

Programmable Multi-Axis Controller

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

CK5M-CPU1□1

CK3M-CPU1□1

CK3W-ECS300

**Startup
Guide**

NOTE

1. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of OMRON.
2. No patent liability is assumed with respect to the use of the information contained herein.
Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice.
3. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions.
Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

Trademarks

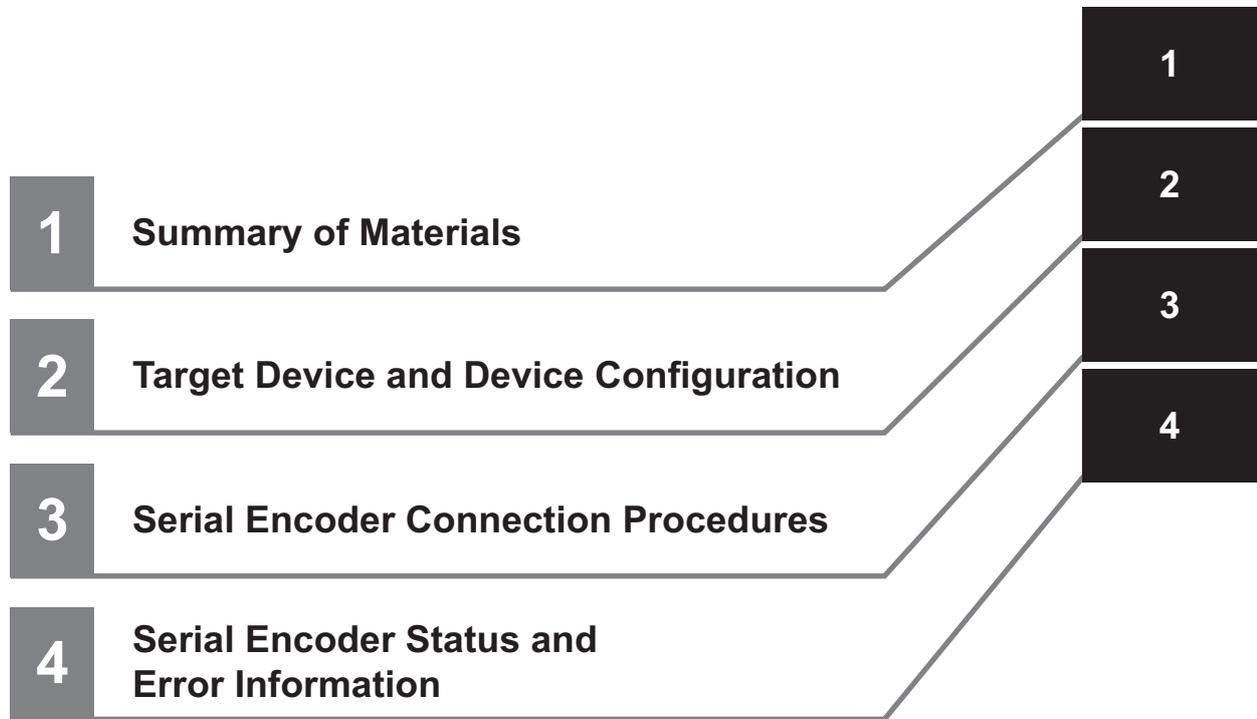
- Microsoft, Windows, Excel, Visual Basic, and Microsoft Edge are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.
- EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Other company names and product names in this document are the trademarks or registered trademarks of their respective companies.

Copyrights

- Microsoft product screen shots used with permission from Microsoft.
- This product incorporates certain third party software. The license and copyright information associated with this software is available at http://www.fa.omron.co.jp/nj_info_e/.

Sections in this Manual



CONTENTS

Sections in this Manual	3
Precautions	5
Related Manuals.....	6
Terms and Definitions.....	7
Revision History.....	8

Section 1 About This Guide

1-1 Introduction	1-2
1-1-1 Intended Audience	1-2

Section 2 Target Device and Device Configuration

2-1 Device Configuration.....	2-2
--------------------------------------	------------

Section 3 Serial Encoder Connection Procedures

3-1 Work Flow.....	3-2
3-2 Controller Setting Preparations.....	3-3
3-2-1 Creation of a New Project	3-3
3-2-2 Controller Initial Setting	3-4
3-3 Serial Encoder Wiring.....	3-6
3-4 Various Controller Settings and Checking Operation	3-7

Section 4 Serial Encoder Status and Error Information

4-1 BiSS-C Encoder Error Information.....	4-2
4-2 EnDAT2.2 Encoder Status and Error Information.....	4-3
4-3 1S Motor Encoder Status and Error Information	4-4

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 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.

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	CK5M-CPU1□1 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

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.

Revision History

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

Cat. No.	O051-E1-02
-----------------	-------------------

↑
Revision code

Revision code	Date	Revised content
01	May 2021	Original production
02	January 2023	<ul style="list-style-type: none">• Revisions due to the addition of the CK5M-CPU1□1• Corrected mistakes.



About This Guide

This section provides an introduction of this document.

1-1	Introduction	1-2
1-1-1	Intended Audience	1-2

1-1 Introduction

This document describes the connecting procedure and confirmation for an OMRON Programmable Multi-Axis Controller CK□M-CPU1□1 (hereinafter referred to as "Controller") and a serial encoder of BiSS-C, EnDAT2.1/2.2, and 1S Motor with serial communication protocols.

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

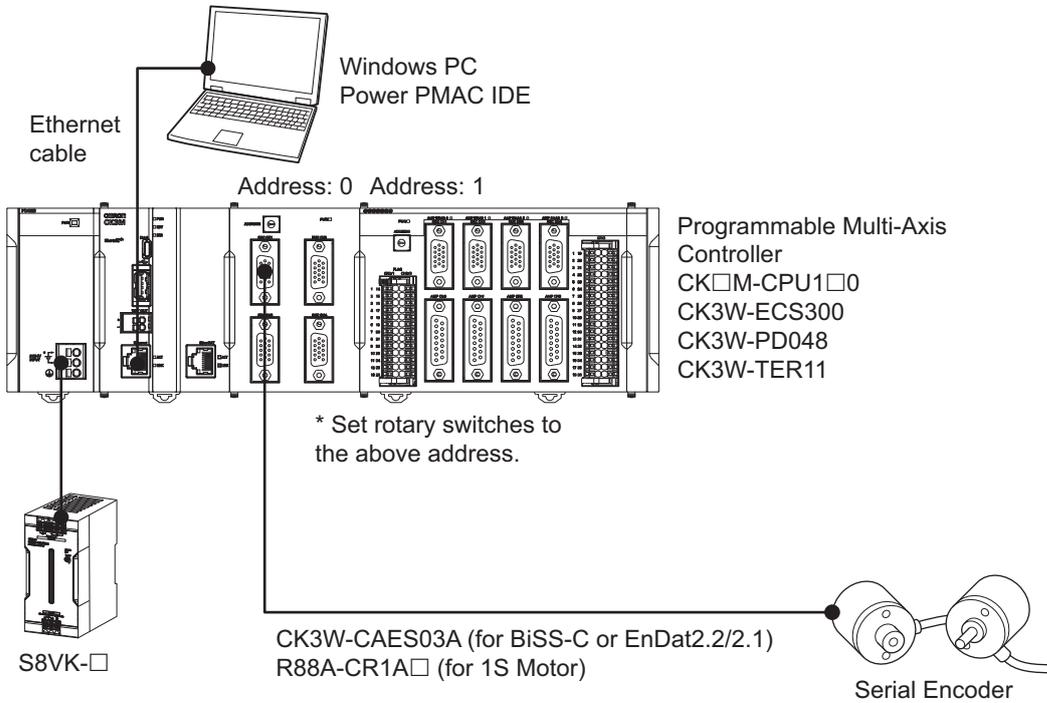
Target Device and Device Configuration

This section lists the target equipment and system configurations for connections in these materials.

2-1	Device Configuration	2-2
------------	-----------------------------------	------------

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	CK□M-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	3-2
3-2	Controller Setting Preparations	3-3
3-2-1	Creation of a New Project	3-3
3-2-2	Controller Initial Setting	3-4
3-3	Serial Encoder Wiring	3-6
3-4	Various Controller Settings and Checking Operation	3-7

3-1 Work Flow

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

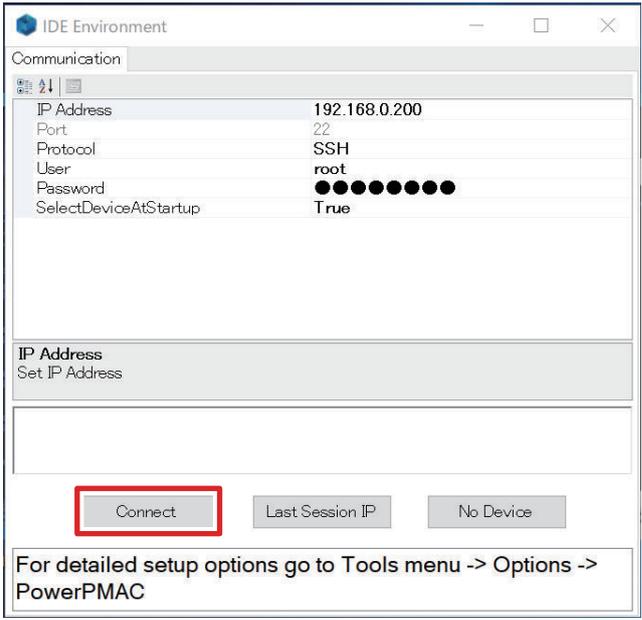
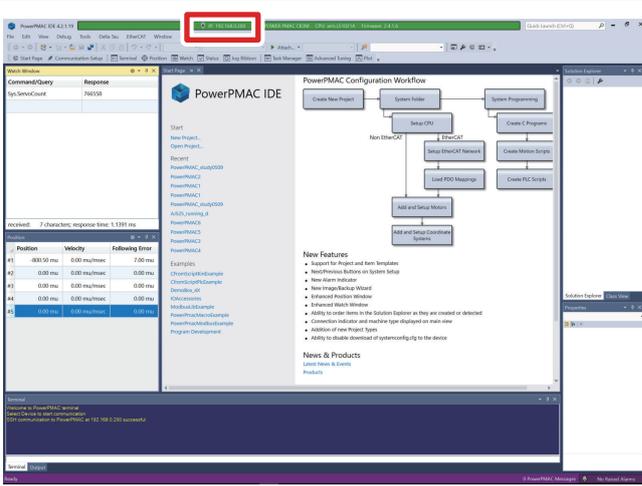
3-2 Controller Setting Preparations on page 3-3	Perform the Controller setting preparations.
▼	
3-2-1 Creation of a New Project on page 3-3	
▼	
3-2-2 Controller Initial Setting on page 3-4	
▽	
3-3 Serial Encoder Wiring on page 3-6	Perform wiring for each device.
▽	
3-4 Various Controller Settings and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

3-2 Controller Setting Preparations

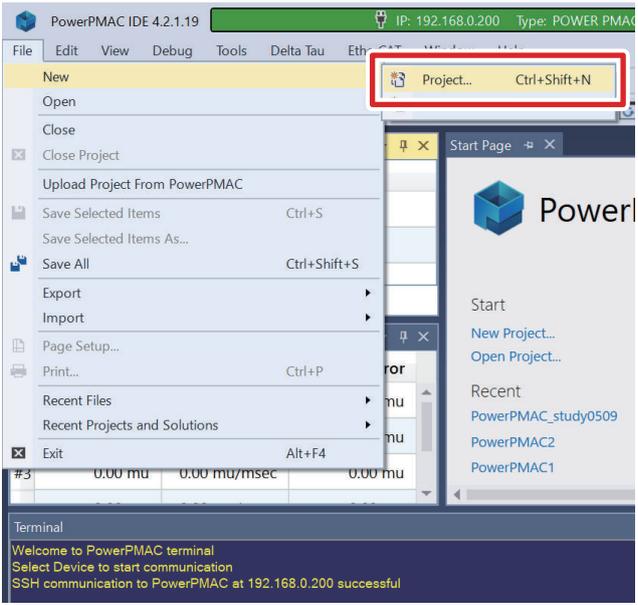
Perform the Controller setting preparations.
Install the Power PMAC IDE on the PC beforehand.

3-2-1 Creation of a New Project

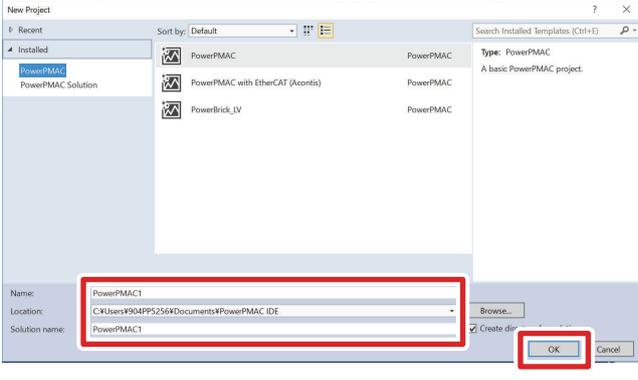
Follow the procedure below to create a new project.

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. <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> The default IP address for the Controller is "192.168.0.200". If necessary, change the Windows IP address to "192.168.0.X". 	 <p>For detailed setup options go to Tools menu -> Options -> PowerPMAC</p>
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.



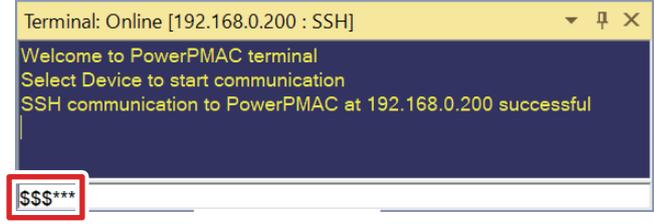
3-2-2 Controller Initial Setting

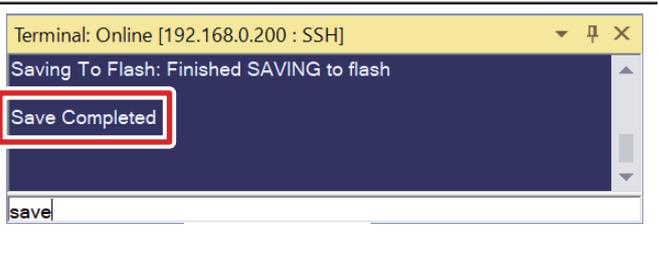
Follow the procedure below to perform the initial settings for the Controller.

 **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.

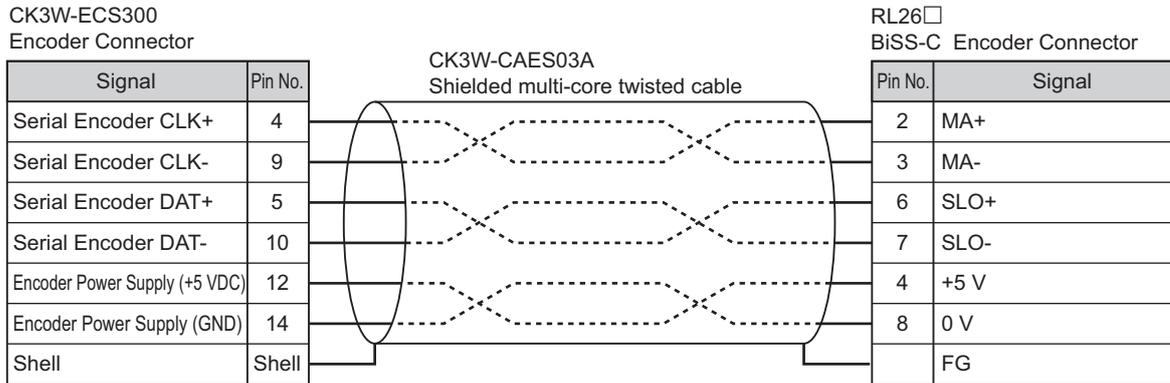


<p>2</p>	<p>Type the save command in the Power PMAC IDE Terminal.</p> <ul style="list-style-type: none"> When the save is completed, "Save Completed" is displayed in the Terminal. 	 <p>The screenshot shows a terminal window titled "Terminal: Online [192.168.0.200 : SSH]". The output text is "Saving To Flash: Finished SAVING to flash" followed by "Save Completed" which is highlighted with a red box. The input "save" is visible at the bottom of the terminal.</p>
<p>3</p>	<p>Type the \$\$\$ command in the Power PMAC IDE Terminal.</p> <ul style="list-style-type: none"> When the reset is completed, "PowerPMAC Reset complete" is displayed in the Terminal. 	 <p>The screenshot shows a terminal window titled "Terminal". The output text is "Saving To Flash: Finished SAVING to flash", "Save Completed", "\$\$\$", and "Resetting PowerPMAC" followed by "PowerPMAC Reset complete" which is highlighted with a red box. The input "\$\$\$" is visible at the bottom of the terminal.</p>

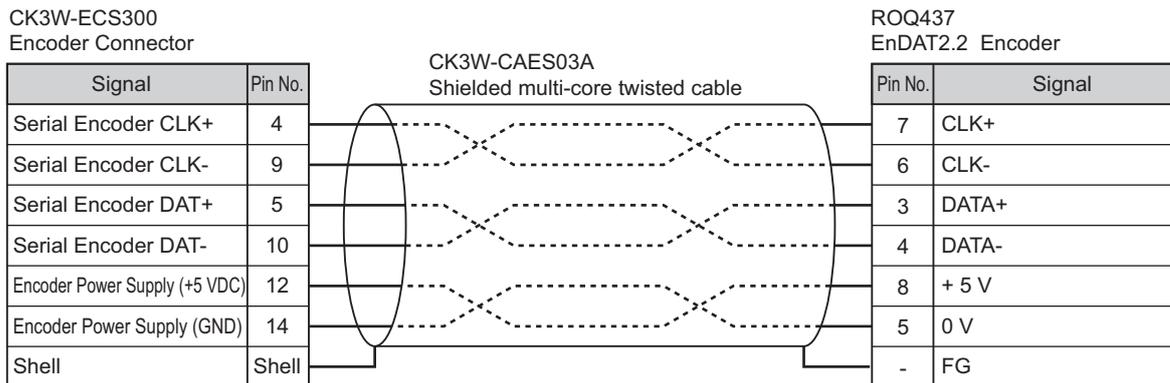
3-3 Serial Encoder Wiring

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

- If BiSS-C Encoder Is Used

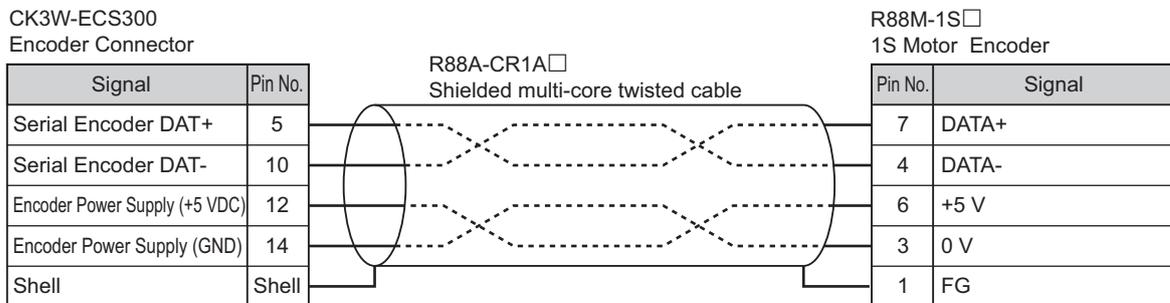


- If EnDAT2.1/2.2 Encoder Is Used



- If 1S MOTOR Encoder Is Used

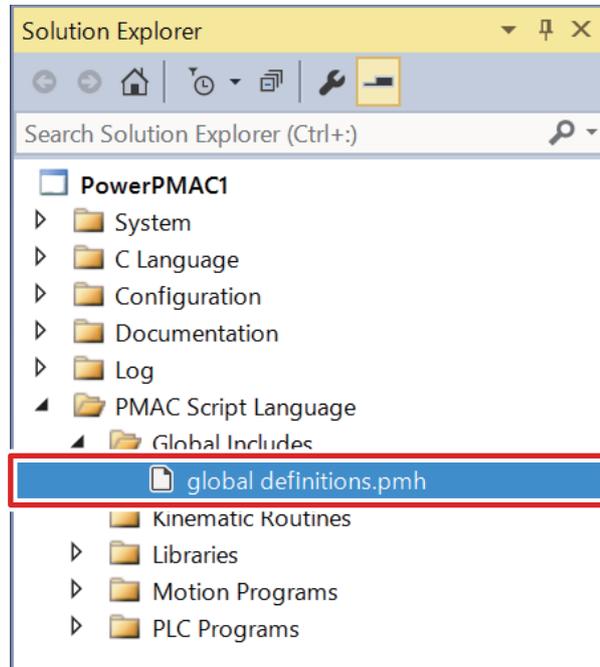
Disconnect the connector on the Servo Drive side of the R88A-CR1A□, and connect the CK3W-ECS300 side of it to the high-density type D sub-15-pin female connector (MIL-C-24308 compliant, lock screw #4-40 UNC).



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)

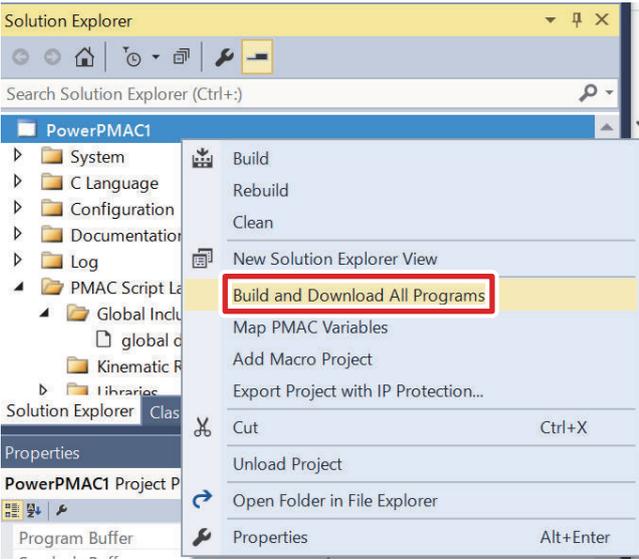
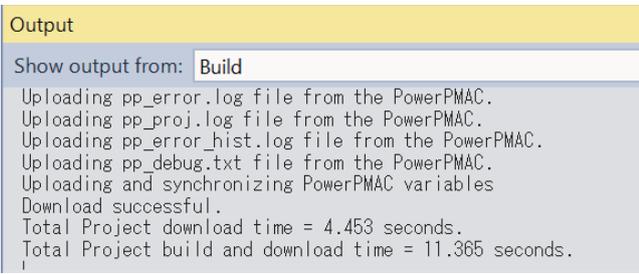
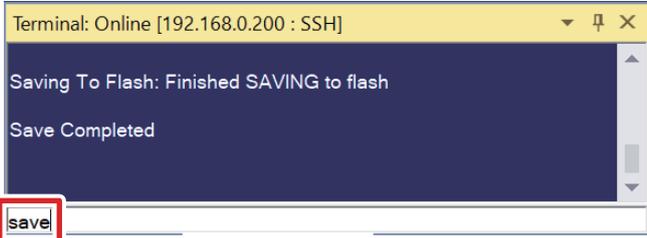
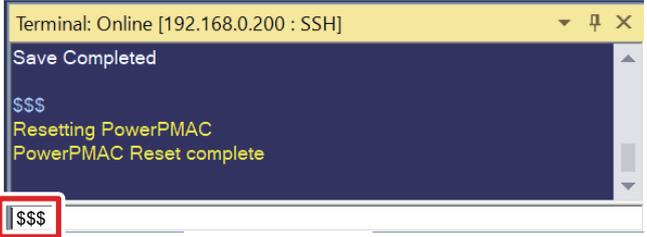
```
Motor[1].pAbsPos = Gate3[0].Chan[0].SerialEncDataA.a
Motor[1].AbsPosFormat = $01001A00
Motor[1].AbsPosSf = 1
Motor[1].PowerOnMode = 4
```

- 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
```

<p>4</p> <p>Download the project.</p> <p>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.</p>													
<p>5</p> <p>Make sure that there are no errors in the Output window.</p> <ul style="list-style-type: none"> If the transfer failed, check the content of the error in the Output window. If it is a program error, fix the program. 													
<p>6</p> <p>Type the save command in the Power PMAC IDE Terminal.</p> <ul style="list-style-type: none"> When the save is completed, "Save Completed" is displayed in the Terminal. 													
<p>7</p> <p>Type the \$\$\$ command in the Terminal.</p>													
<p>8</p> <p>Make sure that the current position is reflected in the Power PMAC IDE Position window.</p>	 <table border="1"> <thead> <tr> <th colspan="2">Position</th> </tr> <tr> <th colspan="2">Position</th> </tr> </thead> <tbody> <tr> <td>#1</td> <td>2,176,411.25 mu</td> </tr> <tr> <td>#2</td> <td>0.00 mu</td> </tr> <tr> <td>#3</td> <td>0.00 mu</td> </tr> <tr> <td>#4</td> <td>0.00 mu</td> </tr> </tbody> </table>	Position		Position		#1	2,176,411.25 mu	#2	0.00 mu	#3	0.00 mu	#4	0.00 mu
Position													
Position													
#1	2,176,411.25 mu												
#2	0.00 mu												
#3	0.00 mu												
#4	0.00 mu												



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

4-1	BiSS-C Encoder Error Information	4-2
4-2	EnDAT2.2 Encoder Status and Error Information	4-3
4-3	1S Motor Encoder Status and Error Information.....	4-4

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.

OMRON Corporation Industrial Automation Company

Kyoto, JAPAN

Contact : www.ia.omron.com

Regional Headquarters

OMRON EUROPE B.V.

Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands

Tel: (31) 2356-81-300 Fax: (31) 2356-81-388

OMRON ASIA PACIFIC PTE. LTD.

438B Alexandra Road, #08-01/02 Alexandra
Technopark, Singapore 119968

Tel: (65) 6835-3011 Fax: (65) 6835-2711

OMRON ELECTRONICS LLC

2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.

Tel: (1) 847-843-7900 Fax: (1) 847-843-7787

OMRON (CHINA) CO., LTD.

Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China

Tel: (86) 21-5037-2222 Fax: (86) 21-5037-2200

Authorized Distributor:

©OMRON Corporation 2021 - 2023 All Rights Reserved.
In the interest of product improvement,
specifications are subject to change without notice.

Cat. No. 0051-E1-02 0123