OMRON

LD Wireless Charging

Technical Guide

LD-60
LD-90
LD-250

25230-000 A

Purpose of This Document

This document was created to support customers who wish to use PULS/Wiferion wireless chargers to charge OMRON batteries in LD-series Autonomous Mobile Robots (AMRs): LD-60, LD-90 and LD-250.

The newest LD battery (part number 20452-700) must be used with the wireless charger. Prior versions of the LD battery (including 20452-000) are prohibited for this application. All further references of LD battery in this document refer to 20452-700.

Disclaimer

The wireless charging system is not an OMRON product. As a result, it is the responsibility of the system integrator (or the end user) to determine the appropriateness of any wireless charging system, perform the implementation, and ensure its safe use.

By using any wireless charging system with the LD-series, the system integrator (or the end user) assumes full responsibility for the risk assessment of the implementation of the wireless charging system with the LD-series.

OMRON will not be responsible for any incidents that may result from the use of wireless charging systems with OMRON's AMRs.

Possible risks and hazardous conditions include the following:

- If the operator/user moves within the defined Danger Zone of the wireless charging equipment and coils, hazard to the operator/user may include health issues due to strong magnetic fields of the wireless charging station.
- For operators/users with pacemakers, metal implants or possession of any metal objects: Moving within 200 mm of the wireless charger while it is charging an AMR can impose danger and harm. Active wireless charging stations cause metal and conductive material to heat up. Hazard towards the operator/user may include external burns, internal burns, health issues and death.
- Any metal and conductive objects that fall close to or in between coils of the wireless charging station when an AMR is charging may impose fire and damage to the charging station, AMR and any electronics in the surrounding area because metal and conductive material heats up when brought close to an actively charging wireless charging station.
- Any contact with the wireless charge housing, wires and connection cables of the wireless charging system may cause the operator/user to suffer from burns.

Cybersecurity

To maintain the security and reliability of the system, a robust cybersecurity defense program should be implemented, which may include some or all of the following:

Anti-virus protection

• Install the latest commercial-quality anti-virus software on the computer connected to the control system and keep the software and virus definitions up-to-date.

• Scan USB drives or other external storage devices before connecting them to control systems and equipment.

Security measures to prevent unauthorized network access

• Install physical controls so that only authorized personnel can access control systems and equipment.

• Reduce connections to control systems and equipment via networks to prevent access from untrusted devices.

• Install firewalls to block unused communications ports and limit communication between systems. Limit access between control systems and systems from the IT network.

• Control remote access and adopt multifactor authentication to devices with remote access to control systems and equipment.

• Set strong password policies and monitor for compliance frequently.

Data input and output protection

• Backup data and keep the data up-to-date periodically to prepare for data loss.

• Validate backups and retention policies to cope with unintentional modification of input/output data to control systems and equipment.

• Validate the scope of data protection regularly to accommodate changes.

• Check validity of backups by scheduling test restores to ensure successful recovery from incidents.

• Safety design, such as emergency shutdown and fail-soft operations in case of data tampering and incidents.

Additional recommendations

• When using an external network environment to connect to an unauthorized terminal such as a SCADA, HMI or to an unauthorized server may result in network security issues such as spoofing and tampering.

• You must take sufficient measures such as restricting access to the terminal, using a terminal equipped with a secure function, and locking the installation area by yourself.

• When constructing network infrastructure, communication failure may occur due to cable disconnection or the influence of unauthorized network equipment.

• Take adequate measures, such as restricting physical access to network devices, by means such as locking the installation area.

• When using devices equipped with an SD Memory Card, there is a security risk that a third party may acquire, alter, or replace the files and data in the removable media by removing or unmounting the media.

• Please take sufficient measures, such as restricting physical access to the Controller or taking appropriate management measures for removable media, by means of locking and controlling access to the installation area.

• Educate employees to help them identify phishing scams received via email on systems that will connect to the control network.

Content of This Document

1 Necessary BOM

Item	Item Type	Part Number	Quantity
PULS Wiferion etaLINK 3000 Wireless charger	Stationary Electronics	100843	1
	Stationary Coil	100990 (3 m)	1
	Mobile Electronics (ME)	100986 (Passive)	1
	Mobile Coil	100993 (1 m)	1
Cable from Core to ME Unit	Off-the-shelf MiniFit Sr cable	Molex: 0369240210	1
Ring lugs for power cable from Core to ME	8 AWG M6 ring lug	Molex: 0192210224	2
Fuse holder for battery turn-on circuit	Inline fuse holder 600 V 10 A / 18 AWG	Memory Protection Devices: BF310	1
Fuse for battery turn-on circuit	3AG Fuse; 3 A; 10 kA interruption rating	Bel Fuse: 0ADBC3000-BE	1
Protection diodes for battery turn-on circuit	60 V 20 A through-hole diode	SMC Diode Solutions: SB2060	1
Component holder for components in battery turn-on circuit (DIN rail)	Feedthrough terminal block DIN rail connector	Altech: CDL4U(O)	4
Pre-crimped wire for digital connection to Core	MiniFit Jr 450 mm pre-crimped lead 18 AWG black; tin contact	Molex: 2153411115	4
Connector to LD Core USER IO	MiniFit Jr connector housing 12-pin receptacle	Molex: 0039012120	1
Spade lugs for connecting to ME	22-16 AWG spade lug #6 lug size red insulated	TE: 34541	2
Ferrule lug to insert into feedthrough terminal Block	18 AWG ferrule lug, red insulated	Phoenix Contact: 3200742	4
M12 A coded male to loose ends cable	M12 4 position A coded male	Phoenix Contact: 1668056	1
Wago for shorting two pins	Wago 24-12 AWG 2POS	Wago: 221-412/VE00-2500	3

1.1 BOM for Configuring the ME (CAN on ME)

Item	Item Type	Part Number	Quantity
M12 A Coded cable for CAN port on ME	M12 A Coded cable (female to male)	Harting: 21350102517020	1

Converter from M12 to DSUB	M12 to DSUB converter	Phoenix Contact: 2902323	1
CAN Bus terminator	CAN Bus DSUB passthrough terminator	GC-CAN-TERM-GC	1
For configuring BlueConfig software on ME	PCAN USB-CAN Bus tool	Peak-system: IPEH-004022	1

1.2 BOM for Externally Providing Power to the ME (EXT. Supply port on ME) for Configuring

Item	Item Type	Part Number	Quantity
Barrel jack to terminal Block	2.1 mm barrel jack to terminal block converter (screw type)	Adafruit: 368	1
Power supply for configuration of Unit	24 VDC 2.1 mm x 5.5 mm barrel jack AC wall wart	MeanWell: GST25U24-P1J	1
M12 A coded male to loose ends cable	M12 5 position A coded male	Phoenix Contact: 1668056	1 (Reuse the one on the Section 1 *Necessary BOM*)
Wago for shorting two pins	Wago 24-12 AWG 2POS	Wago: 21-412/VE00-2500	1 (Reuse the one referenced in Section 1, *Necessary BOM*)

1.3 Additional Parts and Information

- 35 mm DIN rail channel required for mounting components firmly onto the LD AMR.
- 18 AWG stranded wire required for connection, unless stated otherwise.
- There are also other sizes for the stationary coil and the mobile coil that can be used instead, such as 101181 (8 m) and 101234 (0.6 m).

1.4 Required Tools (Non-Standard) or Similar

- Klein tools 3005CR: Handheld crimper red/blue/yellow standard ring and spade lugs
- Eclipse Tools 902-603: Large gauge crimpers for 8 AWG ring lugs
- Phoenix Contact 1212034: Handheld crimper for 10-24 AWG ferrules

1.5 Compatibility Information

Wiferion wireless charging documented here is compatible with all models of LD-series AMRs, which include the following part numbers:

- 37032-00000, 37032-00002, 37032-10004, 37032-20000, 37032-20002, 37032-20004
- 37042-00000, 37042-00002, 37042-10004, 37042-20000, 37042-20002, 37042-20004
- 37222-00000, 37222-00002, 37222-10004, 37222-20000, 37222-20002, 37222-20004
- 37142-00010, 37142-00012, 37142-01014
- 37162-00010, 37162-00012, 37162-01014

The only compatible LD battery is part number 20452-700.

Disclaimer

Information in this document is provided solely as a reference. OMRON does not guarantee the suitability of this wireless charging implementation for any particular purpose.

2 LD Wireless Charging Reference Design

This section contains information about the following:

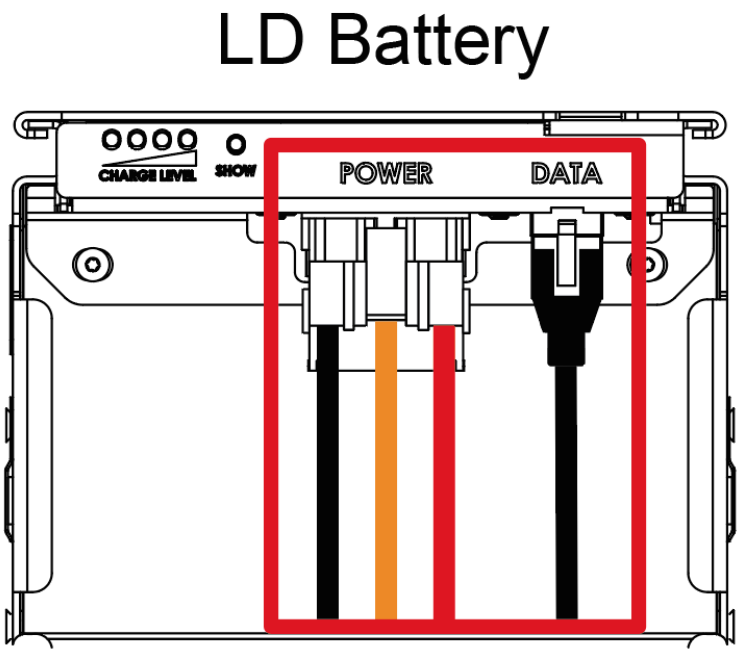
- Prohibited LD battery connections
- Allowed LD Core connections
- Wiring details
- Battery characteristics and Wiferion settings
- Wiferion hardware alignment and installation

2.1 Anatomy of the LD Battery and Prohibited Actions

The LD battery pack is known as a split path battery pack, containing two separate current paths for charge and discharge current. For this reason, its main power cable has three conductors. This cable runs from the LD battery pack to the Core. The cable goes to the BATTERY POWER connector at the Core.

Precautions for Safe Use

Modifying the cables in the image below is prohibited.



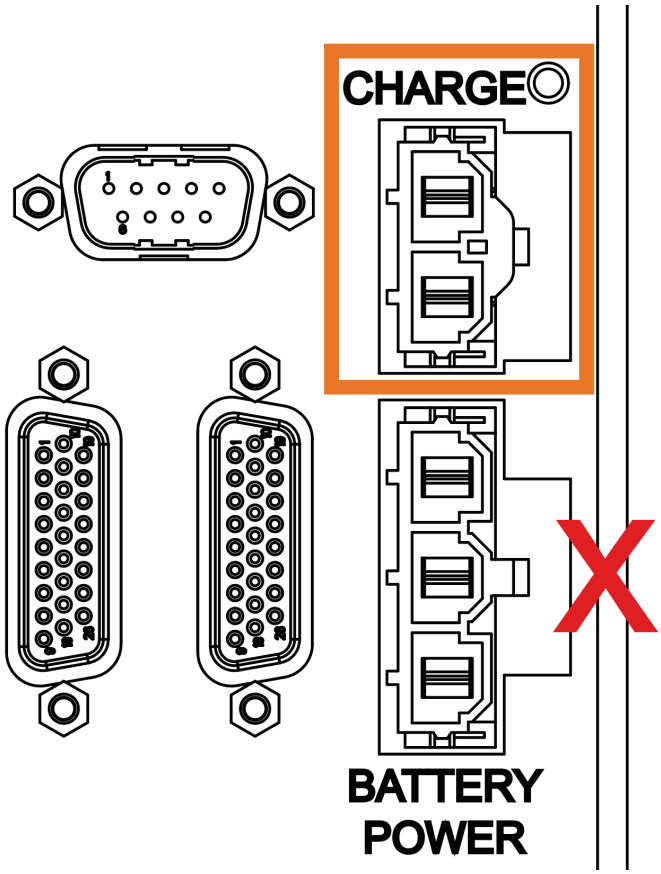
All non-standard modifications to the electrical system must be done at the port labeled CHARGE on the Core. This port has the nets “charge” and “gnd” directly connected to the Core, giving it access to the

battery's charge path (but not the discharge path). More information is provided in Section 2.3 *LD Battery Interface Circuit*.

The circuit schematic and wiring in this document ensure that only the wireless charging or contact charging plug can be physically connected to the CHARGE port at one time (not both). Please refer to Section 2.4 *Wiring Details* and Section 2.4.2 *Required Detailed Wiring Schematic and Drawing* for more information.

Precautions for Safe Use

> Wireless charging and LD dock charging must never take place at the same time. This will cause a short circuit between the Wiferion ME power supply and the LD dock power supply.
>
> Branching of the original cable connected to the CHARGE port on the Core is prohibited, and the original cable must not be modified.



2.2 Charge FET (Field-Effect Transistor) Manipulation

Modern lithium-ion battery chargers require battery voltage to be applied to the charger's connection terminals before allowing charging current to flow. The Wiferion system follows this paradigm.

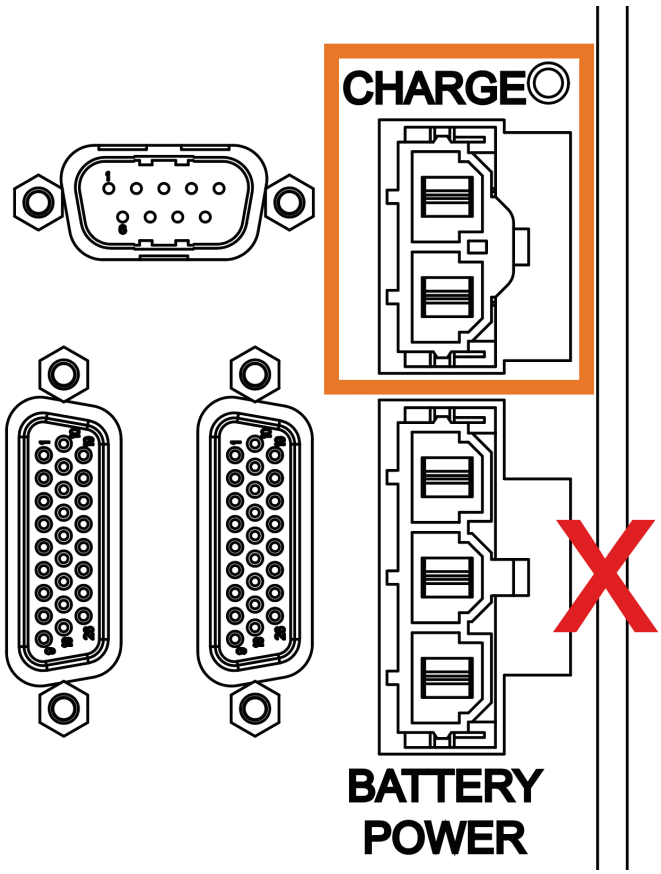
The LD battery pack was designed for a custom charger that required the opposite. In other words, the battery required the charger to present its voltage to the battery first before charging could take place.

Therefore, either battery or charger must be artificially prompted to come on first. The approach taken in this reference design is to trigger the battery to present its voltage to the charger first.

2.3 LD Core Interface Circuit

The following picture reiterates the cables that should and should not be modified. The original cable that connects to the CHARGE port on the Core must not be modified, but it can be unplugged. The cable shown in Section 2.4.2 Required *Detailed Wiring Schematic and Drawing* (WC-H1) can be plugged in instead to allow wireless charging.

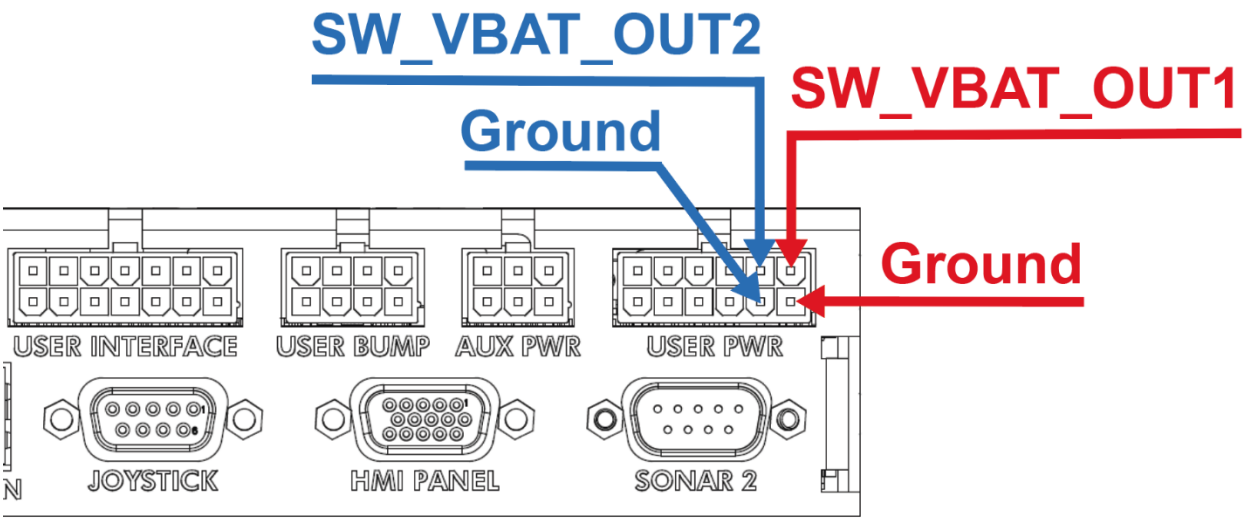
The cable that connects to the BATTERY POWER port must not be modified or unplugged.



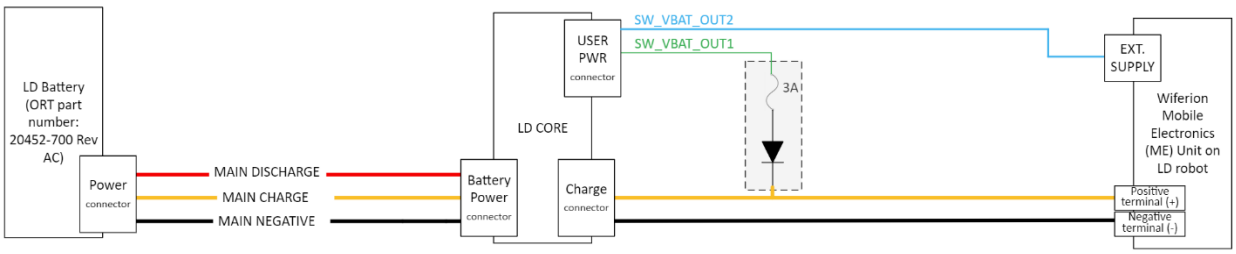
The image below shows where the power to supply the interface circuit comes from (USER PWR port on the Core). The net in red (SW_VBAT_OUT1) should be used to present a voltage of >21 V at the charge net which is a part of the interface circuit. The net in blue (SW_VBAT_OUT2) provides power to the Wiferion ME (EXT. SUPPLY).

Note that the voltage of >21 V must be presented at the charge net so that the AMR can start taking in a charge and be ready to charge.

Note that the power must be provided to the ME (EXT. SUPPLY) to power on the ME so that charging can occur on demand. The ME must only be turned on five seconds after the AMR is parked at the Wiferion stationary charging station, which is after the charge FET is turned on. The ME must be turned off at least one second before leaving the stationary charging station.



Below is the interface circuit. It consists of the battery's unregulated voltage, which is within the range of 21 V to 30.3 V (derived from the USER PWR port on the Core). The circuit elements shown below are there for protective reasons.



2.4 Wiring Details

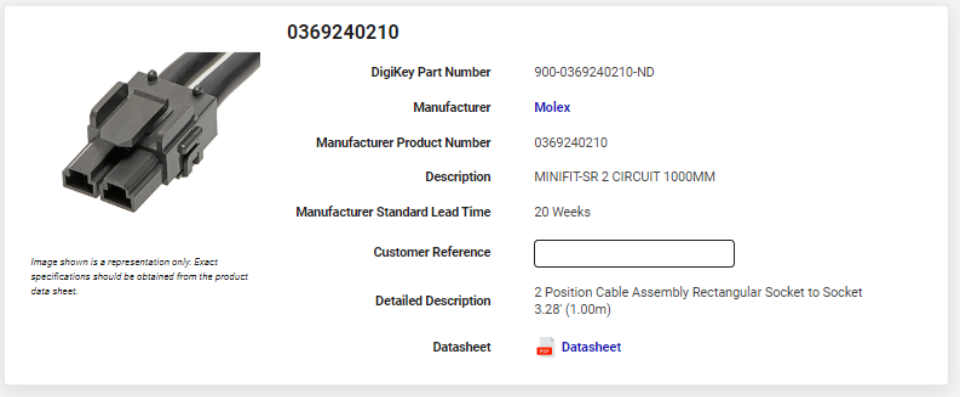
This section contains details about the following:

- Required cable for connection from LD Core to Wiferion ME Unit
- Wiring schematics and drawings for:
    - ME Unit
    - Battery interface circuit
    - Block diagram
    - WC-H1, -H2, -H3 and -H4 cables

2.4.1 Connection From Core to Wiferion Mobile Electronics (ME) Unit

To create the complete cable (WC-H1) shown in Section 2.4.2 *Required Detailed Wiring Schematic and Drawing*, you must use this off-the-shelf cable assembly, Molex PN: 0369240210 (shown below).

Molex PN: 0369240210



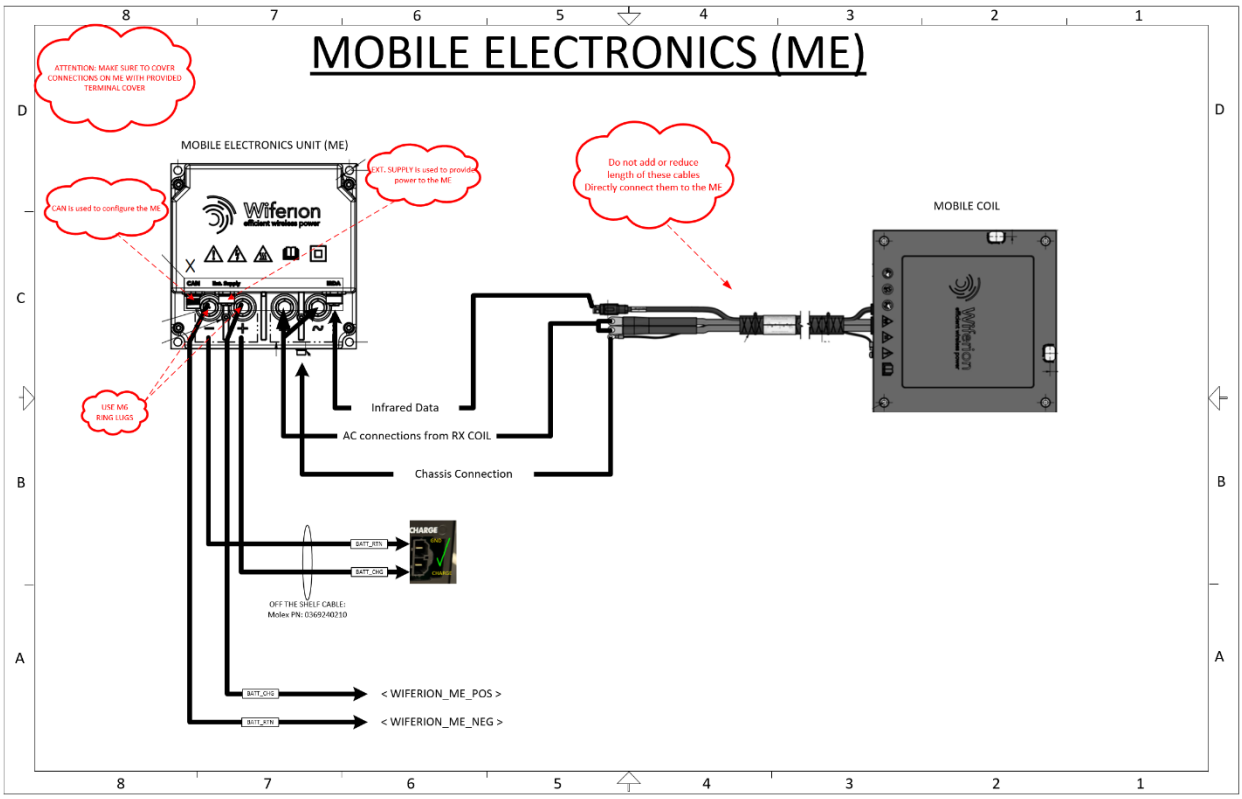
The cable assembly includes the MiniFit Senior 2-pin connector and 1 meter of 8 AWG cable. The BOM includes 8 AWG M6 ring lugs which need to be crimped onto one end of the cable.

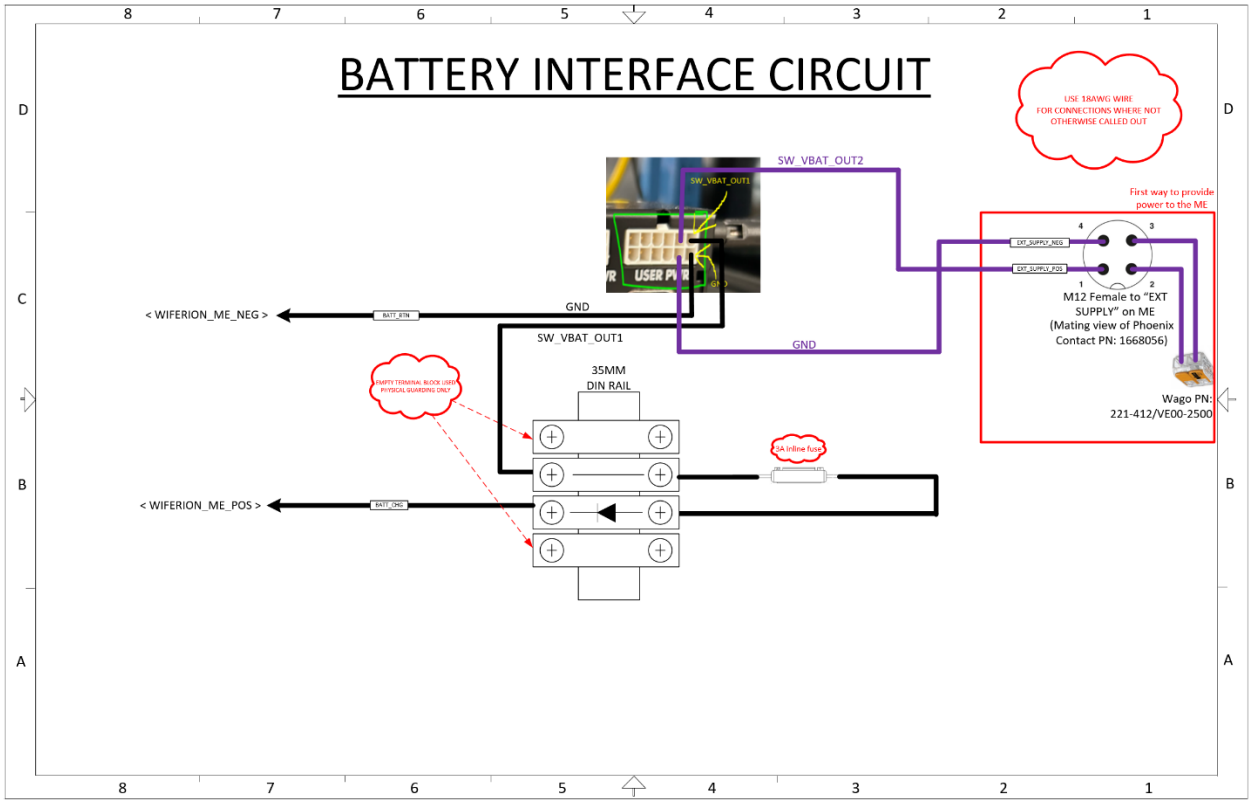
For wireless charging, this connector should be plugged into the CHARGE port on the Core after unplugging the existing connector. The existing connector only allows contact-type LD dock charging.

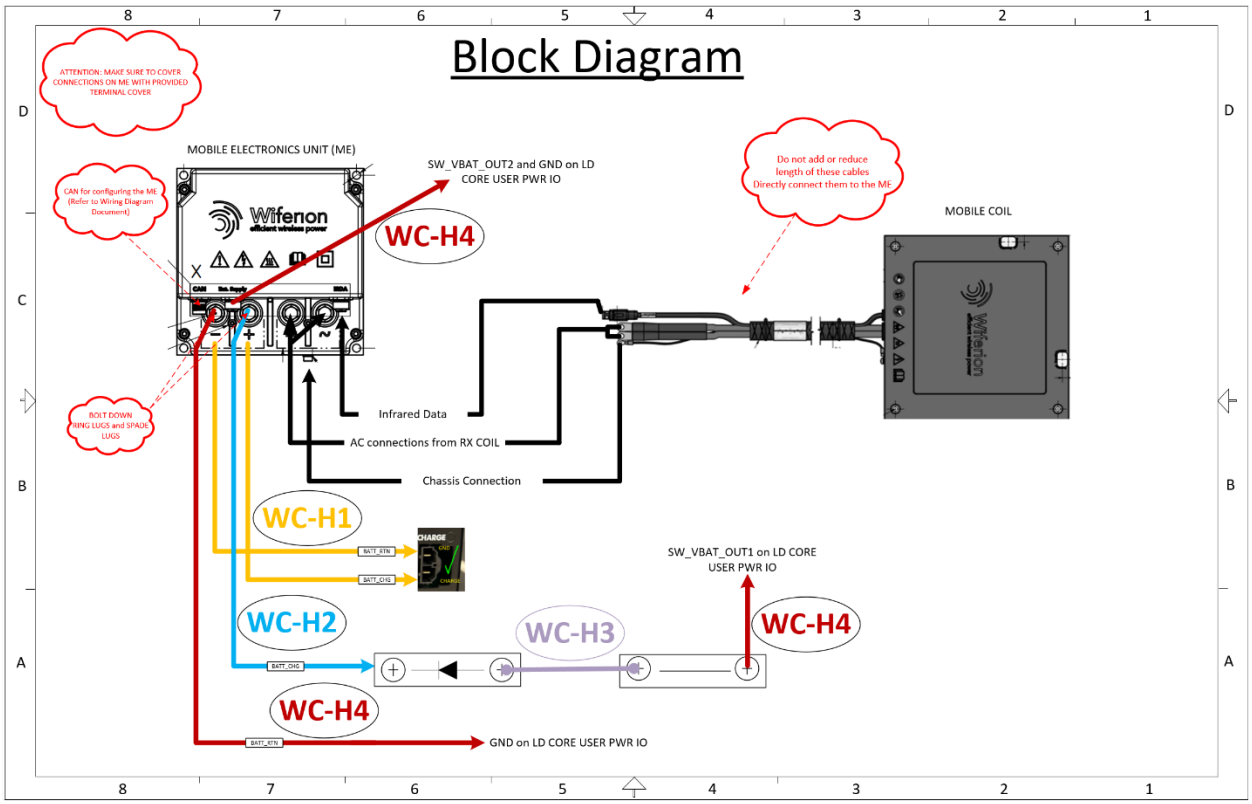
If you wish to switch back to charging with contact-type LD docking station, the original connector must be plugged back into the CHARGE port.

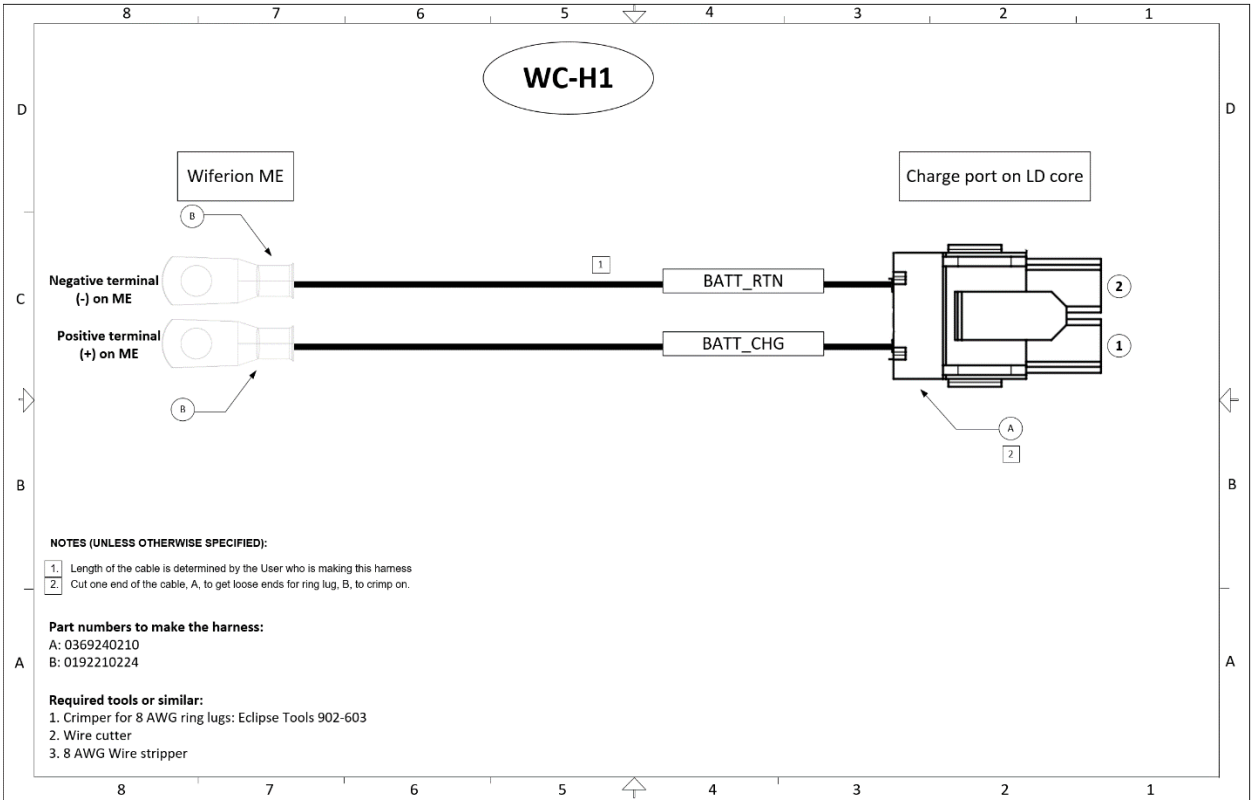
This mechanism ensures wireless charging and contact-type charging will not happen at the same time.

2.4.2 Required Detailed Wiring Schematic and Drawing









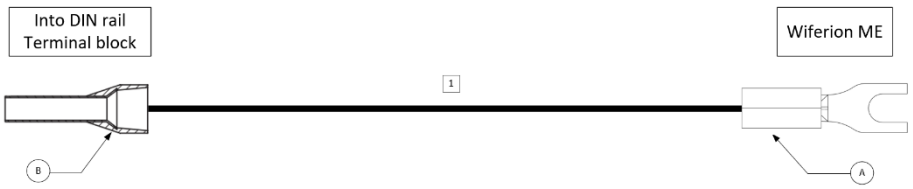
NOTES (UNLESS OTHERWISE SPECIFIED):

1. Length of the cable is determined by the User who is making this harness
2. Cut one end of the cable, A, to get loose ends for ring lug, B, to crimp on.

Part numbers to make the harness:
A: 0369240210
B: 0192210224

Required tools or similar:
1. Crimper for 8 AWG ring lugs: Eclipse Tools 902-603
2. Wire cutter
3. 8 AWG Wire stripper

WC-H2



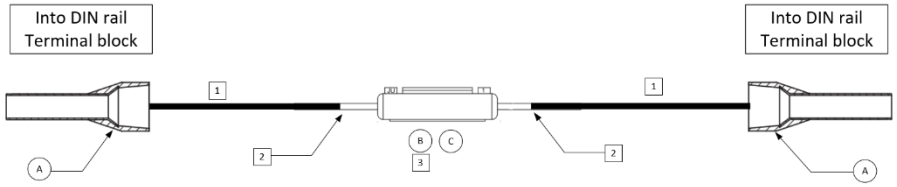
NOTES (UNLESS OTHERWISE SPECIFIED):

1. Length of the 18 AWG wire is determined by the User who is making this harness

Part numbers to make the harness:
A: 34541
B: 3200742

Required tools or similar:
1. Crimper for spade lugs: Klein tools 3005CR
2. Wire cutter
3. 18 AWG Wire stripper
4. Crimper for Ferrules: Phoenix Contact 1212034

WC-H3

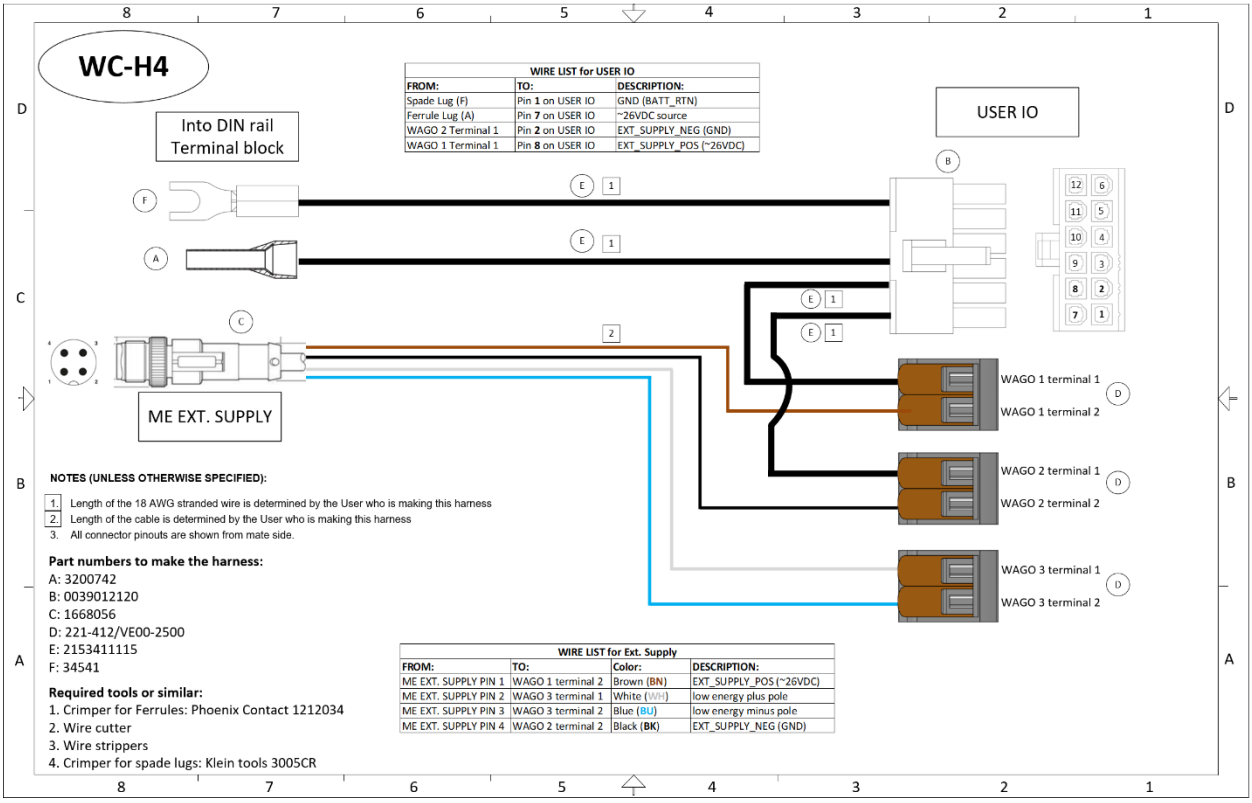


NOTES (UNLESS OTHERWISE SPECIFIED):

1. Length of the 18 AWG stranded wire is determined by the User who is making this harness.
2. Solder the stripped ends of the fuse holder to the stripped ends of 18 AWG wires. The soldered joints must be covered with heat shrink or electrical tape.
3. Place the 3A fuse cartridge inside the fuse holder.

Part numbers to make the harness:
A: 3200742
B: 0ADBC3000-BE
C: BF310

Required tools or similar:
1. Crimper for Ferrules: Phoenix Contact 1212034
2. Wire cutter
3. 18 AWG Wire stripper
4. Soldering equipment and kit



WIRE LIST for USER IO		
FROM:	TO:	DESCRIPTION:
Spade Lug (F)	Pin **1** on USER IO	GND (BATT_RTN)
Ferrule Lug (A)	Pin **7** on USER IO	~26VDC source
WAGO 2 Terminal 1	Pin **2** on USER IO	EXT_SUPPLY_NEG (GND)
WAGO 1 Terminal 1	Pin **8** on USER IO	EXT_SUPPLY_POS (~26VDC)

NOTES (UNLESS OTHERWISE SPECIFIED):

1. Length of the 18 AWG stranded wire is determined by the User who is making this harness
2. Length of the cable is determined by the User who is making this harness
3. All connector pinouts are shown from mate side.

Part numbers to make the harness:

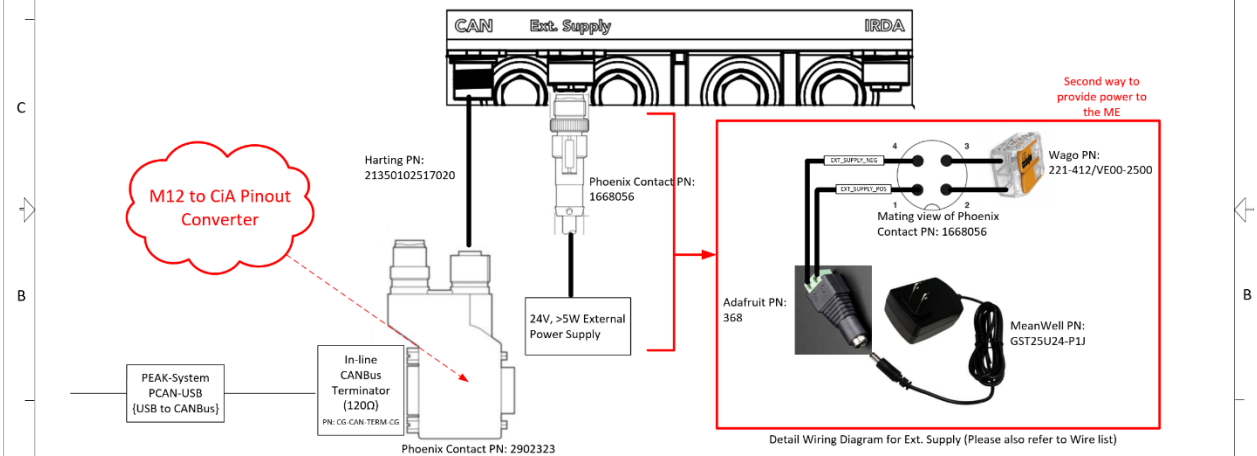
A: 3200742
B: 0039012120
C: 1668056
D: 221-412/VE00-2500
E: 2153411115
F: 34541

Required tools or similar:

1. Crimper for Ferrules: Phoenix Contact 1212034
2. Wire cutter
3. Wire strippers
4. Crimper for spade lugs: Klein tools 3005CR

WIRE LIST for Ext. Supply			
FROM:	TO:	Color:	DESCRIPTION:
ME EXT. SUPPLY PIN 1	WAGO 1 terminal 2	Brown (**BN**)	EXT_SUPPLY_POS (~26VDC)
ME EXT. SUPPLY PIN 2	WAGO 3 terminal 1	White (WH)	low energy plus pole
ME EXT. SUPPLY PIN 3	WAGO 3 terminal 2	Blue (**BU**)	low energy minus pole
ME EXT. SUPPLY PIN 4	WAGO 2 terminal 2	Black (**BK**)	EXT_SUPPLY_NEG (GND)

PROGRAMMING THE ME UNIT



WIRE LIST for Ext. Supply			
FROM:	TO:	Color:	DESCRIPTION:
PIN 1	(+) Terminal of adafruit PN 368	Brown (BN)	EXT_SUPPLY_POS (24VDC)
PIN 2	PIN 3	White (WH)	low energy plus pole
PIN 3	PIN 2	Blue (BU)	low energy minus pole
PIN 4	(-) Terminal of adafruit PN 368	Black (BK)	EXT_SUPPLY_NEG (GND)

2.5 Battery Characteristics and Wiferion Settings

On a perfectly balanced battery pack, the minimum operating voltage is 20 V (2.5 V per cell). However, in practice the battery may report 0% State of Charge at 24 V (3 V per cell) to have some buffer charge to prevent the battery from becoming unusable.

The absolute maximum the pack voltage could reach without turning off is 28.8 V.

When the battery is charged by the OMRON charger, the typical transition point from Constant-Current (CC) charging to Constant-Voltage (CV) charging is 27.8 V (or lower), up to 28.2 V.

The battery is designed to be charged with no more than 20 A.

The battery implements passive balancing internal to the pack and is designed to work with a supply that can provide low currents without turning off (<200 mA).

The battery pack has a nominal resting voltage of 25.6 V.

The BlueConfig Software settings that OMRON used in this development project are shown in the table below. For more instructions on how to configure these settings in BlueConfig Software, refer to *Wiferion Software and Configuration Manual* (Document No: KD100612).

Name	**Value**	**Description**
BMS Type	No external control	Static Mode – Charging parameters stored in the Mobile Electronics
U_{min}	20.0 V	Any battery voltage lower than this, the Wiferion ME will refuse to provide charging current
U_{max}	29.0 V	Any battery voltage above this, the Wiferion ME will refuse to provide charging current
U_{charge}	28.0 V	The transition point from CC to CV charging
I_{charge}	20.0 A	The standard constant current limit for charging
I_{min}	0.5 A	The Wiferion ME will stop charging when current draw drops below this threshold
$U_{restart}$	27.4 V	Once the Wiferion ME has stopped charging if the voltage drops below this threshold, charging can restart

For connecting to the CAN port on the ME unit, refer to Section 1.1 *BOM for Configuring the ME (CAN on ME*). This information is needed to program the ME unit.

The ME electronics must be powered for configuration. This can be done either by triggering custom I/O "SW_VBAT_OUT2" ON with MobilePlanner (Refer to Section 4 *Software Settings and Configuration* for more details) or by using the external 24 V power supply shown in the *Programming the ME Unit* drawing in Section 2.4.2 *Required Detailed Wiring Schematic and Drawing*. Refer to Section 1.2 *BOM for Externally Providing Power to the ME (EXT. Supply port on ME) for Configuring* for BOM needed for the external 24 V power supply.

2.6 Alignment and Installation of Mobile and Stationary Unit

The stationary coil and the mobile coil must be parallel to each other where their IrDa interfaces are aligned and facing each other.

- Both coils must be installed at the same height so that the IrDa windows (c) (d) face each other.

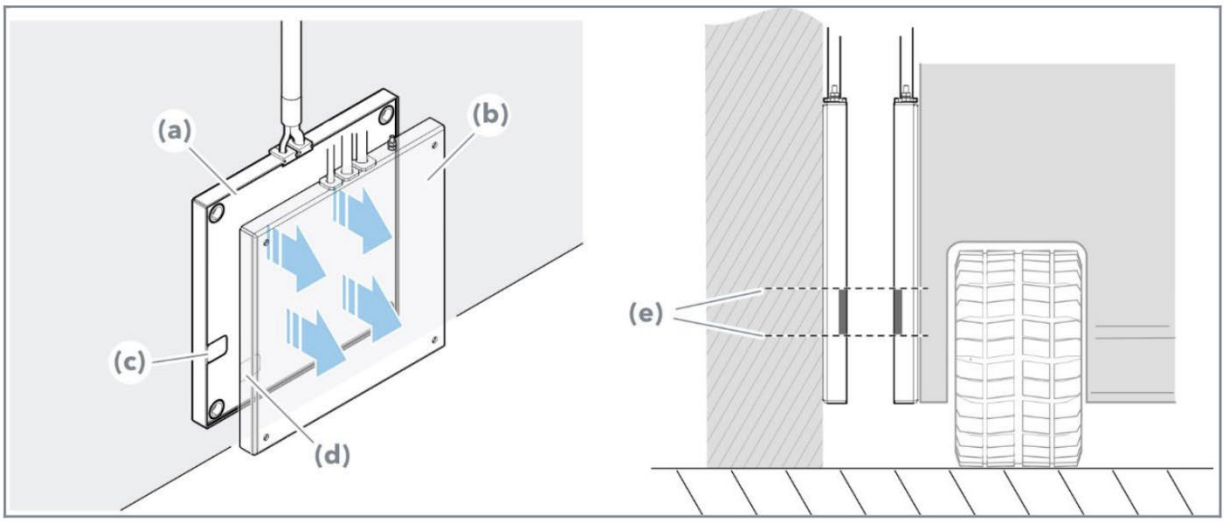


Fig 9 – Installing the stationary coil

(a) Stationary coil
(b) Mobile coil
(c) Stationary coil IrDa interface
(d) Mobile coil IrDa interface
(e) IrDa interface positions

The optimum gap between the stationary coil and the mobile coil is 15 to 40 mm as stated in Specification for etaLINK 3000 on PULS Wiferion website.

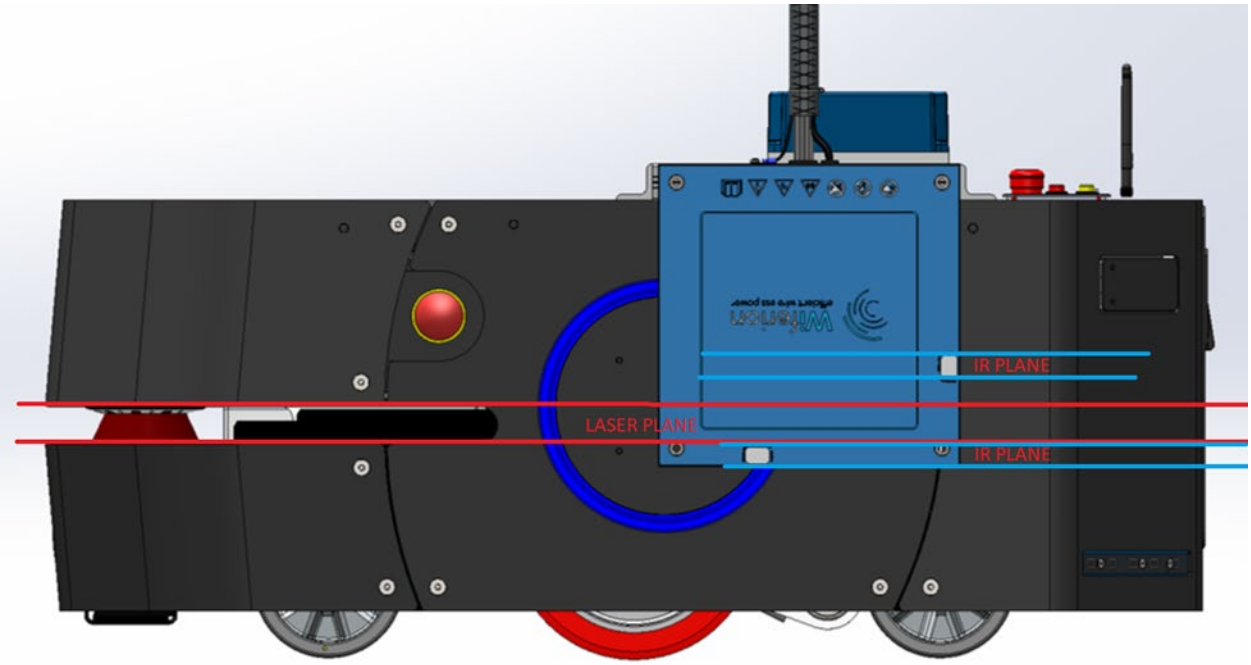
Specifications etaLINK 3000

etaLINK 3000	
Continuous charging power	3000 W
Charging voltage	15 – 60 V
Charging current	60 A
Protection class	IP65 und IP68
Optimum distance	15 – 40 mm
Position tolerance	+/– 30 mm

Download the Specificationsflyer

More information regarding installing and assembling the mobile and stationary units can be found in *Wireless Charging System etaLINK 3000 Operating Instruction Manual* (Document No.: KD 100801).

Application Guideline



The picture above is a reference design for explaining the concept of interference. In some installations, there have been reports that the infrared (IR) sensors on the Wiferion coils interact with lasers on the AMR. Proper care must be taken in the mechanical design phase such that the IR sensors of Wiferion do not coincide with AMR's laser sensing plane, as illustrated in the picture. There is a possibility that other IR sensors like side lasers/optical sensors may interact with this sensor as well. The application should avoid having IR sensors directly facing the IR plane of Wiferion coils. Failure to comply will lead to one of the following behaviors:

- AMR will start seeing ghost laser readings.
- Wireless charging will not start reliably, even after proper alignment.

3 LD Battery Firmware Change

To accommodate reliable wireless charging using Wiferion, OMRON has implemented the following two firmware changes to the LD battery (shown in the table below). It is required to update the firmware of the battery (PN: 20542-700) if the revision is older than AC. See *Application Guideline* in this section for more details.

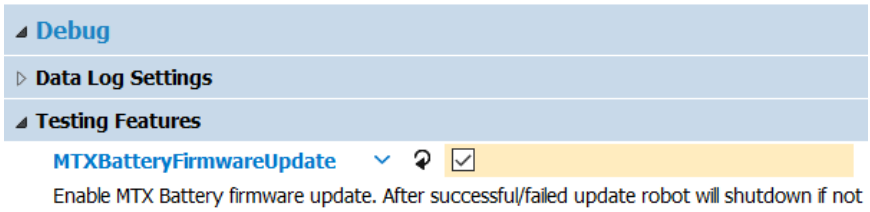
3.1 Firmware Changes

	Current firmware	New and updated firmware
Change 1 (Charge pin presented voltage to allow charging)	27.5 V to 30.3 V	21 V to 30.3 V
Change 2 (Charge FET ON time)	10 seconds	11 seconds

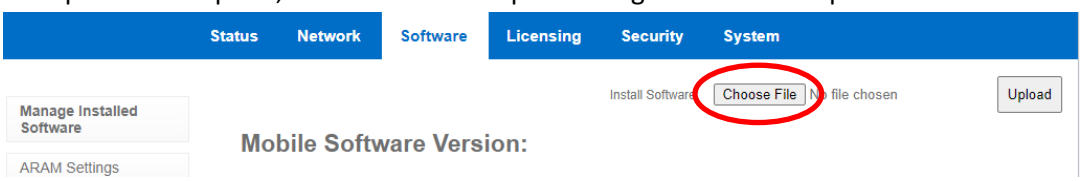
Application Guideline

LD batteries with PN: 20542-700 and revision AC will have these two changes implemented. For batteries shipped prior to this with the same part number, field upgrade will be necessary to get these changes. The minimum version of battery firmware that would have these changes is MTXBatteryV3-2.1.0. The minimum supported FLOW version to perform the update is FLOW 4.0.3. It is required to follow the procedure given below to update the battery firmware to the required version:

1. In MobilePlanner, enable the *MTXBatteryFirmwareUpdate* parameter in the AMR's configuration.



2. Dock the AMR at a docking station, if available. If the AMR is not docked during the update, the AMR will shut down after the update and you will need to turn it back on. Not docking the AMR during the update will not affect the update process.
3. Upload the firmware file package through the SetNetGo interface (like a FLOW package). Once the upload is complete, the AMR will start performing the firmware update.



4. Successful complete bootup of the AMR after the restart will prove that the firmware update is completed. ARAM logs will also have traces of the update being successful.

4 Software Settings and Configuration

This section provides guidance on a method to control the user power using the peripheral power output feature. This section also discusses the use of the newly-added parameters from FLOW Core 4.0.3 that allow additional flexibility in the charge management of AMR platforms. Additionally, there are some application guidelines based on internal testing to perform reliable wireless charging for opportunity charging, long term charging and balancing.

For opportunity charging/short term charging, the Wiferion stationary electronic charger (SE) is set as a goal, and you can create macros to send the AMR to charge at the SE charger.

For “Docked” state charging/long term charging/balancing, the SE charger is set as a docking station, and you can simply dock the AMR there.

4.1 Peripheral Power Digital Output

Peripheral Power Digital Output is a software feature that allows you to interact with peripheral power lines like a digital output. All the peripheral power outputs are ON by default. If you need to turn ON and turn OFF the wireless charger on demand, it needs to be configured as shown below:

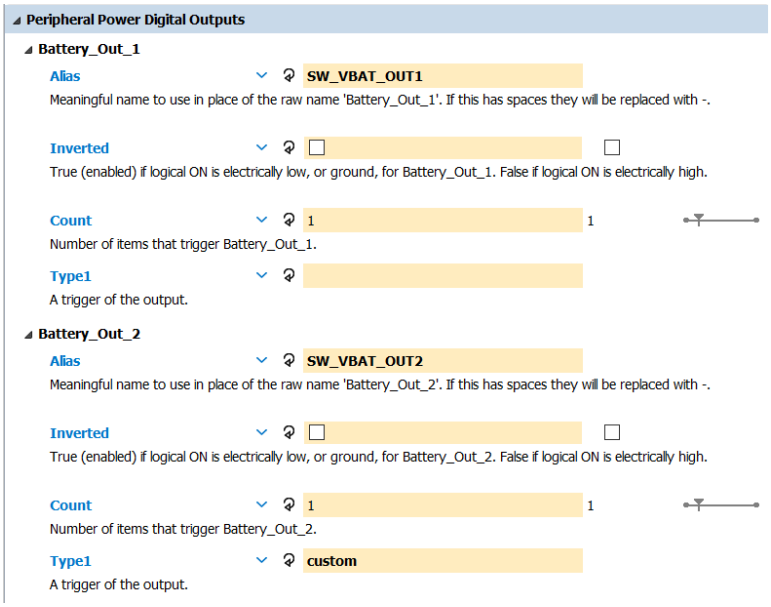


Fig. Configuration of Peripheral Power Digital Output on Mobile Planner

- **Alias:** This is a meaningful name used to replace the default.
- **Inverted:** This inverts the functionality. If enabled, ON would be low and OFF would be high.
- **Count:** This is the number of trigger types for the output.

- **Type:** The triggers for the output. This should be set to *custom*.

Once the above configuration is set, it can then be controlled in two ways: Either through ARCL commands or through MobilePlanner tasks, as mentioned below. Toggling the power inside a macro using a MobilePlanner task is simpler compared to the ARCL command method.

4.2 ARCL Commands

The input/outputs must be a *custom* type to be manipulated by this method. Hence you will not see inputs/outputs that do not have a *custom* type set up on the list, and these cannot be manipulated using ARCL.

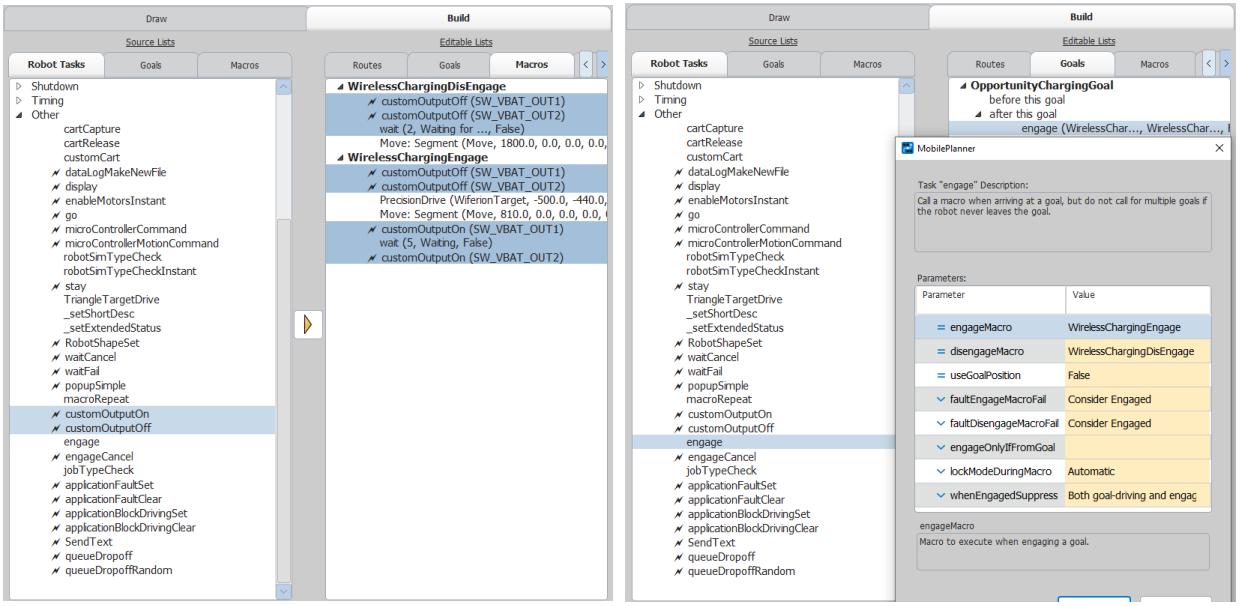
- **outputList**: Lists the named outputs [outL]
- **outputOff**: Turns off a named digital output [outOff]
- **outputOn**: Turns on a named digital output [outOn]
- **outputQuery**: Queries the state of a named output [outQ]

4.3 MobilePlanner Tasks

The input/outputs must be a *custom* type for it to be manipulated by this method. Hence you will not see inputs/outputs that do not have a custom type set up on the list, and these cannot be manipulated using these tasks. With this method the output can be turned ON when at the wireless charging station, and turned OFF during startup and before leaving wireless charging station.

Application Guideline

For opportunity charging, it is recommended to use the *engage* task (requires enable in Configuration tab) under the goal so that the AMR is prevented from rotating when at the charger. You must also use *customOutputOn* and *customOutputOff* to properly toggle the I/Os (SW_VBAT_OUT1 and SW_VBAT_OUT2).



To start charging reliably for opportunity charging, the timing of the I/Os needs to be controlled in a certain way (as explained in the previous section). To achieve this reliability, it is required to trigger the I/Os in the sequence shown in the previous figure. These are some key points to note:

- Before moving towards the target, make sure both SW_VBAT_OUT1 and SW_VBAT_OUT2 are off.
- After the AMR is stopped with charging coils facing each other, follow this sequence:
    - Turn on SW_VBAT_OUT1.
    - Wait for 5 seconds.
    - Turn on SW_VBAT_OUT2.
- Before moving out, turn off both SW_VBAT_OUT1 and SW_VBAT_OUT2.

Following the points above will ensure the charging is started right within 5-10 seconds of alignment for opportunity charging. Having the output turned off during startup and when leaving charger might be beneficial because the AMR would then show the correct status on the skin LEDs, rather than displaying green all the time. However, if you push the AMR to the wireless charging station or restart/turn ON the AMR on the wireless dock, it might not start charging automatically. You need to turn ON the I/O manually in these cases to start charging.

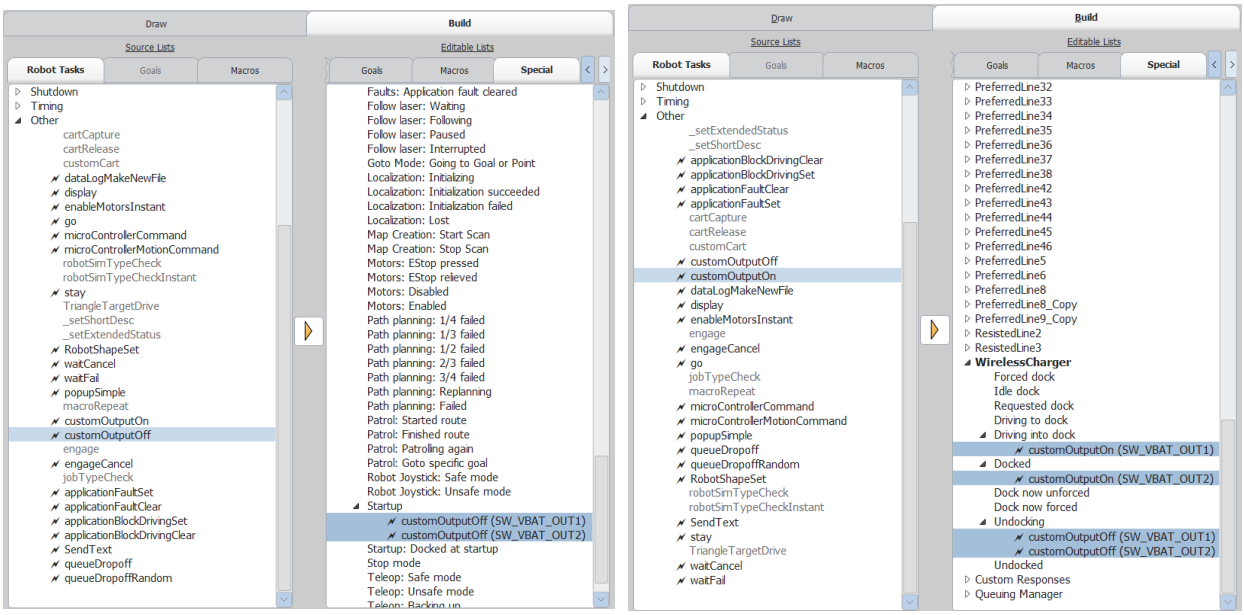
Application Guideline

To start charging reliably for docked state/long-term/balancing charging, it is required to trigger the I/Os in the sequence shown in the below figure. These are some key points to note:

- Before moving towards the target, make sure both SW_VBAT_OUT1 and SW_VBAT_OUT2 are off.
- Before docking, under *Driving into dock,* turn on SW_VBAT_OUT1.
- After docking, under *Docked*, turn on SW_VBAT_OUT2.
- Before moving out, turn off both SW_VBAT_OUT1 and SW_VBAT_OUT2.

Following the points above will ensure charging starts within 120 seconds. This is the case if the AMR State of Charge is below 97.5% and the AMR is sent to dock at the wireless charging station using the Dock command for long-term/balancing charging.

If the AMR's State of Charge is above 97.5% or the AMR is left at the wireless charger for battery balancing, charging will start within approximately 35 minutes for the first few rounds of balancing the battery.



Having the output turned off during startup and when leaving charger might be beneficial because the AMR would then show the correct status on the skin LEDs, rather than displaying green all the time. However, if you push the AMR to the wireless charging station or restart/turn ON the AMR on the wireless dock, it might not start charging automatically. Having the *customOutputOn* for SW_VBAT_OUT1 under *Docked* or *Startup: Docked at startup* state will not work, as this would create a causality dilemma. You must turn ON the I/O manually in these cases to start charging. This must be covered as part of end user/operator training.

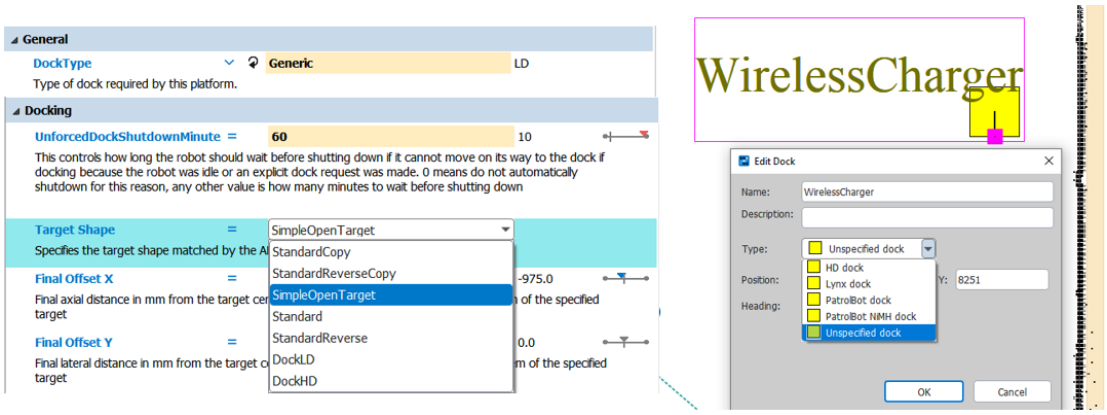
4.4 New Configuration Parameters (Requires FLOW Core 4.0.3 and Above)

1. General -> DockType -> Generic
2. Testing Features -> DisableChargerCheck

4.5 Usage Details

1. General -> DockType -> Generic

A new dock type named “Generic” is added to the configuration.



Advantages:

- When this new dock type is selected, you are given the ability to select the docking target shape. This can be defined in the *Target Definition* section.
- Existing docking strategies in the *Auto Dock* feature can be used with wireless chargers.

Disadvantages:

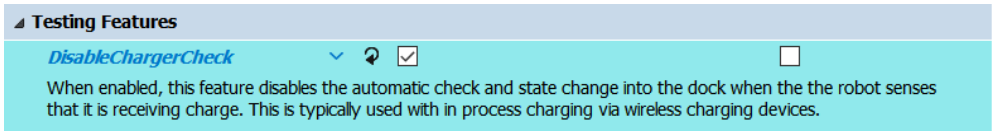
- There needs to be a single target definition for the dock, docking and undocking routine. Hence, this would prevent the AMRs from docking to the standard LD dock.

Application Guideline

If the application only uses wireless charging as opportunity charging and relies on LD contact dock for long-term/balancing charging, it is advised to use the second feature instead of this feature. Note that it is only possible to use either LD or Generic as dock type and not both.

2. Testing Features -> DisableChargerCheck

This feature disables functionality of the AMR to actively check and switch to Docked state when it starts receiving a charge.



Advantages:

- This prevents the AMR from switching to Docked state when it receives a charge in each wireless charger/goal. This will allow the AMR to continue with the jobs without any interruptions. (Note: Intermediate docking state will force the undocking routine before next job.)
- Any residual voltage from the wireless charger will be ignored by the AMR when it has not gone through the docking routine.

Disadvantages:

- When the AMR is manually pushed into the dock/wireless charger, the AMR will not switch to the Docked state. Hence, it will skip the undocking routine before the next job.
  (Note: The AMR may decide to rotate in place at the dock to head to the next goal. To prevent this from happening, you must push it manually out of the dock to a place where it is safe to rotate in place.)

Application Guideline

Another way to prevent the state switching is by using the *engage* task, and *engage* and *disengage* macros. However, there could be some corner cases where the AMR could still switch states at these goals. The frequency of relying on automatic dock vs. manual dock needs to be considered here. If manual dock is required for the application, ensure the drawbacks of this feature are well understood. Proper steps to manually charge the AMR would then be:
E-Stop button pressed -> Push AMR to Dock -> Done charging -> Push AMR to clear space -> Release E-Stop button

Omron Warranty Policy

1. Omron maintains its standard warranty for AMR after installation of wireless charging function provided the end user's strict adherence to the bill of material, installation instruction, and warnings/notations detailed within this technical support document, no deviation allowed. In case of material obsolescence, please contact Omron Product Support for acceptable alternatives.

   Note: End user to maintain written confirmation (i.e. email, meeting minutes, etc.) on agreement of alternative components. Warranty to AMR may be void if no agreement is on record.

2. Installation of PULS/Wiferion wireless charger (ME module) onto AMR must ensure AMR functions are not affected. Omron warranty place priority on restoring AMR functions and may require changes to ME module installation.
3. Omron's standard warranty applies only to Omron's AMR, and does not include components used in assembling the actual wireless charging apparatus. For warranty inquiries of wireless charging components, please contact each component's customer support.
4. As part of its standard warranty disposition process, Omron retains the right to request shipment of suspected AMR failed components back to the factory for detailed analysis. AMR damage due to improper construction, connection, usage, and/or environment remains excluded from AMR warranty.

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