01 (PRG start), 02 (always ON) | – |
| 1214h | (Reserved) | – | – | – | – |
| 1215h | Multi-step speed selection | A019 | R/W | 00 (binary), 01 (bit) | – |
| 1216h | Multi-step speed reference 0 | A020 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 1217h | | A020 (low) | R/W | | |
| 1218h | Multi-step speed reference 1 | A021 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 1219h | | A021 (low) | R/W | | |
| 121Ah | Multi-step speed reference 2 | A022 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 121Bh | | A022 (low) | R/W | | |
| 121Ch | Multi-step speed reference 3 | A023 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 121Dh | | A023 (low) | R/W | | |
| 121Eh | Multi-step speed reference 4 | A024 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 121Fh | | A024 (low) | R/W | | |
| 1220h | Multi-step speed reference 5 | A025 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 1221h | | A025 (low) | R/W | | |
| 1222h | Multi-step speed reference 6 | A026 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |
| 1223h | | A026 (low) | R/W | | |
| 1224h | Multi-step speed reference 7 | A027 (high) | R/W | 0 or “start frequency” to “maximum frequency” | 0.01 [Hz] |

After changing the setting, keep the time 40 ms or longer before actually give run command

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|---|-----------------|
| 1226h | Multi-step speed reference 8 | A028 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 1227h | | A028 (low) | R/W | | |
| 1228h | Multi-step speed reference 9 | A029 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 1229h | | A029 (low) | R/W | | |
| 122Ah | Multi-step speed reference 10 | A030 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 122Bh | | A030 (low) | R/W | | |
| 122Ch | Multi-step speed reference 11 | A031 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 122Dh | | A031 (low) | R/W | | |
| 122Eh | Multi-step speed reference 12 | A032 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 122Fh | | A032 (low) | R/W | | |
| 1230h | Multi-step speed reference 13 | A033 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 1231h | | A033 (low) | R/W | | |
| 1232h | Multi-step speed reference 14 | A034 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 1233h | | A034 (low) | R/W | | |
| 1234h | Multi-step speed reference 15 | A035 (high) | R/W | 0 or "start frequency" to "maximum frequency" | 0.01 [Hz] |
| 1235h | | A035 (low) | R/W | | |
| 1236h | (Reserved) | – | – | – | – |
| 1237h | (Reserved) | – | – | – | – |
| 1238h | Jogging frequency | A038 | R/W | 0.0, "Start frequency" to 999 | 0.01 [Hz] |
| 1239h | Jogging stop selection | A039 | R/W | 00 (free running on jogging stop/Disabled in operation) 01 (deceleration stop on jogging stop/Disabled in operation) 02 (DC injection braking on jogging stop/Disabled in operation) 03 (free running on jogging stop/Enabled in operation) 04 (deceleration stop on jogging stop/Enabled in operation) 05 (DC injection braking on jogging stop/Enabled in operation) | |
| 123Ah | (Reserved) | – | – | – | – |
| 123Bh | Torque boost selection | A041 | R/W | 00 (manual torque boost), 01 (automatic torque boost) | – |
| 123Ch | Manual torque boost voltage | A042 | R/W | 0 to 200 | 0.1 [%] |
| 123Dh | Manual torque boost frequency | A043 | R/W | 0 to 500 | 0.1 [%] |
| 123Eh | V/F characteristics selection | A044 | R/W | 00 (VC), 01 (VP), 02 (free V/f), 03 (sensorless vector control), | – |
| 123Fh | Output voltage gain | A045 | R/W | 20 to 100 | 1 [%] |
| 1240h | Automatic torque boost voltage compensation gain | A046 | R/W | 0 to 255 | 1 [%] |
| 1241h | Automatic torque boost slip compensation gain | A047 | R/W | 0 to 255 | 1 [%] |
| 1242h to 1244h | (Reserved) | – | – | – | – |
| 1245h | DC injection braking enable | A051 | R/W | 00 (disabling), 01 (enabling), 02 (output freq [A052 set value]) | – |
| 1246h | DC injection braking frequency | A052 | R/W | 0 to 6000 | 0.01 [Hz] |
| 1247h | DC injection braking delay time | A053 | R/W | 0 to 50 | 0.1 [sec.] |
| 1248h | DC injection braking power | A054 | R/W | 0 to 100 | 1 [%] |
| 1249h | DC injection braking time | A055 | R/W | 0 to 600 | 0.1 [sec.] |
| 124Ah | DC injection braking method selection | A056 | R/W | 00 (edge operation), 01 (level operation) | – |
| 124Bh | Startup DC injection braking power | A057 | R/W | 0 to 100 | 1 [%] |
| 124Ch | Startup DC injection braking time | A058 | R/W | 0 to 600 | 0.1 [sec.] |
| 124Dh | DC injection braking carrier frequency | A059 | R/W | 20 to 150 | 0.1 [kHz] |
| 124Eh | (Reserved) | – | – | – | – |
| 124Fh | Frequency upper limit | A061 (high) | R/W | 0 or "maximum frequency limit" to "maximum frequency" | 0.01 [Hz] |
| 1250h | | A061 (low) | R/W | | |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|---|-----------------|
| 1251h | Frequency lower limit | A062 (high) | R/W | 0 or "maximum frequency limit" to "maximum frequency" | 0.01 [Hz] |
| 1252h | | A062 (low) | R/W | | |
| 1253h | Jump frequency 1 | A063 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 1254h | | A063 (low) | R/W | | |
| 1255h | Jump frequency width 1 | A064 | R/W | 0 to 1000 | 0.01 [Hz] |
| 1256h | Jump frequency 2 | A065 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 1257h | | A065 (low) | R/W | | |
| 1258h | Jump frequency width 2 | A066 | R/W | 0 to 1000 | 0.01 [Hz] |
| 1259h | Jump frequency 3 | A067 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 125Ah | | A067 (low) | R/W | | |
| 125Bh | Jump frequency width 3 | A068 | R/W | 0 to 1000 | 0.01 [Hz] |
| 125Ch | Acceleration stop frequency | A069 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 125Dh | | A069 (low) | R/W | | |
| 125Eh | Acceleration stop time | A070 | R/W | 0 to 600 | 0.1 [sec.] |
| 125Fh | PID selection | A071 | R/W | 00 (disabling), 01 (enabling), 02 (reverse output enabling) | – |
| 1260h | PID P gain | A072 | R/W | 0 to 2500 | 0.10 |
| 1261h | PID I gain | A073 | R/W | 0 to 36000 | 0.1 [sec.] |
| 1262h | PID D gain | A074 | R/W | 0 to 10000 | 0.01 [sec.] |
| 1263h | PID scale | A075 | R/W | 1 to 9999 | 0.01 |
| 1264h | PID feedback selection | A076 | R/W | 00 (OI), 01 (O), 02 (RS485 communication), 03 (pulse train frequency), 10 (operation function output) | – |
| 1265h | Reverse PID function | A077 | R/W | 00 (disabling), 01 (enabling) | – |
| 1266h | PID output limit function | A078 | R/W | 0 to 1000 | 0.1 [%] |
| 1267h | PID feedforward selection | A079 | R/W | 00 (disabled), 01 (O), 02 (OI) | – |
| 1268h | (Reserved) | – | R/W | – | – |
| 1269h | AVR selection | A081 | R/W | 00 (always on), 01 (always off), 02 (off during deceleration) | – |
| 126Ah | AVR voltage selection | A082 | R/W | 200 V class: 0 (200)/1 (215)/2 (220)/3 (230)/4 (240) 400 V class: 5 (380)/6 (400)/7 (415)/8 (440)/9 (460)/10 (480) | – |
| 126Bh | AVR filter time constant | A083 | R/W | 0.000 to 10.00 | 0.001[sec] |
| 126Ch | AVR deceleration gain | A084 | R/W | 50 to 200 | 1[%] |
| 126Dh | Energy-saving operation mode | A085 | R/W | 00 (normal operation), 01 (energy-saving operation) | – |
| 126Eh | Energy-saving response/accuracy adjustment | A086 | R/W | 0 to 1000 | 0.1 [%] |
| 126Fh to 1273h | (Reserved) | – | – | – | – |
| 1274h | Acceleration time 2 | A092 (high) | R/W | 0 to 360000 | 0.01 [sec.] |
| 1275h | | A092 (low) | R/W | | |
| 1276h | Deceleration time 2 | A093 (high) | R/W | 0 to 360000 | 0.01 [sec.] |
| 1277h | | A093 (low) | R/W | | |
| 1278h | Select method to switch to Acc2/Dec2 profile | A094 | R/W | 00 (switching by 2CH terminal), 01 (switching by setting), 02 (Forward and reverse) | – |
| 1279h | Acc1 to Acc2 frequency transition point | A095 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 127Ah | | A095 (low) | R/W | | |
| 127Bh | Dec1 to Dec2 frequency transition point | A096 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 127Ch | | A096 (low) | R/W | | |
| 127Dh | Acceleration curve selection | A097 | R/W | 00 (linear), 01 (S curve), 02 (U curve), 03 (inv.U curve), 04 (EL-S curve) | – |
| 127Eh | Deceleration curve setting | A098 | R/W | 00 (linear), 01 (S curve), 02 (U curve), 03 (inv.U curve), 04 (EL-S curve) | – |
| 127Fh | (Reserved) | – | – | – | – |
| 1280h | (Reserved) | – | – | – | 0.01 [Hz] |
| 1281h | OI input active range start frequency | A101 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 1282h | | A101 (low) | R/W | | |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|--|-----------------|
| 1283h | OI input active range end frequency | A102 (high) | R/W | 0 to 40000 | 1 [%] |
| 1284h | | A102 (low) | R/W | | |
| 1285h | OI input active range start ratio | A103 | R/W | 0 to "OI input active range end ratio" | 1 [%] |
| 1286h | OI input active range end ratio | A104 | R/W | "OI input active range start ratio" to 100 | — |
| 1287h | OI input start frequency enable | A105 | R/W | 00 (start FQ), 01 (0 Hz) | — |
| 1288h to 12A4h | (Reserved) | — | — | — | — |
| 12A5h | Acceleration curve parameter | A131 | R/W | 01 (small curve) to 10 (large curve) | — |
| 12A6h | Deceleration curve parameter | A132 | R/W | 01 (small curve) to 10 (large curve) | — |
| 12A7h to 12AEh | (Reserved) | — | — | — | — |
| 12AFh | Operation frequency input A setting | A141 | R/W | 00 (digital operator), 01 (freq adjuster), 02 (input O), 03 (input OI), 04 (RS485 communication), 05 (option 1), 06 (Option 2), 07 (pulse train frequency) | — |
| 12B0h | Operation frequency input B setting | A142 | R/W | 00 (digital operator), 01 (freq adjuster), 02 (input O), 03 (input OI), 04 (RS485 communication), 05 (option 1), 06 (Option 2), 07 (pulse train frequency) | — |
| 12B1h | Operator selection | A143 | R/W | 00 (addition (A + B)), 01 (subtraction: (A - B)), 02 (multiplication: (A x B)) | — |
| 12B2h | (Reserved) | — | — | — | — |
| 12B3h | Frequency addition amount | A145 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 12B4h | | A145 (low) | R/W | | |
| 12B5h | Frequency addition direction | A146 | R/W | 00 (frequency command + A145), 01 (frequency command - A145) | — |
| 12B6h to 12B8h | (Reserved) | — | — | — | — |
| 12B9h | EL-S-curve ratio 1 during acceleration | A150 | R/W | 0 to 50 | 1 [%] |
| 12BAh | EL-S-curve ratio 2 during acceleration | A151 | R/W | 0 to 50 | 1 [%] |
| 12BBh | EL-S-curve ratio 1 during deceleration | A152 | R/W | 0 to 50 | 1 [%] |
| 12BCh | EL-S-curve ratio 2 during deceleration | A153 | R/W | 0 to 50 | 1 [%] |
| 12BDh | Deceleration hold frequency | A154 (high) | R/W | 0~40000 | 0.01 [Hz] |
| 12BEh | | A154 (low) | | | |
| 12BFh | Deceleration hold time | A155 | R/W | 0~600 | 0.1 [sec.] |
| 12C0h | PID sleep function action threshold | A156 (high) | R/W | 0~40000 | 0.01 [Hz] |
| 12C1h | | A156 (low) | | | |
| 12C2h | PID sleep function action delay time | A157 | R/W | 0~255 | 0.1 [sec.] |
| 12C3h to 12C5h | (Reserved) | — | — | — | — |
| 12C6h | [VR] input active range start frequency | A161 (high) | R/W | 0~40000 | 0.01 [Hz] |
| 12C7h | | A161 (low) | | | |
| 12C8h | [VR] input active range end frequency | A162 (high) | R/W | 0~40000 | 0.01 [Hz] |
| 12C9h | | A162 (low) | | | |
| 12CAh | [VR] input active range start current | A163 | R/W | 0~100 | 1 [%] |
| 12CBh | [VR] input active range end voltage | A164 | R/W | 0~100 | 1 [%] |
| 12CCh | [VR] input start frequency enable | A165 | R/W | 00 (start FQ) / 01 (0 Hz) | — |
| 12CDh to 1300h | unused | — | — | Inaccessible | — |

Parameter group B

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|--------------|--|---------------|-----|--|-----------------|
| 1301h | Retry selection | b001 | R/W | 00 (trip), 01 (0 Hz start), 02 (frequency matching start), 03 (trip after frequency matching deceleration stop), 04 (active frequency matching restart) | – |
| 1302h | Allowable momentary power interruption time | b002 | R/W | 3 to 250 | 0.1 [sec.] |
| 1303h | Retry wait time | b003 | R/W | 3 to 1000 | 0.1 [sec.] |
| 1304h | Momentary power interruption/undervoltage trip during stop selection | b004 | R/W | 00 (disabling), 01 (enabling), 02 (disabling during stopping and decelerating to stop) | – |
| 1305h | Momentary power interruption retry time selection | b005 | R/W | 00 (16 times), 01 (no limit) | – |
| 1306h | (Reserved) | – | – | – | – |
| 1307h | Frequency matching lower limit frequency setting | b007 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 1308h | | b007 (low) | R/W | | |
| 1309h | Trip retry selection | b008 | R/W | 00 (trip), 01 (0 Hz start), 02 (frequency matching start), 03 (trip after frequency matching deceleration stop), 04 (active frequency matching restart) | – |
| 130Ah | (Reserved) | – | – | – | – |
| 130Bh | Overvoltage/overcurrent retry time selection | b010 | R/W | 1 to 3 | 1 [time] |
| 130Ch | Trip retry wait time | b011 | R/W | 3 to 1000 | 0.1 [sec.] |
| 130Dh | Electronic thermal level | b012 | R/W | 0.20 x Rated current to 1.00 x Rated current | 0.1 [%] |
| 130Eh | Electronic thermal characteristics selection | b013 | R/W | 00 (reduced torque characteristic), 01 (constant torque characteristic), 02 (free setting) | – |
| 130Fh | (Reserved) | – | – | Inaccessible | – |
| 1310h | Free setting, electronic thermal frequency 1 | b015 | R/W | 0 to b017 | 1 [Hz] |
| 1311h | Free setting, electronic thermal current 1 | b016 | R/W | 0 to Rated current | 0.1 [A] |
| 1312h | Free setting, electronic thermal frequency 2 | b017 | R/W | 0 to b019 | 1 [Hz] |
| 1313h | Free setting, electronic thermal current 2 | b018 | R/W | 0 to Rated current | 0.1 [A] |
| 1314h | Free setting, electronic thermal frequency 3 | b019 | R/W | 0 to 400 | 1 [Hz] |
| 1315h | Free setting, electronic thermal current 3 | b020 | R/W | 0 to Rated current | 0.1 [A] |
| 1316h | Overload limit selection | b021 | R/W | 00 (disabling), 01 (enabling during acceleration and constant-speed operation), 02 (enabling during constant-speed operation), 03 (enabling during acceleration and constant-speed operation [speed increase at regeneration]) | – |
| 1317h | Overload limit level | b022 | R/W | 0.32 x Rated current to 3.20 x Rated current | 0.1 [%] |
| 1318h | Overload limit parameter | b023 | R/W | 1 to 30000 | 0.1 [sec.] |
| 1319h | Overload limit selection 2 | b024 | R/W | 00 (disabling), 01 (enabling during acceleration and constant-speed operation), 02 (enabling during constant-speed operation), 03 (enabling during acceleration and constant-speed operation [speed increase at regeneration]) | – |
| 131Ah | Overload limit level 2 | b025 | R/W | 0.32 x Rated current to 3.20 x Rated current | 0.1 [%] |
| 131Bh | Overload limit parameter 2 | b026 | R/W | 1 to 30000 | 0.1 [sec.] |
| 131Ch | Overcurrent suppression function | b027 | R/W | 00 (disabling), 01 (enabling), 02 (enable with reduced voltage) | – |
| 131Dh | Active frequency matching restart level | b028 | R/W | 0.32 x Rated current to 3.20 x Rated current | 0.1 [%] |
| 131Eh | Active frequency matching restart parameter | b029 | R/W | 1 to 30000 | 0.1 [sec.] |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|---|-----------------|
| 131Fh | Starting frequency at active frequency matching restart | b030 | R/W | 00 (frequency at the last shutoff), 01 (maximum frequency), 02 (set frequency) | – |
| 1320h | Soft lock selection | b031 | R/W | 00 (disabling change of data other than “b031” when SFT is on), 01 (disabling change of data other than “b031” and frequency settings when SFT is on), 02 (disabling change of data other than “b031”), 03 (disabling change of data other than “b031” and frequency settings), 10 (enabling data changes during operation) | – |
| 1321h | (Reserved) | – | – | – | – |
| 1322h | Motor cable length parameter | b033 | R/W | 5 to 20 | – |
| 1323h | RUN time/Power ON time setting | b034 (high) | R/W | 0 to 65535 | 1 [10h] |
| 1324h | | b034 (low) | R/W | | |
| 1325h | Rotation direction limit selection | b035 | R/W | 00 (Forward and Reverse are enabled)/ 01 (Enable for forward only)/ 02 (Enable for reverse only) | – |
| 1326h | Reduced voltage startup selection | b036 | R/W | 0 (minimum reduced voltage start time) to 255 (maximum reduced voltage start time) | – |
| 1327h | Display selection | b037 | R/W | 00 (complete display), 01 (function-specific display), 02 (user setting), 03 (data comparison display), 04 (basicdisplay), 05 (monitor display) | – |
| 1328h | Initial screen selection | b038 | R/W | 000-202 | – |
| 1329h | User parameter automatic setting function selection | b039 | R/W | 00 (disabling), 01 (enabling) | – |
| 132Ah | Torque limit selection | b040 | R/W | 00 (quadrant-specific setting), 01 (switching by terminal), 02 (analog input), 03 (option 1) | – |
| 132Bh | Torque limit 1 (fwd-power in 4-quadrant mode) | b041 | R/W | 0 to 200/no | 1 [%] |
| 132Ch | Torque limit 2 (rev/regen. in 4-quadrant mode) | b042 | R/W | 0 to 200/no | 1 [%] |
| 132Dh | Torque limit 3 (rev/power in 4-quadrant mode) | b043 | R/W | 0 to 200/no | 1 [%] |
| 132Eh | Torque limit 4 (fwd/regen. in 4-quadrant mode) | b044 | R/W | 0 to 200/no | 1 [%] |
| 132Fh | Torque LADSTOP selection | b045 | R/W | 00 (disabling), 01 (enabling) | – |
| 1330h | Reverse rotation prevention selection | b046 | R/W | 00 (disabling), 01 (enabling) | – |
| 1331h to 1332h | (Reserved) | – | – | – | – |
| 1333h | Dual rate selection | b049 | R/W | 00 (CT mode)/ 01 (VT mode) | – |
| 1334h | Selection of non-stop function at momentary power interruption | b050 | R/W | 00 (disabling), 01 (enabling), 02 (enabled (deceleration stop)) 03 (RUN) | – |
| 1335h | Starting voltage of non-stop function at momentary power interruption | b051 | R/W | 0 to 10000 | 0.1 [V] |
| 1336h | Stop deceleration level of non-stop function at momentary power interruption | b052 | R/W | 0 to 10000 | 0.1 [V] |
| 1337h | Deceleration time of non-stop function at momentary power interruption | b053 (high) | R/W | 0.01 to 36000 | 0.01 [sec.] |
| 1338h | | b053 (low) | R/W | | |
| 1339h | Deceleration starting width of non-stop function at momentary power interruption | b054 | R/W | 0 to 1000 | 0.01 [Hz] |
| 133Ah to 133Eh | (Reserved) | – | – | – | – |
| 133Fh | Window comparator O upper limit level | b060 | R/W | 0. to 100. (lower limit : b061 + b062 *2) (%) | 1 [%] |
| 1340h | Window comparator O lower limit level | b061 | R/W | 0. to 100. (lower limit : b060 - b062*2) (%) | 1 [%] |
| 1341h | Window comparator O hysteresis width | b062 | R/W | 0. to 10. (lower limit : b061 - b062 / 2) (%) | 1 [%] |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|--|-----------------|
| 1342h | Window comparator OI upper limit level | b063 | R/W | 0. to 100. (lower limit : b064 + b066 *2) (%) | 1 [%] |
| 1343h | Window comparator OI lower limit level | b064 | R/W | 0. to 100. (lower limit : b063 - b066 *2) (%) | 1 [%] |
| 1344h | Window comparator OI hysteresis width | b065 | R/W | 0. to 10. (lower limit : b063 - b064 / 2) (%) | 1 [%] |
| 1345h to 1348h | (Reserved) | – | – | – | – |
| 1349h | Analog operation level at O disconnection | b070 | R/W | 0 to 100 (%) or “no” (ignore) | 1 [%] |
| 134Ah | Analog operation level at OI disconnection | b071 | R/W | 0 to 100 (%) or “no” (ignore) | 1 [%] |
| 134Bh to 134Dh | (reserved) | – | – | – | – |
| 134Eh | Ambient temperature | b075 | R/W | -10 to 50 | 1 [°C] |
| 134Fh to 1350 | (reserved) | – | – | – | – |
| 1351h | Integrated power clear | b078 | R/W | Clearance by setting “01” | – |
| 1352h | Integrated power display gain | b079 | R/W | 1 to 1000 | 1 |
| 1353h to 1354h | (Reserved) | – | – | – | – |
| 1355h | Starting frequency | b082 | R/W | 10 to 999 | 0.01 [Hz] |
| 1356h | Carrier frequency | b083 | R/W | 20 to 150 | 0.1 [kHz] |
| 1357h | Initialization selection | b084 | R/W | 00 (clears the trip monitor), 01 (initializes data), 02 (clears the trip monitor and initializes data), 03 (clears the trip monitor and parameters), 4 (clears the trip monitor, parameters Drive program) | – |
| 1358h | Initialization parameter selection | b085 | R/W | 00 (JPN), 01 (EUR) | – |
| 1359h | Frequency conversion coefficient | b086 | R/W | 1 to 9999 | 0.01 |
| 135Ah | STOP key selection | b087 | R/W | 00 (enabling), 01 (disabling), 02 (disabling only stop) | – |
| 135Bh | Free-run stop selection | b088 | R/W | 0 (starting with 0 Hz), 1 (starting with matching frequency), 2 (starting with active matching frequency) | – |
| 135Ch | Automatic carrier frequency reduction | b089 | R/W | 00 (0 Hz start)/ 01 (frequency matching start)/ 02 (active frequency matching restart) | – |
| 135Dh | Usage rate of regenerative braking function | b090 | R/W | 0 to 1000 | 0.1 [%] |
| 135Eh | Stop selection | b091 | R/W | 00 (deceleration until stop), 01 (free-run stop) | – |
| 135Fh | Cooling fan control | b092 | R/W | 00 (always ON), 01 (ON during RUN), 02 (ON by temp) | – |
| 1360h | Clear elapsed time of cooling fan | b093 | R/W | 00 (OFF)/ 01 (CLR) | – |
| 1361h | Initialization target data | b094 | R/W | 00 (ALL)/ 01 (Exp.COM, TERM)/ 02 (Only U***)/ 03 (All exp.U***) | – |
| 1362h | Regenerative braking function operation selection | b095 | R/W | 00 (disabling), 01 (enabling [disabling while the motor is stopped]), 02 (enabling [enabling also while the motor is stopped]) | – |
| 1363h | Regenerative braking function ON level | b096 | R/W | 330 to 380, 660 to 760 | 1. [V] |
| 1364h | BRD resistor | b097 | R/W | Min. Resistance to 600.0 | 0.1 [Ω] |
| 1365h to 1366h | (Reserved) | – | – | – | – |
| 1367h | Free V/f frequency 1 | b100 | R/W | 0. to “Free V/f frequency 2” | 1 [Hz] |
| 1368h | Free V/f voltage 1 | b101 | R/W | 0. to 8000 | 0.1 [V] |
| 1369h | Free V/f frequency 2 | b102 | R/W | 0. to “Free V/f frequency 3” | 1 [Hz] |
| 136Ah | Free V/f voltage 2 | b103 | R/W | 0. to 8000 | 0.1 [V] |
| 136Bh | Free V/f frequency 3 | b104 | R/W | 0. to “Free V/f frequency 4” | 1 [Hz] |
| 136Ch | Free V/f voltage 3 | b105 | R/W | 0. to 8000 | 0.1 [V] |
| 136Dh | Free V/f frequency 4 | b106 | R/W | 0. to “Free V/f frequency 5” | 1 [Hz] |
| 136Eh | Free V/f voltage 4 | b107 | R/W | 0. to 8000 | 0.1 [V] |
| 136Fh | Free V/f frequency 5 | b108 | R/W | 0. to “Free V/f frequency 6” | 1 [Hz] |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|---|-----------------|
| 1370h | Free V/f voltage 5 | b109 | R/W | 0. to 8000 | 0.1 [V] |
| 1371h | Free V/f frequency 6 | b110 | R/W | 0. to "Free V/f frequency 7" | 1 [Hz] |
| 1372h | Free V/f voltage 6 | b111 | R/W | 0. to 8000 | 0.1 [V] |
| 1373h | Free V/f frequency 7 | b112 | R/W | 0. to 400. | 1 [Hz] |
| 1374h | Free V/f voltage 7 | b113 | R/W | 0. to 8000 | 0.1 [V] |
| 1375h to 137Ah | (Reserved) | – | – | – | – |
| 137Bh | Brake control selection | b120 | R/W | 00 (disabling), 01 (enabling), 02 (enable without DC injection) | – |
| 137Ch | Brake wait time for release | b121 | R/W | 0 to 500 | 0.01 [sec.] |
| 137Dh | Brake wait time for acceleration | b122 | R/W | 0 to 500 | 0.01 [sec.] |
| 137Eh | Brake wait time for stopping | b123 | R/W | 0 to 500 | 0.01 [sec.] |
| 137Fh | Brake wait time for confirmation | b124 | R/W | 0 to 500 | 0.01 [sec.] |
| 1380h | Brake release frequency | b125 | R/W | 0 to 40000 | 0.01 [Hz] |
| 1381h | Brake release current | b126 | R/W | 0.0 to 3.20 x Rated current | 0.1 [%] |
| 1382h | Braking input frequency | b127 | R/W | 0 to 40000 | 0.01 [Hz] |
| 1383h | (Reserved) | – | – | – | – |
| 1384h | (Reserved) | – | – | – | – |
| 1385h | Overvoltage protection function selection during deceleration | b130 | R/W | 00 (disabling), 01 (enabling), 02 (enabling with acceleration) | – |
| 1386h | Overvoltage protection level during deceleration | b131 | R/W | 200 V class: 330 to 390 (V) 400 V class: 660 to 780 (V) | 1 [V] |
| 1387h | Overvoltage protection parameter | b132 | R/W | 10 to 3000 | 0.01 [sec.] |
| 1388h | Overvoltage protection proportional gain setting | b133 | R/W | 0 to 500 | 0.01 |
| 1389h | Overvoltage protection integral time setting | b134 | R/W | 0 to 1500 | 0.1 [sec.] |
| 138Ah to 1393h | (Reserved) | – | – | – | – |
| 1394h | GS input mode | b145 | R/W | 00 (no trip)/ 01 (trip) | – |
| 1395h to 1399h | (Reserved) | – | – | – | – |
| 139Ah | Display ex.operator connected | b150 | R/W | 001 to 060 | - |
| 139Bh to 13A2h | (Reserved) | – | – | – | – |
| 13A3h | 1st parameter of Dual Monitor | b160 | R/W | 001 to 030 | – |
| 13A4h | 2nd parameter of Dual Monitor | b161 | R/W | 001 to 030 | – |
| 13A5h | (Reserved) | – | – | – | – |
| 13A6h | Freq. set in monitoring | b163 | R/W | 00 (disabling), 01 (enabling), | – |
| 13A7h | Auto return initial display | b164 | R/W | 00 (disabling), 01 (enabling), | – |
| 13A8h | Ex. Operator com. loss action | b165 | R/W | 00 (trip), 01 (decel-trip), 02 (ignore), 03 (Free RUN), 04 (decel-stop) | – |
| 13A9h | Data Read/Write selection | b166 | R/W | 00 (Read/Write OK), 01 (Protected) | – |
| 13AAh to 13ADh | (Reserved) | – | – | – | – |
| 13AEh | Inverter mode selection | b171 | R/W | 00 (no), 01 (Std.IM), 02 (Reserved), 03 (PM) | – |
| 13AFh to 13B6h | (Reserved) | – | – | – | – |
| 13B7h | Initialize trigger | b180 | R/W | 00 (no action), 01 (initialize) | – |
| 13B8h to 13C5h | (Reserved) | – | – | – | – |
| 13C6h | E. thermal Dec Mode | b910 | R/W | 00 (Off), 01 (Fixed Linear), 02 (LinDec Time), 03 (DecTimeCnst) | – |
| 13C7h to 13C8h | E. thermal Dec Time | b911 | R/W | 0.10 to 100000.00 | 0.01 [sec.] |
| 13C9h to 13CAh | E. thermal Dec TimeCnst | b912 | R/W | 0.10 to 100000.00 | 0.01 [sec.] |
| 13CBh | E. thermal AccmGain | b913 | R/W | 1.0 to 200.0 | 0.1 [sec.] |
| 13CCh to 1400h | unused | – | – | Inaccessible | – |

Parameter group C

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|---|-----------------|
| 1401h | Multi-function input 1 selection | C001 | R/W | 00 (FW: Forward RUN), 01 (RV: Reverse RUN), 02 (CF1: Multispeed 1 setting), 03 (CF2: Multispeed 2 setting), 04 (CF3: Multispeed 3 setting), 05 (CF4: Multispeed 4 setting), 06 (JG: Jogging), 07 (DB: external DC braking), 08 (SET: Set 2nd motor data), 09 (2CH: 2-stage acceleration/deceleration), 11 (FRS: free-run stop), 12 (EXT: external trip), 13 (USP: unattended start protection), 14: (CS: commercial power source enable), 15 (SFT: software lock), 16 (AT: analog input voltage/current select), 18 (RS: reset), 20 (STA: starting by 3-wire input), 21 (STP: stopping by 3-wire input), 22 (F/R: forward/reverse switching by 3-wire input), 23 (PID: PID disable), 24 (PIDC: PID reset), 27 (UP: remote control UP function), 28 (DWN: remote control DOWN function), 29 (UDC: remote control data clearing), 31 (OPE: forcible operation), 32 (SF1: multispeed bit 1), 33 (SF2: multispeed bit 2), 34 (SF3: multispeed bit 3), 35 (SF4: multispeed bit 4), 36 (SF5: multispeed bit 5), 37 (SF6: multispeed bit 6), 38 (SF7: multispeed bit 7), 39 (OLR: overload restriction selection), 40 (TL: torque limit enable), 41 (TRQ1: torque limit selection bit 1), 42 (TRQ2: torque limit selection bit 2), 44 (BOK: braking confirmation), 46 (LAC: LAD cancellation), 47 (PCLR: clearance of position deviation), 50 (ADD: trigger for frequency addition [A145]), 51 (F-TM: forcible-terminal operation), 52 (ATR: permission of torque command input), 53 (KHC: cumulative power clearance), 56 (MI1: general-purpose input 1), 57 (MI2: general-purpose input 2), 58 (MI3: general-purpose input 3), 59 (MI4: general-purpose input 4), 60 (MI5: general-purpose input 5), 61 (MI6: general-purpose input 6), 62 (MI7: general-purpose input 7), 65 (AHD: analog command holding), 66 (CP1: multistage position settings selection 1), 67 (CP2: multistage position settings selection 2), 68 (CP3: multistage position settings selection 3), 69 (ORL: Zero-return limit function), 70 (ORG: Zero-return trigger function), 73 (SPD: speed / position switching), 77 (GS1: safety input 1), 78 (GS2: safety input 2), 81 (485: EzCOM), 82 (PRG: executing Drive Programming), 83 (HLD: retain output frequency), 84 (ROK: permission of run command), 85 (EB: Rotation direction detection (for V/f with ENC), 86 (DISP: Display limitation), 90 (UIO: Unprotected inverter operation), 91 (PSET: preset position), 255 (no). | – |
| 1402h | Multi-function input 2 selection | C002 | R/W | | – |
| 1403h | Multi-function input 3 selection | C003 | R/W | | – |
| 1404h | Multi-function input 4 selection | C004 | R/W | | – |
| 1405h | Multi-function input 5 selection | C005 | R/W | | – |
| 1406h | Multi-function input 6 selection | C006 | R/W | | – |
| 1407h | Multi-function input 7 selection | C007 | R/W | | – |
| 1408h to 140Ah | (Reserved) | - | - | Inaccessible | – |
| 140Bh | Multi-function input 1 operation selection | C011 | R/W | 00 (NO), 01 (NC) | – |
| 140Ch | Multi-function input 2 operation selection | C012 | R/W | 00 (NO), 01 (NC) | – |
| 140Dh | Multi-function input 3 operation selection | C013 | R/W | 00 (NO), 01 (NC) | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|--|-----------------|
| 140Eh | Multi-function input 4 operation selection | C014 | R/W | 00 (NO), 01 (NC) | – |
| 140Fh | Multi-function input 5 operation selection | C015 | R/W | 00 (NO), 01 (NC) | – |
| 1410h | Multi-function input 6 operation selection | C016 | R/W | 00 (NO), 01 (NC) | – |
| 1411h | Multi-function input 7 operation selection | C017 | R/W | 00 (NO), 01 (NC) | – |
| 1412h to 1414h | (Reserved) | – | – | Inaccessible | – |
| 1415h | Multi-function output terminal 11 selection | C021 | R/W | 00 (RUN: running), 01 (FA1: constant-speed reached), 02 (FA2: set frequency overreached), 03 (OL: overload notice advance signal (1)), 04 (OD: output deviation for PID control), 05 (AL: alarm signal), 06 (FA3: set frequency reached), 07 (OTQ: over-torque), 09 (UV: undervoltage), 10 (TRQ: torque limited), 11 (RNT: operation time over), | – |
| 1416h | Multi-function output terminal 12 selection | C022 | R/W | 12 (ONT: plug-in time over), 13 (THM: thermal alarm signal), 19 (BRK: brake release), 20 (BER: braking error), 21 (ZS: 0 Hz detection signal), 22 (DSE: speed deviation maximum), 23 (POK: positioning completed), 24 (FA4: set frequency overreached 2), 25 (FA5: set frequency reached 2), 26 (OL2: overload notice advance signal (2)), 31 (FBV: PID feedback comparison), 32 (NDc: communication line disconnection), 33 (LOG1: logical operation result 1), 34 (LOG2: logical operation result 2), 35 (LOG3: logical operation result 3), 39 (WAC: capacitor life warning), 40 (WAF: cooling-fan), 41 (FR: starting contact signal), 42 (OHF: heat sink overheat warning), 43 (LOC: low-current indication signal), 44 (M01: general-purpose output 1), 45 (M02: general-purpose output 2), 46 (M03: general-purpose output 3), 50 (IRDY: inverter ready), 51 (FWR: forward rotation), 52 (RVR: reverse rotation), 53 (MJA: major failur), 54 (WCO: window comparator O), 55 (WCOI: window comparator OI), 58(FREF), 59(REF), 60(SETM), | – |
| 1421h to 1423h | (Reserved) | – | – | (FBV: PID feedback comparison), 32 (NDc: communication line disconnection), 33 (LOG1: logical operation result 1), 34 (LOG2: logical operation result 2), 35 (LOG3: logical operation result 3), 39 (WAC: capacitor life warning), 40 (WAF: cooling-fan), 41 (FR: starting contact signal), 42 (OHF: heat sink overheat warning), 43 (LOC: low-current indication signal), 44 (M01: general-purpose output 1), 45 (M02: general-purpose output 2), 46 (M03: general-purpose output 3), 50 (IRDY: inverter ready), 51 (FWR: forward rotation), 52 (RVR: reverse rotation), 53 (MJA: major failur), 54 (WCO: window comparator O), 55 (WCOI: window comparator OI), 58(FREF), 59(REF), 60(SETM), | – |
| 141Ah | Relay output (AL2, AL1) function selection | C026 | R/W | (FBV: PID feedback comparison), 32 (NDc: communication line disconnection), 33 (LOG1: logical operation result 1), 34 (LOG2: logical operation result 2), 35 (LOG3: logical operation result 3), 39 (WAC: capacitor life warning), 40 (WAF: cooling-fan), 41 (FR: starting contact signal), 42 (OHF: heat sink overheat warning), 43 (LOC: low-current indication signal), 44 (M01: general-purpose output 1), 45 (M02: general-purpose output 2), 46 (M03: general-purpose output 3), 50 (IRDY: inverter ready), 51 (FWR: forward rotation), 52 (RVR: reverse rotation), 53 (MJA: major failur), 54 (WCO: window comparator O), 55 (WCOI: window comparator OI), 58(FREF), 59(REF), 60(SETM), | – |
| 141Bh | [EO] terminal selection | C027 | R/W | 00 (output frequency), 01 (output current), 02 (output torque), 03 (digital output frequency), 04 (output voltage), 05 (input power), 06 (electronic thermal overload), 07 (LAD frequency), 08 (digital current monitoring), 10 (heat sink temperature), 12 (general-purpose output YA0), 15 (pulse input), 16 (option) | – |
| 141Ch | AM selection | C028 | R/W | 00 (output frequency), 01 (output current), 02 (output torque), 04 (output voltage), 05 (input power), 06 (electronic thermal overload), 07 (LAD frequency), 10 (heat sink temperature), 11 (output torque [signed value]), 13 (general-purpose output YA1), 16(option) | – |
| 141Dh | (reserved) | – | – | – | – |
| 141Eh | Digital current monitor reference value | C030 | R/W | 0.32 x Rated current to 3.20 x Rated current | 0.1 [%] |
| 141Fh | Multi-function output terminal 11 contact selection | C031 | R/W | 00 (NO), 01 (NC) | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|---|-----------------|
| 1420h | Multi-function output terminal 12 contact selection | C032 | R/W | 00 (NO), 01 (NC) | – |
| 1421h to 1423h | (Reserved) | – | – | – | – |
| 1424h | Relay output (AL2, AL1) contact selection | C036 | R/W | 00 (NO contact at AL2, NC contact at AL1), 01 (NC contact at AL2, NO contact at AL1) | – |
| 1425h | (Reserved) | – | – | – | – |
| 1426h | Light load signal output mode | C038 | R/W | 00 (output during acceleration/deceleration and constant-speed operation), 01 (output only during constant-speed operation) | – |
| 1427h | Light load detection level | C039 | R/W | 0.0 to 3.20 x Rated current | 0.1 [%] |
| 1428h | Overload warning signal output mode | C040 | R/W | 00 (output during acceleration/deceleration and constant-speed operation), 01 (output only during constant-speed operation) | – |
| 1429h | Overload warning level | C041 | R/W | 0.1 to 3.20 x Rated current | 0.1 [%] |
| 142Ah | Arrival frequency during acceleration | C042 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 142Bh | | C042 (low) | R/W | | |
| 142Ch | Arrival frequency during deceleration | C043 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 142Dh | | C043 (low) | R/W | | |
| 142Eh | PID deviation excessive level | C044 | R/W | 0 to 1000 | 0.1 [%] |
| 142Fh | Arrival frequency during acceleration 2 | C045 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 1430h | | C045 (low) | R/W | | |
| 1431h | Arrival frequency during deceleration 2 | C046 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 1432h | | C046 (low) | R/W | | |
| 1433h | Pulse train input scale conversion for EO output | C047 | R/W | 0.01 - 99.99 | – |
| 1434h to 1437h | (Reserved) | – | – | – | – |
| 1438h | PID FB upper limit | C052 | R/W | 0 to 1000 | 0.1 [%] |
| 1439h | PID FB lower limit | C053 | R/W | 0 to 1000 | 0.1 [%] |
| 143Ah | Over-torque/under-torque selection | C054 | R/W | 00 (Over torque)/ 01 (under torque) | – |
| 143Bh | Overtorque level (forward power running) | C055 | R/W | 0 to 200 | 1 [%] |
| 143Ch | Overtorque level (reverse regeneration) | C056 | R/W | 0 to 200 | 1 [%] |
| 143Dh | Overtorque level (reverse power running) | C057 | R/W | 0 to 200 | 1 [%] |
| 143Eh | Overtorque level (forward regeneration) | C058 | R/W | 0 to 200 | 1 [%] |
| 143Fh | Signal output mode of Over/under torque | C059 | R/W | 00 (output during acceleration/deceleration and constant-speed operation), 01 (output only during constant-speed operation) | – |
| 1440h | (Reserved) | – | – | – | – |
| 1441h | Thermal warning level | C061 | R/W | 0 to 100 | 1 [%] |
| 1442h | (Reserved) | – | – | – | – |
| 1443h | 0 Hz detection level | C063 | R/W | 0 to 10000 | 0.01 [Hz] |
| 1444h | Fin overheat warning level | C064 | R/W | 0 to 110 | 1 [°C] |
| 1445h to 144Ah | (Reserved) | – | – | – | – |
| 144Bh | Communication speed selection (Baud rate selection) | C071 | R/W | 03 (2400bps), 04 (4800bps), 05 (9600bps), 06 (19.2kbps), 07 (38.4kbps), 08 (57.6kbps), 09 (76.8kbps), 10 (115.2kbps) | – |
| 144Ch | Communication station No. Selection | C072 | R/W | 1 to 247 | – |
| 144Dh | (Reserved) | – | – | – | – |
| 144Eh | Communication parity selection | C074 | R/W | 00 (no parity), 01 (even parity), 02 (odd parity) | – |
| 144Fh | Communication stop bit selection | C075 | R/W | 1 (1 bit), 2 (2 bits) | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|---|-----------------|
| 1450h | Communication error selection | C076 | R/W | 00 (trip), 01 (tripping after deceleration stop), 02 (ignore), 03 (free-run stop), 04 (deceleration stop) | – |
| 1451h | Communication error timeout | C077 | R/W | 0 to 9999 | 0.01 [sec.] |
| 1452h | Communication wait time | C078 | R/W | 0 to 1000 | 1 [msec.] |
| 1453h to 1454h | (Reserved) | – | – | – | – |
| 1455h | O adjustment | C081 | R/W | 0 to 2000 | 0.1 |
| 1456h | OI adjustment | C082 | R/W | 0 to 2000 | 0.1 |
| 1457h to 1458h | (Reserved) | – | – | – | – |
| 1459h | Thermistor adjustment | C085 | R/W | 0 to 2000 | 0.1 |
| 145Ah to 145Eh | (Reserved) | – | – | – | – |
| 145Fh | Debug mode selection | C091 | R | “00” Do not change | – |
| 1460h to 1463h | (Reserved) | – | – | – | – |
| 1464h | Communication selection | C096 | R/W | 00 (Modbus-RTU)/ 01(EzCOM)/ 02 (EzCOM<administrator>) | – |
| 1465h | (Reserved) | – | – | – | – |
| 1466h | EzCOM start adr. of master | C098 | R/W | 1~8 | – |
| 1467h | EzCOM end adr. of master | C099 | R/W | 1~8 | – |
| 1468h | EzCOM starting trigger | C100 | R/W | 00 (485 input)/ 01 (Always ON) | – |
| 1469h | UP/DWN selection | C101 | R/W | 00 (not storing the frequency data), 01 (storing the frequency data) | – |
| 146Ah | Reset selection | C102 | R/W | 00 (trip reset at power-on), 01 (trip reset when the power is OFF), 02 (enabled only during trip), 03 (trip reset only) | – |
| 146Bh | Restart frequency matching selection | C103 | R/W | 00 (0 Hz start), 01 (frequency matching start), 02 (active frequency matching restart) | – |
| 146Ch | UP/DWN clear mode | C104 | R/W | 00 (0Hz)/ 01 (Pow-ON data) | – |
| 146Dh | EO gain setting | C105 | R/W | 50 to 200 | 1 [%] |
| 146Eh | AM gain setting | C106 | R/W | 50 to 200 | 1 [%] |
| 146Fh | (Reserved) | – | – | Inaccessible | 1 [%] |
| 1471h | AM bias setting | C109 | R/W | 0 to 100 | 1 [%] |
| 1472h | (Reserved) | – | – | – | 1 [%] |
| 1473h | Overload warning level 2 | C111 | R/W | 0.0 to 3.20 x Rated current | 0.1 [%] |
| 1474h to 1485h | (Reserved) | – | – | – | – |
| 1486h | Output 11 ON delay | C130 | R/W | 0 to 1000 | 0.1 [sec.] |
| 1487h | Output 11 OFF delay | C131 | R/W | 0 to 1000 | 0.1 [sec.] |
| 1488h | Output 12 ON delay | C132 | R/W | 0 to 1000 | 0.1 [sec.] |
| 1489h | Output 12 OFF delay | C133 | R/W | 0 to 1000 | 0.1 [sec.] |
| 148Ah to 148F | (Reserved) | – | – | – | – |
| 1490h | Relay output ON delay | C140 | R/W | 0 to 1000 | 0.1 [sec.] |
| 1491h | Relay output OFF delay | C141 | R/W | 0 to 1000 | 0.1 [sec.] |
| 1492h | Logic output signal 1 selection 1 | C142 | R/W | Same as the settings of C021 to C026 (except those of LOG1 to LOG6, OPO, no) | – |
| 1493h | Logic output signal 1 selection 2 | C143 | R/W | Same as the settings of C021 to C026 (except those of LOG1 to LOG6, OPO, no) | – |
| 1494h | Logical output signal 1 operator selection | C144 | R/W | 00 (AND), 01 (OR), 02 (XOR) | – |
| 1495h | Logic output signal 2 selection 1 | C145 | R/W | Same as the settings of C021 to C026 (except those of LOG1 to LOG6, OPO, no) | – |
| 1496h | Logic output signal 2 selection 2 | C146 | R/W | Same as the settings of C021 to C026 (except those of LOG1 to LOG6, OPO, no) | – |
| 1497h | Logical output signal 2 operator selection | C147 | R/W | 00 (AND), 01 (OR), 02 (XOR) | – |
| 1498h | Logic output signal 3 selection 1 | C148 | R/W | Same as the settings of C021 to C026 (except those of LOG1 to LOG6, OPO, no) | – |
| 1499h | Logic output signal 3 selection 2 | C149 | R/W | Same as the settings of C021 to C026 (except those of LOG1 to LOG6, OPO, no) | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|------------------------------|-----------------|
| 149Ah | Logical output signal 3 operator selection | C150 | R/W | 00 (AND), 01 (OR), 02 (XOR) | – |
| 149Bh to 14A3h | (Reserved) | – | – | – | – |
| 14A4h | Input terminal response time 1 | C160 | R/W | 0 to 200 | |
| 14A5h | Input terminal response time 2 | C161 | R/W | 0 to 200 | |
| 14A6h | Input terminal response time 3 | C162 | R/W | 0 to 200 | |
| 14A7h | Input terminal response time 4 | C163 | R/W | 0 to 200 | |
| 14A8h | Input terminal response time 5 | C164 | R/W | 0 to 200 | |
| 14A9h | Input terminal response time 6 | C165 | R/W | 0 to 200 | |
| 14AAh | Input terminal response time 7 | C166 | R/W | 0 to 200 | |
| 14ABh to 14ACh | (Reserved) | – | – | – | |
| 14ADh | Multi-step speed/position determination time | C169 | R/W | 0 to 200 | |
| 14A4h to 1500h | unused | – | – | Inaccessible | – |

Parameter group H

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|---|---------------------|
| 1501h | Auto-tuning selection | H001 | R/W | 00 (disabled), 01 (stop), 02 (rotation) | – |
| 1502h | Motor parameter selection | H002 | R/W | 00 (Standard motor parameter), 02 (auto-tuning parameter) | – |
| 1503h | Motor capacity selection | H003 | R/W | 00 (0.1kW) - 15 (18.5kW) | – |
| 1504h | Motor pole number selection | H004 | R/W | 2/4/6/8/10/12/14/16/18/20/22/24/26/28/30/32/34/36/38/40/42/44/46/48 | – |
| 1505h | (Reserved) | – | – | – | – |
| 1506h | Speed response | H005 | R/W | 1 to 1000 | 1[%] |
| 1507h | Stabilization parameter | H006 | R/W | 0 to 255 | 1 |
| 1508h to 1514h | (Reserved) | – | – | – | – |
| 1516h | Motor parameter R1 | H020 | R/W | 1 to 65530 | 0.001 [O] |
| 1517h | (Reserved) | – | – | – | – |
| 1518h | Motor parameter R2 | H021 | R/W | 1 to 65530 | 0.001 [O] |
| 1519h | (Reserved) | – | – | – | – |
| 151Ah | Motor parameter L | H022 | R/W | 1 to 65530 | 0.01 [mH] |
| 151Bh | (Reserved) | – | – | – | – |
| 151Ch | Motor parameter Io | H023 | R/W | 1 to 65530 | 0.01 [A] |
| 151Dh | Motor parameter J | H024 (high) | R/W | 1 to 9999000 | 0.001 |
| 151Eh | | H024 (low) | R/W | | |
| 151Hf to 1524h | (Reserved) | – | – | – | – |
| 1525h | Motor parameter R1 (auto-tuning data) | H030 | R/W | 1 to 65530 | 0.001 [O] |
| 1526h | (Reserved) | – | – | Inaccessible | – |
| 1527h | Motor parameter R2 (auto-tuning data) | H031 | R/W | 1 to 65530 | 0.001 [O] |
| 1528h | (Reserved) | – | – | – | – |
| 1529h | Motor parameter L (auto-tuning data) | H032 | R/W | 1 to 65530 | 0.01 [mH] |
| 152Ah | (Reserved) | – | – | Inaccessible | – |
| 152Bh | Motor parameter Io (auto-tuning data) | H033 | R/W | 1 to 65530 | 0.01 [A] |
| 152Ch | Motor parameter J (auto-tuning data) | H034 (high) | R/W | 1 to 9999000 | 0.001 |
| 152Dh | | H034 (low) | R/W | | |
| 152Eh to 153Ch | (Reserved) | – | – | – | – |
| 153Dh | Slip compensation P gain for V/f control with FB | H050 | R/W | 0 to 10000 | 0.1 |
| 153Eh | Slip compensation I gain for V/f control with FB | H051 | R/W | 0 to 10000 | 1 |
| 1571h | PM motor code selection | H102 | R/W | 00 Standard motor parameter 02 Auto-tuning parameter | – |
| 1572h | PM motor capacity | H103 | R/W | 0.10 to 18.50 | – |
| 1573h | PM motor pole number selection | H104 | R/W | 2/4/6/8/10/12/14/16/18/20/22/24/26/28/30/32/34/36/38/40/42/44/46/48 poles | – |
| 1574h | PM rated current | H105 | R/W | 0.00 x Rated current to 1.60 x Rated current | 0.01 [A] |
| 1575h | PM parameter R | H106 | R/W | 0.001 to 65.535 Ω | 0.001 [Ω] |
| 1576h | PM parameter Ld | H107 | | 0.01 to 655.35 mH | 0.01 [mH] |
| 1577h | PM parameter Lq | H108 | | 0.01 to 655.35 mH | 0.01 [mH] |
| 1578h | PM parameter Ke | H109 | | 0.0001 to 6.5535 Vp/(rad/s) | 0.0001 [Vp/(rad/s)] |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|------------------------------------|---------------|-----|------------------------------------|----------------------------|
| 1579h to 157Ah | PM parameter J | H110 | | 0.001 - 9999.000 kg/m ² | 0.001 [kg/m ²] |
| 157Bh | PM parameter R (auto-tuning data) | H111 | | 0.001 to 65.535 Ω | 0.001 [Ω] |
| 157Ch | PM parameter Ld (auto-tuning data) | H112 | | 0.01 to 655.35 mH | 0.01 [mH] |
| 157Dh | PM parameter Lq (auto-tuning data) | H113 | | 0.01 to 655.35 mH | 0.01 [mH] |
| 1581h | PM speed response | H116 | | 1 to 1000 | – |
| 1582h | PM starting current | H117 | | 20.00 to 100.00% | – |
| 1583h | PM starting time | H118 | | 0.01 to 60.00 s | 0.01 [s] |
| 1584h | PM stabilization constant | H119 | | 0 to 120% | – |
| 1586h | PM minimum frequency | H121 | | 0.0 to 25.5% | – |
| 1587h | PM No-Load current | H122 | | 0.00 to 100.00% | – |
| 1588h | PM starting method | H123 | | 00 Normal 01 IMPE | – |
| 158Ah | PM IMPE 0V wait | H131 | | 0 to 255 | – |
| 158Bh | PM IMPE detect wait | H132 | | 0 to 255 | – |
| 158Ch | PM IMPE detect | H133 | | 0 to 255 | – |
| 158Dh | PM IMPE voltage gain | H134 | | 0 to 200 | – |
| 158Eh to 1600h | unused | – | – | Inaccessible | – |

Parameter group P

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|--|-----------------|
| 1601h | Operation selection at option 1 error | P001 | R/W | 00 (trip), 01 (continues operation) | – |
| 1602h | (Reserved) | – | – | – | – |
| 1603h | EA terminal selection | P003 | R/W | 00 (FQ set), 01 (Encoder FB), 02 (EzSQ) | |
| 1604h | Pulse train input mode for feedback | P004 | R/W | 00 (Single ph.), 01 (2 ph.1), 02 (2 ph.2), 03 (Single+Dir) | |
| 1605h to 160Ah | (Reserved) | – | – | – | – |
| 160Bh | Encoder pulses | P011 | R/W | 32 to 1024 | 1 |
| 160Ch | Simple positioning selection | P012 | R/W | 00 (OFF), 02 (ON) | – |
| 160Dh to 160Eh | (Reserved) | – | – | – | – |
| 160Fh | Creep speed | P015 | R/W | “start frequency” to 1000 | 0.01 [Hz] |
| 1610h | (Reserved) | – | – | – | – |
| 1611h | Positioning range | P017 | R/W | 0 to 10000 | pulses |
| 1612h to 1619h | (Reserved) | – | – | – | – |
| 161Ah | Over-speed error detection level | P026 | R/W | 0 to 1500 | 0.1 [%] |
| 161Bh | Speed deviation error detection level | P027 | R/W | 0 to 12000 | 0.01 [Hz] |
| 161Ch to 161Eh | (Reserved) | – | – | – | – |
| 161Fh | Acceleration/deceleration time input type | P031 | R/W | 00 (digital operator), 03 (drive programming) | – |
| 1620h | (Reserved) | – | – | – | – |
| 1621h | Torque reference input selection | P033 | R/W | 00 (terminal O), 01 (terminal OI), 03 (digital operator), 06 (Option 1) | – |
| 1622h | Torque reference setting | P034 | R/W | 0 to 200 | 1 [%] |
| 1623h | (Reserved) | – | – | – | – |
| 1624h | Torque bias mode | P036 | R/W | 00 (none), 01 (digital operator), 05 (option 1) | – |
| 1625h | Torque bias value | P037 | R/W | -200 to +200 | 1 [%] |
| 1626h | Torque bias polarity selection | P038 | R/W | 00 (signed), 01 (depends on the run direction) | – |
| 1627h | Speed limit value in torque control (forward) | P039 (high) | R/W | 0 to 12000 | 0.01 [Hz] |
| 1628h | | P039 (low) | R/W | | |
| 1629h | Speed limit value in torque control (reverse) | P040 (high) | R/W | 0 to 12000 | 0.01 [Hz] |
| 162Ah | | P040 (low) | R/W | | |
| 162Bh | Speed / torque control switching time | P041 | R/W | 0 to 1000 | – |
| 162Ch to 162Dh | (Reserved) | – | – | – | – |
| 162Eh | Network comm. Watchdog timer | P044 | R/W | 0 to 9999 | 0.01 [sec.] |
| 162Fh | Operation setting at communications error | P045 | R/W | 00 (trip), 01 (trip after deceleration stop), 02 (ignore), 03 (free RUN), 04 (deceleration stop) | – |
| 1630h | Instance number | P046 | R/W | 0-20 | – |
| 1631h | (Reserved) | – | – | – | – |
| 1632h | Operation setting at idle mode detection | P048 | R/W | 00 (trip), 01 (trip after deceleration stop), 02 (ignore), 03 (free RUN), 04 (deceleration stop) | – |
| 1633h | Polarity setting for rotation speed | P049 | R/W | 2/4/6/8/10/12/14/16/18/20/22/24/26/28/30/32/34/36/38/40/42/44/46/48 | – |
| 1634h to 1638h | (Reserved) | – | – | – | – |
| 1639h | Pulse train frequency scale | P055 | R/W | 10 to 320 (input frequency corresponding to the allowable maximum frequency) | 0.1 [kHz] |
| 163Ah | Pulse train frequency filter time constant | P056 | R/W | 1 to 200 | 0.01 [sec.] |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|----------------------------------|-----------------|
| 163Bh | Pulse train frequency bias amount | P057 | R/W | -100 to +100 | 1 [%] |
| 163Ch | Pulse train frequency limit | P058 | R/W | 0 to 100 | 1 [%] |
| 163Dh | Pulse input lower cut | P059 | R/W | 0.01 to 20.00 | 0.01 [%] |
| 163Eh | Multi-step position command 0 | P060(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 163Fh | | P060(LOW) | R/W | | |
| 1640h | Multi-step position command 1 | P061(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 1641h | | P061(LOW) | R/W | | |
| 1642h | Multi-step position command 2 | P062(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 1643h | | P062(LOW) | R/W | | |
| 1644h | Multi-step position command 3 | P063(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 1645h | | P063(LOW) | R/W | | |
| 1646h | Multi-step position command 4 | P064(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 1647h | | P064(LOW) | R/W | | |
| 1648h | Multi-step position command 5 | P065(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 1649h | | P065(LOW) | R/W | | |
| 164Ah | Multi-step position command 6 | P066(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 164Bh | | P066(LOW) | R/W | | |
| 164Ch | Multi-step position command 7 | P067(HIGH) | R/W | -268435455 to 268435455 | 1 |
| 164Dh | | P067(LOW) | R/W | | |
| 164Eh | Zero return mode | P068 | R/W | 00 (Low speed) / 01 (High speed) | |
| 164Fh | Zero return direction selection | P069 | R/W | 00 (FW) / 01 (RV) | |
| 1650h | Low-speed zero return frequency | P070 | R/W | 0 to 1000 | |
| 1651h | High-speed zero return frequency | P071 | R/W | 0 to 40000 | |
| 1652h | Position range specification (forward) | P072(HIGH) | R/W | 0 to 268435455 | 1 |
| 1653h | | P072(LOW) | R/W | | |
| 1654h | Position range specification (reverse) | P073(HIGH) | R/W | -268435455 to 0 | 1 |
| 1655h | | P073(LOW) | R/W | | |
| 1656h | (Reserved) | – | – | – | – |
| 1657h | Positioning mode | P075 | R/W | 00...Limit 01...No limit | – |
| 1658h | (Reserved) | – | – | – | – |
| 1659h | Encoder disconnection timeout | P077 | R/W | 0 to 100 | 0.1[sec.] |
| 165Ah to 165Bh | (Reserved) | – | – | – | – |
| 165Ch | Position restarting range | P080 | R/W | 0 to 10000 | pulses |
| 165Dh | Save position at power off | P081 | R/W | 00...OFF 01...ON | – |
| 165Eh | Curnt pos at poff | P082 | R/W | -268435455 to 268435455 | 1 |
| 165Fh | (Reserved) | – | – | – | – |
| 1660h | Preset position data | P083 | R/W | -268435455 to 268435455 | 1 |
| 1661h to 1665h | (Reserved) | – | – | – | – |
| 1666h | Drive Program parameter U(00) | P100 | R/W | 0 to 65535 | 1 |
| 1667h | Drive Program parameter U(01) | P101 | R/W | 0 to 65535 | 1 |
| 1668h | Drive Program parameter U(02) | P102 | R/W | 0 to 65535 | 1 |
| 1669h | Drive Program parameter U(03) | P103 | R/W | 0 to 65535 | 1 |
| 166Ah | Drive Program parameter U(04) | P104 | R/W | 0 to 65535 | 1 |
| 166Bh | Drive Program parameter U(05) | P105 | R/W | 0 to 65535 | 1 |
| 166Ch | Drive Program parameter U(06) | P106 | R/W | 0 to 65535 | 1 |
| 166Dh | Drive Program parameter U(07) | P107 | R/W | 0 to 65535 | 1 |
| 166Eh | Drive Program parameter U(08) | P108 | R/W | 0 to 65535 | 1 |
| 166Fh | Drive Program parameter U(09) | P109 | R/W | 0 to 65535 | 1 |
| 1670h | Drive Program parameter U(10) | P110 | R/W | 0 to 65535 | 1 |
| 1671h | Drive Program parameter U(11) | P111 | R/W | 0 to 65535 | 1 |
| 1672h | Drive Program parameter U(12) | P112 | R/W | 0 to 65535 | 1 |
| 1673h | Drive Program parameter U(13) | P113 | R/W | 0 to 65535 | 1 |
| 1674h | Drive Program parameter U(14) | P114 | R/W | 0 to 65535 | 1 |
| 1675h | Drive Program parameter U(15) | P115 | R/W | 0 to 65535 | 1 |
| 1676h | Drive Program parameter U(16) | P116 | R/W | 0 to 65535 | 1 |
| 1677h | Drive Program parameter U(17) | P117 | R/W | 0 to 65535 | 1 |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|-------------------------------|---------------|-----|---|-----------------|
| 1678h | Drive Program parameter U(18) | P118 | R/W | 0 to 65535 | 1 |
| 1679h | Drive Program parameter U(19) | P119 | R/W | 0 to 65535 | 1 |
| 167Ah | Drive Program parameter U(20) | P120 | R/W | 0 to 65535 | 1 |
| 167Bh | Drive Program parameter U(21) | P121 | R/W | 0 to 65535 | 1 |
| 167Ch | Drive Program parameter U(22) | P122 | R/W | 0 to 65535 | 1 |
| 167Dh | Drive Program parameter U(23) | P123 | R/W | 0 to 65535 | 1 |
| 167Eh | Drive Program parameter U(24) | P124 | R/W | 0 to 65535 | 1 |
| 167Fh | Drive Program parameter U(25) | P125 | R/W | 0 to 65535 | 1 |
| 1680h | Drive Program parameter U(26) | P126 | R/W | 0 to 65535 | 1 |
| 1681h | Drive Program parameter U(27) | P127 | R/W | 0 to 65535 | 1 |
| 1682h | Drive Program parameter U(28) | P128 | R/W | 0 to 65535 | 1 |
| 1683h | Drive Program parameter U(29) | P129 | R/W | 0 to 65535 | 1 |
| 1684h | Drive Program parameter U(30) | P130 | R/W | 0 to 65535 | 1 |
| 1685h | Drive Program parameter U(31) | P131 | R/W | 0 to 65535 | 1 |
| 1686h to 168Dh | (Reserved) | — | — | — | — |
| 168Eh | EzCOM number of data | P140 | R/W | 1 to 5 | — |
| 168Fh | EzCOM destination 1 address | P141 | R/W | 1 to 247 | — |
| 1690h | EzCOM destination 1 register | P142 | R/W | 0000 to FFFF | — |
| 1691h | EzCOM source 1 register | P143 | R/W | 0000 to FFFF | — |
| 1692h | EzCOM destination 2 address | P144 | R/W | 1 to 247 | — |
| 1693h | EzCOM destination 2 register | P145 | R/W | 0000 to FFFF | — |
| 1694h | EzCOM source 2 register | P146 | R/W | 0000 to FFFF | — |
| 1695h | EzCOM destination 3 address | P147 | R/W | 1 to 247 | — |
| 1696h | EzCOM destination 3 register | P148 | R/W | 0000 to FFFF | — |
| 1697h | EzCOM source 3 register | P149 | R/W | 0000 to FFFF | — |
| 1698h | EzCOM destination 4 address | P150 | R/W | 1 to 247 | — |
| 1699h | EzCOM destination 4 register | P151 | R/W | 0000 to FFFF | — |
| 169Ah | EzCOM source 4 register | P152 | R/W | 0000 to FFFF | — |
| 169Bh | EzCOM destination 5 address | P153 | R/W | 1 to 247 | — |
| 169Ch | EzCOM destination 5 register | P154 | R/W | 0000 to FFFF | — |
| 169Dh | EzCOM source 5 register | P155 | R/W | 0000 to FFFF | — |
| 169Eh~16A1h | (Reserved) | — | — | — | — |
| 16A2h | Option I/F cmd W register 1 | P160 | R/W | 0000 to FFFF | — |
| 16A3h | Option I/F cmd W register 2 | P161 | R/W | 0000 to FFFF | — |
| 16A4h | Option I/F cmd W register 3 | P162 | R/W | 0000 to FFFF | — |
| 16A5h | Option I/F cmd W register 4 | P163 | R/W | 0000 to FFFF | — |
| 16A6h | Option I/F cmd W register 5 | P164 | R/W | 0000 to FFFF | — |
| 16A7h | Option I/F cmd W register 6 | P165 | R/W | 0000 to FFFF | — |
| 16A8h | Option I/F cmd W register 7 | P166 | R/W | 0000 to FFFF | — |
| 16A9h | Option I/F cmd W register 8 | P167 | R/W | 0000 to FFFF | — |
| 16AAh | Option I/F cmd W register 9 | P168 | R/W | 0000 to FFFF | — |
| 16ABh | Option I/F cmd W register 10 | P169 | R/W | 0000 to FFFF | — |
| 16ACh | Option I/F cmd R register 1 | P170 | R/W | 0000 to FFFF | — |
| 16ADh | Option I/F cmd R register 2 | P171 | R/W | 0000 to FFFF | — |
| 16AEh | Option I/F cmd R register 3 | P172 | R/W | 0000 to FFFF | — |
| 16AFh | Option I/F cmd R register 4 | P173 | R/W | 0000 to FFFF | — |
| 16B0h | Option I/F cmd R register 5 | P174 | R/W | 0000 to FFFF | — |
| 16B1h | Option I/F cmd R register 6 | P175 | R/W | 0000 to FFFF | — |
| 16B2h | Option I/F cmd R register 7 | P176 | R/W | 0000 to FFFF | — |
| 16B3h | Option I/F cmd R register 8 | P177 | R/W | 0000 to FFFF | — |
| 16B4h | Option I/F cmd R register 9 | P178 | R/W | 0000 to FFFF | — |
| 16B5h | Option I/F cmd R register 10 | P179 | R/W | 0000 to FFFF | — |
| 16B6h | Profibus node address | P180 | R/W | 0 to 125 | — |
| 16B7h | Profibus clear mode | P181 | R/W | 00 (clear)/ 01 (last value) | — |
| 16B8h | Profibus map selection | P182 | R/W | 00 (PPO)/ 01 (Conventional)/ 02 (Flexible mode) | — |
| 16B9h to 16BAh | (Reserved) | — | — | — | — |
| 16BBh | CANopen node address | P185 | R/W | 0 to 127 | — |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|------------------------------|---------------|-----|--|-----------------|
| 16BCh | CAN open communication speed | P186 | R/W | 00 (auto) 05 (250kbps) 01 (10kbps) 06 (500kbps) 02 (20kbps) 07 (800kbps) 03 (50kbps) 08 (1Mbps) 04 (125kbps) | – |
| 16BDh to 16BFh | Unused | – | – | – | – |
| 16C0h | CompoNet node address | P190 | R/W | 0 to 63 | – |
| 16C2h | DeviceNet node address | P192 | R/W | 0 to 63 | – |
| 16C3h to 16C7h | Unused | – | – | – | – |
| 16C8h | Serial comms mode | P200 | R/W | 00...Standard 01...Free mapping | – |
| 16C9h | Modbus external register 1 | P201 | R/W | 0000 to FFFF | – |
| 16CAh | Modbus external register 2 | P202 | R/W | 0000 to FFFF | – |
| 16CBh | Modbus external register 3 | P203 | R/W | 0000 to FFFF | – |
| 16CCh | Modbus external register 4 | P204 | R/W | 0000 to FFFF | – |
| 16CDh | Modbus external register 5 | P205 | R/W | 0000 to FFFF | – |
| 16CEh | Modbus external register 6 | P206 | R/W | 0000 to FFFF | – |
| 16CFh | Modbus external register 7 | P207 | R/W | 0000 to FFFF | – |
| 16D0h | Modbus external register 8 | P208 | R/W | 0000 to FFFF | – |
| 16D1h | Modbus external register 9 | P209 | R/W | 0000 to FFFF | – |
| 16D2h | Modbus external register 10 | P210 | R/W | 0000 to FFFF | – |
| 16D3h | Modbus register format 1 | P211 | R/W | 00...Unsigned 01...Signed | – |
| 16D4h | Modbus register format 2 | P212 | R/W | 00...Unsigned 01...Signed | – |
| 16D5h | Modbus register format 3 | P213 | R/W | 00...Unsigned 01...Signed | – |
| 16D6h | Modbus register format 4 | P214 | R/W | 00...Unsigned 01...Signed | – |
| 16D7h | Modbus register format 5 | P215 | R/W | 00...Unsigned 01...Signed | – |
| 16D8h | Modbus register format 6 | P216 | R/W | 00...Unsigned 01...Signed | – |
| 16D9h | Modbus register format 7 | P217 | R/W | 00...Unsigned 01...Signed | – |
| 16DAh | Modbus register format 8 | P218 | R/W | 00...Unsigned 01...Signed | – |
| 16DBh | Modbus register format 9 | P219 | R/W | 00...Unsigned 01...Signed | – |
| 16DCh | Modbus register format 10 | P220 | R/W | 00...Unsigned 01...Signed | – |
| 16DDh | Modbus register scaling 1 | P221 | R/W | 0.001 to 65.535 | 0.001 |
| 16DEh | Modbus register scaling 2 | P222 | R/W | 0.001 to 65.535 | 0.001 |
| 16DFh | Modbus register scaling 3 | P223 | R/W | 0.001 to 65.535 | 0.001 |
| 16E0h | Modbus register scaling 4 | P224 | R/W | 0.001 to 65.535 | 0.001 |
| 16E1h | Modbus register scaling 5 | P225 | R/W | 0.001 to 65.535 | 0.001 |
| 16E2h | Modbus register scaling 6 | P226 | R/W | 0.001 to 65.535 | 0.001 |
| 16E3h | Modbus register scaling 7 | P227 | R/W | 0.001 to 65.535 | 0.001 |
| 16E4h | Modbus register scaling 8 | P228 | R/W | 0.001 to 65.535 | 0.001 |
| 16E5h | Modbus register scaling 9 | P229 | R/W | 0.001 to 65.535 | 0.001 |
| 16E6h | Modbus register scaling 10 | P230 | R/W | 0.001 to 65.535 | 0.001 |
| 16E7h | Modbus internal register 1 | P301 | R/W | 0000 to FFFF | – |
| 16E8h | Modbus internal register 2 | P302 | R/W | 0000 to FFFF | – |
| 16E9h | Modbus internal register 3 | P303 | R/W | 0000 to FFFF | – |
| 16EAh | Modbus internal register 4 | P304 | R/W | 0000 to FFFF | – |
| 16EBh | Modbus internal register 5 | P305 | R/W | 0000 to FFFF | – |
| 16ECh | Modbus internal register 6 | P306 | R/W | 0000 to FFFF | – |
| 16EDh | Modbus internal register 7 | P307 | R/W | 0000 to FFFF | – |
| 16EEh | Modbus internal register 8 | P308 | R/W | 0000 to FFFF | – |
| 16EFh | Modbus internal register 9 | P309 | R/W | 0000 to FFFF | – |
| 16F0h | Modbus internal register 10 | P310 | R/W | 0000 to FFFF | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|-----------------------------|---------------|-----|---|-----------------|
| 16F1h | Big/Little endian selection | P400 | R/W | 00...Big endian 01...Little endian 02...Special endian | — |
| 16F2 to 1E00h | Unused | — | — | — | — |
| 1E01h | Coil data 1 | — | R/W | 2 ¹ : coil number 0010h - 2 ¹⁵ : coil number 001Fh - | — |
| 1E02h | Coil data 2 | — | R/W | 2 ¹ : coil number 0020h - 2 ¹⁵ : coil number 002Fh - | — |
| 1E03h | Coil data 3 | — | R/W | 2 ¹ : coil number 0030h - 2 ¹⁵ : coil number 003Fh - | — |
| 1E04h | Coil data 4 | — | R/W | 2 ¹ : coil number 0030h - 2 ¹⁵ : coil number 003Fh - | — |
| 1E05h | Coil data 5 | — | R/W | 2 ¹ : coil number 0040h - 2 ¹⁵ : coil number 004Fh - | — |
| 1E06h to 1F18h | (reserved) | — | — | — | — |
| 1E19h to 1F00h | Unused | — | — | — | — |
| 1F01h | Coil data 0 | — | R/W | 2 ¹ : coil number 0001h - 2 ¹⁵ : coil number 000Fh - | — |
| 1F02h to 1F1Dh | (reserved) | — | — | (note: 2) | — |
| 1F1Eh to 2102h | Unused | — | — | Inaccessible | — |

Note 1 Above register (coil data 0 to 5) is consisted with 16 coil data. EzCOM communication (inverter to inverter) doesn't support coil, but only register is supported, in case of need to access coil, please use above registers.

Note 2 Be sure not to write into above 1F02h to 1F1Dh.

(vi) List of registers (2nd control settings)

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|-------------------------|---------------|-----|------------------------------|-----------------|
| 2103h | 2nd acceleration time 1 | F202 (high) | R/W | 1 to 360000 | 0.01 [sec.] |
| 2104h | | F202 (low) | R/W | | |
| 2105h | 2nd deceleration time 1 | F203 (high) | R/W | 1 to 360000 | 0.01 [sec.] |
| 2106h | | F203 (low) | R/W | | |
| 2107h to 2200h | unused | – | – | Inaccessible | – |

(vii) List of registers (function modes for the 2nd control settings)

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|--|---------------|-----|--|-----------------|
| 2201h | Frequency reference selection, 2nd motor | A201 | R/W | 00 (digital operator), 01 (terminal), 02 (operator), 03 (Modbus communication), 04 (option), 06 (pulse train frequency), 7 (drive programming), 10 (operation function result) | – |
| 2202h | RUN command selection, 2nd motor | A202 | R/W | 01 (terminal), 02 (operator), 03 (Modbus communication), 04 (option) | – |
| 2203h | 2nd set base frequency | A203 | R/W | 300 to “maximum frequency, 2nd motor” | 0.1 [Hz] |
| 2204h | 2nd maximum frequency | A204 | R/W | 300 to 4000 | 0.1 [Hz] |
| 2205h to 2215h | (Reserved) | – | – | Inaccessible | – |
| 2216h | 2nd multi-step speed reference 0 | A220 (high) | R/W | 0 or “start frequency” to “maximum frequency, 2nd motor” | 0.01 [Hz] |
| 2217h | | A220 (low) | R/W | | |
| 2218h to 223Ah | (Reserved) | – | – | Inaccessible | – |
| 223Bh | 2nd torque boost selection | A241 | R/W | 00 (manual torque boost), 01 (automatic torque boost) | – |
| 223Ch | 2nd torque boost voltage | A242 | R/W | 20 to 200 | 1 [%] |
| 223Dh | 2nd manual torque boost frequency | A243 | R/W | 0 to 50 | 1 [%] |
| 223Eh | 2nd V/f characteristics selection | A244 | R/W | 00 (VC), 01 (VP), 02 (free V/f), 03 (sensorless vector control) | – |
| 223Fh | Output voltage gain, 2nd motor | A245 | R/W | 20 to 100 | 1 [%] |
| 2240h | 2nd automatic torque boost voltage compensation gain | A246 | R/W | 0 to 255 | 1 |
| 2241h | 2nd automatic torque boost slip compensation gain | A247 | R/W | 0 to 255 | 1 |
| 2242h to 224Eh | (Reserved) | – | – | Inaccessible | – |
| 224Fh | 2nd frequency upper limit | A261 (high) | R/W | 00 or “2nd minimum frequency limit” to “maximum frequency, 2nd motor” | 0.01 [Hz] |
| 2250h | | A261 (low) | R/W | | |
| 2251h | 2nd frequency lower limit | A262 (high) | R/W | 00 or “start frequency” to “maximum frequency, 2nd motor limit” | 0.01 [Hz] |
| 2252h | | A262 (low) | R/W | | |
| 2253h to 2268h | (Reserved) | – | – | Inaccessible | – |
| 2269h | AVR selection, 2nd motor | A281 | R/W | 00 (always on), 01 (always off), 02 (off during deceleration) | – |
| 226Ah | AVR voltage selection, 2nd motor | A282 | R/W | 200 V class: 0 (200)/1 (215)/2 (220)/3 (230)/4 (240) 400 V class: 5 (380)/6 (400)/7 (415)/8 (440)/9 (460)/10 (480) | – |
| 226Bh to 226Eh | (Reserved) | – | – | Inaccessible | – |
| 226Fh | 2nd acceleration time 2 | A292 (high) | R/W | 1 to 360000 | 0.01 [sec.] |
| 2270h | | A292 (low) | R/W | | |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|----------------|---|---------------|-----|--|-----------------|
| 2271h | 2nd deceleration time 2 | A293 (high) | R/W | 1 to 360000 | 0.01 [sec.] |
| 2272h | | A293 (low) | R/W | | |
| 2273h | Select method to switch to Acc2/Dec2 profile, 2nd motor | A294 | R/W | 00 (switching by 2CH terminal), 01 (switching by setting), 02 (switching only when the rotation is forward/reversed) | – |
| 2274h | Acc1 to Acc2 frequency transition point, 2nd motor | A295 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 2275h | | A295 (low) | R/W | | |
| 2276h | Dec1 to Dec2 frequency transition point, 2nd motor | A296 (high) | R/W | 0 to 40000 | 0.01 [Hz] |
| 2277h | | A296 (low) | R/W | | |
| 2278h to 230Bh | (Reserved) | – | – | – | – |
| 230Ch | 2nd electronic thermal level | b212 | R/W | 0.20 x Rated current to 1.00 x Rated current | 0.1 [%] |
| 230Dh | 2nd electronic thermal characteristics selection | b213 | R/W | 00 (reduced TRQ), 01 (constant torque characteristics), 02 (free setting) | – |
| 230Eh to 2315h | (Reserved) | – | – | – | – |
| 2316h | Overload limit selection, 2nd motor | b221 | R/W | 00 (disabling), 01 (enabling during acceleration and constant-speed operation), 02 (enabling during constant-speed operation), 03 (enabling during acceleration and constant-speed operation [speed increase at regeneration]) | – |
| 2317h | Overload limit level, 2nd motor | b222 | R/W | 100 to 2000 | 0.1[%] |
| 2318h | Overload limit parameter, 2nd motor | b223 | R/W | 1 to 30000 | 0.1[?] |
| 2319h to 2428h | unused | – | – | Inaccessible | – |
| 2429h | Overload warning level 2, 2nd motor | C241 | R/W | 0 to 2000 | 0.1[%] |
| 242Ah to 2501h | Unused | – | – | Inaccessible | – |
| 2502h | 2nd motor parameter selection | H202 | R/W | 00 (standard motor parameter), 02 (auto-tuning parameter) | – |
| 2503h | 2nd motor capacity selection | H203 | R/W | 00 (0.1kW) - 15 (18.5kW) | – |
| 2504h | 2nd motor pole number selection | H204 | R/W | 2/4/6/8/10/12/14/16/18/20/22/24/26/28/30/32/34/36/38/40/42/44/46/48 | – |
| 2505h | 2nd speed response | H205 | R/W | 1 to 1000 | 1[%] |
| 2506h | 2nd stabilization parameter | H206 | R/W | 0 to 255 | 1 |
| 2507h | (Reserved) | – | – | – | – |
| 2508h to 2515h | (Reserved) | – | – | – | – |
| 2516h | 2nd motor parameter R1 | H220 (high) | R/W | 1 to 65535 | 0.001 [O] |
| 2517h | (Reserved) | – | – | – | – |
| 2518h | 2nd motor parameter R2 | H221 (high) | R/W | 1 to 65535 | 0.001 [O] |
| 2519h | (Reserved) | – | – | – | – |
| 251Ah | 2nd motor parameter L | H222 (high) | R/W | 1 to 65535 | 0.01 [mH] |
| 251Bh | (Reserved) | – | – | – | – |
| 251Ch | 2nd motor parameter Io | H223 (high) | R/W | 1 to 65535 | 0.01 [A] |
| 251Dh | 2nd motor parameter J | H224 (high) | R/W | 1 to 9999000 | 0.001 |
| 251Eh | | H224 (low) | R/W | | |
| 251Fh to 2524h | (Reserved) | – | – | – | – |
| 2525h | 2nd motor parameter R1 (auto-tuning data) | H230 (high) | R/W | 1 to 65530 | 0.001 [O] |
| 2526h | (Reserved) | – | – | – | – |

| Register No. | Function name | Function code | R/W | Monitoring and setting items | Data resolution |
|--------------|---|---------------|-----|------------------------------|-----------------|
| 2527h | 2nd motor parameter R2 (auto-tuning data) | H231 (high) | R/W | 1 to 65530 | 0.001 [O] |
| 2528h | (Reserved) | – | – | – | – |
| 2529h | 2nd motor parameter L (auto-tuning data) | H232 (high) | R/W | 1 to 65530 | 0.01 [mH] |
| 252Ah | (Reserved) | – | – | – | – |
| 252Bh | 2nd motor parameter Io (auto-tuning data) | H233 (high) | R/W | 1 to 65530 | 0.01 [A] |
| 252Ch | 2nd motor parameter J (auto-tuning data) | H234 (high) | R/W | 1 to 9999000 | 0.001 |
| 252Dh | | H234 (low) | R/W | | |
| 252Eh ~ | Unused | – | – | Inaccessible | – |

B-5 ModBus mapping

B-5-1 Modbus mapping function

B-5-1-1 Functional outline

An existing register number is allocated in an arbitrary register number.
The list of the communication that can use this function is shown below.

| No. | Communication |
|-----|----------------|
| 1 | Option board |
| 2 | Modbus (RS485) |
| 3 | USB |

B-5-1-2 Setting parameter

Setting parameters of Modbus mapping function:

P200 (Serial comms mode): Communication mode selection

P201 to P210 (Modbus external register 1 to 10): External register selection

P211 to P220 (Modbus register format 1 to 10): Format of external register

P221 to P230 (Modbus register scaling 1 to 10): Scaling data

P301 to P310 (Modbus internal register 1 to 10): Internal register selection

The number of set registers is limited to 10.

B-5-1-2-1 P200 (Serial comms mode): Communication mode selection

| Func. Code | Name | Settings | EU |
|------------|-------------------|----------------------------------|----|
| P200 | Serial comms mode | 00: Standard 01: Free mapping | 00 |

00: Standard Modbus registers according with Appendix B-4 list.

01: Free mapping where special registers on parameters P201 to P210 could be used.

When the setting is changed, new configuration will be reflected immediately.
(But only if inverter is not in RUN.)

Please don't access the register relevant to Modbus mapping at the time of P200 data change to avoid unexpected operation.

P201 to P230, P301 to P310: When this parameters are modified is necessary to recycle power supply for this changes to become effective.

B-5-1-2-2 P201-P210 (Modbus external register 1 to 10): External register select

| Func. Code | Name | Settings | EU |
|--------------|----------------------------------|----------------|-------|
| P201 to P210 | Modbus external register 1 to 10 | 0000h to FFFFh | 0000h |

Defines the addresses to be used by the external controller.

0000h is considered as not used.

B-5-1-2-3 P301-P310 (Modbus internal register 1 to 10): Internal register selection

| Func. Code | Name | Settings | EU |
|--------------|----------------------------------|----------------|-------|
| P301 to P310 | Modbus internal register 1 to 10 | 0000h to FFFFh | 0000h |

Defines the internal register address that will be linked to external registers in parameters P201 to P210.

0000h is considered as not used.

Only single word registers could be addressed but some double word registers could be accessed by a single word with limited range. Check next table for details.

| Register No. | R/W | Function name | Data range |
|--------------|-----|---|---|
| 1E21h | R | (d001) Output frequency monitor | 0.00 to 400.00 [Hz] |
| 1E22h | R | (d004) PID feedback value monitor | 0.00 to 10000 |
| 1E23h | R | (d007) Output frequency monitor | 0.00 to 40000.00 |
| 1E24h | R | (d008) Real frequency monitor | -327.68 to 327.68 [Hz] |
| 1E25h | R | (d081) Fault monitor 1 | - |
| 1F31h | R/W | (F001) Output frequency setting/monitor | 0.0 / Start frequency to 655.35 [Hz] |
| 1F32h | R/W | (F002) Acceleration time 1 | 0.00 to 655.35 [sec] |
| 1F33h | R/W | (F003) Deceleration time 1 | 0.00 to 655.35 [sec] |
| 1F34h | R/W | (A020) Multi-step speed reference 0 | 0.00 / Start frequency to 655.35 [Hz] |
| 1F35h | R/W | (A021) Multi-step speed reference 1 | 0.00 / Start frequency to 655.35 [Hz] |
| 1F36h | R/W | (A022) Multi-step speed reference 2 | 0.00 / Start frequency to 655.35 [Hz] |
| 1F37h | R/W | (A023) Multi-step speed reference 3 | 0.00 / Start frequency to 655.35 [Hz] |
| 1F38h | R/W | (A061) Frequency upper limit | 0.00 / Frequency lower limit to 655.35 [Hz] |
| 1F39h | R/W | (A062) Frequency lower limit | 0.00 / Start frequency to 655.35 [Hz] |
| 1F3Ah | R/W | (A069) Acceleration stop frequency | 0.00 to 655.35 [Hz] |
| 1F3Bh | R/W | (A145) Frequency addition amount | 0.00 to 655.35 [Hz] |
| 1F3Ch | R/W | (A154) Deceleration hold frequency | 0.00 to 655.35 [Hz] |
| 1F3Dh | R/W | (A156) PID sleep function action threshold | 0.00 to 655.35 [Hz] |
| 1F3Eh | R/W | (b007) Frequency matching lower limit frequency setting | 0.00 to 655.35 [Hz] |

B-5-1-2-4 P211-P220 (Modbus register format 1 to 10): Format of external register

| Func. Code | Name | Settings | EU |
|--------------|--------------------------------|----------------------------|----|
| P211 to P220 | Modbus register format 1 to 10 | 00: Unsigned 01: Signed | 00 |

This parameters could be used to adjust the user register data. When data is written into the inverter, the sign information from P211 to P220 is used to convert data according to MX2.

Example: External register = “signed” (sign-having), Internal register = “unsigned” (sign-less)

After minus data is converted into the absolute value, data writing is carried out after an upper and lower limit check.

In MX2, since the data is sign-less data, it is read as sign-less data.

Example: External register = “signed” (sign-having), Internal register = “signed” (sign-having)

After an upper lower limit check, data writes minus data as it is.

The sign having data is read.

B-5-1-2-5 P221-P230 (Modbus register scaling 1 to 10): Scaling data

| Func. Code | Name | Settings | EU |
|--------------|---------------------------------|-----------------|-------|
| P221 to P230 | Modbus register scaling 1 to 10 | 0.001 to 65.535 | 1.000 |

Scale the data when reading or writing an external register to an internal one.

A calculation result is restricted to the following range:

Signed: -32768 to 32767

Unsigned: 0 to 65535

B-5-1-3 Error code

These new error codes has been added:

| No. | Code | Explanation |
|-----|------|----------------------------------|
| 1 | 31h | Modbus mapping mismatch |
| 2 | 32h | Access to a duplication register |

| No. | Internal register | External register | Result |
|-----|-----------------------|-----------------------|--------|
| 1 | 0000h (Initial value) | 0001h to FFFFh | Error |
| 2 | 0001h to FFFFh | 0000h (Initial value) | Error |
| 3 | 0001h to FFFFh | 0001h to FFFFh | Normal |

B-5-1-3-1 Register allocation combination checks

When two or more internal registers in which values differ are in the same external register, both are considered incorrect.

In the same way two or more internal registers couldn't be allocated to one external register.

B-5-1-3-2 Overlapped external register

When an external register and retry a existing register overlap, access to the register is not available.

Moreover, when the overlapping existing register is a double word parameter, access of the register used as a pair is also forbidden.

Example:

External register = 1216 (overlaps with higher rank of existing register: 1216h = A020.)

Internal register = 1201h (existing register: 1201h = A001)

Address 1216h will be associated with two parameters, A020 and A001, As this is not possible only the modbus mapping setting is used and it means that neither lower or higher rank of A020 could be accessed.

B-5-1-3-3 Internal register setup

Is not possible to use a double word or a none existing register as internal register.

B-5-1-4 Examples**B-5-1-4-1 When an external register doesn't overlap with an existing register**

P201 = External register: 4001h
P301 = Internal register: 120Fh (A013)
P221 = Scaling: 1.000
P211 = Format: Unsigned
A013 value: 33 (21h)

(1) Read (0x03) / Object register: External register (4001h) Modbus command use register number -1

Transmission: 01 03 **40 00** 00 01 91 CA

Reception: 01 03 02 **00 21** 78 5C

(2) Read (0x03) / Object register: Internal register (120Fh)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **00 21** 78 5C

(3) Write (0x06) / Object register: External register (4001h)

Transmission: 01 06 **40 00 00 30** 9C 1E

Reception: 01 06 **40 00 00 30** 9C 1E

(4) Read (0x03) / Object register: Internal register (120Fh)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **00 30** B8 50

B-5-1-4-2 When external register overlaps with existing register (1 word)

1. P201 = External register: 1201h (A001)
P301 = Internal register: 1210h (A014)
P221 = Scaling: 1.000
P211 = Format: Unsigned

2. P202 = External register: 5001h
P302 = Internal register: 1201h (A001)
P222 = Scaling: 1.000
P212 = Format: Unsigned

A014 value: 100 (64h)

A001 value: 1 (01h)

(1) Read (0x03) / Object register: External register 1 (1201h)

Transmission: 01 03 **12 00** 00 01 81 72

Reception: 01 03 02 **00 64** B9 AF

(2) Read (0x03) / Object register: Internal register 1 (1210h)

Transmission: 01 03 **12 0F** 00 01 B1 71

Reception: 01 03 02 **00 64** B9 AF

(3) Write (0x06) / Object register: External register 1 (1201h)

Transmission: 01 06 **12 00 00 50** 8C 8E

Reception: 01 06 **12 00 00 50** 8C 8E

(4) Read (0x03) / Object register: Internal register 1 (1210h)

Transmission: 01 03 **12 0F** 00 01 B1 71

Reception: 01 03 02 **00 50** B8 78

(5) Read (0x03) / Object register: External register 2 (5001h)

Transmission: 01 03 **50 00** 00 01 95 0A

Reception: 01 03 02 **00 01** 79 84

B-5-1-4-3 When external register overlaps with existing register (2-word higher rank)

P201 = External register: 1218h (A021 (HIGH))

P301 = Internal register: 120Fh (A013)

P221 = Scaling: 1.000

P211 = Format: Unsigned

A013 value: 33 (21h)

(1) Read (0x03) / Object register: External register (1218h)

Transmission: 01 03 **12 17** 00 01 31 76

Reception: 01 03 02 **00 21** 78 5C

(2) Read (0x03) / Object register: Internal register (120Fh)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **00 21** 78 5C

(3) Read (0x03) / Object register: 1219h (A021 (LOW))

Transmission: 01 03 **12 18** 00 01 01 75

Reception: 01 83 **32 C0** E5 (Error 32h: access to duplication register)

(4) Write (0x10) / Object register: 1219h (A021 (LOW))

Transmission: 01 10 **12 18** 00 02 04 00 00 10 00 2A 65

Reception: 01 90 **32 CD** D5 (Error 32h: access to duplication register)

B-5-1-4-4 When an external register overlaps with the existing register (2-word low rank)

P201 = External register: 1217h (A020 (LOW))

P301 = Internal register: 120Fh (A013)

P221 = Scaling: 1.000

P211 = Format: Unsigned

A013 value: 33 (21h)

(1) Read (0x03) / Object register: External register (1217h)

Transmission: 01 03 **12 16** 00 01 60 B6

Reception: 01 03 02 **00 21** 78 5C

(2) Read (0x03) / Object register: Internal register (120Fh)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **00 21** 78 5C

(3) Read (0x03) / Object register: 1216h (A020 (HIGH))

Transmission: 01 03 **12 15** 00 01 90 B6

Reception: 01 83 **32** C0 E5 (Error 32h: access to duplication register)

(4) Write (0x10) / Object register: 1216h (A020 (HIGH))

Transmission: 01 10 **12 15** 00 02 04 **00 00 10 00** EB FC

Reception: 01 90 **32** CD D5 (Error 32h: access to duplication register)

B-5-1-4-5 When internal register is not correct

1. P201 = External register: 6001h

P301 = Internal register: 0000h

P221 = Scaling: 1.000

P211 = Format: Unsigned

2. P202 = External register: 6002h

P302 = Internal register: 1216h (A020 (HIGH))

P222 = Scaling: 1.000

P212 = Format: Unsigned

3. P203 = External register: 6003h

P303 = Internal register: 1217h (A020 (LOW))

P223 = Scaling: 1.000

P213 = Format: Unsigned

4. P204 = External register: 6004h

P304 = Internal register: 12FFh

P224 = Scaling: 1.000

P214 = Format: Unsigned

(1) Read (0x03) / Object register: External register 1 (6001h)
Transmission: 01 03 **60 00** 00 01 9A 0A
Reception: 01 83 **31** 80 E4 (Error 31h: modbus mapping mismatch)

(2) Read (0x03) / Object register: External register 2 (6002h)
Transmission: 01 03 **60 01** 00 01 CB CA
Reception: 01 83 **31** 80 E4 (Error 31h: modbus mapping mismatch)

(3) Read (0x03) / Object register: External register 3 (6003h)
Transmission: 01 03 **60 02** 00 01 3B CA
Reception: 01 83 **31** 80 E4 (Error 31h: modbus mapping mismatch)

(4) Read (0x03) / Object register: External register 4 (6004h)
Transmission: 01 03 **60 03** 00 01 6A 0A
Reception: 01 83 **31** 80 E4 (Error 31h: modbus mapping mismatch)

B-5-1-4-6 When external register is not correct

1. P201 = External register: 6001h
P301 = Internal register: 120Fh (A013)
P221 = Scaling: 1.000
P211 = Format: Unsigned

2. P202 = External register: 6001h
P302 = Internal register: 1210h (A014)
P222 = Scaling: 1.000
P212 = Format: Unsigned

(1) Read (0x03) / Object register: External register (6001h)
Transmission: 01 03 **60 00** 00 01 9A 0A
Reception: 01 83 **31** 80 E4 (Error 31h: modbus mapping mismatch)

B-5-2 Big/Little endian setup

B-5-2-1 Functional outline

It allows to change the message structure of the Modbus, USB and Option communication.

B-5-2-2 Setting parameter

P400 (Big endian / Little endian selection)

| Func. Code | Name | Settings | EU |
|------------|-----------------------------|---|----|
| P400 | Big/Little endian selection | 00: Big endian 01: Little endian 02: Special endian | 00 |

Example:

Word Data = 0x0102, Double Word Data = 0x01020304

Word Data / Endian of Word Data:

| No. | Big endian | Little endian | Special endian |
|-----|------------|---------------|----------------|
| 1 | 01 | 02 | 01 |
| 2 | 02 | 01 | 02 |

Double Word Data / Endian of Double Word Data

| No. | Big endian | Little endian | Special endian |
|-----|------------|---------------|----------------|
| 1 | 01 | 04 | 03 |
| 2 | 02 | 03 | 04 |
| 3 | 03 | 02 | 01 |
| 4 | 04 | 01 | 02 |

Note The software tool will not operate if modified.

B-5-2-3 Coverage of endian

Endian is applied only to the register data.

It is not applied to the coil and the register number, etc.

B-5-2-4 Parameter enable

P400: Changes on this parameter becomes effective at power ON or after a reset.

B-5-2-5 Communication command that can be used by this function

The list of the communication that can use this function are shown below.

Modbus communication command (RS485, USB)

| No. | Modbus function code | Function name |
|-----|----------------------|-------------------------------|
| 1 | 03h | Read Holding Register |
| 2 | 06h | Write Single Register |
| 3 | 10h | Write Multiple Registers |
| 4 | 17h | Read/Write Multiple Registers |

B-5-2-6 Examples**B-5-2-6-1 Big endian**

A013 = Register number: 120Fh

Value: 33 (21h)

F002 = Register number: 1103h

Value: 360000 (57E40h)

(1) Read (0x03) / Object register: 120Fh (A013)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **00 21** 78 5C

(2) Read (0x03) / Object register: 1103h (F002)

Transmission: 01 03 **11 02** 00 02 60 F7

Reception: 01 03 04 **00 05 7E 40** CA 62

(3) Write (0x06) / Object register: 120Fh (A013) / Write data: 100 (64h)

Transmission: 01 06 **12 0E 00 64** EC 9A

Reception: 01 06 **12 0E 00 64** EC 9A

(4) Write (0x10) / Object register: 1103h (F002) / Write data: 74565 (12345h)

Transmission: 01 10 **11 02** 00 02 04 **00 01 23 45** 3B 25

Reception: 01 10 **11 02** 00 02 E5 34

B-5-2-6-2 Little endian

A013 = Register number: 120Fh

Value: 33 (21h)

F002 = Register number: 1103h

Value: 360000 (57E40h)

(1) Read (0x03) / Object register: 120Fh (A013)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **21 00** A0 14

(2) Read (0x03) / Object register: 1103h (F002)

Transmission: 01 03 **11 02** 00 02 60 F7

Reception: 01 03 04 **40 7E 05 00** 8C BB

(3) Write (0x06) / Object register: 120Fh (A013) / Write data: 100 (64h)

Transmission: 01 06 **12 0E 64 00** C7 B1

Reception: 01 06 **12 0E 64 00** C7 B1

(4) Write (0x10) / Object register: 1103h (F002) / Write data: 74565 (12345h)

Transmission: 01 10 **11 02** 00 02 04 **45 23 01 00** 57 70

Reception: 01 10 **11 02** 00 02 E5 34

B-5-2-6-3 Special endian

A013 = Register number: 120Fh

Value: 33 (21h)

F002 = Register number: 1103h

Value: 360000 (57E40h)

(1) Read (0x03) / Object register: 120Fh (A013)

Transmission: 01 03 **12 0E** 00 01 E0 B1

Reception: 01 03 02 **00 21** 78 5C

(2) Read (0x03) / Object register: 1103h (F002)

Transmission: 01 03 **11 02** 00 02 60 F7

Reception: 01 03 04 **7E 40 00 05** 23 CC

(3) Write (0x06) / Object register: 120Fh (A013) / Write data: 100 (64h)

Transmission: 01 06 **12 0E 00 64** EC 9A

Reception: 01 06 **12 0E 00 64** EC 9A

(4) Write (0x10) / Object register: 1103h (F002) / Write data: 74565 (12345h)

Transmission: 01 10 **11 02 00 02 04 23 45 00 01** 69 B7

Reception: 01 10 **11 02 00 02** E5 34

Appendix C

Drive Parameter Setting Tables

C-1 Introduction

This appendix lists the user-programmable parameters for the MX2 series inverters and the default values for European and U.S. product types. The right-most column of the tables is blank, so you can record values you have changed from the default. This involves just a few parameters for most applications. This appendix presents the parameters in a format oriented toward the keypad on the inverter.

C-2 Parameter Settings for Keypad Entry

MX2 series inverters provide many functions and parameters that can be configured by the user. We recommend that you record all parameters that have been edited, in order to help in troubleshooting or recovery from a loss of parameter data.

| | | | | |
|----------------|-----|--|---|--|
| Inverter model | MX2 | | } | This information is printed on the specification label located on the right side of the inverter |
| MFG. No. | | | | |

C-2-1 Main Profile Parameters

Note Mark “✓” in b031=10 shows the accessible parameters when b031 is set “10”, high level access.

| “F” Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---------------------------------------|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| F001 | Output frequency setting/monitor | 0.00 | ✓ | |
| F002 | Acceleration time 1 | 10.00 | ✓ | |
| F202 | 2nd Acceleration time 1 | 10.00 | ✓ | |
| F003 | Deceleration time 1 | 10.00 | ✓ | |
| F203 | 2nd Deceleration time 1 | 10.00 | ✓ | |
| F004 | Operator rotation direction selection | 00 | ✕ | |

C-2-2 Standard Functions

Note Mark “✓” in b031=10 shows the accessible parameters when b031 is set “10”, high level access.

| “A” Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|--|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| A001 | Frequency reference selection | 01 | x | |
| A201 | Frequency reference selection, 2nd motor | 01 | x | |
| A002 | Run command selection | 01 | x | |
| A202 | Run command selection, 2nd motor | 01 | x | |
| A003 | Base frequency | 50.0 | x | |
| A203 | 2nd set base frequency | 50.0 | x | |
| A004 | Maximum frequency | 50.0 | x | |
| A204 | 2nd maximum frequency | 50.0 | x | |
| A005 | O/OI selection | 00 | x | |
| A011 | O start frequency | 0.00 | x | |
| A012 | O end frequency | 0.00 | x | |
| A013 | O start ratio | 0 | x | |
| A014 | O end ratio | 100 | x | |
| A015 | O start selection | 01 | x | |
| A016 | O, O2, OI sampling | 8 | x | |
| A017 | Drive Programming (EzSQ) Selection | 00 | x | |
| A019 | Multi-step speed selection | 00 | x | |
| A020 | Multi-step speed reference 0 | 6.00 | ✓ | |
| A220 | 2nd multi-step speed reference 0 | 6.00 | ✓ | |
| A021 | Multi-step speed reference 1 | 0.00 | ✓ | |
| A022 | Multi-step speed reference 2 | 0.00 | ✓ | |
| A023 | Multi-step speed reference 3 | 0.00 | ✓ | |
| A024 | Multi-step speed reference 4 | 0.00 | ✓ | |
| A025 | Multi-step speed reference 5 | 0.00 | ✓ | |
| A026 | Multi-step speed reference 6 | 0.00 | ✓ | |
| A027 | Multi-step speed reference 7 | 0.00 | ✓ | |
| A028 | Multi-step speed reference 8 | 0.00 | ✓ | |
| A029 | Multi-step speed reference 9 | 0.00 | ✓ | |
| A030 | Multi-step speed reference 10 | 0.00 | ✓ | |
| A031 | Multi-step speed reference 11 | 0.00 | ✓ | |
| A032 | Multi-step speed reference 12 | 0.00 | ✓ | |
| A033 | Multi-step speed reference 13 | 0.00 | ✓ | |
| A034 | Multi-step speed reference 14 | 0.00 | ✓ | |
| A035 | Multi-step speed reference 15 | 0.00 | ✓ | |
| A038 | Jogging frequency | 6.00 | ✓ | |
| A039 | Jogging stop selection | 04 | x | |
| A041 | Torque boost selection | 00 | x | |
| A241 | 2nd torque boost selection | 00 | x | |
| A042 | Manual torque boost voltage | 1.0 | ✓ | |
| A242 | 2nd manual torque boost voltage | 1.0 | ✓ | |
| A043 | Manual torque boost frequency | 5.0 | ✓ | |
| A243 | 2nd manual torque boost frequency | 5.0 | ✓ | |
| A044 | V/f characteristics selection | 00 | x | |
| A244 | 2nd V/f characteristics selection | 00 | x | |

| "A" Group Parameters | | Default Setting | b031=10 | User Setting |
|------------------------|--|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| A045 | Output voltage gain | 100 | ✓ | |
| A245 | Output voltage gain, 2nd motor | 100 | ✓ | |
| A046 | Automatic torque boost voltage compensation gain | 100 | ✓ | |
| A246 | 2nd automatic torque boost voltage compensation gain | 100 | ✓ | |
| A047 | Automatic torque boost slip compensation gain | 100 | ✓ | |
| A247 | 2nd automatic torque boost slip compensation gain | 100 | ✓ | |
| A051 | DC injection braking selection | 01 | ✗ | |
| A052 | DC injection braking frequency | 0.50 | ✗ | |
| A053 | DC injection braking delay time | 0.0 | ✗ | |
| A054 | DC injection braking power | 50 40 | ✗ | |
| A055 | DC injection braking time | 0.5 | ✗ | |
| A056 | DC injection braking method selection | 01 | ✗ | |
| A057 | Startup DC injection braking power | 0 | ✗ | |
| A058 | Startup DC injection braking time | 0.0 | ✗ | |
| A059 | DC injection braking carrier frequency | 5.0 | ✗ | |
| A061 | Frequency upper limit | 0.00 | ✗ | |
| A261 | 2nd frequency upper limit | 0.00 | ✗ | |
| A062 | Frequency lower limit | 0.00 | ✗ | |
| A262 | 2nd frequency lower limit | 0.00 | ✗ | |
| A063, A065, A067 | Jump frequency 1 to 3 | 0.00 | ✗ | |
| A064, A066, A068 | Jump frequency width 1 to 3 | 0.50 | ✗ | |
| A069 | Acceleration stop frequency | 0.00 | ✗ | |
| A070 | Acceleration stop time | 0.0 | ✗ | |
| A071 | PID selection | 00 | ✗ | |
| A072 | PID P gain | 1.0 | ✓ | |
| A073 | PID I gain | 1.0 | ✓ | |
| A074 | PID D gain | 0.00 | ✓ | |
| A075 | PID scale | 1.00 | ✗ | |
| A076 | PID feedback selection | 00 | ✗ | |
| A077 | Reverse PID function | 00 | ✗ | |
| A078 | PID output limit function | 0.0 | ✗ | |
| A079 | PID feedforward selection | 00 | ✗ | |
| A081 | AVR selection | 02 | ✗ | |
| A281 | AVR selection, 2nd motor | 02 | ✗ | |
| A082 | AVR voltage selection | 230/400 | ✗ | |
| A282 | AVR voltage selection, 2nd motor | 230/400 | ✗ | |
| A083 | AVR filter time constant | 0.300 | ✗ | |
| A084 | AVR deceleration gain | 100 | ✗ | |
| A085 | Energy-saving operation mode | 00 | ✗ | |
| A086 | Energy-saving response/accuracy adjustment | 50.0 | ✓ | |

| "A" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| A092 | Acceleration time 2 | 10.00 | ✓ | |
| A292 | 2nd acceleration time 2 | 10.00 | ✓ | |
| A093 | Deceleration time 2 | 10.00 | ✓ | |
| A293 | 2nd deceleration time 2 | 10.00 | ✓ | |
| A094 | Select method to switch to Acc2/ Dec2 profile | 00 | × | |
| A294 | Select method to switch to Acc2/ Dec2 profile, 2nd motor | 00 | × | |
| A095 | Acc1 to Acc2 frequency transition point | 0.00 | × | |
| A295 | Acc1 to Acc2 frequency transition point, 2nd motor | 0.00 | × | |
| A096 | Dec1 to Dec2 frequency transition point | 0.00 | × | |
| A296 | Dec1 to Dec2 frequency transition point, 2nd motor | 0.00 | × | |
| A097 | Acceleration curve selection | 01 | × | |
| A098 | Deceleration curve selection | 01 | × | |
| A101 | OI input active range start frequency | 0.00 | × | |
| A102 | OI input active range end frequency | 0.00 | × | |
| A103 | OI input active range start ratio | 20 | × | |
| A104 | OI input active range end ratio | 100 | × | |
| A105 | OI input start frequency enable | 00 | × | |
| A131 | Acceleration curve parameter | 02 | × | |
| A132 | Deceleration curve parameter | 02 | × | |
| A141 | Operation frequency input A setting | 02 | × | |
| A142 | Operation frequency input B setting | 03 | × | |
| A143 | Operator selection | 00 | × | |
| A145 | Frequency addition amount | 0.00 | × | |
| A146 | Frequency addition direction | 00 | × | |
| A150 | EL-S-curve ratio 1 during acceleration | 10 | × | |
| A151 | EL-S-curve ratio 2 during acceleration | 10 | × | |
| A152 | EL-S-curve ratio 1 during deceleration | 10 | × | |
| A153 | EL-S-curve ratio 2 during deceleration | 10 | × | |
| A154 | Deceleration hold frequency | 0.00 | × | |
| A155 | Deceleration hold time | 0.0 | × | |
| A156 | PID sleep function action threshold | 0.00 | × | |
| A157 | PID sleep function action delay time | 0.0 | × | |
| A161 | [VR] input active range start frequency | 0.00 | × | |
| A162 | [VR] input active range end frequency | 0.00 | × | |
| A163 | [VR] input active range start current | 0 | × | |
| A164 | [VR] input active range end voltage | 100 | × | |
| A165 | [VR] input start frequency enable | 01 | × | |

C-2-3 Fine Tuning Functions

| "B" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|--|---|---------|--------------|
| Func. Code | Name | (EU) | | |
| b001 | Retry selection | 00 | x | |
| b002 | Allowable momentary power interruption time | 1.0 | x | |
| b003 | Retry wait time | 1.0 | x | |
| b004 | Momentary power interruption/undervoltage trip during stop selection | 00 | x | |
| b005 | Momentary power interruption retry time selection | 00 | x | |
| b007 | Frequency matching lower limit frequency setting | 0.00 | x | |
| b008 | Trip retry selection | 00 | x | |
| b010 | Overvoltage/overcurrent retry time selection | 3 | x | |
| b011 | Trip retry wait time | 1.0 | x | |
| b012 | Electronic thermal level | Rated current | x | |
| b212 | 2nd electronic thermal level | Rated current | x | |
| b013 | Electronic thermal characteristics selection | 00 | x | |
| b213 | 2nd electronic thermal characteristics selection | 00 | x | |
| b015 | Free setting, electronic thermal frequency 1 | 0 | x | |
| b016 | Free setting, electronic thermal current 1 | 0.00 | x | |
| b017 | Free setting, electronic thermal frequency 2 | 0 | x | |
| b018 | Free setting, electronic thermal current 2 | 0.00 | x | |
| b019 | Free setting, electronic thermal frequency 3 | 0 | x | |
| b020 | Free setting, electronic thermal current 3 | 0.00 | x | |
| b021 | Overload limit selection | 01 | x | |
| b221 | Overload limit selection, 2nd motor | 01 | x | |
| b022 | Overload limit level | Rated current x 1.5 (HD) 1.2 (ND) | x | |
| b222 | Overload limit level, 2nd motor | Rated current x 1.5 (HD) 1.2 (ND) | x | |
| b023 | Overload limit parameter | 1.0 | x | |
| b223 | Overload limit parameter, 2nd motor | 1.0 | x | |
| b024 | Overload limit selection | 01 | x | |
| b025 | Overload limit level 2 | 1.50 x Rated current | x | |
| b026 | Overload limit parameter 2 | 1.00 | x | |
| b027 | Overcurrent suppression function | 00 | x | |
| b028 | Active Frequency Matching restart level | Rated current | x | |
| b029 | Active Frequency Matching restart parameter | 0.50 | x | |
| b030 | Starting frequency at Active Frequency Matching restart | 00 | x | |

| "B" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|--|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| b031 | Soft lock selection | 01 | x | |
| b033 | Motor cable length parameter | 10 | ✓ | |
| b034 | RUN time/Power ON time setting | 0 | x | |
| b035 | Rotation direction limit selection | 00 | x | |
| b036 | Reduced voltage startup selection | 2 | x | |
| b037 | Display selection | 00 | x | |
| b038 | Initial screen selection | 001 | x | |
| b039 | User parameter automatic setting function selection | 00 | x | |
| b040 | Torque limit selection | 00 | x | |
| b041 | Torque limit 1 (Four-quadrant mode forward power running) | 200 | x | |
| b042 | Torque limit 2 (Four-quadrant mode reverse regeneration) | 200 | x | |
| b043 | Torque limit 3 (Four-quadrant mode reverse power running) | 200 | x | |
| b044 | Torque limit 4 (Four-quadrant mode forward regeneration) | 200 | x | |
| b045 | Torque LADSTOP selection | 00 | x | |
| b046 | Reverse rotation prevention selection | 00 | x | |
| b049 | Dual rate selection | 00 | x | |
| b050 | Selection of non-stop function at momentary power interruption | 00 | x | |
| b051 | Starting voltage of non-stop function at momentary power interruption | 220/440 | x | |
| b052 | Stop deceleration level of non-stop function at momentary power interruption | 360/720 | x | |
| b053 | Deceleration time of non-stop function at momentary power interruption | 1.00 | x | |
| b054 | Deceleration starting width of non-stop function at momentary power interruption | 0.00 | x | |
| b060 | Window comparator O upper limit level | 100 | ✓ | |
| b061 | Window comparator O lower limit level | 0 | ✓ | |
| b062 | Window comparator O hysteresis width | 0 | ✓ | |
| b063 | Window comparator OI upper limit level | 100 | ✓ | |
| b064 | Window comparator OI lower limit level | 0 | ✓ | |
| b065 | Window comparator OI hysteresis width | 0 | ✓ | |
| b070 | Analog operation level at O disconnection | no | x | |
| b071 | Analog operation level at OI disconnection | no | x | |
| b075 | Ambient temperature | 40 | x | |
| b078 | Integrated power clear | 00 | ✓ | |
| b079 | Integrated power display gain | 1 | x | |
| b082 | Starting frequency | 0.50 | x | |

| "B" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| b083 | Carrier frequency | 10.0 | x | |
| b084 | Initialization selection | 00 | x | |
| b085 | Initialization parameter selection | 01 | x | |
| b086 | Frequency conversion coefficient | 1.00 | ✓ | |
| b087 | STOP key selection | 00 | x | |
| b088 | Free-run stop selection | 00 | x | |
| b089 | Automatic carrier reduction | 01 | x | |
| b090 | Usage rate of regenerative braking function | 0.0 | x | |
| b091 | Stop selection | 00 | x | |
| b092 | Cooling fan control | 01 | x | |
| b093 | Clear elapsed time of cooling fan | 00 | x | |
| b094 | Initialization target data | 00 | x | |
| b095 | Regenerative braking function operation selection | 00 | x | |
| b096 | Regenerative braking function ON level | 360/720 | x | |
| b097 | BRD resistor | 100.0 | x | |
| b100 | Free V/f frequency 1 | 0 | x | |
| b101 | Free V/f voltage 1 | 0.0 | x | |
| b102 | Free V/f frequency 2 | 0 | x | |
| b103 | Free V/f voltage 2 | 0.0 | x | |
| b104 | Free V/f frequency 3 | 0 | x | |
| b105 | Free V/f voltage 3 | 0.0 | x | |
| b106 | Free V/f frequency 4 | 0 | x | |
| b107 | Free V/f voltage 4 | 0.0 | x | |
| b108 | Free V/f frequency 5 | 0 | x | |
| b109 | Free V/f voltage 5 | 0.0 | x | |
| b110 | Free V/f frequency 6 | 0 | x | |
| b111 | Free V/f voltage 6 | 0.0 | x | |
| b112 | Free V/f frequency 7 | 0 | x | |
| b113 | Free V/f voltage 7 | 0.0 | x | |
| b120 | Brake control selection | 00 | x | |
| b121 | Brake wait time for release | 0.00 | x | |
| b122 | Brake wait time for acceleration | 0.00 | x | |
| b123 | Brake wait time for stopping | 0.00 | x | |
| b124 | Brake wait time for confirmation | 0.00 | x | |
| b125 | Brake release frequency | 0.00 | x | |
| b126 | Brake release current | Rated current | x | |
| b127 | Braking input frequency | 0.00 | x | |
| b130 | Overvoltage protection function selection during deceleration | 01 | x | |
| b131 | Overvoltage protection level during deceleration | 380 / 760 | x | |
| b132 | Overvoltage protection parameter | 1.00 | x | |
| b133 | Overvoltage protection proportional gain setting | 0.20 | ✓ | |
| b134 | Overvoltage protection integral time setting | 1.0 | ✓ | |
| b145 | GS input mode | 00 | x | |
| b150 | Display ex.operator connected | 001 | ✓ | |

| "B" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|-------------------------------|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| b160 | 1st parameter of Dual Monitor | 001 | ✓ | |
| b161 | 2nd parameter of Dual Monitor | 002 | ✓ | |
| b163 | Freq. set in monitoring | 00 | ✓ | |
| b164 | Auto return initial display | 00 | ✗ | |
| b165 | Ex. Operator com. Loss action | 02 | ✓ | |
| b166 | Data Read/Write selection | 00 | ✗ | |
| b171 | Inverter mode selection | 00 | ✗ | |
| b180 | Initialize trigger | 00 | ✗ | |
| b190 | Password A setting | 0000 | ✗ | |
| b191 | Password A for authentication | **** | ✗ | |
| b192 | Password B setting | 0000 | ✗ | |
| b193 | Password B for authentication | **** | ✗ | |
| b910 | E. thermal Dec Mode | 00 | ✗ | |
| b911 | E. thermal Dec Time | 600.00 | ✗ | |
| b912 | E. thermal Dec TimeCnst | 120.00 | ✗ | |
| b913 | E. thermal AccmGain | 100.0 | ✗ | |

C-2-4 Intelligent Terminal Functions

| "C" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| C001 | Multi-function input 1 selection | 00 | x | |
| C002 | Multi-function input 2 selection | 01 | x | |
| C003 | Multi-function input 3 selection | 12 | x | |
| C004 | Multi-function input 4 selection | 18 | x | |
| C005 | Multi-function input 5 selection | 02 | x | |
| C006 | Multi-function input 6 selection | 03 | x | |
| C007 | Multi-function input 7 selection | 06 | x | |
| C011 | Multi-function input 1 operation selection | 00 | x | |
| C012 | Multi-function input 2 operation selection | 00 | x | |
| C013 | Multi-function input 3 operation selection | 00 | x | |
| C014 | Multi-function input 4 operation selection | 00 | x | |
| C015 | Multi-function input 5 operation selection | 00 | x | |
| C016 | Multi-function input 6 operation selection | 00 | x | |
| C017 | Multi-function input 7 operation selection | 00 | x | |
| C021 | Multi-function output terminal 11 selection | 00 | x | |
| C022 | Multi-function output terminal 12 selection | 01 | x | |
| C026 | Relay output (AL2, AL1) function selection | 05 | x | |
| C027 | [EO] terminal selection | 07 | x | |
| C028 | AM selection | 00 | x | |
| C030 | Digital current monitor reference value | Rated current | ✓ | |
| C031 | Multi-function output terminal 11 contact selection | 00 | x | |
| C032 | Multi-function output terminal 12 contact selection | 00 | x | |
| C036 | Relay output (AL2, AL1) contact selection | 01 | x | |
| C038 | Light load signal output mode | 01 | x | |
| C039 | Light load detection level | Rated current | x | |
| C040 | Overload warning signal output mode | 01 | x | |
| C041 | Overload warning level | Rated current | x | |
| C241 | Overload warning level, 2nd motor | Rated current | x | |
| C042 | Arrival frequency during acceleration | 0.00 | x | |
| C043 | Arrival frequency during deceleration | 0.00 | x | |
| C044 | PID deviation excessive level | 3 | x | |
| C045 | Arrival frequency during acceleration 2 | 0.00 | x | |
| C046 | Arrival frequency during deceleration 2 | 0.00 | x | |

| "C" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| C047 | Pulse train input scale conversion for EO output | 1.00 | ✓ | |
| C052 | PID FB upper limit | 100 | ✗ | |
| C053 | PID FB lower limit | 0 | ✗ | |
| C054 | Over-torque/under-torque selection | 00 | ✗ | |
| C055 | Overtorque level (Forward power running) | 100 | ✗ | |
| C056 | Overtorque level (Reverse regeneration) | 100 | ✗ | |
| C057 | Overtorque level (Reverse power running) | 100 | ✗ | |
| C058 | Overtorque level (Forward regeneration) | 100 | ✗ | |
| C059 | Signal output mode of Over/under torque | 01 | ✗ | |
| C061 | Thermal warning level | 90 | ✗ | |
| C063 | 0 Hz detection level | 0.00 | ✗ | |
| C064 | Fin overheat warning level | 100 | ✗ | |
| C071 | Communication speed selection (Baud rate selection) | 05 | ✗ | |
| C072 | Communication station No. Selection | 1 | ✗ | |
| C074 | Communication parity selection | 00 | ✗ | |
| C075 | Communication stop bit selection | 01 | ✗ | |
| C076 | Communication error selection | 02 | ✗ | |
| C077 | Communication error timeout | 0.00 | ✗ | |
| C078 | Communication wait time | 0 | ✗ | |
| C081 | O adjustment | 100.0 | ✓ | |
| C082 | OI adjustment | 100.0 | ✓ | |
| C085 | Thermistor adjustment | 100.0 | ✓ | |
| C091 | Debug mode selection | 00 | ✗ | |
| C096 | Communication selection | 00 | ✗ | |
| C098 | EzCOM start adr. Of master | 1 | ✗ | |
| C099 | EzCOM end adr. Of master | 1 | ✗ | |
| C100 | EzCOM starting trigger | 00 | ✗ | |
| C101 | UP/DWN selection | 00 | ✗ | |
| C102 | Reset selection | 00 | ✗ | |
| C103 | Reset frequency matching selection | 00 | ✗ | |
| C104 | UP/DWN clear mode | 00 | ✗ | |
| C105 | EO gain setting | 100 | ✓ | |
| C106 | AM gain setting | 100 | ✓ | |
| C109 | AM bias setting | 0 | ✓ | |
| C111 | Overload warning level 2 | Rated current | ✗ | |
| C130 | Output 11 ON delay | 0.0 | ✗ | |
| C131 | Output 11 OFF delay | 0.0 | ✗ | |
| C132 | Output 12 ON delay | 0.0 | ✗ | |
| C133 | Output 12 OFF delay | 0.0 | ✗ | |
| C140 | Relay output ON delay | 0.0 | ✗ | |
| C141 | Relay output OFF delay | 0.0 | ✗ | |
| C142 | Logic output signal 1 selection 1 | 00 | ✗ | |
| C143 | Logic output signal 1 selection 2 | 00 | ✗ | |

| "C" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|--|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| C144 | Logic output signal 1 operator selection | 00 | x | |
| C145 | Logic output signal 2 selection 1 | 00 | x | |
| C146 | Logic output signal 2 selection 2 | 00 | x | |
| C147 | Logic output signal 2 operator selection | 00 | x | |
| C148 | Logic output signal 3 selection 1 | 00 | x | |
| C149 | Logic output signal 3 selection 2 | 00 | x | |
| C150 | Logic output signal 3 operator selection | 00 | x | |
| C160 | Input terminal response time 1 | 1 | x | |
| C161 | Input terminal response time 2 | 1 | x | |
| C162 | Input terminal response time 3 | 1 | x | |
| C163 | Input terminal response time 4 | 1 | x | |
| C164 | Input terminal response time 5 | 1 | x | |
| C165 | Input terminal response time 6 | 1 | x | |
| C166 | Input terminal response time 7 | 1 | x | |
| C169 | Multi-step speed/position determination time | 0 | x | |

C-2-5 Motor Constants Functions

| "H" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---|--|---------|--------------|
| Func. Code | Name | (EU) | | |
| H001 | Auto-tuning selection | 00 | x | |
| H002 | Motor parameter selection | 00 | x | |
| H202 | 2nd motor parameter selection | 00 | x | |
| H003 | Motor capacity selection | Specified by the capacity of each inverter model | x | |
| H203 | 2nd motor capacity selection | | x | |
| H004 | Motor pole number selection | 4 | x | |
| H204 | 2nd motor pole number selection | 4 | x | |
| H005 | Speed response | 100 | ✓ | |
| H005 | 2nd speed response | 100 | ✓ | |
| H006 | Stabilization parameter | 100 | ✓ | |
| H206 | 2nd stabilization parameter | 100 | ✓ | |
| H020 | Motor parameter R1 | Depends on the motor capacity | x | |
| H220 | 2nd motor parameter R1 | | x | |
| H021 | Motor parameter R2 | Depends on the motor capacity | x | |
| H221 | 2nd motor parameter R2 | | x | |
| H022 | Motor parameter L | Depends on the motor capacity | x | |
| H222 | 2nd motor parameter L | | x | |
| H023 | Motor parameter lo | Depends on the motor capacity | x | |
| H223 | 2nd motor parameter lo | | x | |
| H024 | Motor parameter J | Depends on the motor capacity | x | |
| H224 | 2nd motor parameter J | | x | |
| H030 | Motor parameter R1 (auto-tuning data) | Depends on the motor capacity | x | |
| H230 | 2nd motor parameter R1 (auto-tuning data) | | x | |

| "H" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|--|-------------------------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| H031 | Motor parameter R2 (auto-tuning data) | Depends on the motor capacity | x | |
| H231 | 2nd motor parameter R2 (auto-tuning data) | | x | |
| H032 | Motor parameter L (auto-tuning data) | Depends on the motor capacity | x | |
| H232 | 2nd motor parameter L (auto-tuning data) | | x | |
| H033 | Motor parameter Io (auto-tuning data) | Depends on the motor capacity | x | |
| H233 | 2nd motor parameter Io (auto-tuning data) | | x | |
| H034 | Motor parameter J (auto-tuning data) | Depends on the motor capacity | x | |
| H234 | 2nd motor parameter J (auto-tuning data) | | x | |
| H050 | Slip compensation P gain for V/f control with FB | 0.20 | ✓ | |
| H051 | Slip compensation I gain for V/f control with FB | 2 | ✓ | |
| H102 | PM motor code selection | 00 | x | |
| H103 | PM motor capacity | kW dependent | x | |
| H104 | PM motor pole number selection | 4 | x | |
| H105 | PM rated current | Rated current | x | |
| H106 | PM parameter R | kW dependent | x | |
| H107 | PM parameter Ld | kW dependent | x | |
| H108 | PM parameter Lq | kW dependent | x | |
| H109 | PM parameter Ke | kW dependent | x | |
| H110 | PM parameter J | kW dependent | x | |
| H111 | PM parameter R (auto-tuning data) | kW dependent | x | |
| H112 | PM parameter Ld (auto-tuning data) | kW dependent | x | |
| H113 | PM parameter Lq (auto-tuning data) | kW dependent | x | |
| H116 | PM speed response | 100 | ✓ | |
| H117 | PM starting current | 70.00 | ✓ | |
| H118 | PM starting time | 1.00 | ✓ | |
| H119 | PM stabilization constant | 100 | ✓ | |
| H121 | PM minimum frequency | 8.0 | ✓ | |
| H122 | PM No-Load current | 10.00 | ✓ | |
| H123 | PM starting method | 00 | x | |
| H131 | PM IMPE 0V wait | 10 | x | |
| H132 | PM IMPE detect wait | 10 | x | |
| H133 | PM IMPE detect | 30 | x | |
| H134 | PM IMPE voltage gain | 100 | x | |

C-2-6 Expansion Card Functions

“P” parameters will be appeared when the expansion option is connected.

| “P” Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|---|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| P001 | Operation selection at option 1 error | 00 | × | |
| P003 | EA terminal selection | 00 | × | |
| P004 | Pulse train input mode for feedback | 00 | × | |
| P011 | Encoder pulses | 512 | × | |
| P012 | Simple positioning selection | 00 | × | |
| P014 | Creep pulse ratio | 125.0 | × | |
| P015 | Creep speed | 5.00 | × | |
| P017 | Positioning range | 50 | × | |
| P026 | Overspeed error detection level | 115.0 | × | |
| P027 | Speed deviation error detection level | 10.00 | × | |
| P031 | Acceleration/deceleration time input type | 00 | × | |
| P033 | Torque reference input selection | 00 | × | |
| P034 | Torque reference setting | 0 | ✓ | |
| P036 | Torque bias mode | 00 | × | |
| P037 | Torque bias value | 0 | ✓ | |
| P038 | Torque bias polarity selection | 00 | × | |
| P039 | Speed limit value in torque control (forward) | 0.00 | ✓ | |
| P040 | Speed limit value in torque control (reverse) | 0.00 | ✓ | |
| P041 | Speed / torque control switching time | 0 | ✓ | |
| P044 | Network comm. Watchdog timer | 1.00 | × | |
| P045 | Operation setting at communications error | 00 | × | |
| P046 | Instance number | 1 | × | |
| P048 | Operation setting at idle mode detection | 00 | × | |
| P049 | Polarity setting for rotation speed | 0 | × | |
| P055 | Pulse train frequency scale | 1.5 | × | |
| P056 | Pulse train frequency filter time constant | 0.10 | × | |
| P057 | Pulse train frequency bias amount | 0 | × | |
| P058 | Pulse train frequency limit | 100 | × | |
| P059 | Pulse input lower cut | 1.00 | × | |
| P060 | Multi-step position command 0 | 0 | ✓ | |
| P061 | Multi-step position command 1 | 0 | ✓ | |
| P062 | Multi-step position command 2 | 0 | ✓ | |
| P063 | Multi-step position command 3 | 0 | ✓ | |
| P064 | Multi-step position command 4 | 0 | ✓ | |
| P065 | Multi-step position command 5 | 0 | ✓ | |
| P066 | Multi-step position command 6 | 0 | ✓ | |
| P067 | Multi-step position command 7 | 0 | ✓ | |
| P068 | Zero return mode | 00 | ✓ | |
| P069 | Zero return direction selection | 00 | ✓ | |
| P070 | Low-speed zero return frequency | 5.00 | ✓ | |
| P071 | High-speed zero return frequency | 5.00 | ✓ | |

| "P" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|--|-------------------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| P072 | Position range specification (forward) | 268435455 | ✓ | |
| P073 | Position range specification (reverse) | -268435455 | ✓ | |
| P075 | Positioning mode | 00 | ✓ | |
| P077 | Encoder disconnection timeout | 1.0 | ✓ | |
| P080 | Position restarting range | 0 | ✗ | |
| P081 | Save position at power off | 00 | ✗ | |
| P082 | Curnt pos at poff | 0 | ✓ | |
| P083 | Preset position data | -268435455 to 268435455 | ✓ | |
| P100 | Drive Program parameter U(00) | 0 | ✓ | |
| P101 | Drive Program parameter U(01) | 0 | ✓ | |
| P102 | Drive Program parameter U(02) | 0 | ✓ | |
| P103 | Drive Program parameter U(03) | 0 | ✓ | |
| P104 | Drive Program parameter U(04) | 0 | ✓ | |
| P105 | Drive Program parameter U(05) | 0 | ✓ | |
| P106 | Drive Program parameter U(06) | 0 | ✓ | |
| P107 | Drive Program parameter U(07) | 0 | ✓ | |
| P108 | Drive Program parameter U(08) | 0 | ✓ | |
| P109 | Drive Program parameter U(09) | 0 | ✓ | |
| P110 | Drive Program parameter U(10) | 0 | ✓ | |
| P111 | Drive Program parameter U(11) | 0 | ✓ | |
| P112 | Drive Program parameter U(12) | 0 | ✓ | |
| P113 | Drive Program parameter U(13) | 0 | ✓ | |
| P114 | Drive Program parameter U(14) | 0 | ✓ | |
| P115 | Drive Program parameter U(15) | 0 | ✓ | |
| P116 | Drive Program parameter U(16) | 0 | ✓ | |
| P117 | Drive Program parameter U(17) | 0 | ✓ | |
| P118 | Drive Program parameter U(18) | 0 | ✓ | |
| P119 | Drive Program parameter U(19) | 0 | ✓ | |
| P120 | Drive Program parameter U(20) | 0 | ✓ | |
| P121 | Drive Program parameter U(21) | 0 | ✓ | |
| P122 | Drive Program parameter U(22) | 0 | ✓ | |
| P123 | Drive Program parameter U(23) | 0 | ✓ | |
| P124 | Drive Program parameter U(24) | 0 | ✓ | |
| P125 | Drive Program parameter U(25) | 0 | ✓ | |
| P126 | Drive Program parameter U(26) | 0 | ✓ | |
| P127 | Drive Program parameter U(27) | 0 | ✓ | |
| P128 | Drive Program parameter U(28) | 0 | ✓ | |
| P129 | Drive Program parameter U(29) | 0 | ✓ | |
| P130 | Drive Program parameter U(30) | 0 | ✓ | |
| P131 | Drive Program parameter U(31) | 0 | ✓ | |
| P140 | EzCOM number of data | 5 | ✓ | |
| P141 | EzCOM destination 1 address | 1 | ✓ | |
| P142 | EzCOM destination 1 register | 0000 | ✓ | |
| P143 | EzCOM source 1 register | 0000 | ✓ | |
| P144 | EzCOM destination 2 address | 1 | ✓ | |
| P145 | EzCOM destination 2 register | 0000 | ✓ | |
| P146 | EzCOM source 2 register | 0000 | ✓ | |

| "P" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|------------------------------|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| P147 | EzCOM destination 3 address | 1 | ✓ | |
| P148 | EzCOM destination 3 register | 0000 | ✓ | |
| P149 | EzCOM source 3 register | 0000 | ✓ | |
| P150 | EzCOM destination 4 address | 1 | ✓ | |
| P151 | EzCOM destination 4 register | 0000 | ✓ | |
| P152 | EzCOM source 4 register | 0000 | ✓ | |
| P153 | EzCOM destination 5 address | 1 | ✓ | |
| P154 | EzCOM destination 5 register | 0000 | ✓ | |
| P155 | EzCOM source 5 register | 0000 | ✓ | |
| P160 | Option I/F cmd W register 1 | 0000 | ✓ | |
| P161 | Option I/F cmd W register 2 | 0000 | ✓ | |
| P162 | Option I/F cmd W register 3 | 0000 | ✓ | |
| P163 | Option I/F cmd W register 4 | 0000 | ✓ | |
| P164 | Option I/F cmd W register 5 | 0000 | ✓ | |
| P165 | Option I/F cmd W register 6 | 0000 | ✓ | |
| P166 | Option I/F cmd W register 7 | 0000 | ✓ | |
| P167 | Option I/F cmd W register 8 | 0000 | ✓ | |
| P168 | Option I/F cmd W register 9 | 0000 | ✓ | |
| P169 | Option I/F cmd W register 10 | 0000 | ✓ | |
| P170 | Option I/F cmd R register 1 | 0000 | ✓ | |
| P171 | Option I/F cmd R register 2 | 0000 | ✓ | |
| P172 | Option I/F cmd R register 3 | 0000 | ✓ | |
| P173 | Option I/F cmd R register 4 | 0000 | ✓ | |
| P174 | Option I/F cmd R register 5 | 0000 | ✓ | |
| P175 | Option I/F cmd R register 6 | 0000 | ✓ | |
| P176 | Option I/F cmd R register 7 | 0000 | ✓ | |
| P177 | Option I/F cmd R register 8 | 0000 | ✓ | |
| P178 | Option I/F cmd R register 9 | 0000 | ✓ | |
| P179 | Option I/F cmd R register 10 | 0000 | ✓ | |
| P180 | Profibus node address | 0 | ✗ | |
| P181 | Profibus clear mode | 00 | ✗ | |
| P182 | Profibus Map selection | 00 | ✗ | |
| P190 | CompoNet node address | 0 | ✗ | |
| P192 | DeviceNet node address | 63 | ✗ | |
| P195 | ML2 frame length | 00 | ✗ | |
| P196 | ML2 node address | 21 | ✗ | |
| P200 | Serial comms mode | 00 | ✓ | |
| P201 | Modbus external register 1 | 0000 | ✓ | |
| P202 | Modbus external register 2 | 0000 | ✓ | |
| P203 | Modbus external register 3 | 0000 | ✓ | |
| P204 | Modbus external register 4 | 0000 | ✓ | |
| P205 | Modbus external register 5 | 0000 | ✓ | |
| P206 | Modbus external register 6 | 0000 | ✓ | |
| P207 | Modbus external register 7 | 0000 | ✓ | |
| P208 | Modbus external register 8 | 0000 | ✓ | |
| P209 | Modbus external register 9 | 0000 | ✓ | |
| P210 | Modbus external register 10 | 0000 | ✓ | |
| P211 | Modbus register format 1 | 00 | ✓ | |
| P212 | Modbus register format 2 | 00 | ✓ | |

| "P" Group Parameters | | Default Setting | b031=10 | User Setting |
|----------------------|-----------------------------|-----------------|---------|--------------|
| Func. Code | Name | (EU) | | |
| P213 | Modbus register format 3 | 00 | ✓ | |
| P214 | Modbus register format 4 | 00 | ✓ | |
| P215 | Modbus register format 5 | 00 | ✓ | |
| P216 | Modbus register format 6 | 00 | ✓ | |
| P217 | Modbus register format 7 | 00 | ✓ | |
| P218 | Modbus register format 8 | 00 | ✓ | |
| P219 | Modbus register format 9 | 00 | ✓ | |
| P220 | Modbus register format 10 | 00 | ✓ | |
| P221 | Modbus register scaling 1 | 1.000 | ✓ | |
| P222 | Modbus register scaling 2 | 1.000 | ✓ | |
| P223 | Modbus register scaling 3 | 1.000 | ✓ | |
| P224 | Modbus register scaling 4 | 1.000 | ✓ | |
| P225 | Modbus register scaling 5 | 1.000 | ✓ | |
| P226 | Modbus register scaling 6 | 1.000 | ✓ | |
| P227 | Modbus register scaling 7 | 1.000 | ✓ | |
| P228 | Modbus register scaling 8 | 1.000 | ✓ | |
| P229 | Modbus register scaling 9 | 1.000 | ✓ | |
| P230 | Modbus register scaling 10 | 1.000 | ✓ | |
| P301 | Modbus internal register 1 | 0000 | ✓ | |
| P302 | Modbus internal register 2 | 0000 | ✓ | |
| P303 | Modbus internal register 3 | 0000 | ✓ | |
| P304 | Modbus internal register 4 | 0000 | ✓ | |
| P305 | Modbus internal register 5 | 0000 | ✓ | |
| P306 | Modbus internal register 6 | 0000 | ✓ | |
| P307 | Modbus internal register 7 | 0000 | ✓ | |
| P308 | Modbus internal register 8 | 0000 | ✓ | |
| P309 | Modbus internal register 9 | 0000 | ✓ | |
| P310 | Modbus internal register 10 | 0000 | ✓ | |
| P400 | Big/Little endian selection | 00 | ✓ | |

Appendix D

CE-EMC Installation Guidelines

D-1 CE-EMC Installation Guidelines

You are required to satisfy the EMC directive (2004/108/EC) when using an MX2 inverter in an EU country.

To satisfy the EMC directive and to comply with standard, you need to use a dedicated EMC filter suitable for each model, and follow the guidelines in this section. Following table shows the compliance condition for reference.

Table 1: Condition for the compliance

| Model | Cat. | Carrier f | Motor cable |
|------------------|------|-----------|------------------|
| 1-ph. 200V class | C1 | 15 kHz | 25 m (Shielded) |
| 3-ph. 400V class | C2 | 15 kHz | 100 m (Shielded) |
| 3-ph. 200V class | C1 | 15 kHz | 25 m (Shielded) |
| | C2 | 15 kHz | 50 m (Shielded) |

Table 2: Applicable EMC filter

| Input class | Inverter model | Filter model RASMI |
|------------------|-------------------------------|----------------------|
| 1-ph. 200V class | AB001 / AB002 / AB004 | AX-FIM1010-RE (10A) |
| | AB007 | AX-FIM1014-RE (14A) |
| | AB015 / AB022 | AX-FIM1024-RE (24A) |
| 3-ph. 200V class | A2001 / A2002 / A2004 / A2007 | AX-FIM2010-RE (10A) |
| | A2015 / A2022 | AX-FIM2020-RE (20A) |
| | A2037 | AX-FIM2030-RE (30A) |
| | A2055 / A2075 | AX-FIM2060-RE (60A) |
| | A2110 | AX-FIM2080-RE (80A) |
| | A2150 | AX-FIM2100-RE (100A) |
| 3-ph. 400V class | A4004 / A4007 | AX-FIM3005-RE (5A) |
| | A4015 / A4022 / A4030 | AX-FIM3010-RE (10A) |
| | A4040 | AX-FIM3014-RE (14A) |
| | A4055 / A4075 | AX-FIM3030-RE (23A) |
| | A4110 / A4150 | AX-FIM3050-RE (50A) |

D-1-1 Important notes

1. Input choke or other equipment is required if necessary to comply with EMC directive from the harmonic distortion point of view (IEC 61000-3-2 and 4).
2. If the motor cable length exceeds 25 m, use output choke to avoid unexpected problem due to the leakage current from the motor cable (such as malfunction of the thermal relay, vibration of the motor, etc.).
3. As user you must ensure that the HF (high frequency) impedance between adjustable frequency inverter, filter, and ground is as small as possible.
 - Ensure that the connections are metallic and have the largest possible contact areas (zinc-plated mounting plates).
4. Avoid conductor loops that act like antennas, especially loops that encompass large areas.
 - Avoid unnecessary conductor loops.
 - Avoid parallel arrangement of low-level signal wiring and power-carrying or noise-prone conductors.

5. Use shielded wiring for the motor cable and all analog and digital control lines.
 - Allow the effective shield area of these lines to remain as large as possible; i.e., do not strip away the shield (screen) further away from the cable end than absolutely necessary.
 - With integrated systems (for example, when the adjustable frequency inverter is communicating with some type of supervisory controller or host computer in the same control cabinet and they are connected at the same ground + PE-potential), connect the shields of the control lines to ground + PE (protective earth) at both ends. With distributed systems (for example the communicating supervisory controller or host computer is not in the same control cabinet and there is a distance between the systems), we recommend connecting the shield of the control lines only at the end connecting to the adjustable frequency inverter. If possible, route the other end of the control lines directly to the cable entry section of the supervisory controller or host computer. The shield conductor of the motor cables always must be connected to ground + PE at both ends.
 - To achieve a large area contact between shield and ground + PE-potential, use a PG screw with a metallic shell, or use a metallic mounting clip.
 - Use only cable with braided, tinned copper mesh shield (type "CY") with 85% coverage.
 - The shielding continuity should not be broken at any point in the cable. If the use of reactors, contactors, terminals, or safety switches in the motor output is necessary, the unshielded section should be kept as short as possible.
 - Some motors have a rubber gasket between terminal box and motor housing. Very often, the terminal boxes, and particularly the threads for the metal PG screw connections, are painted. Make sure there is always a good metallic connection between the shielding of the motor cable, the metal PG screw connection, the terminal box, and the motor housing. If necessary, carefully remove paint between conducting surfaces.
6. Take measures to minimize interference that is frequently coupled in through installation cables.
 - Separate interfering cables with 0.25 m minimum from cables susceptible to interference. A particularly critical point is laying parallel cables over longer distances. If two cables intersect (one crosses over the other), the interference is smallest if they intersect at an angle of 90°. Cables susceptible to interference should therefore only intersect motor cables, intermediate circuit cables, or the wiring of a rheostat at right angles and never be laid parallel to them over longer distances.

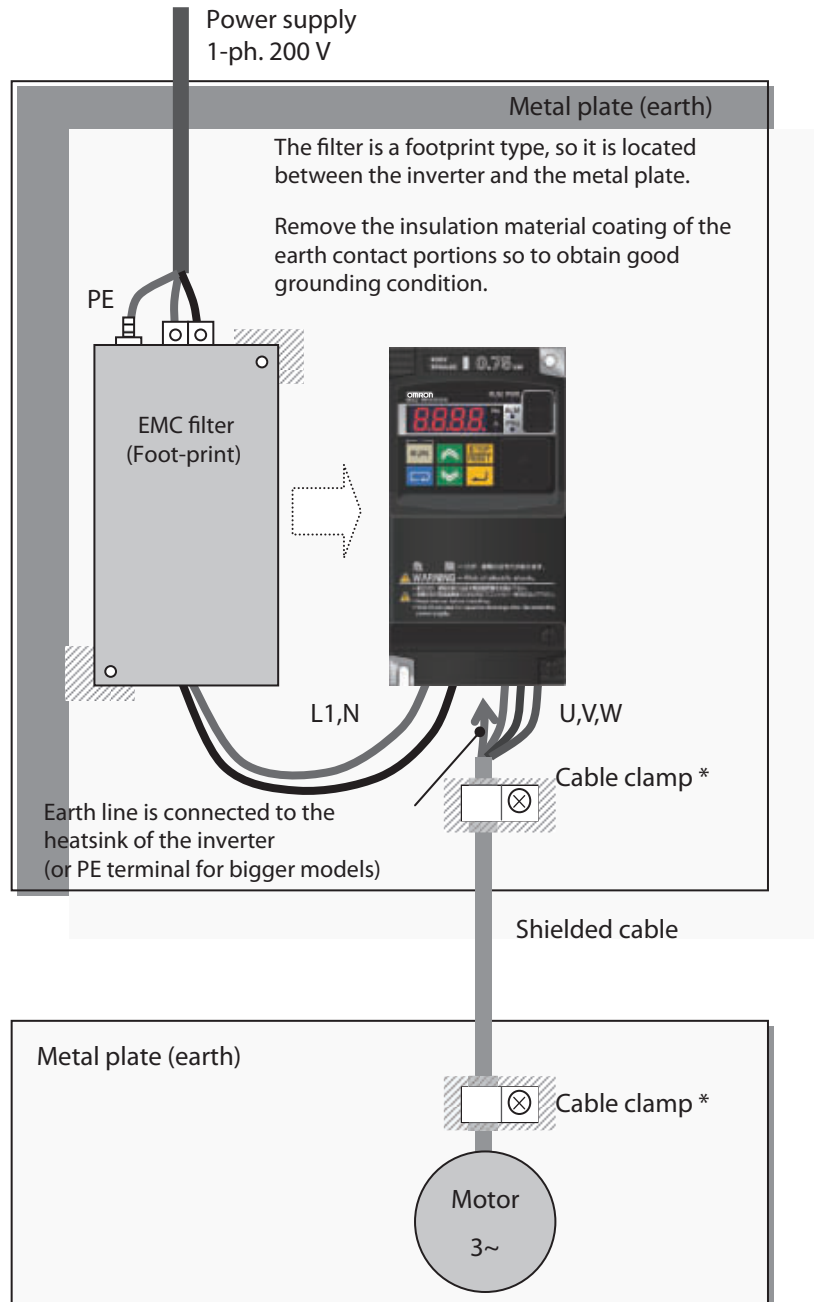
7. Minimize the distance between an interference source and an interference sink (interference- threatened device), thereby decreasing the effect of the emitted interference on the interference sink.
 - You should use only interference-free devices and maintain a minimum distance of 0.25 m from the adjustable frequency inverter.
8. Follow safety measures in the filter installation.
 - If using external EMC filter, ensure that the ground terminal (PE) of the filter is properly connected to the ground terminal of the adjustable frequency inverter. An HF ground connection via metal contact between the housings of the filter and the adjustable frequency inverter, or solely via cable shield, is not permitted as a protective conductor connection. The filter must be solidly and permanently connected with the ground potential so as to preclude the danger of electric shock upon touching the filter if a fault occurs.

To achieve a protective ground connection for the filter:

- Ground the filter with a conductor of at least 10 mm² cross-sectional area.
- Connect a second grounding conductor, using a separate grounding terminal parallel to the protective conductor. (The cross section of each single protective conductor terminal must be sized for the required nominal load.)

D-1-2 Installation for MX2 series


Model 3-ph. 200 V class and 3-ph. 400 V class are the same concept for the installation.



* Both earth portions of the shielded cable must be connected to the earth point by cable clamps.

Input choke or equipment to reduce harmonic current is necessary for CE marking (IEC 61000-3-2 and IEC61000-3-4) from the harmonic current point of view, even conducted emission and radiated emission passed without the input choke.

D-2 Omron EMC Recommendations

 **WARNING** This equipment should be installed, adjusted, and serviced by qualified personal familiar with construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury.

Use the following checklist to ensure the inverter is within proper operating ranges and conditions.

1. The power supply to MX2 inverters must meet these specifications:
 - Voltage fluctuation $\pm 10\%$ or less
 - Voltage imbalance $\pm 3\%$ or less
 - Frequency variation $\pm 4\%$ or less
 - Voltage distortion THD = 10% or less
2. Installation measure:
 - Use a filter designed for MX2 inverter. Refer to the instruction of the applicable external EMC filter.
3. Wiring:
 - Shielded wire (screened cable) is required for motor wiring, and the length must be 25 meter or less.
 - If the motor cable length exceeds the value shown above, use output choke to avoid unexpected problem due to the leakage current from the motor cable.
 - Lowering carrier frequency will help to satisfy EMC requirements.
 - Separate the power input and motor wiring from the signal/process circuit wiring.
4. Environmental conditions-when using a filter, follow these guidelines:
 - Ambient temperature: -10 to 40°C
 - Humidity: 20 to 90% RH (non-condensing)
 - Vibration: 5.9 m/sec^2 (0.6 G) 10 ~ 55Hz
 - Location: 1000 meters or less altitude, indoors (no corrosive gas or dust)

E-4 Activation

Turning on the safety switch automatically assign the GS1 input and GS2 input automatically.

To assign EDM (external device monitor) output, please turn the EDM function switch on. EDM output is automatically assigned on intelligent output terminal 11. (When safety switch or EDM switch is turned off, the intelligent input and output terminal assigned on will be set as “no” function, and contact will remain normally off.)

Always use both inputs to disable the drive. If for any reason only one channel is opened, the drive output is stopped but the EDM output is not activated. In this case the Safe Disable input wiring must be checked.

E-5 Installation

According to the safety standard listed above, please install referring to the example. Please be sure to use the both GS1 and GS2, and construct the system that GS1 and GS2 are both turned off when safety input is given to the inverter.

 **Caution** Be sure to carry out the proof test when installation is ready before operation.

When the Gate Suppress function is utilized, connect the drive to a safety certified interrupting device utilizing EDM output signal to reconfirm both safety inputs GS1 and GS2.

| Item | Function code | Data | Description |
|---|---------------|------|--|
| Multi-function input 3 and 4 selection | C003 | 77 | GS1: Safety input 1 ^{*1} |
| | C004 | 78 | GS2: Safety input 2 ^{*1} |
| Multi-function input 3 and 4 operation selection | C013 | 01 | NC: Normally Closed ^{*1} |
| | C014 | 01 | NC: Normally Closed ^{*1} |
| Multi-function output terminal 11 selection | C021 | 62 | EDM: External Device Monitor ^{*2} |
| Multi-function output terminal 11 contact selection | C031 | 00 | NO: Normally Open ^{*2} |
| GS input mode | b145 | 00 | No trip |
| | | 01 | Trip ^{*3 *4} |

Note 1 They are automatically set when safety switch is turned ON, cannot be changed.

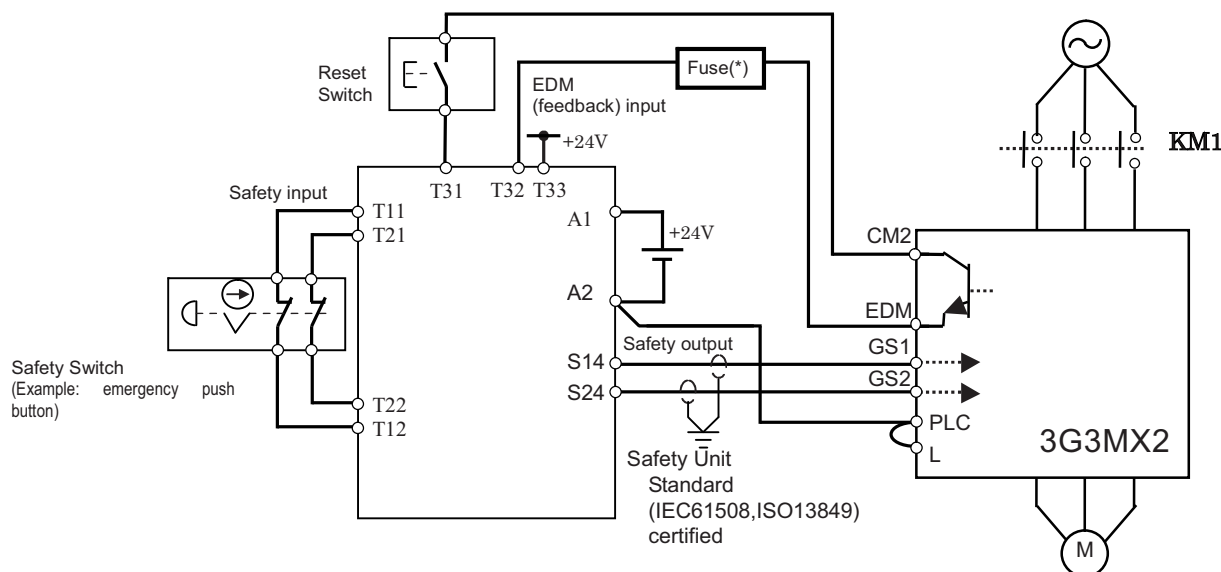
Note 2 Those are automatically assigned when EDM switch is turned ON, cannot be changed.

Note 3 Inverter trips with “E37”. When competing with external trip (E12), E37 has priority.

Note 4 While the drive is the trip status “E37” and either GS1 or GS2 is activated, on the safety by is not guaranteed.

E-6 Wiring example

When the Gate Suppress function is utilized, connect the drive to a safety certified interrupting device utilizing EDM output signal to reconfirm both safety inputs GS1 and GS2.



(*) Specifications of the fuse:

The arch extinguish fuse with rated voltage 250 VAC, rated current 100 mA complies to either IEC6127-2/-3/-4.

Example:

SOC ... <http://www.socfuse.com>

EQ series 250 VAC, 100 mA (UL, SEMKO, BSI)

littell ... <http://www.littelfuse.co.jp>

216 series 250 VAC, 100 mA (CCC, UL, CSA, SEMKO, CE, VDE)

Any external signal voltage connected to the 3G3MX2 must be from a SELV Power.

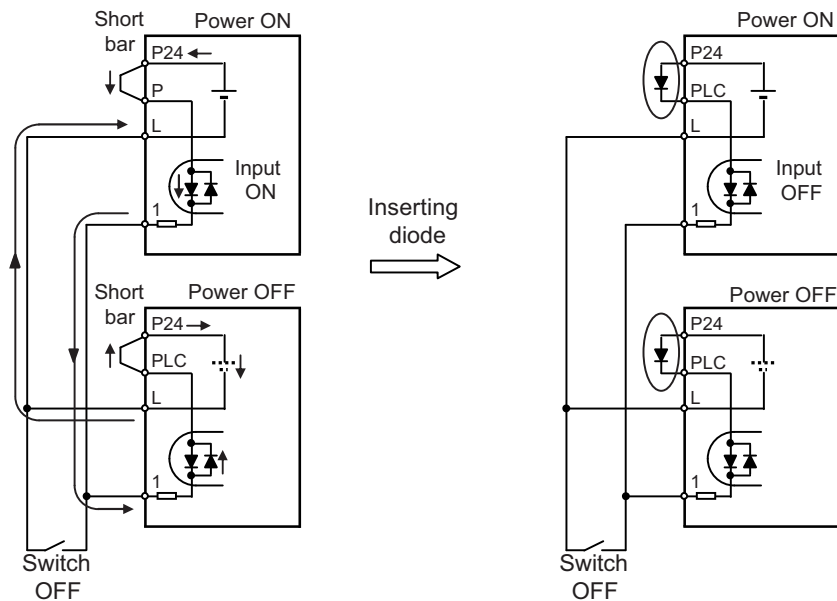
By pressing the emergency stop button, the current to GS1 and GS2 is shut off, and the inverter output is shut off. By this, motor is free-running. This behaviour is according to the stop category 0 defined in EN60204.

- Note 1** Above is the example to use the intelligent input terminal with source logic. When it is used with sink logic, the wiring is to be modified.
- Note 2** The wire for safety relay and emergency input signal are to be shielded. Please be sure to ground the shielding.
- Note 3** All the inductance related parts such as relay and contactor are required to contain the over-voltage protection circuit.

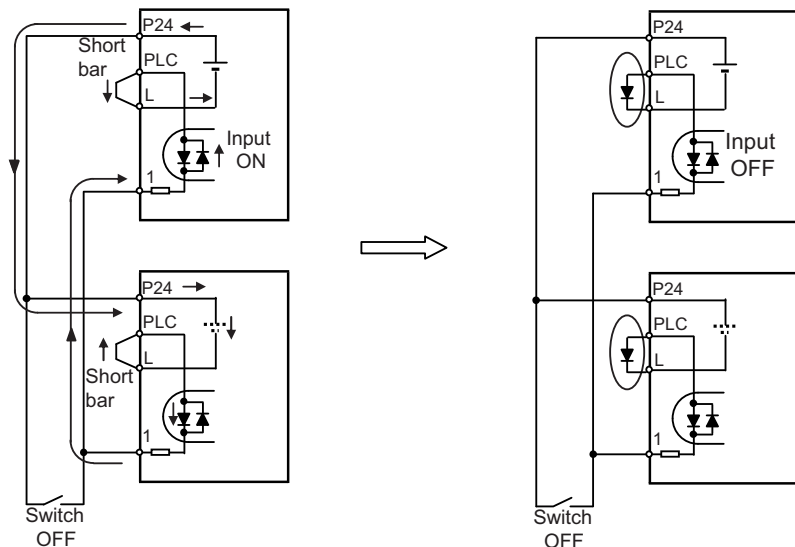
⚠ Caution Inverter doesn't block the current flowing into itself when it is not powered. This may cause the closed circuit when two or more inverters are connected to common I/O wiring as shown below to result in unexpected turning on the input. This may lead to dangerous situation. To avoid this closed circuit, please put the diode (rated: 50 V/0.1 A) in the path as described below.

⚠ Caution If the protection diodes used when the units are in wired parallel are only single diodes then their condition would be checked as part of the proof test.

In case of Source logic:



In case of Sink logic:



The current loop cause turn the input ON even the switch is off when diode is not inserted.

The current loop is to be prevented by inserting diode instead of short bar.

E-7 Components to be combined

Followings are the example of the safety devices to be combined.

| Series | Model | Norms to comply | Certification date |
|--------|--------------|-----------------------|--------------------|
| GS9A | 301 | ISO13849-2 cat4, SIL3 | 06.06.2007 |
| G9SX | GS226-T15-RC | IEC61508 SIL1-3 | 04.11.2004 |
| NE1A | SCPU01-V1 | IEC61508 SIL3 | 27.09.2006 |

The configuration of and components used in any circuit other than an appropriately pre approved safety module that interfaces with the 3G3MX2 GS1/GS2 and EDM ports must be at least equivalent to CAT 3 PLd under ISO 13849-1:2006 in order to be able to claim an overall CAT 3 PLd for the 3G3MX2 and external circuit combination.

The EMI level that the external module has been assessed to must be at least equivalent to that of Appendix E IEC 62061.

E-8 Periodical check (Proof test)


Proof test is essential to be able to reveal any dangerous undetected failures after a period of time, in this case 1 year. Carrying out this proof test at least one a year is the condition to comply the ISO13849-1 PLd.

- To activate (give current to) GS1 and GS2 simultaneously and separately to see output is allowed and EDM is conducting.





| Terminal | Status | | | |
|----------|-------------|---------------|---------------|---------------|
| | Current OFF | Current ON | Current OFF | Current ON |
| GS1 | Current OFF | Current ON | Current OFF | Current ON |
| GS2 | Current OFF | Current OFF | Current ON | Current ON |
| EDM | Conducted | Not conducted | Not conducted | Not conducted |
| (Output) | Forbidden | Forbidden | Forbidden | Allowed |

- To activate (give current to) both GS1 and GS2 to see output is allowed and EDM is not conducting.
- To activate (give current to) GS1, not to activate GS2 and see output is forbidden and EDM is not conducting.
- To activate (give current to) GS2, not to activate GS1 and see output is forbidden and EDM is not conducting.
- To deactivate (interrupt current to) both GS1 and GS2 to see output is forbidden and EDM is conducting.

Be sure to carry out the proof test when installation is ready before operation.

 **Caution** If the protection diodes used when the units are in wired parallel are only single diodes then their condition would be checked as part of the proof test. Check to reconfirm the diodes are not damaged when proof test is done.

E-9 Precautions

-  **Caution** To assure, that the Safe Disable function appropriately fulfills the safety requirements of the application, a throughout risk assessment for the whole safety system has to be carried out.
-  **Caution** The Safe Disable function does not cut the power supply to the drive and does not provide electrical isolation. Before any installation or maintenance work is done, the drives power supply must be switched off and place a tag/lock-out.
-  **Caution** The wiring distance for Safe Disable inputs should be shorter than 30 m.
-  **Caution** The time from opening the Safe Disable input until the drive output is switched off is less than 10 ms.

E-10 EC DECLARATION OF CONFORMITY

No. EMEC065H

Original



EU DECLARATION OF CONFORMITY

1. **Product Models/Products:**
3G3MX2 series type V1
3G3MX2 series type E
2. **Name and address of the manufacturer:**
OMRON Corporation
Shiokoji Horikawa, Shimogyo-Ku, Kyoto, 600-8530 Japan
3. **This declaration of conformity is issued under the sole responsibility of the manufacturer.**
4. **Objects of the declaration:**
3G3MX2 series type V1, Inverter
3G3MX2 series type E, Inverter
5. **The objects of the declaration described above are in conformity with the relevant Union harmonisation legislation:**
2014/30/EU EMC Directive
2006/42/EC Machinery Directive
6. **References to the relevant harmonised standards used or references to the other technical specifications in relation to which conformity is declared:**
EMC Directive: EN61800-3:2004/A1:2012
Machinery Directive: IEC61800-5-2:2016 IEC61800-5-1:2016
EN ISO13849-1:2015

"The electrical safety requirements of the Low Voltage Directive according to Annex I, section 1.5.1 of the Machinery Directive are fulfilled."

Signed and on behalf of: OMRON Corporation
 Place and date of issue: Kyoto JAPAN, July 30, 2018

Signature: 
 Name: Kozo Kando
 Function: Industrial Automation Company
Product Business Division HQ, Drive Div. Manager

No. EMEC065H

Name and address of contact in EU

OMRON Europe B.V.
Quality & Environment Department
Attn: J.J.P.W. Vogelaar, European Quality & Environment Manager
Zilverenberg 2, 5234 GM, 's-Hertogenbosch, The Netherlands

Name, address, and identification number of Notified Body, Number of EC Type Examination

Machinery Directive:
Notified body: TÜV Rheinland Industrie Service GmbH
Address: Am Grauen Stein, 51105 Köln, Germany
Notified Body identification No.: NB0035
Certificate for EU Type Examination: Reg-No.: 01/205/5328.01/18

Additional information

Types List

| Model Type | | Model Type | |
|-----------------|-----------------|----------------|----------------|
| 3G3MX2-AB001-V1 | 3G3MX2-A4004-V1 | 3G3MX2-AB001-E | 3G3MX2-A4004-E |
| 3G3MX2-AB002-V1 | 3G3MX2-A4007-V1 | 3G3MX2-AB002-E | 3G3MX2-A4007-E |
| 3G3MX2-AB004-V1 | 3G3MX2-A4015-V1 | 3G3MX2-AB004-E | 3G3MX2-A4015-E |
| 3G3MX2-AB007-V1 | 3G3MX2-A4022-V1 | 3G3MX2-AB007-E | 3G3MX2-A4022-E |
| 3G3MX2-AB015-V1 | 3G3MX2-A4030-V1 | 3G3MX2-AB015-E | 3G3MX2-A4030-E |
| 3G3MX2-AB022-V1 | 3G3MX2-A4040-V1 | 3G3MX2-AB022-E | 3G3MX2-A4040-E |
| 3G3MX2-A2001-V1 | 3G3MX2-A4055-V1 | 3G3MX2-A2001-E | 3G3MX2-A4055-E |
| 3G3MX2-A2002-V1 | 3G3MX2-A4075-V1 | 3G3MX2-A2002-E | 3G3MX2-A4075-E |
| 3G3MX2-A2004-V1 | 3G3MX2-A4110-V1 | 3G3MX2-A2004-E | 3G3MX2-A4110-E |
| 3G3MX2-A2007-V1 | 3G3MX2-A4150-V1 | 3G3MX2-A2007-E | 3G3MX2-A4150-E |
| 3G3MX2-A2015-V1 | | 3G3MX2-A2015-E | |
| 3G3MX2-A2022-V1 | | 3G3MX2-A2022-E | |
| 3G3MX2-A2037-V1 | | 3G3MX2-A2037-E | |
| 3G3MX2-A2055-V1 | | 3G3MX2-A2055-E | |
| 3G3MX2-A2075-V1 | | 3G3MX2-A2075-E | |
| 3G3MX2-A2110-V1 | | 3G3MX2-A2110-E | |
| 3G3MX2-A2150-V1 | | 3G3MX2-A2150-E | |

Type name may be followed by additional letter(s) and /or number(s) for sale purposes.

E-11 Safety Certification

2010-02-03



Annex to Report-No.: 968/M 247.00/10

Summary of the characteristic data for use of the product in safety-related applications

Product: Inverter Drive 3G3MX2 series and MX2 series with STO feature

Customer: Omron Corporation
Shioikoji Horikawa, Shimogyo-ku
Kyoto 600-8530
Japan

1. Characteristic data acc. to IEC 61508-1 till -7 and IEC 62061

1.1 Data for use of the product as a subsystem in safety functions

| | Value | Remark |
|------------------------|---------------|--|
| Safety Integrity Level | SIL CL 2 | |
| PFH | 1,08 E-07 1/h | corresponds to 10,8 % of SIL 2 |
| PFH _{av} | 4,73 E-04 | corresponds to 4,7 % of SIL 2; this value is valid for the stated Proof Test Interval T |
| Proof Test Interval T | 1 a | |

Remark: At a PFH value, which is < 1 % of the allowed SIL-threshold, the performance of special Proof Tests within the mission time of the product is regarded as not necessary.

2. Characteristic data acc. to EN ISO 13849-1

| | Value | Remark |
|--|--------|--------|
| Performance Level | PL d | |
| Category | Cat. 3 | |
| MTTF _d | High | |
| Average Diagnostic Coverage DC _{av} | Low | |

Besides these summary of the characteristic data always the information provided in the product documents of the manufacturer have to be considered.

Source of failure rate data: SN 29500, so far no data from the component manufacturer were available.

Max. average ambient temperature: 40°C

General assumption that 50 % of the component failures are dangerous failures ($\lambda_d = 0.5 \lambda$), MTTF_d = 2 MTTF), so far no further information was available.

Appendix F

Unprotected Inverter Operation Mode

F-1 Unprotected Inverter Operation Mode

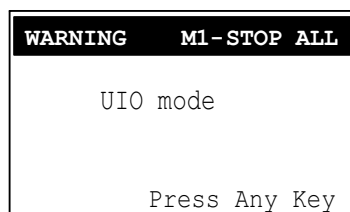
1. With this function, when unprotected signal is input, the inverter can continue driving.
2. It means that some trips are reflected or (it not possible to avoid), they are automatically reset with no limits.
3. The forced driving is only activated via digital input terminal. (cannot be activated via fieldbus or Drive Programming.)
4. The software trips is invalid in this mode.
5. When a hardware trip occurs, the inverter is turned off and restarts automatically. Then, the inverter drives again. However, when the inverter was in auto tuning state, retrying operation decreases the accuracy and the inverter makes the transition to the trip state.
6. The Bracking resistor overload (BRD) is disabled. However, BRD operates according to %ED, and doesn't detect BRD overload trip. Moreover, because the EXT trip is disabled on the IO signal, the protection by opening EXT circuit with the temperature relay built-in BRD resistance is invalid.
7. The Safety function has priority over the Unprotected Operation mode function.
8. The display shows Unprotected Inverter Operation status:

LED Digital Operator:

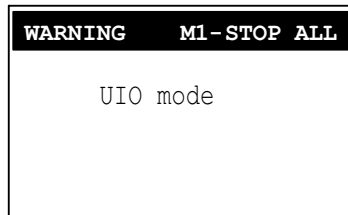
7-seg LED displays "7 SEGMENT FONT" when changing to "Unprotected Inverter Operation mode", and PRG LED blinks. This mode is canceled by pressing any key, but the PRG LED blink is not cancelled. During "Unprotected Inverter Operation mode", d090 (Warning monitor) displays "UIO". However, when changing to "Unprotected Inverter Operation mode" and a warning occurs, the warning code is displayed in d090 (Warning monitor).

LCD Digital Operator:

The "WARNING mode" display will appear automatically when changing to "Unprotected Inverter Operation mode", and displays the next screen. Moreover, WARNING LED and orange backlight turns on.



This mode is cancelled by pressing any key, but the WARNING LED and the orange backlight lighting are not cancelled. During "Unprotected Inverter Operation mode", d090 (Warning monitor) displays "UIO". Moreover, the WARNING mode screen displays the following screen:



However, when changing to “Unprotected Inverter Operation mode” and a warning occurs, the warning code is displayed in d090 (Warning monitor).

9. The setting procedure for this function is as follows (only via operator):
When UIO digital input is turned on, if it is turned off before 60 sec, the function is not applied and warranty is kept.
When UIO digital input is kept active for more than 60 sec, the function is effective (UIO status flag is enabled) and inverter warranty is lost.
The UIO status history flag is permanently stored in the inverter and cannot be deleted.
10. The “Unprotected Inverter Operation mode” is out of warranty.
11. All of responsibility of PS/PL accident by this function is on the user side.
OMRON does not accept any liability in case the use of this function leads to the personal or material damage.
This function is designed in a way that it is not possible to enable inadvertently. As well this manual does not contain enough information for enabling it, reducing the risk of activation.
The additional information for enabling this function has to be requested to OMRON representative.

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Note: Specifications subject to change without notice.
Cat. No. I570-E2-02F

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