FRENIC-Multi

Profibus DP Interface Option "OPC-E1-PDP"

⚠CAUTION

Thank you for purchasing our PROFIBUS DP Interface Option OPC-E1-PDP.

- This product is designed to connect the FRENIC-Multi series of inverters to PROFIBUS DP Communications Network. Read through this instruction manual and be familiar with the handling procedure for correct use.
- Improper handling blocks correct operation or causes a short life or failure.
- Deliver this manual to the end user of the product. The end user should keep this manual in a safe place until the PROFIBUS DP Interface Option is discarded.
- For the usage of inverters, refer to the instruction manual prepared for the FRENIC-Multi series of inverters.

Fuji Electric Systems Co., Ltd.

INR-SI47-1159-EU REV 052010

Preface

Thank you for purchasing our PROFIBUS DP Interface Option OPC-E1-PDP.

This manual has been prepared to help you connect your FRENIC-Multi to a PROFIBUS DP master (Siemens PLC, computer, etc.) via PROFIBUS DP.

Mounting this option on your FRENIC-Multi allows you to connect the FRENIC-Multi to a PROFIBUS DP master node and control it as a slave unit using run and frequency commands, and access to function codes.

This option has the following features:

• PROFIBUS version: DP-V0 compliant

• Transmission speed: 9.6 Kbps to 12 Mbps

• Maximum network cable length per segment: 100 m (12 Mbps) to 1200 m (9.6 Kbps) (328 ft (12 Mbps) to 3937 ft (9.6 Kbps)

• Applicable Profile: PROFIBUS V2 compliant

• Able to read and write all function codes supported in FRENIC-Multi

This instruction manual does not contain inverter handling instructions. Read through this instruction manual in conjunction with the FRENIC-Multi Instruction Manual (INR-SI47-1204-E) and be familiar with proper handling and operation of this product. Improper handling might result in incorrect operation, a short life, or even a failure of this product.

Keep this manual in a safe place.

Related Publications

Listed below are the other materials related to the use of the PROFIBUS DP Interface Option OPC-E1-PDP. Read them in conjunction with this manual as necessary.

• RS-485 Communication User's Manual   (MEH448)
• FRENIC-Multi Instruction Manual   (INR-SI47-1204-E)

The materials are subject to change without notice. Be sure to obtain the latest editions for use.

■ Safety precautions

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

Installation and wiring

⚠ WARNING
• Turn the inverter's power OFF and wait at least five minutes. Further, check that the DC link bus voltage between the P (+) and N (-) terminals is lower than 25 VDC.
• Qualified electricians should carry out wiring.
Otherwise, electric shock could occur.

⚠ CAUTION
• Do not use the products that are damaged or lacking parts.
Doing so could cause a fire, accident, or injury.
• Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter and the option.
Otherwise, a fire or an accident might result.
• Incorrect handling in installation/removal jobs could cause a failure.
A failure might result.
• Noise may be emitted from the inverter, motor and wires. Implement appropriate measure to prevent the nearby sensors and devices from malfunctioning due to such noise.
Otherwise, an accident could occur.

Operation

⚠ WARNING
• Be sure to mount the inverter's and option's terminal covers before turning the inverter's power ON. Do not remove the covers while power is applied.
Otherwise electric shock could occur.
• Do not operate switches with wet hands.
Doing so could cause electric shock.
• If you configure the function codes wrongly or without completely understanding FRENIC-Multi Instruction Manual (INR-SI47-1204-E) and the FRENIC-Multi User's Manual (MEH457), the motor may rotate with a torque or at a speed not permitted for the machine. Confirm and adjust the setting of the function codes before running the inverter.
Otherwise, an accident could occur.

Maintenance and inspection, and parts replacement

⚠ WARNING
• Turn the inverter's power OFF and wait at least five minutes before starting inspection. Further, check that the DC link bus voltage between the P (+) and N (-) terminals is lower than 25 VDC.
Otherwise, electric shock could occur.
• Maintenance, inspection, and parts replacement should be made only by qualified persons.
• Take off the watch, rings and other metallic objects before starting work.
• Use insulated tools.
Otherwise, electric shock or injuries could occur.

Disposal

⚠CAUTION
• Treat the product as an industrial waste when disposing of it. 　**Otherwise injuries could occur.**

Others

⚠WARNING
• Never attempt to modify the product. 　**Doing so could cause electric shock or injuries.**

How this manual is organized

This manual is made up of chapters 1 through 12.

Chapter 1 BEFORE USING THE PROFIBUS DP INTERFACE OPTION
Lists points to be checked upon delivery of this option and describes the applicable inverters.

Chapter 2 NAMES AND FUNCTIONS
Shows the part names of this option and describes the terminating resistor switch, node address switches, and status indicator LEDs.

Chapter 3 MOUNTING THE PROFIBUS DP INTERFACE OPTION
Provides instructions and precautions for mounting this option.

Chapter 4 WIRING AND CABLING
Provides wiring instructions around the terminal blocks on this option and the cable specifications.

Chapter 5 CONFIGURING INVERTER'S FUNCTION CODES FOR PROFIBUS DP COMMUNICATION
Describes the inverter's function codes to be set for the PROFIBUS DP communications link. Also this chapter lists the related function codes.

Chapter 6 ESTABLISHING A PROFIBUS COMMUNICATIONS LINK
Guides you to establish a PROFIBUS DP communications link between the PROFIBUS DP master node and this option (slave node).

Chapter 7 QUICK SETUP GUIDE FOR RUNNING THE INVERTER
Describes a simple profile (data format) dedicated to inverter's run and frequency commands, taking the actual data transaction data as an example.

Chapter 8 DETAILS OF PROFIBUS DP PROFILES
Details PROFIBUS DP profile data formats and parameters supported by this option. Furthermore, this chapter describes how the master node accesses inverter's function codes.

Chapter 9 INVERTER REACTION TO PROFIBUS COMMUNICATIONS ERRORS
Describes on how the inverter operates if a PROFIBUS communications error occurs.

Chapter 10 LIST OF INVERTER ALARM CODES
Lists and explains inverter's alarm codes.

Chapter 11 TROUBLESHOOTING
Provides troubleshooting instructions for certain problems, e.g., when the inverter does not operate as ordered or when an alarm condition has been recognized.

Chapter 12 SPECIFICATIONS
Lists the general specifications and communications specifications.

Icons

The following icons are used throughout this manual.

Note This icon indicates information which, if not heeded, can result in the product not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

Tip This icon indicates information that can prove handy when performing certain settings or operations.

This icon indicates a reference to more detailed information.

Table of Contents

Chapter 1 BEFORE USING THE PROFIBUS DP INTERFACE OPTION

1.1 Acceptance Inspection

Unpack the package and check the following:

(1) A PROFIBUS DP interface option and the following accessories are contained in the package. (See Figure 1.1.)
   - Two option connection cables
     (A short one for inverters with a capacity of 5 HP or below and a long one for inverters with a capacity of 7.5 HP or above)
   - One ferrite core
   - One option fixing screw
   - PROFIBUS DP Interface Option Instruction Manual (this manual)

(2) The option and accessories have not been damaged during transportation—there should be no dents or parts missing.

(3) The model name "OPC-E1-PDP" is printed on the nameplate attached to the right side of the option. (See Figure 1.1.)

If you suspect the product is not working properly or if you have any questions about your product, contact your Fuji Electric representative.
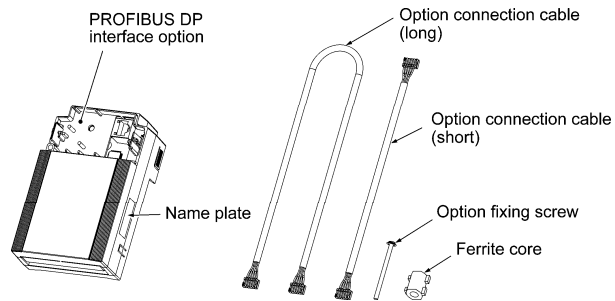
Figure 1.1 PROFIBUS DP Interface Option and Accessories

Chapter 2 NAMES AND FUNCTIONS

2.1 Parts Names

Figure 2.1 shows the inside view of the PROFIBUS DP interface option with its terminal cover (See Figure 3.3) removed.
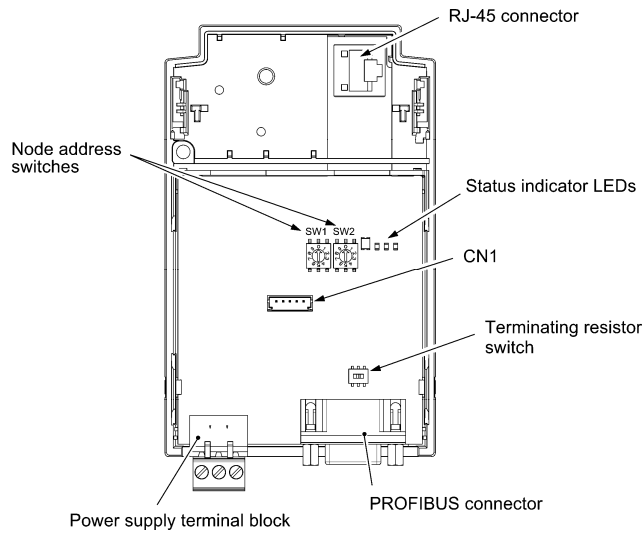
Figure 2.1 Parts Names of PROFIBUS DP Interface Option

2.2 Terminating Resistor Switch

The PROFIBUS DP communications network requires insertion of line terminating resistors at its both ends. When this option is mounted on the inverter at either end of the network, turn this switch ON to insert the terminating resistor.

OFF: No insertion of terminating resistor

ON: Insertion of terminating resistor

Figure 2.2 Terminating Resistor Switch Settings

6

2.3 Node Address Switches

The node address switches (SW1 and SW2) on the interface option are rotary ones that are used to specify the PROFIBUS DP communications network node address (station address) of the option. The setting range is from 0 to 99 in decimal. The SW1 specifies a 10s digit of the node address and the SW2, a 1s digit.

The node address can also be specified with the inverter's function code o31. The setting range is from 0 to 125 in decimal. Note that validating the node address specified with the function code o31 requires setting the node address switches to "00."

Example 1: Setting the node address 27 using the node address switches
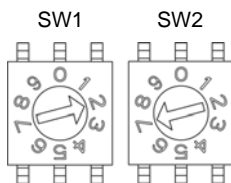
Figure 2.3 Node Address Setting Example 1

1. When the inverter and this option are powered OFF:
   Set SW1 to "2."
   Set SW2 to "7."
2. Turn the inverter and this option ON.
   The setting procedure is completed.

Example 2: Setting the node address 125 using the function code o31
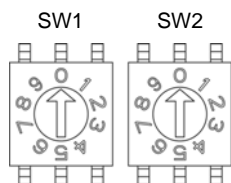
Figure 2.4 Node Address Setting Example 2

1. When the inverter and this option are powered OFF:
   Set both the SW1 and SW2 to "0."
2. Turn the inverter and this option ON and set the function code o31 data to "125."
3. Turn the inverter and this option OFF and ON.
   The setting procedure is completed.

Note
1. The node address switches should be accessed with all the power to the inverter and this option (including the auxiliary power) being OFF. Setting these switches with the power to the inverter and this option being ON requires turning the power OFF and ON to validate the new setting.
2. To validate the node address setting using the function code o31, turn the inverter and this option OFF and ON.
3. Setting the function code o31 data to "126" or greater will cause a data setting error. The ERR LED on the option blinks in red and the inverter issues the alarm code *er5*.

2.4 Setting the Transmission Speed (Baud rate)

No transmission speed setting is required on the interface option (slave). Setting the transmission speed in the PROFIBUS DP network master node automatically configures the transmission speed of this option.

Tip This option supports the following transmission speed.
9.6, 19.2, 45.45, 93.75, 187.5, and 500 Kbps
1.5, 3, 6, and 12 Mbps

2.5 Status Indicator LEDs

This interface option has four status indicator LEDs shown in Figure 2.5. They indicate the operation status of the option as listed in Table 2.1.

Figure 2.5 Status Indicator LEDs

Table 2.1 LED Indications and Operation Status

Name	Color	Meaning	Note
PWR	Lights in green	Normal	---
	Blinks in green	Self-diagnostic test running or initialization in progress during powering on sequence	This test takes approx. 0.5 second.
	Blinks in red	PROFIBUS communications error	The inverter shows *er5*. *1
	Lights in red	Hardware error (Option not properly installed or option faulty)	The inverter shows *er4*.
ERR	Blinks in red	Wrong configuration of PROFIBUS protocol (Discrepancy between PPO type defined by the inverter's function code o30 and the one defined in the PROFIBUS master node)*2	---
		Wrong configuration of PROFIBUS protocol (The node address is set to 126 or greater.)	The inverter shows *er5*. *1
ONL	Lights in green	Online (The option communicates normally on the PROFIBUS network.)	---
	OFF	Not online	---
OFFL	Lights in red	Offline (The option is not connected to PROFIBUS)	---
	OFF	Not offline	---

*1 Configuration for ignoring *er5* is possible. For details, refer to Chapter 9, "INVERTER REACTION TO PROFIBUS COMMUNICATIONS ERRORS."

*2 PPO (Parameter Process-data Object) type defined in this option should be consistent with that in the PROFIBUS DP master node. To define the PPO type in this option, use the inverter's function code o30; to define that in the master node, use a configuration tool designed for the master node.

📖 For defining the PPO type in the master node, refer to the documentation of the master node.

📖 For details about the PPO type, see Chapter 8, "DETAILS OF PROFIBUS DP PROFILES." For details about the function code o30, see Chapter 5 "CONFIGURING INVERTER'S FUNCTION CODES FOR PROFIBUS DP COMMUNICATION."

2.6 RJ-45 Connector

The RJ-45 connector is used to connect the keypad of the FRENIC-Multi to this option.

📖 The keypad can be detached from the option and mounted on a panel. For details, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 2, Section 2.4 "Mounting and Connecting a Keypad."

2.7 Power Supply Terminal Block and PROFIBUS DP Terminal Block

The power supply terminal block and PROFIBUS DP terminal block are used to connect the 24V power cable and PROFIBUS DP cable, respectively, in order to operate this option.

📖 For details, refer to Chapter 4 "WIRING AND CABLING."

Chapter 3 MOUNTING THE PROFIBUS DP INTERFACE OPTION

<table>
<tr><td align="center">⚠ WARNING</td></tr>
<tr><td>

Turn the inverter's power OFF and wait at least five minutes. Further, check that the DC link bus voltage between the P (+) and N (-) terminals is lower than 25 VDC.

Otherwise, electric shock could occur.
</td></tr>
</table>

<table>
<tr><td align="center">⚠CAUTION</td></tr>
<tr><td>

- Do not use the products that are damaged or lacking parts.
  Doing so could cause a fire, accident, or injury.

- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter and the option.
  Otherwise, a fire or an accident might result.

- Incorrect handling in installation/removal jobs could cause a failure.
- When handling this option, take any antistatic measure or hold the plastic parts taking care not to directly touch the circuit board; otherwise, the static electricity charged in your body may damage it.
  A failure might result.
</td></tr>
</table>

Before mounting the option, perform the wiring for the main circuit terminals and control circuit terminals.

(1) Remove the terminal cover from the inverter.

    Note: For inverters with a capacity of 7.5 to 20 HP, you need to remove the terminal cover fixing screw to remove the terminal cover.

    📖 For details on how to remove the terminal cover, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 2, Section 2.3 "Wiring."

(2) Connect the option connection cable to the CN1 connector on the interface printed circuit board (interface PCB) on the inverter.

    Use the short cable for inverters with a capacity of 5 HP or below, and the long cable for the ones with a capacity of 7.5 HP or above.

(3) Mount the terminal cover.

    📖 For details on how to mount the terminal cover, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 2, Section 2.3 "Wiring."

(4) Push the hooks provided on both sides of the keypad and pull the keypad up and out of the inverter.

    📖 For details on how to remove the keypad, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 2, Section 2.4 "Mounting and Connecting a Keypad."
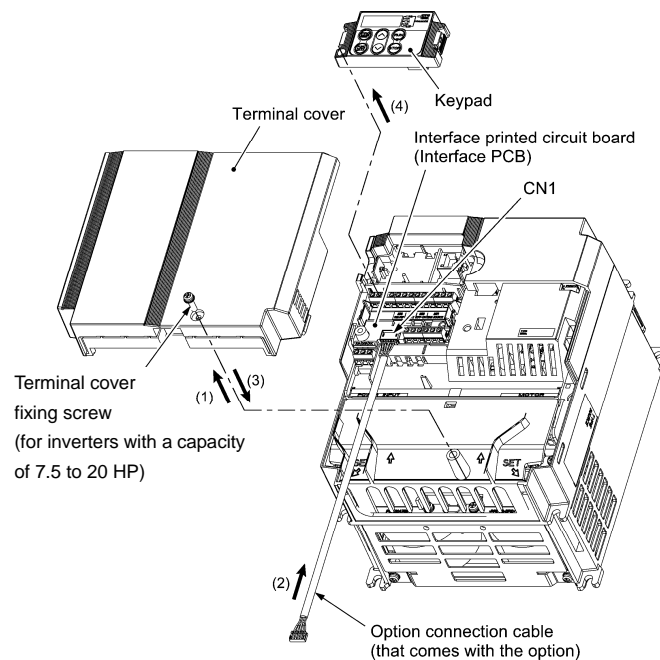
Figure 3.1   Connecting the Option Connection Cable to the Interface PCB and Removing the Keypad (For inverters with a capacity of 15 and 20 HP)

(5) Mount the option on the inverter, making the RJ-45 connector on the back side of the option engage with the RJ-45 connector on the inverter (to which the keypad had been connected).

(6) Connect the keypad to the RJ-45 connector on the front side of the option, then secure the keypad and option to the inverter with the option fixing screw (that comes with the option).

When using the keypad at a remote site, secure the option without the keypad to the inverter with the screw.

Tightening torque: 0.6 N·m(0.4 lbf·ft)

Note Take care not to tighten the option fixing screw too much. Doing so could make the screw defective.
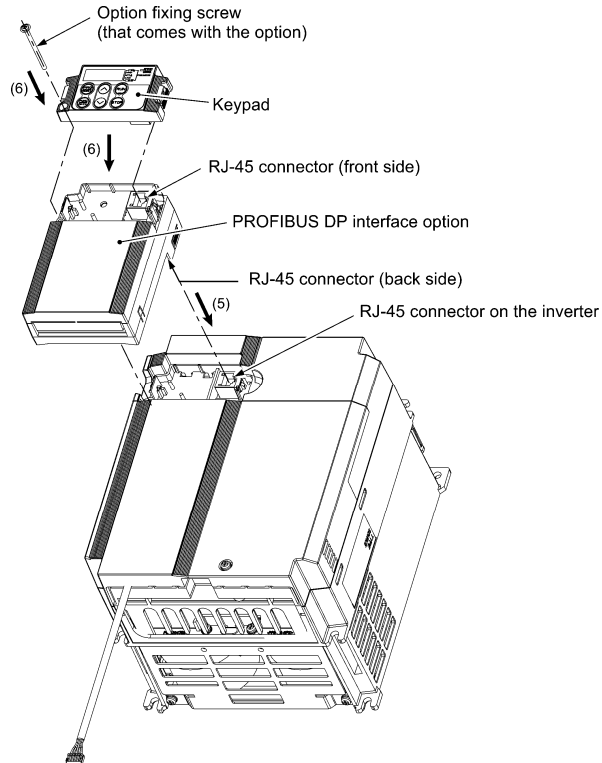
Figure 3.2 Mounting the PROFIBUS DP Interface Option and the Keypad

(7) Slightly pull the bottom of the option terminal cover towards you and remove it downward.

(8) Attach the ferrite core to the other end of the option connection cable (whose end has been connected to the interface PCB on the inverter in step (2) above) and connect the cable to the CN1 connector on the interface option printed circuit board (interface option PCB).

(9) Mount the option terminal cover.

First fit the bosses on the top of the cover into the square holes provided in the option, and then push the bottom of the cover until it snaps into place.
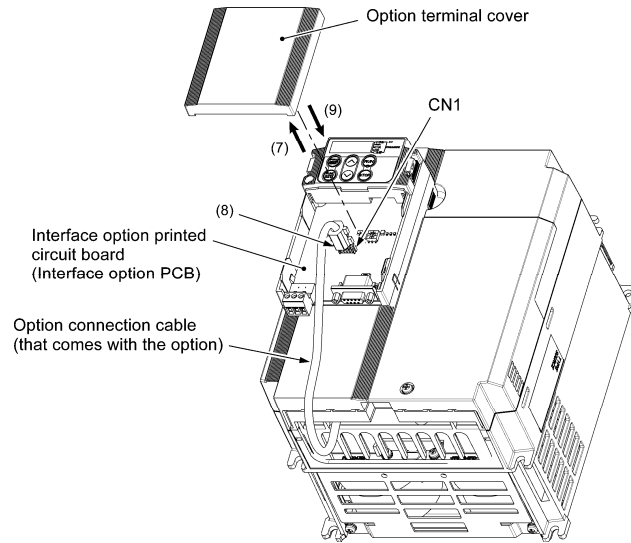
Figure 3.3 Connecting the Option Connection Cable to the Interface Option PCB

Chapter 4 WIRING AND CABLING

⚠ WARNING

• Before starting installation, turn the inverter's power OFF and wait at least five minutes. Further, check that the DC link bus voltage between the P (+) and N (-) terminals is lower than 25 VDC.

• Qualified electricians should carry out wiring.

Otherwise, electric shock could occur.

⚠ CAUTION

The inverter, motor, and wiring emit electrical noise. Take appropriate measures to prevent the nearby sensors and devices from malfunctioning due to such noise.

Otherwise, an accident could occur.

4.1 Basic Connection Diagram
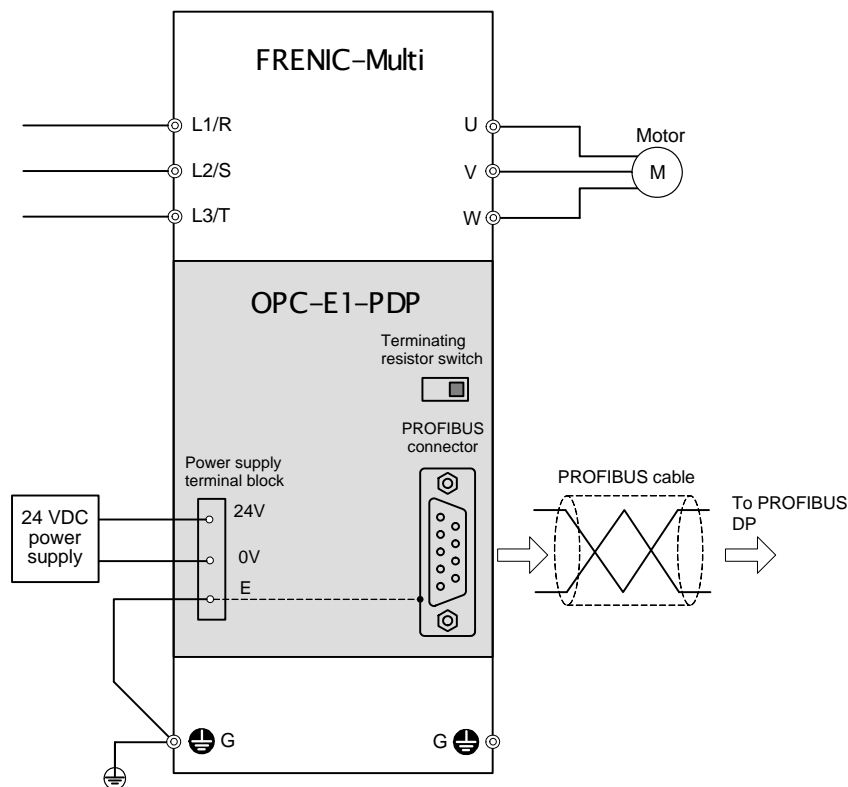
Figure 4.1 Basic Connection Diagram

⚠ CAUTION

For the 24 VDC power supply to be connected to the power supply terminal block, be sure to use an external 24 V power supply with a capacity of at least 200 mA. Never use the PLC terminal on the inverter; doing so flows a current exceeding the capacity of the PLC terminal, resulting in a damaged inverter.

A failure might result.

4.2 Wiring for Power Supply Terminal Block

This terminal block is used to supply this option with 24 V power to operate it. Perform wiring for the terminal block as described blow.

> # ⚠CAUTION
>
> For the 24 VDC power supply to be connected to the power supply terminal block, be sure to use an external 24 V power supply with a capacity of at least 200 mA. Never use the PLC terminal on the inverter; doing so flows a current exceeding the capacity of the PLC terminal, resulting in a damaged inverter.
> **A failure might result.**

(1) Wiring for the power supply terminal block (TERM3)

   The terminal block uses a pluggable 3-pin connector as shown in Figure 4.2. Table 4.1 shows the pin assignment.
   A typical connector that matches this terminal block is Phoenix Contact MSTB 2.5/3-ST-5.08.

Table 4.1 Pin Assignment on Power Supply Terminal Block

Pin #	Terminal name	Description	Remarks
1	24 V	Power supply (24 VDC, + side)	Never use the PLC terminal on the inverter for 24 V power.
2	0 V	Power supply (24 VDC, - side)	
3	E	Grounding terminal	Connect the ground terminal of the inverter (⏚G) to this terminal.
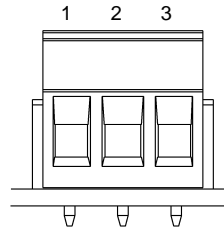
Figure 4.2   Connectors of the Power Supply Terminal Block

(Note) For protection against external noise and prevention of failures, be sure to connect a grounding wire.

Table 4.2 lists the recommended wire size, terminal screw size and its tightening torque. Before connecting the cable to the terminal block, strip the cable wire end. Figure 4.3 shows the recommended wire strip length.

Table 4.2 Recommended Wire Size, Terminal Screw Size, and Its Tightening Torque
for the Power Supply Terminal Block

Wire size	Terminal screw size	Tightening torque
AWG20 to AWG16 (0.5 to 1.5 mm^2), wire with rated temperature 105°C(221 °F) (UL) recommended	M3	0.5 to 0.6 N·m (0.37 to 0.44 lbf·ft)
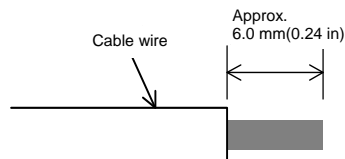
Figure 4.3   Recommended Strip Length of the Cable Wire End for Terminal Connection

<center>(2) Input power requirements</center>

Select the 24 V input power supply that meets the specifications listed in Table 4.3.

<center>Table 4.3 Input Power Requirements</center>

Item	Specifications
Input power voltage range	21.6 to 27.0 V
Current capacity	Minimum 200 mA

4.3 Wiring for PROFIBUS Connector

(1) To connect this option to PROFIBUS DP network, use a shielded twist pair cable that complies with the PROFIBUS specifications.

Tip   The recommended cable is a PROFIBUS FC standard cable 6XV1 830-0EH10 manufactured by Siemens AG.

(2) Wiring for the PROFIBUS connector

The PROFIBUS connector is a 9-pin D-sub female connector shown in Figure 4.4. Table 4.4 shows the pin assignment.

Tip   The PROFIBUS cable should have a 9-pin male D-sub connector. The recommended connector is an RS-485 PROFIBUS bus connector 6GK1 500-0FC00 manufactured by Siemens AG.

<center>Table 4.4 Pin Assignment of the PROFIBUS Connector</center>

| Pin#	Pin Assignment	Description
Housing	Shield	Terminal for connecting the cable shield *1
1	-	NC
2	-	NC
3	B-Line	Terminal for the positive (+) line of PROFIBUS cable (red wire)
4	RTS	Data transmission control for the repeater (direction control)
5	GND BUS	Ground signal for PROFIBUS cable
6	+5V BUS	Power supply for terminating resistors *2
7	-	NC
8	A-Line	Terminal for the negative (-) line (green wire)
9	-	NC
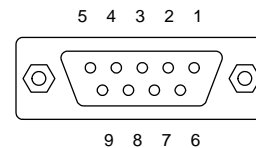
Figure 4.4 PROFIBUS Connector
(Female connector with M2.6 fixing screws)

*1 The Shield terminal on the PROFIBUS connector and Ground terminal (E) on the power supply terminal block (TERM3) are connected internally.

*2 This power supply is required when an external terminating resistor (not the one built in this option) are used (e.g., when using the terminal resistor built in the recommended bus connector described above). Do not use this power supply for any other purposes.

For details about wiring for PROFIBUS, refer to the "Installation Guideline for PROFIBUS DP/FMS" and "Handbook PROFIBUS Installation Guideline" published by the PROFIBUS Organization. It can be downloaded for free from the PROFIBUS Organization's website at:
http://www.profibus.com/pall/meta/downloads/

4.4 ON/OFF Timing of the Option and the Inverter

Observe the following instructions about the ON/OFF timing of this option and the inverter.

(1) Power ON

It is recommended that this option be turned ON at the same time as or before the inverter. Turning the inverter ON first may detect no operation of the option, causing a trip with *er4* alarm. The *er4* alarm can be reset after this option is turned ON.

(2) Power OFF

It is recommended that this option be turned OFF at the same time as or after the inverter. Turning the option OFF first may cause the inverter to detect no operation of the option, causing a trip with *er4* alarm. Turning the inverter OFF resets the *er4* alarm.

Tip The inverter issues an alarm *er4* if the option's power stays OFF for approximately 1 second when the inverter power is ON.

Chapter 5 CONFIGURING INVERTER'S FUNCTION CODES FOR PROFIBUS DP COMMUNICATION

To perform data transmission between the inverter equipped with this option and the PROFIBUS DP master node, configure the function codes listed in Table 5.1.

Table 5.2 lists inverter's function codes related to PROFIBUS DP communication. Configure those function codes if necessary.

📖 For details about function codes, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 5 "FUNCTION CODES" and RS-485 Communication User's Manual (MEH448), Chapter 5, Section 5.2 "Data Formats."

Table 5.1 Inverter's Function Code Settings Related to PROFIBUS Communications

Function codes	Description	Factory default setting	Function code data	Remarks
o30 *1	Select PPO type (data format)	0	Available data is: 0, 1, 6 to 255:　　　PPO type 1 2 and 5:　　PPO type 2 3:　　　　　PPO type 3 4:　　　　　PPO type 4	The selected PPO type should be consistent with that of the master node.
y98 *2	Select run/frequency command source	0	Available data is: |	Frequency command	Run command
0	Inverter	Inverter
1	PROFIBUS	Inverter
2	Inverter	PROFIBUS
3	PROFIBUS	PROFIBUS		If there is no special problem with your system, setting y98 = 3 is recommended.

*1 After setting up the function code o30, turn the inverter and this option OFF and ON to validate the new setting.
　 For details about the function code o30, refer to Chapter 8 "DETAILS OF PROFIBUS DP PROFILES."

*2 In addition to y98, the FRENIC-Multi has other function codes related to the run/frequency command source. Setting up those codes realizes more precise selection of the command sources. For details, refer to the descriptions of H30 and y98 in the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 5 "FUNCTION CODES."

Table 5.2 Other Related Function Codes

Function codes	Description	Factory default setting	Function code setting range	Remarks
o27 *1	Select the inverter's operation mode to apply when a PROFIBUS communications error occurs.	0	0 to 15	
o28 *1	Set the operation timer to apply when a PROFIBUS communications error occurs.	0.0 s	0.0 s to 60.0 s	
o31 *2	Set the PROFIBUS network node address.	0	0 to 255 (Setting range: 0 to 125)	Valid only when both SW1 and SW2 are set to "00." Setting 126 or greater causes an error, flashing the ERR LED and issuing an *er5.*
o40 to o43 *3	Assign the function code writing data cyclically.	0 (No assignment)	0000 to FFFF (hex)	Valid only when PPO type 2 or 4 is selected.
o48 to o51 *3	Assign the function code reading data cyclically.	0 (No assignment)	0000 to FFFF (hex)	
W90	Show the software version of the PROFIBUS interface option on the LED monitor.	Depends on the option	--- (Only for monitoring)	4-digit decimal If the version is V.1.23, the LED shows "0123."

*1 For details about function codes o27 and o28, refer to Chapter 9 "INVERTER REACTION TO PROFIBUS COMMUNICATIONS ERRORS."

*2 For details about the function code o31, refer to Chapter 2, Section 2.3 "Node Address Switches."

*3 For details about function codes o40 to o43 and o48 to o51, refer to Chapter 8, Section 8.2 (4) "PCD1 to PCD4."

Chapter 6 ESTABLISHING A PROFIBUS COMMUNICATIONS LINK

This chapter guides you to establish a PROFIBUS DP communications link between the PROFIBUS DP master node and this option (slave node).

Follow the steps below.

Step 1 Configuring the PROFIBUS DP master node equipment
Step 2 Configuring this option and inverter's function codes
Step 3 Powering ON the inverter and this option $\Rightarrow$ Initiating the PROFIBUS data transaction

Each of the above steps is detailed below.

Step 1 Configuring the PROFIBUS DP master node equipment

Step 1.1: Specify the master node address (station address) and baud rate.

Step 1.2: Register this option to the master node using the GSD file prepared for the option.

Step 1.3: Choose a PPO type (data format) to be applied to the registered option, from PPO type 1 to PPO type 4.

   📖 For details about the configuration of the PROFIBUS DP master node equipment, refer to the user's manual or documentations of your master equipment.
   📖 For details about PPO types, refer to Chapter 8 "DETAILS OF PROFIBUS DP PROFILES."

IMPORTANT
A GSD file, which is required for registering the PROFIBUS DP interface option to the PROFIBUS master node, does not come with the option.
It is available as a free download from our website at:
http://web1.fujielectric.co.jp/Kiki-Info-EN/User/index.html
(Fuji Electric FA Components & Systems Co., Ltd. Technical Information site)
Before downloading, you are requested to register as a member (free of charge).

Step 2 Configuring this option and inverter's function codes

Step 2.1: Specify the node address that must be identical with the option address registered to the master node.

Step 2.2: Set up the data of inverter function codes o27 and o28, if needed.

Step 2.3: Choose a PPO type from PPO type 1 to PPO type 4, using the inverter's function code o30.

     The PPO type must be identical with the one selected for the master node. After changing the data of the function code o30, be sure to turn the inverter and this option OFF and ON.

   📖 For details about function codes o27 and o28, refer to Chapter 9 "INVERTER REACTION TO PROFIBUS COMMUNICATIONS ERRORS."

Step 3 Powering ON the inverter and this option $\Rightarrow$ Initiating the PROFIBUS data transaction

When the inverter equipped with this option and the PROFIBUS DP master node are correctly set up, turning the inverter and this option OFF and ON automatically establishes a PROFIBUS communications link, enabling the data transaction between them. The PWR and ONL LEDs on the option light in green.

Send run and frequency commands from the master to this option.

   📖 For specific data formats and data transaction, refer to Chapter 7 "QUICK SETUP GUIDE FOR RUNNING THE INVERTER" and Chapter 8 "DETAILS OF PROFIBUS DP PROFILES."
   📖 For the wiring, refer to Chapter 4 "WIRING AND CABLING."

Chapter 7 QUICK SETUP GUIDE FOR RUNNING THE INVERTER

This chapter provides a quick setup guide for running the inverter from a PROFIBUS DP master node according to the simplest data format (PPO type 3), taking an operation example. PPO type 3 is a simple format dedicated to inverter's run and frequency commands.

> Tip   The description of PPO type 3 in this chapter can apply to other PPO types, except the format assignment maps.

📖 To simplify the description, this chapter confines the description to running of an inverter. For more information, refer to Chapter 8 "DETAILS OF PROFIBUS DP PROFILES."

7.1 Before Proceeding to Data Exchange

(1) At the PROFIBUS DP master node, select PPO type 3 for this interface option.

📖 For the setting procedure of PPO types at the PROFIBUS DP master node, refer to the user's manual of your master node equipment.

(2) Set function codes of your inverter as follows.

F03 = 60 (Maximum frequency in Hz), y98 = 3 (Validate frequency and run commands from PROFIBUS), and o30 = 3 (Select PPO type 3)

Also set the data of function codes o27 and o28, if needed.

After settings are completed, turn the inverter and this option OFF and ON to validate the new settings.

📖 For details about function codes o27 and o28, refer to Chapter 9 "INVERTER REACTION TO PROFIBUS COMMUNICATIONS ERRORS."

7.2 Data Transaction Examples in Running an Inverter

Before providing data transaction examples, this section shows the data frame formats of PPO type 3. The following descriptions are based on these formats.

(Byte)	0	1	2	3
Request (Master → Slave)	CTW		MRV	
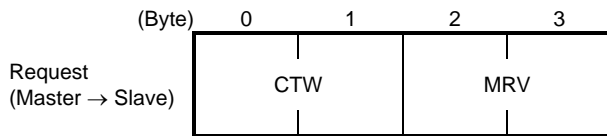
CTW: Control word (2 bytes) that sends a run command. The LSB determines ON/OFF of the run command.

MRV: Sends a frequency command that is expressed relative to the maximum frequency (defined by F03 in Hz) being assumed as 4000hex.

(Byte)	0	1	2	3
Response (Salve → Master)	STW		MAV	
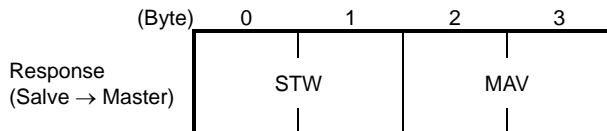
STW: Status word (2 bytes) that sends the running status of the inverter to be monitored at the master node.

MAV: Sends the current output frequency of the inverter to be monitored at the master node, which is expressed relative to the maximum frequency (defined by F03 in Hz) being assumed as 4000hex.

Given below is a PROFIBUS DP communication sample in which the master node runs the inverter in the forward direction in 60 Hz.

(1) Turning the inverter and this option ON initiates PROFIBUS DP communication. Immediately after the power is ON, the data in the request/response frames is as follows.

(Byte)	0	1	2	3
Request (Master → Slave)	00 CTW	00	00 MRV	00

(Byte)	0	1	2	3
Response (Salve → Master)	02 STW	40	00 MAV	00
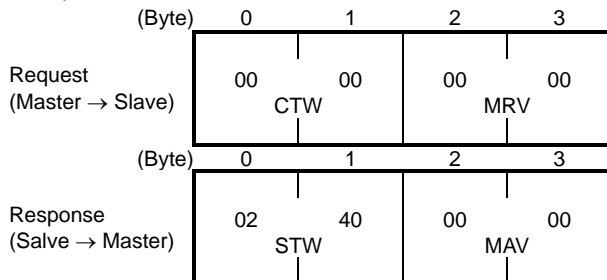
STW: Data 02 indicates that frequency and run commands from PROFIBUS are enabled. Data 40 indicates that the inverter is not ready to turn a run command ON.

MAV: Data 0000 means that the current output frequency is 0 Hz.

(2) In step (1), the inverter is not ready to turn a run command ON as shown in STW.

First, enter the request data "04 7E" to CTW, to make the inverter ready to turn a run command ON. In the example below, the frequency command 60 Hz (maximum frequency being assumed as 4000hex) is entered to MRV at the same time.

(Byte)	0	1	2	3
Request (Master → Slave)	04	7E	40	00
	CTW		MRV	

CTW: Data 04 enables the contents in this frame. Data 7E requests the inverter to get ready to turn a run command ON.

MRV: The frequency command is 4000hex (= Maximum frequency defined by F03 in Hz).

In response to the above request, this interface option returns the following response to the master node.

(Byte)	0	1	2	3
Response (Salve → Master)	02	31	00	00
	STW		MAV	
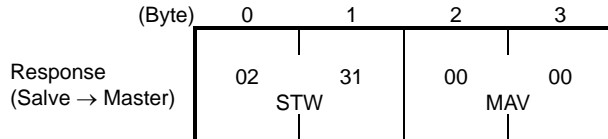
STW: Data 02 indicates that frequency and run commands from PROFIBUS are enabled. Data 31 indicates that the inverter is ready to turn a run command ON.

MAV: The current output frequency is 0 Hz.

(3) Since the inverter has been ready to turn a run command ON, enter run command data "04 7F" to CTW.
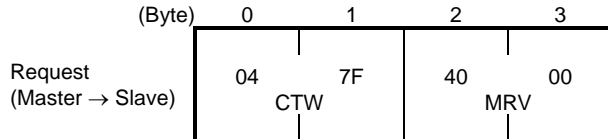
(Byte)	0	1	2	3
Request (Master → Slave)	04	7F	40	00
	CTW		MRV	

CTW: Data 04 enables the contents in this frame. Data 7F requests the inverter to turn a run command ON.

MRV: The frequency command is 4000hex (= Maximum frequency defined by F03 in Hz).

In response to the above request, the inverter starts running the motor. The option returns the following response to the master node.
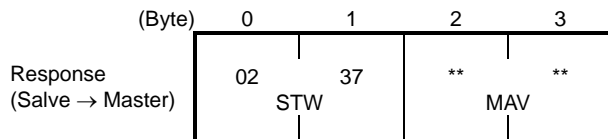
(Byte)	0	1	2	3
Response (Salve → Master)	02	37	**	**
	STW		MAV	

STW: Data 02 indicates that frequency and run commands from PROFIBUS are enabled. Data 37 indicates that the inverter is running.

MAV: The output frequency is accelerating.

(4) To stop the inverter, enter data "04 7E" to CTW.

(Byte)	0	1	2	3
Request (Master → Slave)	04	7E	40	00
	CTW		MRV	
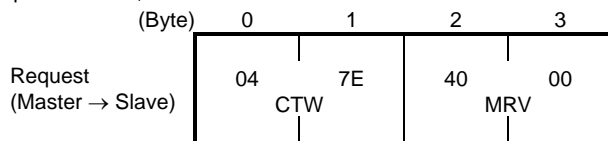
CTW: Data 04 enables the contents in this frame. Data 7E requests the inverter to turn the run command OFF.

MRV: The frequency command is 4000hex (= Maximum frequency defined by F03 in Hz).
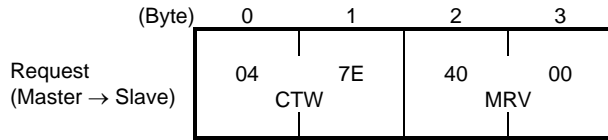
In response to the above request, the inverter decelerates to a stop. The option returns the following response to the master node.

(Byte)	0	1	2	3
Response (Salve → Master)	02	33/31	**	**
	STW		MAV	
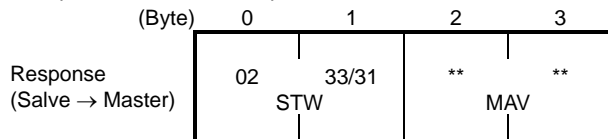
STW: Data 02 indicates that frequency and run commands from PROFIBUS are enabled. Data 33 indicates that the inverter is decelerating, and data 31 indicates that the inverter is ready to turn a run command ON (when the inverter is stopped).

MAV: The output frequency is decreasing.

(5) To restart running the inverter, enter data "04 7F" to CTW. To run the inverter in the reverse direction, enter data "0C 7F" instead. The example below specifies "Run reverse at the frequency of 30 Hz (2000hex)."

(Byte)	0	1	2	3
Request (Master → Slave)	0C	7F	20	00
	CTW		MRV	
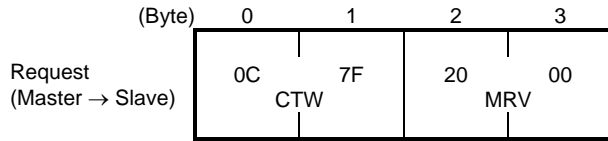
CTW: Data 0C enables the contents in this frame and requests the inverter to turn a run reverse command ON. Data 7F requests the inverter to turn a run command ON.

MRV: The frequency command is 2000hex (Frequency (Hz) = F03 × 2000hex/4000hex).

In response to the above request, the inverter starts running the motor in the reverse direction. The example below shows a response indicating that the inverter has reached the commanded frequency level in the reverse direction.

(Byte)	0	1	2	3
Response (Salve → Master)	03	37	E0	00
	STW		MAV	
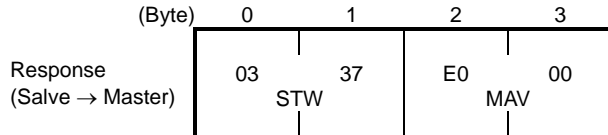
STW: Data 03 indicates that frequency and run commands from PROFIBUS are enabled and the output frequency arrives the reference one. Data 37 indicates that the inverter is running.

MAV: The current output frequency is E000hex (2's complement expression of 2000hex (Frequency = F03 × -2000hex/4000hex).

(6) Entering a negative value to MRV also allows the inverter to run in the reverse direction. The example below enters E000hex, 2's complement of 2000hex.
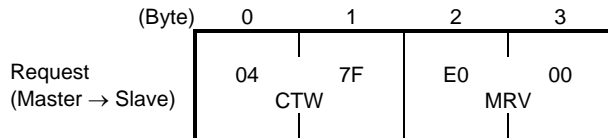
(Byte)	0	1	2	3
Request (Master → Slave)	04	7F	E0	00
	CTW		MRV	

CTW: Data 04 enables the contents in this frame. Data 7F requests the inverter to turn a run command ON.

MRV: The frequency command is E000hex (-2000hex) (Frequency = F03 × -2000hex/4000hex).

In response to the above request, the inverter starts running the motor in the reverse direction. The example below shows a response indicating that the inverter has reached the commanded frequency level in the reverse direction.

(Byte)	0	1	2	3
Response (Salve → Master)	03	37	E0	00
	STW		MAV	
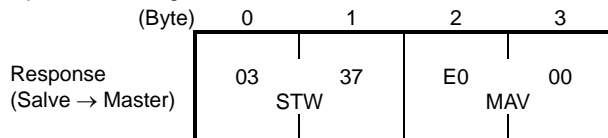
STW: Data 03 indicates that frequency and run commands from PROFIBUS are enabled and the output frequency arrives the reference one. Data 37 indicates that the inverter is running.

MAV: The current output frequency is E000hex (Frequency = F03 × -2000hex/4000hex).

(7) If any trip occurs in the inverter, remove the trip factor and then enter data "04 80" to CTW to cancel the trip. After the trip is cancelled, enter data "04 00." (Note: The MSB in the 2nd byte (Byte 1) acts as a trip cancellation bit.)

(Byte)	0	1	2	3
Request (Master → Slave)	04	80	10	00
	CTW		MRV	
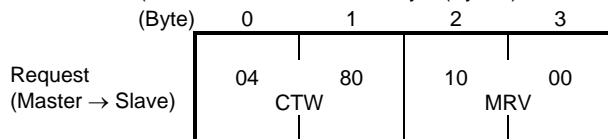
CTW: Data 04 enables the contents in this frame. Data 80 requests canceling of the trip.

MRV: The frequency command is 1000hex (Frequency = F03 × 1000hex/4000hex).

Canceling a trip returns the inverter to the state immediately after the power is turned ON. To restart operation using PROFIBUS network, go back to step (2).
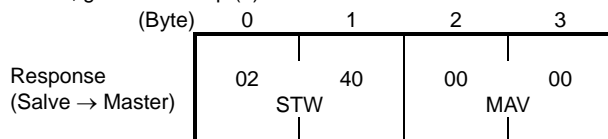
(Byte)	0	1	2	3
Response (Salve → Master)	02	40	00	00
	STW		MAV	

STW: Data 02 indicates that frequency and run commands from PROFIBUS are enabled. Data 37 indicates that the inverter is running.

MAV: The current output frequency is 0000hex.

# Chapter 8 DETAILS OF PROFIBUS PROFILES

The interface option supports PROFIdrive V2 of a motor control profile which is instituted by the PROFIBUS Organization. This chapter describes the PROFIdrive profile.

8.1 Description of PPO Types Supported

The PROFIdrive profile defines several data formats called PPO (Parameter Process-data Object). This interface option supports four PPO types shown in Figure 8.1. Select a PPO type to apply to the option using the function code o30 (see Table 8.1). Table 8.2 lists the features of these PPO types. Tables 8.3 and 8.4 list the parts in the PPO.
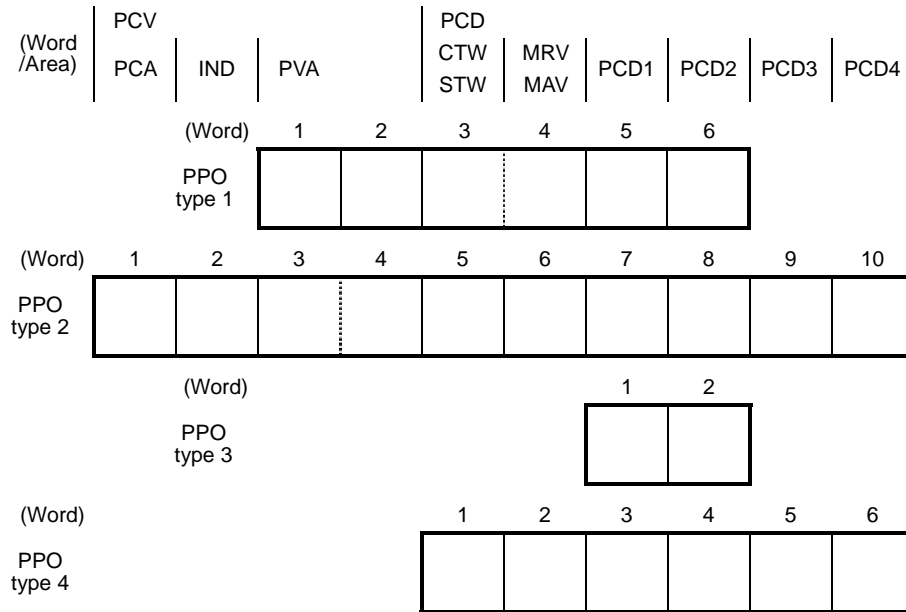
Figure 8.1 Data Formats of PPO Types Supported

Table 8.1 Choice of PPO Type Using the Inverter's Function Code o30

Data of o30	PPO	Remarks
0, 1, 6 to 255	PPO type 1	Factory default PPO type
2, 5	PPO type 2	
3	PPO type 3	
4	PPO type 4	

Note Turn the inverter and this option OFF and ON after setting the function code o30 to validate the new setting.

Table 8.2 Features of PPO Types

PPO	Features
PPO type 1	Most typical data format that supports run command/running status monitor, frequency command/output frequency monitor, and on-demand accesses to inverter's function codes.
PPO type 2	Fully functional data format that supports run command/running status monitor, frequency command/output frequency monitor, on-demand accesses to inverter's function codes, and cyclic access to up to four inverter's function codes previously specified.
PPO type 3	Simplified data format specialized for defining run command/running status monitor and frequency command/output frequency monitor.
PPO type 4	Data format that supports cyclic access to up to four inverter's function codes previously specified, in addition to the features of PPO type 3.

Table 8.3 Parts in PPO

Parts	Description
PCD	Parameter area used for cyclic data communication with the PROFIBUS DP master node. Run command/running status monitor and frequency command/output frequency monitor can be assigned to this area. PPO type 2 and type 4 additionally can assign arbitrary inverter's function codes to this area, enabling cyclic data writing and reading, each with up to four function codes.
PCV	Parameter area used for an on-demand access to the parameter (inverter's function codes and PROFIdrive specific parameters). PPO type 1 and type 2 support this area.

Table 8.4 Words in PCV and PCD Parts

Parts	Words	Function	Description
PCD	CTW/STW	Request	CTW: Control word that sends a run command from the master to the slave.
		Response	STW: Status word that returns the inverter's running status from the slave to the master as a response.
	MRV/MAV	Request	MRV: Word area that sends a frequency command expressed relative to the maximum frequency (defined by F03 in Hz) being assumed as 4000hex, from the master to the slave.
		Response	MAV: Word area that returns the current inverter's output frequency expressed relative to the maximum frequency (defined by F03 in Hz) being assumed as 4000hex, from the slave to the master.
	PCD1	Request	Word area that writes data of the inverter's function code specified by o40.
		Response	Word area that cyclically monitors data of the inverter's function code specified by o48.
	PCD2	Request	Word area that writes data of the inverter's function code specified by o41.
		Response	Word area that cyclically monitors data of the inverter's function code specified by o49.
	PCD3	Request	Word area that writes data of the inverter's function code specified by o42.
		Response	Word area that cyclically monitors data of the inverter's function code specified by o50.
	PCD4	Request	Word area that writes data of the inverter's function code specified by o43.
		Response	Word area that cyclically monitors data of the inverter's function code specified by o51.
PCV	PCA	Request	Word area that specifies the parameter (for the inverter's function code and PROFIBUS parameter) and access method to the parameter such as "write" and "read."
		Response	Word area that returns the parameter specified by the request above and the access result as a response.
	IND	Request /Response	Word area that is used to specify indexes of array parameters and inverter's function code numbers.
	PVA	Request /Response	Word area that shows the parameter value written or read.

For details about inverter's function codes o40 to o43 and o48 to o51, refer to Section 8.2 (4) "PCD1 to PCD4."

Tip The "Request" and "Response" denote data transfer from the PROFIBUS master node to the inverter (slave node) equipped with this interface option and that from the inverter to the PROFIBUS master node, respectively.

8.2 PCD Word Area

The PCD word area controls the cyclic data transfer between the PROFIBUS DP master node and the inverter (slave node) equipped with this interface option. It consists of CTW (run command), STW (running status monitor), MRV (frequency command), MAV (output frequency monitor), and PCD1 to PCD4 (cyclic accesses up to four inverter's function codes previously assigned) word areas.

(1) CTW (Control word)

CTW is a word area for controlling the data transfer of run command and its related ones from the PROFIBUS DP master node to the inverter (salve node) equipped with this interface option.

(bit)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
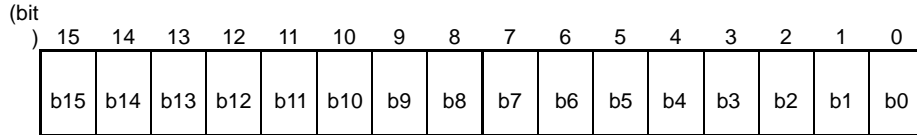
Table 8.5 Bit Definition in CTW

Bit	Command/Status	False (0)	True (1)
b0	ON/OFF	Turn a run command OFF	Turn a run command ON
b1	ON2/OFF2	OFF2: Coast to stop	ON2: Request the inverter to be ready for turning a run command ON (1)
b2	ON3/OFF3	OFF3: Stop command following the deceleration time specified by the function code H56	ON3: Request the inverter to be ready for turning a run command ON (2)
b3	Enable operation	Disable inverter operation	Enable inverter operation
b4	Enable ramp generator	Fix the inverter output frequency at 0 Hz	Enable the ramp frequency generator (RFG)
b5	Unfreeze ramp generator	Freeze the RFG with the current output frequency fixed	Unfreeze RFG command
b6	Enable setpoint	Disable	Enable ON-bit
b7	ALM RST	Do not reset alarm	Reset alarm (Resetting an alarm makes the option unready to turn a run command ON.)
b8, b9	Not used.	---	---
b10	Enable PCD	Ignore data entered in the PCD area (CTW+MRV)	Enable data entered in the PCD area (CTW+MRV)
b11	Run direction	Run in the forward direction	Run in the reverse direction
b12 to b15	Not used.	---	---

Tip For the use under the usual operation conditions, setting b1 through b6 and b10 to "1" could not cause any problem.

Note The PROFIdrive profile controls an inverter, following the status transition in the interface option. It means that only turning a run command ON cannot run the inverter. After the inverter undergoes the status transition scheduled by the PROFIdrive profile and enters the appropriate state, a run command should be turned ON. The status word STW described in the next section informs you of the current status of the interface option.

For the status transition condition of the PROFIdrive profile, refer to Section (2) "STW (status word)" and Figure 8.2 on the following pages.

Tip If you do not need any strict control with the status transition, follow the procedure given in Chapter 7 "QUICK SETUP GUIDE FOR RUNNING THE INVERTER."

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(2) STW (Status word)

STW is a word area for monitoring the inverter's running status.

📖 STW indicates the status transition of the PROFIdrive. The status transition details are shown in Figure 8.2.

(bit)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
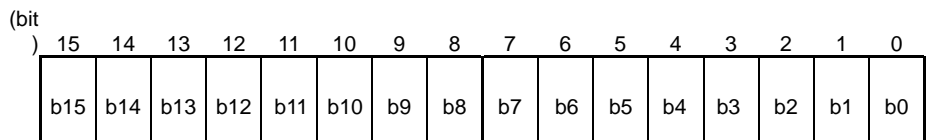
Table 8.6 Bit Definition in STW

Bit	Status	False (0)	True (1)
b0	Ready to switch ON	Not ready to turn a run command ON	Ready to turn a run command ON
b1	Ready to run	Not ready to run	Ready to run
b2	Running state	Running disabled	Running
b3	ALM	No inverter trip present	Inverter being tripped
b4	ON2/OFF2	OFF2: b1 in CTW is "0"	ON2: b1 in CTW is "1"
b5	ON3/OFF3	OFF3: b2 in CTW is "0"	ON3: b2 in CTW is "1"
b6	Run command ON inhibited	Ready to turn a run command ON (logical negation of b0)	Not ready to turn a run command ON (logical negation of b0)
b7	Not used.	---	---
b8	FAR	Not reached the reference frequency	Reached the reference frequency
b9	R/L	Both frequency and run commands from PROFIBUS are invalid	Either one of frequency and run commands from PROFIBUS is valid
b10	FDT	Output frequency has not reached the level specified by the function code E31	Output frequency has reached or exceeded the level specified by the function code E31
b11 to b15	Not used.	---	---

Figure 8.2 illustrates a status transition diagram of the PROFIdrive profile.

Immediately after the inverter and this option are turned ON, the status first moves to S1 "Not ready to turn a run command ON." Bit manipulation in CTW shifts the status to S2 "Ready to turn a run command ON," S3 "Ready to run" and finally S4 "Running" in sequence. In S4 state, the inverter enters the running state. Turning a run command OFF in S4 state shifts the status to S5 "Turn a run command OFF." After the motor stops, the status moves to S2 or S1 state.

Note In Figure 8.2, to simplify the description, values of Bit 4 to Bit 6 and Bit 10 in CTW are always "1." If any one of these bit values is not "1," the inverter will not enter the running state even if the status transition properly proceeds.
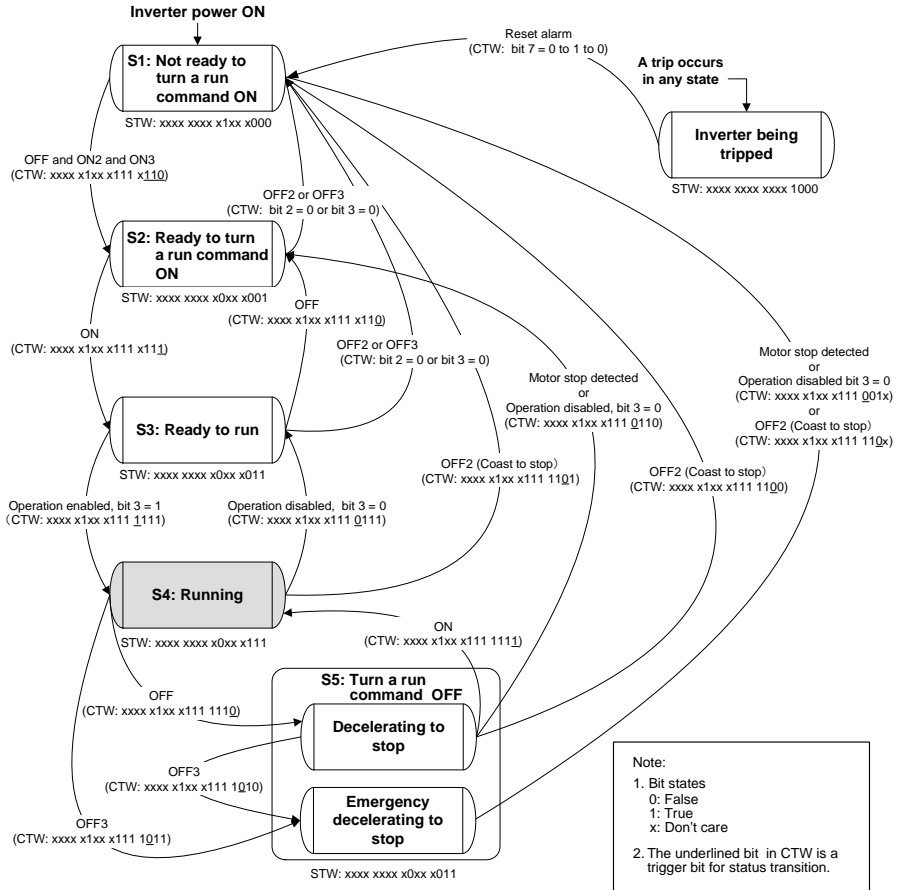
Figure 8.2 Status Transition Diagram of PROFIdrive Profile

(3) MRV (frequency command) and MAV (output frequency)

MRV and MAV are word areas for setting a frequency command and monitoring an output frequency, respectively.

MRV: Frequency command word area that sends a frequency command from the PROFIBUS DP master node to an inverter (slave node).

MAV: Output frequency monitoring word area that returns the current inverter's output frequency to the PROFIBUS DP master node as a response from the inverter (slave node).

In each word, the frequency is expressed relative to the maximum frequency (defined by F01 in Hz) being assumed as 4000hex. The conversion expression is shown below.

$$\text{MRV or MAV} = \frac{\text{Frequency (Hz)}}{\text{Function code F03 (Hz)}} \times 4000\text{hex} \quad \text{or} \quad \text{Frequency (Hz)} = \text{Function code F03 (Hz)} \times \frac{\text{MRV or MAV}}{4000\text{hex}}$$

Tip A negative value is expressed by 2's complement of 4000hex. When the inverter is running in the *reverse* direction, the value of MAV (output frequency) is a negative value. Setting a negative value to MRV (frequency command) causes even a run *forward* command to run the motor in the *reverse* direction.

(4) PCD1 to PCD4

PCD1 to PCD4 are word areas exclusively supported by PPO type 2 and type 4. They enable cyclic write request and read (monitor) response to/from up to four inverter's function codes previously specified for each of PCD1 to PCD4.

Note Values written and read to/from the specified function codes are in the same data format as defined in individual inverter's function codes.

📖 For the formats of inverter's function codes, refer to the RS-485 Communication User's Manual (MEH448), Chapter 5, Section 5.2 "Data Formats."

To assign inverter's function codes to PCD1 to PCD4 words, use function codes o40 to o43 and o48 to o51 as listed in Table 8.7. Table 8.8 on the next page shows how to use these function codes.

Table 8.7 Function Codes to Assign Inverter's Function Codes to PCD1 to PCD4 Words

	PCD area	Function codes	Remarks
Request (Write a function code)	PCD1	o40	Also assignable by PNU915, index 1 *
	PCD2	o41	Also assignable by PNU915, index 2 *
	PCD3	o42	Also assignable by PNU915, index 3 *
	PCD4	o43	Also assignable by PNU915, index 4 *
Response (Monitor a function code)	PCD1	o48	Also assignable by PNU916, index 1 *
	PCD2	o49	Also assignable by PNU916, index 2 *
	PCD3	o50	Also assignable by PNU916, index 3 *
	PCD4	o51	Also assignable by PNU916, index 4 *

* PNU915 and PNU916 refer to PROFIdrive specific parameters. For details, refer to Section 8.3 (4) "PROFIdrive specific parameters."

📖 For details of assignment of inverter's function codes using function codes o40 to o43 and o48 to o51, refer to the descriptions on the next page.

To assign an inverter's function code to PCD1 to PCD4 word areas using function codes o40 to o43 and o48 to o51, enter four digit hexadecimals to specify the function code group and number as listed in Table 8.8.
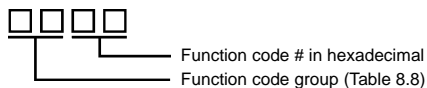
☐☐☐☐
— Function code # in hexadecimal
— Function code group (Table 8.8)

(Note) • Inverter's communication-related function codes S01 and S05 act as a reading specific code in this interface option. Therefore, assigning these codes to a PCD word area as a write request will be ignored.
Bits in the function code S06 are writable except bit 0 and bit 1. Data written in bit 0 and bit 1 will be ignored.

📖 For details about inverter's communication-related function codes S01, S05 and S06, refer to the RS-485 Communication User's Manual (MEH448), Chapter 5, Section 5.1 "Communications Dedicated Function Codes."

Table 8.8 Function Code Group Conversion Table

Function code group	Group number		Function code name	Function code group	Group number		Function code name
S	2	02hex	Command/function data	o	10	0Ahex	Option functions
M	3	03hex	Monitor data	J	14	0Ehex	Application functions
F	4	04hex	Fundamental functions	y	15	0Fhex	Link functions
E	5	05hex	Extension terminal functions	W	16	10hex	Monitor data 2
C	6	06hex	Control functions	X	17	11hex	Alarm 1
P	7	07hex	Motor parameters 1	Z	18	12hex	Alarm 2
H	8	08hex	High performance functions	---	---	---	---

Example for F26 F ⇒ Function code group 04hex ⎫
                   26 ⇒ Function code number 1Ahex ⎬ "041A"
                                                   ⎭

(Note) • After setting up function codes o40 to o43 and o48 to o51, turn the inverter and this option OFF and ON to validate the new setting.
• If a same function code is assigned to the PCD areas using function codes o40 to o43, the function code assigned by the o code with the youngest number takes effect and other assignments will be ignored.

8.3 PCV Word Area

The PCV word area controls an on-demand access to parameters (inverter's function codes and PROFIdrive specific parameters). It is supported by PPO type 1 and type 2. Its structure is shown below.

(Word)	1	2	3	4
PCV word	PCA	IND	PVA (H)	(L)
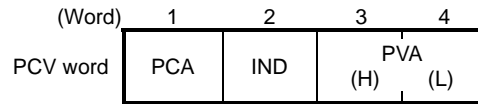
Figure 8.3 Structure of PCV Word Area

(1) PCA and IND

These two word areas specify a parameter. Their structures are shown below.

(bit)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PCA		RC			SPM					PNU						

(bit)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IND			Subindex								Not used.					
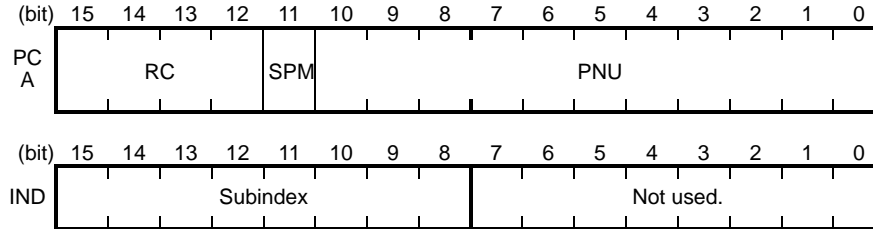
RC: Request code/response code (See Table 8.9.)
SPM: Not used. Fixed at "0."
PNU: Parameter number to be accessed
Subindex: Inverter's function code number (numeric following a function code group) or an index number of array PROFIdrive specific parameters.

Tip To specify an inverter's function code, use PNU and Subindex areas. Enter "Function code group + 100hex" (see Table 8.8) to the PNU area, and the function code number to the Subindex area.

📖 For how to specify and read/write an inverter's function code, refer to Section 8.3 (3) "Access to inverter's function codes and PROFIdrive specific parameters."

Table 8.9 RC Part

RC part	Request/response	Descriptions
0	Request (Master → Slave)	No request
1		Read parameter value
2		Write parameter value in word
3 to 5		Not used.
6		Read array parameter value
7		Write array parameter in array word
8		Not used.
9		Read element count of array parameter
10 to 15		Not used.
0	Response (Slave → Master)	No response
1		Parameter value in word sent normally
2, 3		Not used.
4		Parameter value in array word sent normally
5		Not used.
6		Normal response to the request of array element count
7		Transmission error (Error code stored in PVA)*
8 to 15		Not used.

* For error codes and information, see Table 8.10.

Table 8.10 List of Error Codes for Parameter Access Errors

RC part	Error code stored in PVA word	Error information
7	0	Nonexistent parameter specified
	1	Parameter value writing inhibited
	2	Specified parameter value out of range
	3	Invalid Subindex specified
	4	Specified parameter not array
	11	Parameter write-protect error during inverter running or digital input terminal (for run command) being ON
	17	Read process not executable
	101	Link priority error
	104	Busy error during parameter writing

(2) PVA word area

PVA is a two-word area that represents write/read parameter values. This interface option uses the lower one word (the fourth word counted from the PCV word head).

To write a parameter value into an inverter (slave node), enter the value to the master node and send the word to the slave. To read a parameter value, refer to this area of the slave node in response to the previous request. If a parameter access error occurs (Response to RC part is "7"), the slave node outputs an error code (Table 8.10) to this area and returns the response to the master node.

(bit)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PVA (H)								Not used.								

(bit)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PVA (L)						Write/read parameter value or error code (See Table 8.10.)										
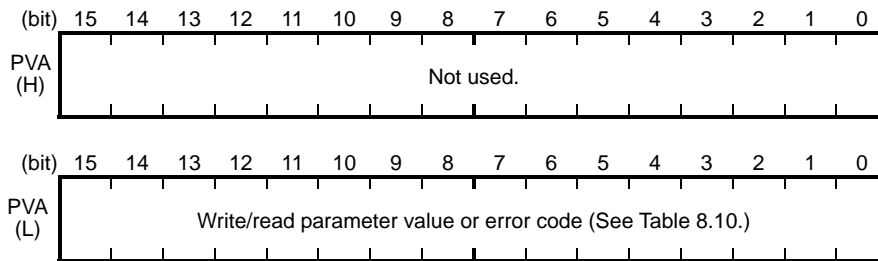
(3) Access to inverter's function codes and PROFIdrive specific parameters

1) Specify the target parameter to be accessed using PNU and Subindex areas (see Figure 8.4).

When specifying an inverter's function code, enter the numeral of "Function code group number + 100hex" (see Table 8.8) to the PNU area, and "Function code number" to the Subindex area. For example, enter "104 01" for F01.

2) Specify how to access the specified parameter, for example, Write or Read, in the RC area. For details about the RC area, see Table 8.9.

3) To write a parameter value, enter the write data into the PVA lower area and send the word to the salve node. To read a parameter value from the slave, refer to the PVA lower area in the response from the slave node. If a parameter access error occurs, the RC part of the response is filled with "7" and the PVA area contains one of the error codes listed in Table 8.10.

Note Inverter's communication-related function codes S01 and S05 act as a reading specific code in this interface option. Therefore, assigning these codes to a PCD word area as a write request will be ignored.

Bits in the function code S06 are writable except bit 0 and bit 1 (FWD and REV commands). Data written in bit 0 and bit 1 will be ignored.

📖 For details about inverter's communication-related function codes S01, S05 and S06, refer to the RS-485 Communication User's Manual (MEH448), Chapter 5, Section 5.1 "Communications Dedicated Function Codes."

📖 Values written and read to/from the specified function codes are in the same data format as defined in individual inverter's function codes. For the formats of inverter's function codes, refer to the RS-485 Communication User's Manual (MEH448), Chapter 5, Section 5.2 "Data Formats."
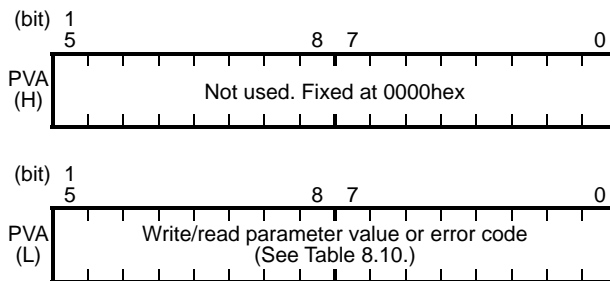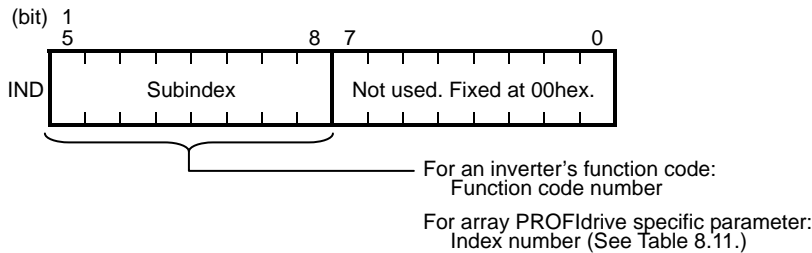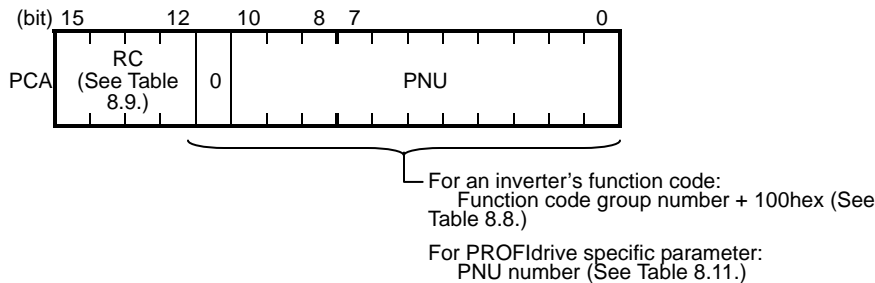
Figure 8.4 How to Access Parameters

The actual parameter access examples are given on the following pages.

Example 1: Writing data "15" to the inverter's function code F26

1) Send the request to write data "15" to the inverter's function code F26, from the master node to the slave node (inverter)
   RC = 2hex   → Write parameter value (word).
   PNU = 104hex, Subindex = 1Ahex→ Specify F26 (Function code group number 04h + 100hex = 104hex,
                                       Function code number = 1Ahex).
   PVA=0000 000F(hex)   → Enter parameter value 15 (= 000Fhex).
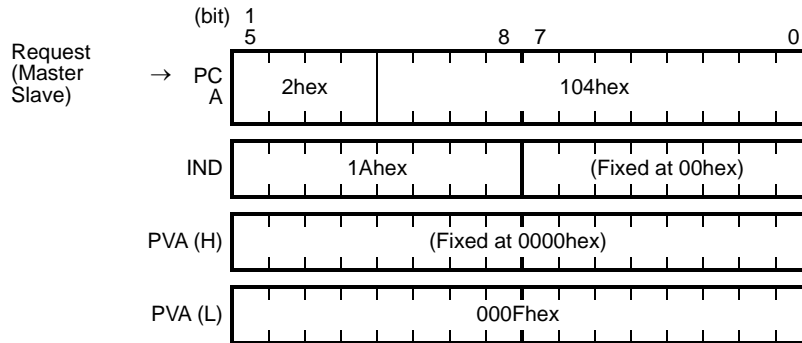
```
                              (bit) 1
                                    5              8 7              0
Request
(Master      →  PCA      |  2hex   |        104hex          |
Slave)

                IND      |    1Ahex        |  (Fixed at 00hex)   |

                PVA (H)  |        (Fixed at 0000hex)            |

                PVA (L)  |            000Fhex                   |
```

2) Response example sent from the option (normal response from the slave node)
   RC = 1hex   → Requested parameter value is normally returned.
   PNU = 104hex, Subindex = 1Ahex→ Accessed parameter is function code F26.
   PVA = 0000 000Fhex   → Parameter value written is 15.

```
                              (bit) 1
                                    5              8 7              0
Response
(Slave       →  PCA      |  1hex   |        104hex          |
Master)

                IND      |    1Ahex        |  (Fixed at 00hex)   |

                PVA
                (H)      |        (Fixed at 0000hex)            |

                PVA (L)  |            000Fhex                   |
```
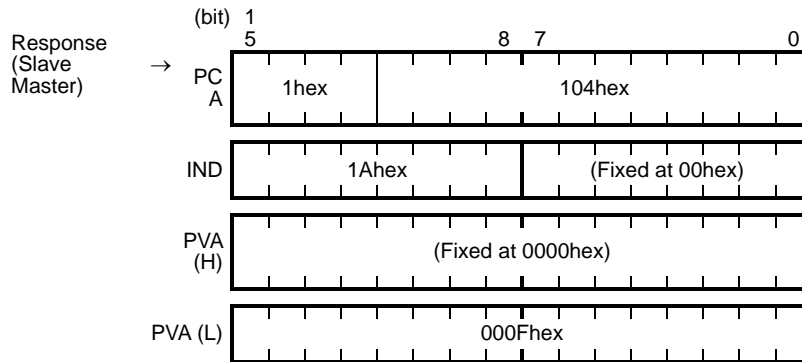
3) Response example for the write data error (Specified parameter value out of range)
   RC = 7hex   → Parameter value transmission error.
   PNU = 104hex, Subindex = 1Ahex→ Accessed parameter is function code F26.
   PVA = 0000 0002hex   → Error code 2 (Specified parameter value out of range)

```
                              (bit) 1        1 1
                                    5        2 1    8 7              0
Response
(Slave       →  PCA      |  7hex   |        104hex          |
Master)

                IND      |    1Ahex        |  (Fixed at 00hex)   |

                PVA
                (H)      |        (Fixed at 0000hex)            |

                PVA (L)  |            0002hex                   |
```
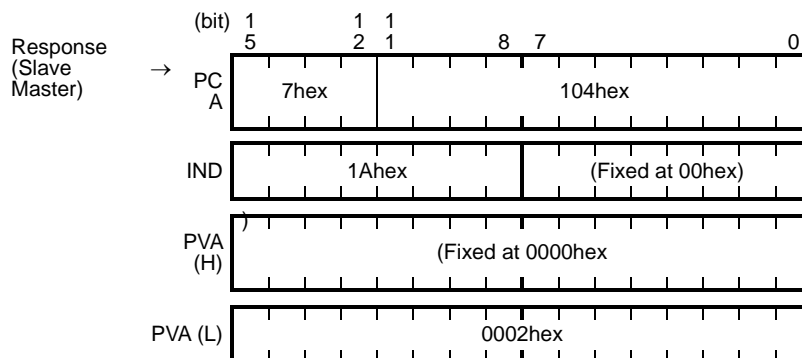
Example 2: Reading (monitoring) data from the inverter's function code y98

1) Send the request to read data from the function code y98, from the master node to the slave node.
   RC = 1hex   → Read parameter value.
   PNU = 10Fhex, Subindex = 62hex →   Specify y98 (Function code group number 0Fhex + 100hex = 10Fhex, Function code number = 62hex)
   PVA = 0000 0000hex   → No entry required for PVA.

```
                        (bit)  1
                               5                8  7              0
Request      →   PC   ┌──────────────┬─────────────────────────────┐
(Master          A    │    1hex      │          10Fhex             │
Slave)                └──────────────┴─────────────────────────────┘

                 IND  ┌──────────────────────┬──────────────────────┐
                      │        62hex         │   (Fixed at 00hex)   │
                      └──────────────────────┴──────────────────────┘

                 PVA  ┌─────────────────────────────────────────────┐
                 (H)  │            (Fixed at 0000hex)               │
                      └─────────────────────────────────────────────┘

                 PVA (L) ┌──────────────────────────────────────────┐
                         │              0000hex                     │
                         └──────────────────────────────────────────┘
```

2) Response example sent from the option (normal response from the slave node)
   RC = 1hex   → Requested parameter value is normally returned.
   PNU = 10Fhex, Subindex = 62hex →   Accessed parameter is function code y98.
   PVA = 0000 0003hex   → Parameter value read is 3.
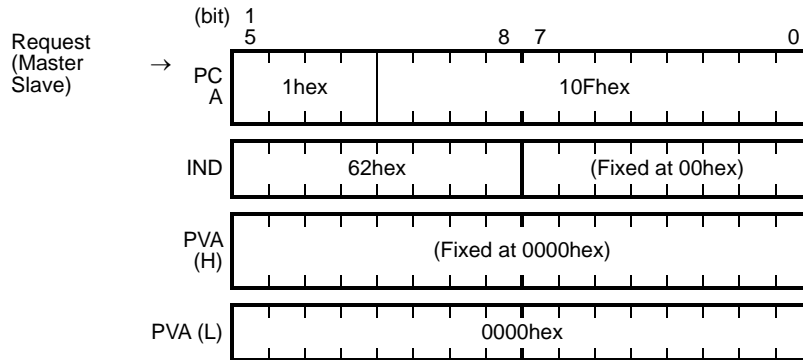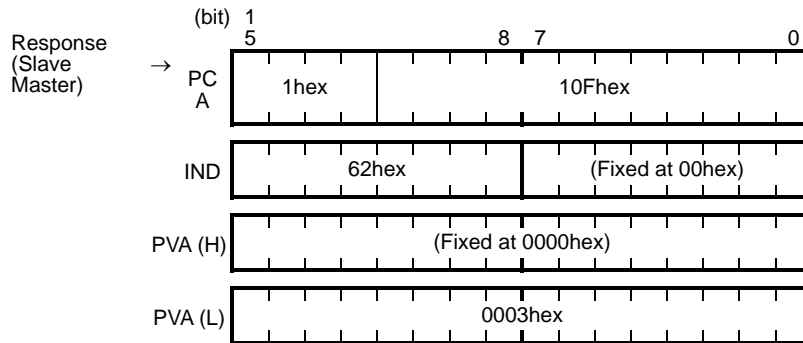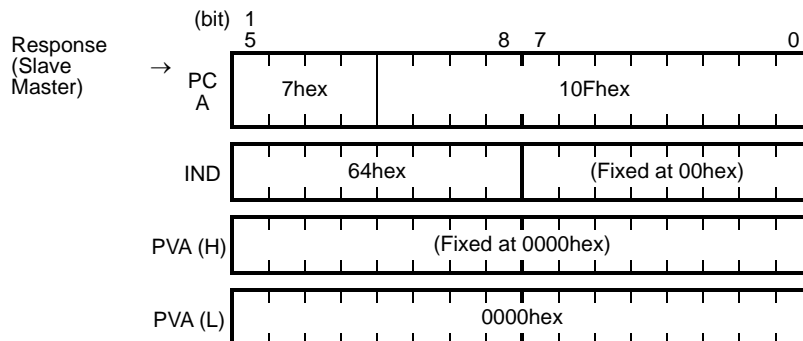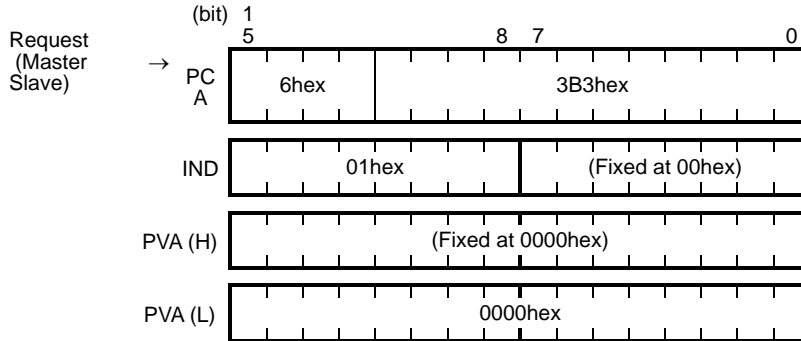
```
                        (bit)  1
                               5                8  7              0
Response     →   PC   ┌──────────────┬─────────────────────────────┐
(Slave           A    │    1hex      │          10Fhex             │
Master)               └──────────────┴─────────────────────────────┘

                 IND  ┌──────────────────────┬──────────────────────┐
                      │        62hex         │   (Fixed at 00hex)   │
                      └──────────────────────┴──────────────────────┘

                 PVA (H) ┌──────────────────────────────────────────┐
                         │          (Fixed at 0000hex)              │
                         └──────────────────────────────────────────┘

                 PVA (L) ┌──────────────────────────────────────────┐
                         │              0003hex                     │
                         └──────────────────────────────────────────┘
```

3) Response example for the read data error (Specified function code does not exist)
   RC = 7hex   → Parameter transmission error.
   PNU = 10Fhex, Subindex = 64hex →   Accessed parameter is function code y100.
   PVA = 0000 0000hex   → Error code 0 (Nonexistent parameter specified)

```
                        (bit)  1
                               5                8  7              0
Response     →   PC   ┌──────────────┬─────────────────────────────┐
(Slave           A    │    7hex      │          10Fhex             │
Master)               └──────────────┴─────────────────────────────┘

                 IND  ┌──────────────────────┬──────────────────────┐
                      │        64hex         │   (Fixed at 00hex)   │
                      └──────────────────────┴──────────────────────┘

                 PVA (H) ┌──────────────────────────────────────────┐
                         │          (Fixed at 0000hex)              │
                         └──────────────────────────────────────────┘

                 PVA (L) ┌──────────────────────────────────────────┐
                         │              0000hex                     │
                         └──────────────────────────────────────────┘
```
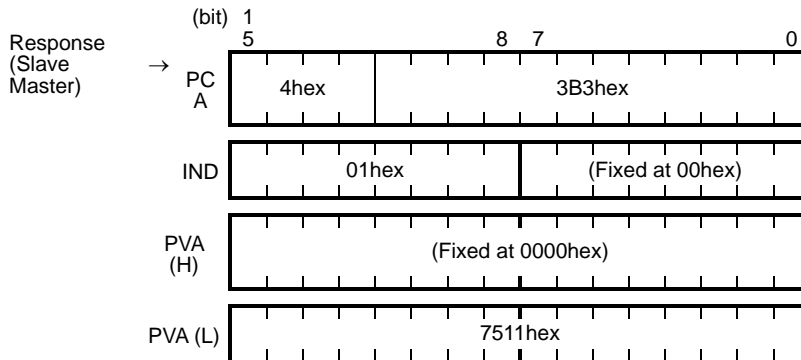
Example 3: Reading from an array PROFIdrive specific parameter PNU947 (Alarm history)

1) Send the request to read PNU947 from the master node to the slave node. The example below reads Index 1.

RC = 6hex   → Read an array parameter.
PNU = 3B3hex, Subindex = 1hex →   Specify PNU947 (= 3B3hex) and Index 1.
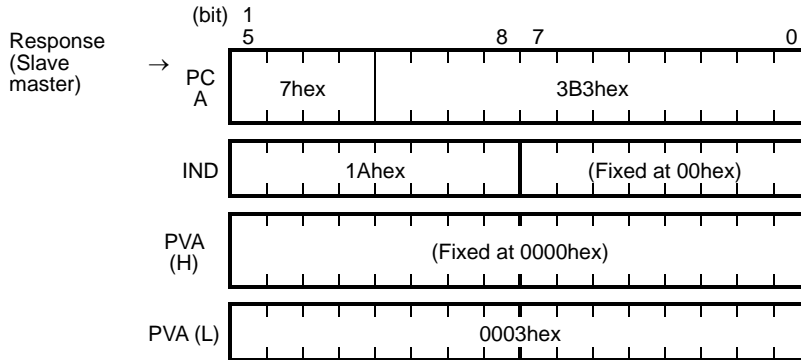PVA = 0000 0000hex   → No entry required for PVA.

Request (Master → Slave) →

(bit) 15 ... 8	7 ... 0
PCA	6hex	3B3hex
IND	01hex	(Fixed at 00hex)
PVA (H)	(Fixed at 0000hex)	
PVA (L)	0000hex	

2) Response example sent from the option (normal response from the slave node)

RC = 4hex   → Requested array parameter value is normally returned.
PNU = 3B3(hex), Subindex = 01 hex →   Accessed parameter is PNU947 (=3B3hex), Index 1.
PVA = 0000 7511hex   → Parameter value read is 7511hex,
                                       PROFIBUS communications error *er5*

    📖 For the values of PNU947, refer to Chapter 10 " LIST OF INVERTER ALARM CODES."

Response (Slave → Master) →

(bit) 15 ... 8	7 ... 0
PCA	4hex	3B3hex
IND	01hex	(Fixed at 00hex)
PVA (H)	(Fixed at 0000hex)	
PVA (L)	7511hex	

3) Response example for the read data error (Accessed parameter cannot be read as an array parameter.)

RC = 7hex   → Parameter transmission error.
PNU = 3B3hex, Subindex = 01hex →   Accessed parameter is function code y100.
PVA = 0000 0003hex   → Error code 3 (Invalid Subindex specified)

Response (Slave → master) →

(bit) 15 ... 8	7 ... 0
PCA	7hex	3B3hex
IND	1Ahex	(Fixed at 00hex)
PVA (H)	(Fixed at 0000hex)	
PVA (L)	0003hex	

(4) PROFIdrive specific parameters

Table 8.11 lists PROFIdrive specific parameters supported by this option. PNUs with descriptions in the index column are array parameters.

Table 8.11 List of PROFIdrive Specific Parameters

PNU	Index	Description	Range	R/W	Remarks
915	1 to 4	Function code assignment to PCD1 to PCD4 (Request) (Write function code data)	0000 to FFFFhex	R/W	Same as o40 to o43.
916	1 to 4	Function code assignment to PCD1 to PCD4 (Response) (Read/monitor function code data)	0000 to FFFFhex	R/W	Same as o48 to o51.
918	None	Node (station) address	0 to 125	R	
927	None	Access permission to PCV area 0: Inhibit to write 1: Permit to write	0 or 1	R/W	Once writing is inhibited, this PNU only is writable.
947	1	Malfunction history (Latest)	Depends on errors listed in Table 10.1.	R	Indicated by PROFIdrive malfunction codes whose data formats differ from the ones of inverter's alarm codes defined by inverter's function codes M16 to M19.*
	9	Malfunction history (Last)			
	17	Malfunction history (2nd last)			
	25	Malfunction history (3rd last)			
	Other than the above	Fixed to 0.			
963	None	Current baud rate 0: Not specified 1: 9.6 Kbps 2: 19.2 Kbps 3: 45.45 Kbps 4: 93.75 Kbps 5: 187.5 Kbps 6: 500 Kbps 7: 1.5 Mbps 8: 3 Mbps 9: 6 Mbps 10: 12 Mbps	0 to 10	R	
965	None	PROFIdrive version	Fixed to 2	R	Shows PROFIdrive V2.
967	None	Last CTW sent	0000 to FFFFhex	R	
968	None	Latest STW	0000 to FFFFhex	R	
970	None	Initialize the inverter (Changing from "1" to "0" triggers the initialization.)	0 or 1	R/W	Functionally equivalent to H03.

* For the relationship between the malfunction codes and alarm codes, refer to Chapter 10 " LIST OF INVERTER ALARM CODES."

Chapter 9 INVERTER REACTION TO PROFIBUS COMMUNICATIONS ERRORS

The PROFIBUS DP master node can be equipped with a watchdog timer (WDT) that detects communications timeout for monitoring the communications status. If this option receives no response within the WDT timeout length, it interprets the timeout state as an occurrence of a communications error.

Inverter's function codes o27 and o28 specify the inverter reaction to be taken after such an error occurrence. (See Table 9.1.)

📖 For the setup of WDT in the PROFIBUS DP master equipment, see the user's manual of your master equipment.

📖 For the error indication on the option at the time of a communications error, see Chapter 2, Section 2.5 "Status Indicator LEDs."

(Note) If a communications error occurs immediately after the inverter and this option are powered on, no *er5* trip will be issued. The *er5* trip is issued when a communications error is detected after once the option received data normally.

Table 9.1 Inverter Reaction to PROFIBUS DP Communications Errors Using Function Codes o27 and o28

o27 data	o28 data	Inverter reaction to PROFIBUS DP communications errors	Remarks
0, 4 to 9	Invalid	Immediately coast to a stop and trip with *er5*.	
1	0.0 s to 60.0 s	After the time specified by o28, coast to a stop and trip with *er5*.	
2	0.0 s to 60.0 s	If the inverter receives any data within the time specified by o28, ignore the communications error. After the timeout, coast to a stop and trip with *er5*.	
3, 13 to 15	Invalid	Keep the current operation, ignoring the communications error. (No *er5* trip)	During the communications error state, the LED displays the abnormal state. (PWR: Flashes in red, OFFL: Lights in red.)
10	Invalid	Immediately decelerate to a stop. Issue *er5* after stopping.	The inverter's function code F08 specifies the deceleration time.
11	0.0 s to 60.0 s	After the time specified by o28, decelerate to a stop. Issue *er5* after stopping.	Same as above.
12	0.0 s to 60.0 s	If the inverter receives any data within the time specified by o28, ignore the communications error. After the timeout, decelerate to a stop and trip with *er5*.	Same as above.

Chapter 10   LIST OF INVERTER ALARM CODES

In PROFIBUS DP communication, alarms that occur in the inverter can be monitored with malfunction codes in the PROFIdrive specific parameter PNU974 or with alarm codes in the inverter's function codes M16 through M19.

(1) PROFIdrive specific parameter PNU947
(2) Inverter's function codes M16, M17, M18 and M19 (latest, last, 2nd last, and 3rd last alarm codes).

Table 10.1 lists their malfunction codes and alarm codes.

Note The data format used for PNU947 is different from that for the inverter's function codes M16 to M19.

📖 For details about PNU947, refer to Chapter 8, Section 8.3 (4) "PROFIdrive Specific Parameters."

Table 10.1 Malfunction Codes and Alarm Codes

Malfunction codes in PNU947	Alarm codes in M16 to M19	Description		Malfunction codes in PNU947	Alarm codes in M16 to M19	Description	
0000	0	---	---	4210	22	Braking resistor overheated	dbh
2301	1	Overcurrent (during acceleration)	0c1	2211	23	Motor overload 1	0l1
2302	2	Overcurrent (during deceleration)	0c2	2212	24	Motor overload 2	0l2
2303	3	Overcurrent (during running at constant speed)	0c3	2200	25	Inverter overload	0lu
2330	5	Grounding fault	ef	5500	31	Memory error	er1
3211	6	Overvoltage (during acceleration)	0u1	7520	32	Keypad communication error	er2
3212	7	Overvoltage (during deceleration)	0u2	5220	33	CPU error	er3
3213	8	Overvoltage (during running at constant speed or being stopped)	0u3	7510	34	Interface option communications error	er4
3220	10	Undervoltage	lu	7511	35	Field bus communications error	er5
3130	11	Input phase loss	lln	F004	36	Operation protection	er6
5450	14	Blown fuse	fus	7200	37	Tuning error	er7
5440	16	Charging circuit fault	pbf	B100	38	RS-485 communications error	er8
4310	17	Overheating of the heat sink	0h1	3300	46	Output phase loss	0pl
9000	18	External alarm	0h2	6300	51	Data save error due to undervoltage	erf
4110	19	Inverter overheat	0h3	7520	53	RS-485 communications error (option)	erp
4310	20	Motor protection (PTC thermistor)	0h4	5220	54	LSI error (power printed circuit board)	erh

Chapter 11   TROUBLESHOOTING

If any problem occurs with the option, follow the procedures below.

No.	Problems	Possible causes
1	None of the LEDs on the option would light.	• The inverter and this option are not powered ON. • The option is not properly installed. • The option is defective.
2	The inverter cannot escape from the *er4* alarm trip. The PWR LED lights in red.	• The option is not properly installed. • The option is not powered ON. • The option is defective.
3	PROFIBUS communication is not possible. The PWR LED blinks in red and the OFFL LED lights in red.	• The valid GSD file has not been registered to the PROFIBUS master node. • The node address of the option is not identical with the one registered to the PROFIBUS master node. • Node addresses duplicated. • The cabling does not meet PROFIBUS DP requirements. • The cable used is not a PROFIBUS DP dedicated one. • Terminating resistors are not inserted at both ends of the PROFIBUS DP communications network.
4	PROFIBUS communications is not possible. The ERR LED blinks in red.	• The inverter's function code o30 has not been configured. The data for o30 should be identical with the PPO type registered for the PROFIBUS master node. • The inverter and this option have not been turned OFF and ON again after setting of the function code o30.
5	The inverter cannot escape from the *er5* alarm trip. or The inverter trips with *er5* soon after starting FROFIBUS communication. The PWR LED blinks in red and the OFFL LED lights in red.	• The timeout length specified in the watchdog timer in the PROFIBUS master node equipment is too short. • The inverter's function code o31 is set to "126" or greater. • The cable used is not a PROFIBUS DP dedicated one.. • The option is not grounded.
6	Run or frequency command by CTW or MRV is not validated.	• The inverter's function code y98 is not set to "3." • Run or frequency command specified by the function code has priority. (e.g. y99 specifies, terminal command *LE* or *LOC*) • Check the PPO type format selected.
7	PCD1 to PCD4 assignments for PPO type 2 or type 4 are not validated properly.	• The inverter's function code o30 is not set. Or the inverter and this option have not been turned OFF and ON again after setting of the function code o30. • The inverter and this option have not been turned OFF and ON again after setting of function codes o40 to o43 and o48 to o51.
8	Setting the node address to "0" does not take effect.	• The inverter and this option have not been turned OFF and ON again after changing of the node address. • The inverter's function code o31 is set to nonzero.
9	Frequency command validated, but the actual motor speed is different from the command.	• Refer to the FRENIC-Multi Instruction Manual (INR-SI47-1204-E), Chapter 6, Section 6.2.1 "Motor is running abnormally."

Chapter 12　　　SPECIFICATIONS

12.1 General Specifications

For items not contained in the following table, the specifications of the inverter apply.

Item	Specifications
Input power voltage	21.6 to 27.0 V
Power consumption	Max. 200 mA, 24 VDC
Operating ambient temperature	-10 to +50°C (14 to +122°F)
Operating ambient humidity	5 to 95% RH (There shall be no condensation.)
External dimensions	79.6 x 127 x 47.5 mm(3.13 x 5 x 1.87 in)

12.2 Communications Specifications

For the items not covered in this section, the specifications of the PROFIBUS DP apply.

Item		Specifications	Remarks
Transmission section	Lines	RS-485 (insulated cable)	
	Cable length	See the table below.	
	Transmission speed	9.6 Kbps to 12 Mbps (auto configuration)	To be specified in the master node
	Protocol	PROFIBUS DP (DP-V0)	IEC 61158 and 61784
Connector		Pluggable, six-pin terminal block	MSTB1.5/6-STF-3.81 manufactured by Phoenix Contact Inc.
Control section	Controller	SPC3 (Siemens)	
	Comm. buffer	1472 bytes (SPC3 built-in memory)	
Addressing		By on-board node address switches (rotary switches) (0 to 99) or By inverter's function code o31 (data = 0 to 125)	Setting both node address switches SW1 and SW2 to "0" enables the o31 setting.
Diagnostics		Detection of disconnection	Indicated by the OFFL LED
		Detection of the illegal configuration	Indicated by the ERR LED

Maximum cable length per segment for PROFIBUS DP specific cable

Transmission speed	Maximum cable length (m) per segment
9.6 Kbps	1200(3937 ft)
19.2 Kbps	1200(3937 ft)
45.45 Kbps	1200(3937 ft)
93.75 Kbps	1000(3281 ft)
187.5 Kbps	1000(3281 ft)
500 Kbps	400(1312 ft)
1.5 Mbps	200(656 ft)
3 Mbps	100(328 ft)
6 Mbps	100(328 ft)
12 Mbps	100(328 ft)

PROFIBUS DP Interface Card "OPC-E1-PDP"

Instruction Manual

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The purpose of this manual is to provide accurate information in the handling, setting up and operating of PROFIBUS DP Interface Option "OPC-E1-PDP" for the FRENIC-Multi series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric FA Components & Systems Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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