OMRON

Programmable Multi-Axis Controller

Startup Guide
for Serial Encoder BiSS-C/EnDAT 2.1/2.2/1S Motor

CK3M-CPU1□1
CK3W-ECS300

O051-E1-01

NOTE

Trademarks

Copyrights

Sections in this Manual

CONTENTS

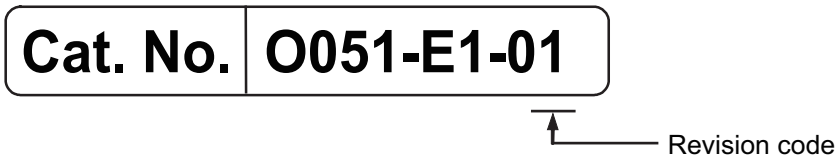
Related Manuals

To safely use the system, obtain manuals or user's guides for devices and equipment that make up the system, and confirm and understand the precautions related to safety such as "Safety Precautions" and "Precautions for Safe Use", and other contents of the manuals or user's guides, including "Precautions for Correct Use", before use.
The manuals provided by OMRON Corporation (hereinafter, "OMRON") and Delta Tau Data Systems Inc. (hereinafter "DT") are as shown below.

Manufacturer	Cat. No.	Model	Manual name
OMRON	O036	CK3M-CPU1□1 CK3W-ECS300	Programmable Multi-Axis Controller Hardware User's Manual
DT	O014	---	Power PMAC User's Manual
DT	O015	---	Power PMAC Software Reference Manual
DT	O016	---	Power PMAC IDE User's Manual

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.



Revision code	Date	Revised content
01	May 2021	Original production

Terms and Definitions

Term	Description and definition
PMAC	An acronym for Programmable Multi-Axis Controller.
Power PMAC IDE	Computer software that is used to configure the Controller, create user programs, and perform monitoring.
Serial Encoder	An encoder that uses communications to perform data transfer.

Precautions

- For actual system construction, check the specifications for devices and equipment that make up the system, use a method with sufficient margin for ratings and performance, and adopt safety circuits and other safety measures to minimize risks even if a breakdown occurs.
- To safely use the system, obtain manuals or user's guides for devices and equipment that make up the system, and confirm and understand the precautions related to safety such as "Safety Precautions" and "Precautions for Safe Use", and other contents of the manuals or user's guides, including "Precautions for Correct Use", before use.
- The customer themselves must check all regulations, laws, and rules that are applicable to the system.
- No part or the whole of this document may be copied, duplicated, or redistributed without the permission of OMRON Corporation.
- The contents of this document are current as of May 2021.
  The contents of this document may be subject to change without notice for the purpose of improvement.

Special information in this document is classified as follows:

Precautions for Correct Use

Precautions on what to do and what not to do to ensure correct operation and performance.

1

Introduction

This section provides an introduction of this document.

1-1 Summary

This document summarizes the procedures and confirmation methods for connecting a Serial Encoder that supports the BiSS-C, EnDAT2.1/2.2, or 1S Motor serial communications protocol with the OMRON Programmable Multi-Axis Controller CK3M-CPU1□1 (hereinafter called “Controller”). Understanding the settings and key points of the setting procedures described in *Section 3 Serial Encoder Connection Procedures* on page 3-1, helps you configure the Controller to communicate with a Serial Encoder that supports each protocol and receive absolute position information.

1-1-1 Intended Audience

This guide is intended for the following personnel, who must also have knowledge of electrical systems (electrical or the equivalent).

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- Personnel in charge of managing FA systems and facilities.

Also, this guide is intended for personnel who understand the contents described in the DT manual.

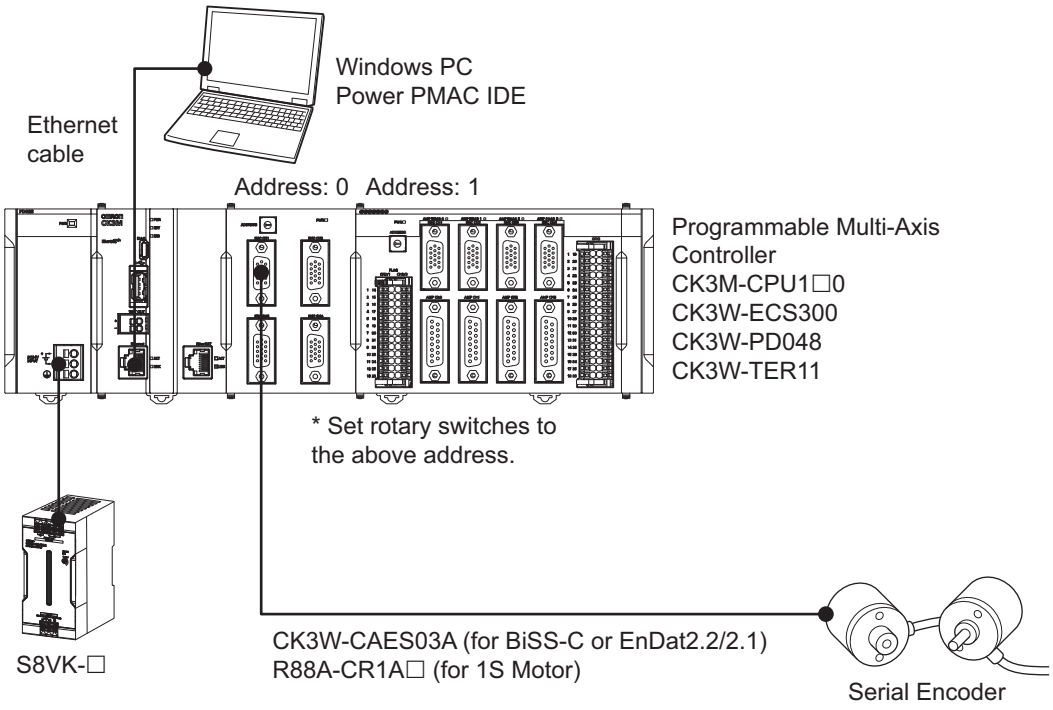
2

Device Configuration

This section describes the configuration of devices.

2-1 Device Configuration

The configuration devices for reproducing the connection procedures in this document are shown below.



Manufacturer	Name	Model	Version
OMRON	Programmable Multi-Axis Controller CPU Unit	CK3M-CPU1□1	Ver. 2.6.1 or later
OMRON	Programmable Multi-Axis Controller Axis Interface Unit	CK3W-ECS300	---
OMRON	Programmable Multi-Axis Controller Power Supply Unit	CK3W-PD048	---
OMRON	Programmable Multi-Axis Controller End Cover	CK3W-TER11	---
HEIDENHAIN	Serial Encoder (EnDat2.1/2.2)	ROQ437	---
Renishaw	Serial Encoder (BiSS-C)	RL26□	---
OMRON	Servomotor	R88M-1S□	---
OMRON	Encoder Cable	R88A-CR1A□	---
OMRON	Switch Mode Power Supply	S8VK-□	---
OMRON	Encoder Cable	CK3W-CAES03A	---
---	Windows PC	---	---
DT	Power PMAC Setting Tool	Power PMAC IDE	Ver. 4.5 or later

3

Serial Encoder Connection Procedures

This section describes the procedures to connect the Controller and Serial Encoder.
The description assumes that the Controller is set to factory default.

3-1 Work Flow

The procedures for connecting the Controller and Serial Encoder are shown below.

***3-2 Controller Setting Preparations* on page 3-3**	Perform the Controller setting preparations.
▼	
3-2-1 Creation of a New Project on page 3-3	
▼	
3-2-2 Controller Initial Setting on page 3-4	
▽	
***3-3 Serial Encoder Wiring* on page 3-6**	Perform wiring for each device.
▽	
***3-4 Various Controller Settings and Checking Operation* on page 3-7**	Perform the Controller settings and operation check.

3-2 Controller Setting Preparations

Perform the Controller setting preparations.
Install the Power PMAC IDE on the PC beforehand.

3-2-1 Creation of a New Project

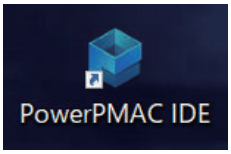
Follow the procedure below to create a new project.

1 Connect the Controller and computer with an Ethernet cable.

2 Turn ON the power supply to the Controller.

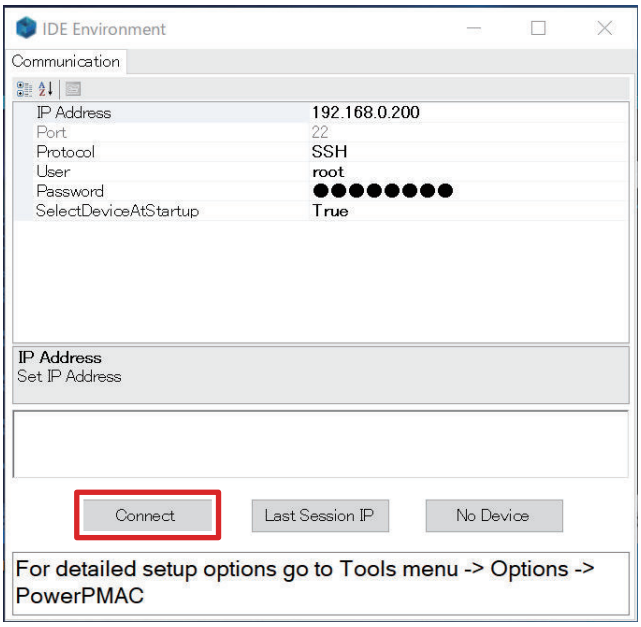
3 Start up Power PMAC IDE.

- If a dialog for checking access rights is displayed at the time of startup, select the option for starting up.

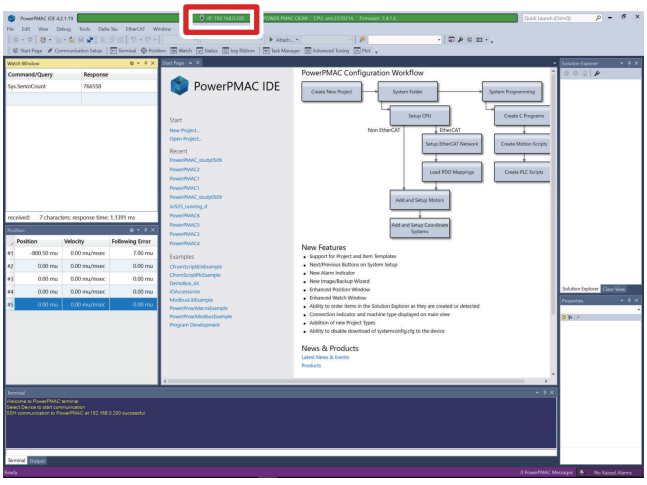


4 The Communication screen is displayed, so specify the IP address of the Controller to be connected to, and click the **Connect** button.

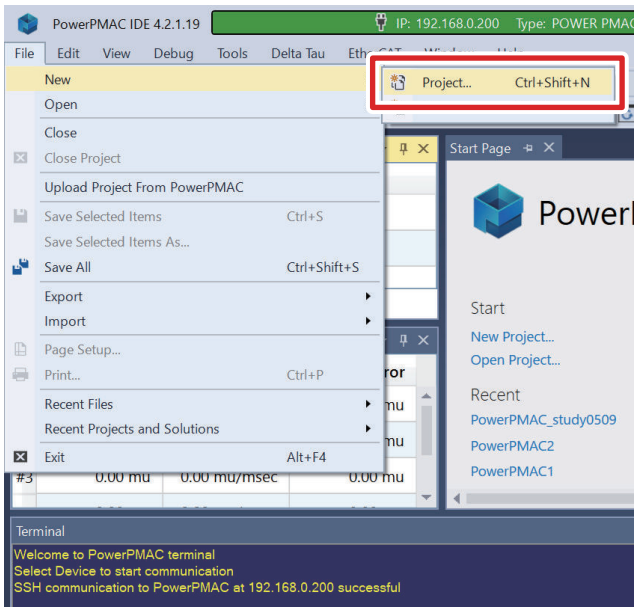
- The default IP address for the Controller is "192.168.0.200".
- If necessary, change the Windows IP address to "192.168.0.X".



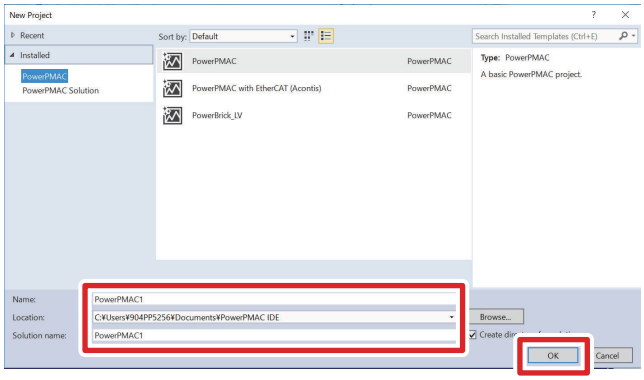
5 Power PMAC IDE starts up, and the Controller will come online.



6 From the **File** menu, select **New** – **Project**.



7 Input a project name and save destination, and select the **OK** button.



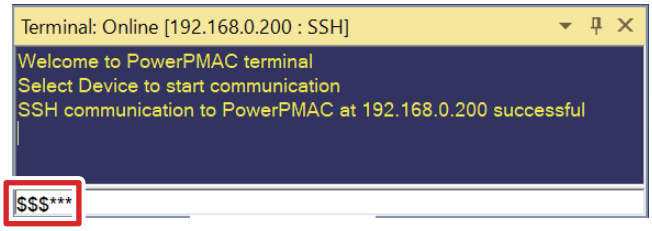
3-2-2 Controller Initial Setting

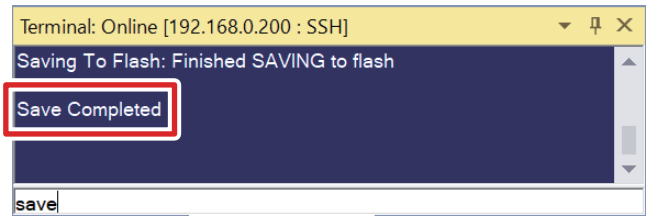
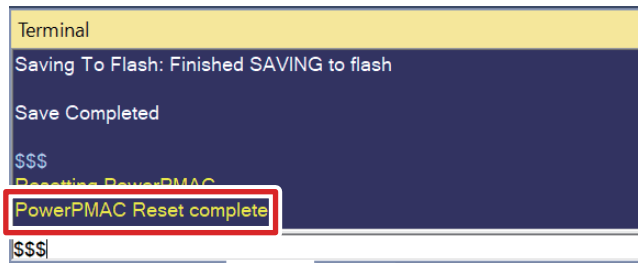
Follow the procedure below to perform the initial settings for the Controller.

Precautions for Correct Use

Since all memory is cleared by the initial settings, be sure to save any data remaining in the Controller that you may need.

1 Type the **$$$*** ** command from the Terminal, and set the Controller to the factory default state.



2	Type the **save** command in the Power PMAC IDE Terminal. • When the save is completed, "Save Completed" is displayed in the Terminal.	
3	Type the **$$$** command in the Power PMAC IDE Terminal. • When the reset is completed, "PowerPMAC Reset complete" is displayed in the Terminal.	

3-3 Serial Encoder Wiring

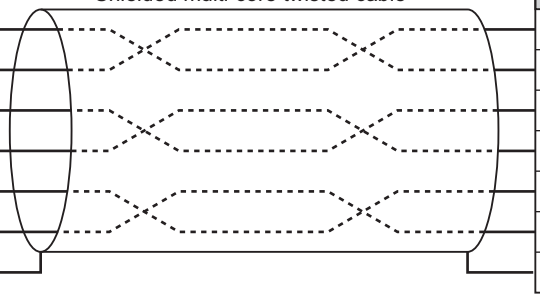
Perform wiring for the Axis Interface Unit and various Serial Encoders in accordance with the wiring diagrams below.

- If BiSS-C Encoder Is Used

CK3W-ECS300
Encoder Connector

Signal	Pin No.
Serial Encoder CLK+	4
Serial Encoder CLK-	9
Serial Encoder DAT+	5
Serial Encoder DAT-	10
Encoder Power Supply (+5 VDC)	12
Encoder Power Supply (GND)	14
Shell	Shell

CK3W-CAES03A
Shielded multi-core twisted cable



RL26□
BiSS-C Encoder Connector

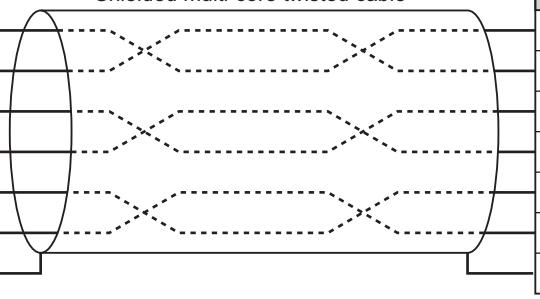
Pin No.	Signal
2	MA+
3	MA-
6	SLO+
7	SLO-
4	+5 V
8	0 V
	FG

- If EnDAT2.1/2.2 Encoder Is Used

CK3W-ECS300
Encoder Connector

Signal	Pin No.
Serial Encoder CLK+	4
Serial Encoder CLK-	9
Serial Encoder DAT+	5
Serial Encoder DAT-	10
Encoder Power Supply (+5 VDC)	12
Encoder Power Supply (GND)	14
Shell	Shell

CK3W-CAES03A
Shielded multi-core twisted cable



ROQ437
EnDAT2.2 Encoder

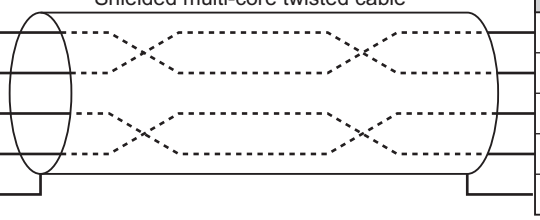
Pin No.	Signal
7	CLK+
6	CLK-
3	DATA+
4	DATA-
8	+ 5 V
5	0 V
-	FG

- If 1S MOTOR Encoder Is Used
  Disconnect the connector on the Servo Drive side of the R88A-CR1A□, and connect the CK3W-ECS300 side of it to the high-density type D sub-15-pin female connector (MIL-C-24308 compliant, lock screw #4-40 UNC).

CK3W-ECS300
Encoder Connector

Signal	Pin No.
Serial Encoder DAT+	5
Serial Encoder DAT-	10
Encoder Power Supply (+5 VDC)	12
Encoder Power Supply (GND)	14
Shell	Shell

R88A-CR1A□
Shielded multi-core twisted cable



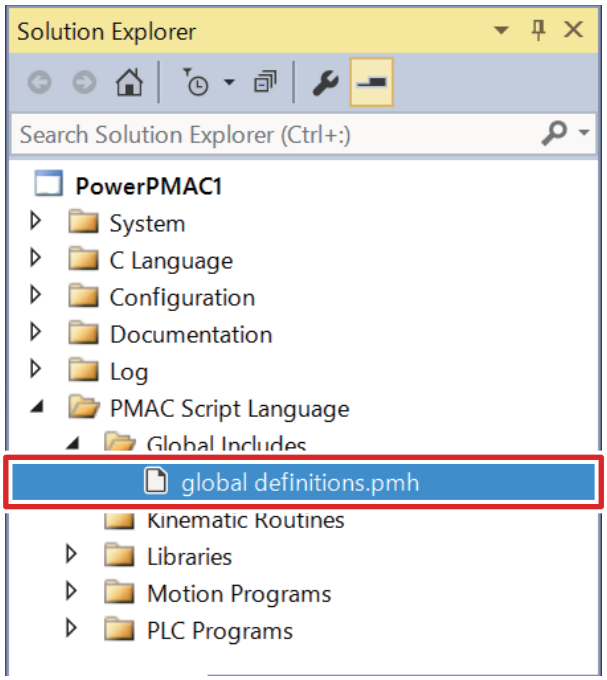
R88M-1S□
1S Motor Encoder

Pin No.	Signal
7	DATA+
4	DATA-
6	+5 V
3	0 V
1	FG

3-4 Various Controller Settings and Checking Operation

Perform the settings for connecting the Controller to the Serial Encoder.

1 Open the **global definitions.pmh** under **PMAC Script Language** – **Global Includes** in the Solution Explorer.



2 Write the text shown on the right to the global definitions.pmh.

The settings are based on the following conditions.

- Phase frequency: 8 kHz
- Servo period: 2 kHz

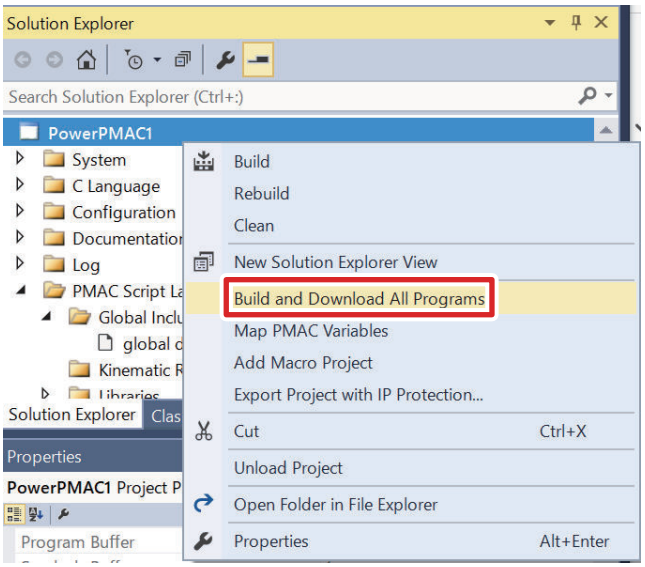
```
Sys.WpKey = $AAAAAAAA

Gate3[1].PhaseFreq=8000
Gate3[1].ServoClockDiv=3
Sys.ServoPeriod=1/2

EncTable[1].type = 1
EncTable[1].pEnc = Gate3[0].Chan[0].SerialEncData
A.a
EncTable[1].ScaleFactor = 1

Motor[1].ServoCtrl = 1
Motor[1].pEnc = EncTable[1].a
Motor[1].pEnc2 = EncTable[1].a

Gate3[0].Chan[0].SerialEncEna = 1
```

	Add the text shown on the right to the global definitions.pmh.
	The settings must be written according to the encoder specifications. For details on the registers, refer to *Power PMAC Software Reference Manual (SBCE-405)* provided by DT.
		For BiSS-C encoders with the following conditions
		• The bit transmission rate is 2 MHz.
		• A trigger is received at the rising edge of every phase clock cycle (no delay).
		• The CRC polynomial is $x^6 + x^1 + 1$.
		• Parity bits and gray codes are not used.
		• 26-bit position data and 2-bit status data are obtained.
		
		`Gate3[0].SerialEncCtrl=$3100000B`
		`Gate3[0].Chan[0].SerialEncCmd=$0021149A`
		
		For EnDAT2.2 encoders with the following conditions
		• The bit transmission rate is 2 MHz.
		• A trigger is received at the rising edge of every phase clock cycle (no delay).
		• The command code is Reporting Position (0x07).
		• 37-bit position data is obtained.
		
		`Gate3[0].SerialEncCtrl=$01000003`
		`Gate3[0].Chan[0].SerialEncCmd=$00071025`
		
		For 1S encoders with the following conditions
		• A trigger is received at the rising edge of every phase clock cycle (no delay).
		• The command code is Position Data (0x00).
		
		`Gate3[0].SerialEncCtrl=$0000000E`
		`Gate3[0].Chan[0].SerialEncCmd=$00001000`

3	To read the absolute position when the power supply is turned ON, add the settings shown on the right to the bottom of the global definitions.pmh file.	• BiSS-C encoders (26-bit position data)
		
		`Motor[1].pAbsPos = Gate3[0].Chan[0].SerialEncDataA.a`
		`Motor[1].AbsPosFormat = $01001A00`
		`Motor[1].AbsPosSf = 1`
		`Motor[1].PowerOnMode = 4`
		
		• EnDAT2.2 encoders (37-bit position data)
		
		`Motor[1].pAbsPos = Gate3[0].Chan[0].SerialEncDataA.a`
		`Motor[1].AbsPosFormat = $01002500`
		`Motor[1].AbsPosSf = 1`
		`Motor[1].PowerOnMode = 4`
		
		• 1S Motor encoder (39-bit position data)
		
		`Motor[1].pAbsPos = Gate3[0].Chan[0].SerialEncDataA.a`
		`Motor[1].AbsPosFormat = $01002700`
		`Motor[1].AbsPosSf = 1`
		`Motor[1].PowerOnMode = 4`

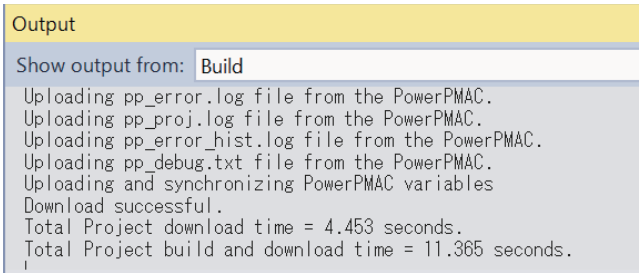
4 Download the project.

Right click on the **Solution Explorer** project name at the upper right of the Power PMAC IDE screen, select **Build and Download All Programs**, and execute Build and Download.



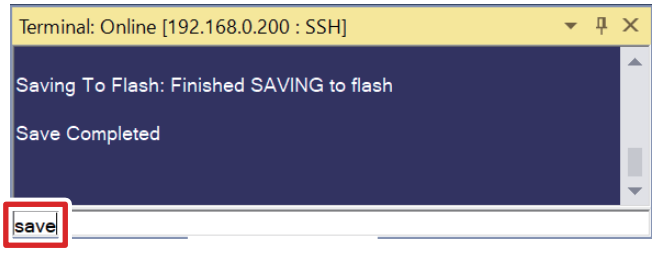
5 Make sure that there are no errors in the Output window.

- If the transfer failed, check the content of the error in the Output window. If it is a program error, fix the program.

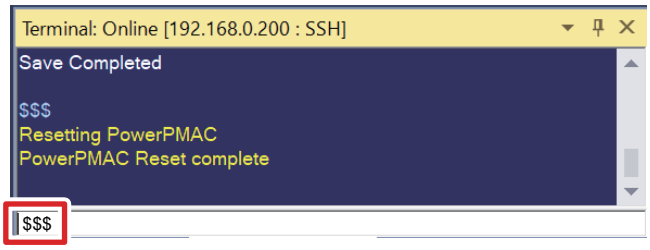


6 Type the **save** command in the Power PMAC IDE Terminal.

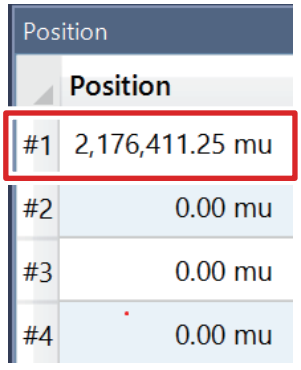
- When the save is completed, "Save Completed" is displayed in the Terminal.



7 Type the **$$$** command in the Terminal.



8 Make sure that the current position is reflected in the Power PMAC IDE Position window.



Precautions for Correct Use

If the **save** command is not successfully completed, the transferred project is not saved in the Controller. If the power to the Controller is switched OFF without the project being saved, the transferred project is destroyed.

4

Serial Encoder Status and Error Information

This section describes the status and error information for various Serial Encoders. This information is stored in Gate3[i].Chan[j].SerialEncDataB. For details, refer to the *Power PMAC Software Reference Manual (SBCE-405)* provided by DT.

4-1 BiSS-C Encoder Error Information

For the BiSS-C encoder, Gate3[i].Chan[j].SerialEncDataB is set as follows.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Error		Status						–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Position							

Bits 30 and 31 represent the communication error bits, which are set as follows, respectively.
Bit 30: CRC error
Bit 31: Timeout error

If a CRC error occurs frequently due to noise, etc. when you monitor each communications error bit with a user program, it is necessary to modify the program so that only three consecutive occurrences of the error are regarded as an error. If the CRC error still occurs frequently even after such a modification of the program, it is assumed that the influence of noise is significant. In this case, reduce the noise level by enhancing the shielding and grounding effects or changing the wiring.

Bits 24 to 29 represent the status data notified by the encoder. The meaning of each bit varies depending on the encoder model. For details, refer to the encoder manual.

Bits 0 to 7 are the upper 8 bits of position data from the encoder.

4-2 EnDAT2.2 Encoder Status and Error Information

For the EnDAT2.2 encoder, Gate3[i].Chan[j].SerialEncDataB is set as follows.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Error			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Position							

Bits 29, 30, and 31 represent the communication error bits, which are set as follows, respectively.
Bit 29: Error bit (For the meaning of this bit, refer to the encoder manual.)
Bit 30: CRC error
Bit 31: Timeout error

If a CRC error occurs frequently due to noise, etc. when you monitor each communications error bit with a user program, it is necessary to modify the program so that only three consecutive occurrences of the error are regarded as an error. If the CRC error still occurs frequently even after such a modification of the program, it is assumed that the influence of noise is significant. In this case, reduce the noise level by enhancing the shielding and grounding effects or changing the wiring.

Bits 0 to 7 are the upper 8 bits of position data from the encoder.

4-3 1S Motor Encoder Status and Error Information

For the 1S Motor encoder, Gate3[i].Chan[j].SerialEncDataB is set as follows.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Error	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Position							

Bits 30 and 31 represent the communication error bits, which are set as follows, respectively.
Bit 30: CRC error
Bit 31: Timeout error

If a CRC error occurs frequently due to noise, etc. when you monitor each communications error bit with a user program, it is necessary to modify the program so that only three consecutive occurrences of the error are regarded as an error. If the CRC error still occurs frequently even after such a modification of the program, it is assumed that the influence of noise is significant. In this case, reduce the noise level by enhancing the shielding and grounding effects or changing the wiring.

Bits 0 to 7 are the upper 7 bits of position data from the encoder.

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