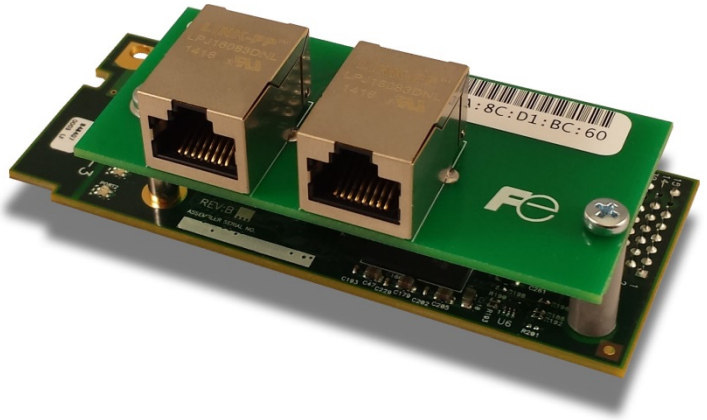
Instruction Manual

Fuji Electric
Innovating Energy Technology

FRENIC-MEGA
FRENIC-HVAC

OPC-PRT2
PROFINET IO Interface



⚠CAUTION

Thank you for purchasing the OPC-PRT2 PROFINET IO Interface.

- This product is designed to connect the FRENIC-MEGA and FRENIC-HVAC series of inverters to PROFINET networks. Please read this instruction manual thoroughly in order to become familiar with the proper interface handling, installation and usage procedures.
- Improper handling may inhibit correct operation or cause premature interface failure.
- Please deliver this instruction manual to the end user of the interface, and retain it in an accessible location.
- For inverter usage instructions, please refer to the applicable inverter instruction manual.

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Part #10946

OPC-PRT2 PROFINET IO Interface Instruction Manual

Part Number 10946
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Notice to Users

PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE-SUPPORT DEVICES OR SYSTEMS. Life-support devices or systems are devices or systems intended to sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling and user's manual, can be reasonably expected to result in significant injury.

No complex software or hardware system is perfect. Bugs may always be present in a system of any size. In order to prevent danger to life or property, it is the responsibility of the system designer to incorporate redundant protective mechanisms appropriate to the risk involved.

Preface

This instruction manual has been prepared to help you connect your FRENIC-MEGA or FRENIC-HVAC inverter to a PROFINET IO network using the OPC-PRT2 PROFINET IO interface card. This instruction manual does not contain inverter usage instructions. Please refer to this instruction manual in conjunction with the applicable inverter instruction manual in order to become familiar with the proper handling, installation and operation of this product. Improper handling or installation procedures may result in incorrect operation or premature product failure.

Related Publications

Listed below are publications that are necessary for reference in conjunction with this instruction manual.

- **RS-485 Communication User's Manual (24A7-E-0082)**
- **FRENIC-MEGA Instruction Manual (INR-SI47-1457-E)**
- **FRENIC-HVAC Instruction Manual (INR-S147-1610-E)**
- **FRENIC-MEGA User's Manual (MEHT536)**
- **FRENIC-HVAC User's Manual (24A7-E-0069)**

These documents are subject to change without notice. Please be sure to refer to the most recent available versions.

Safety precautions

Please read this instruction manual thoroughly prior to proceeding with installation, connections, operation, or maintenance and inspection. Additionally, ensure that all aspects of the system are fully understood, and familiarize yourself with all safety information and precautions before operating the inverter.

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

⚠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

- To avoid electrical shock, remove all power from the inverter and wait at least five minutes prior to starting installation. Additionally, confirm that the DC link bus voltage as measured between the P (+) and N (-) terminals is less than 25 VDC.
- Installation should be performed only by qualified personnel.
- To avoid electrical shock, do not operate the inverter with the front cover or wiring cover removed, as accidental contact with exposed high-voltage terminals and internal components may occur.
- To prevent explosions or similar damage, ensure that all cables are properly connected to the correct terminals, and observe all wiring polarity indicators.

⚠CAUTION

- Do not install or operate the interface if it is damaged or has parts missing.
- Prevent conductive items such as screws and metal fragments, or flammable substances such as oil, lint, paper fibers and sawdust from entering the inverter and interface card enclosure.
- Incorrect handling during installation or removal may cause equipment failure.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching.
- To prevent damage due to electrostatic discharge, always touch a grounded piece of metal prior to touching any equipment.
- Do not stand on or rest heavy objects on the equipment.
- To prevent burns from hot components, do not touch the inverter while power is on, or for some time after power is removed.
- Electrical noise may be emitted from the inverter, motor and wires. Always implement appropriate countermeasures to prevent nearby sensors and devices from malfunctioning due to such noise.

Operation

⚠WARNING

- To avoid electrical shock, do not open the front cover of the inverter while power is on or while the inverter is running.
- To avoid electrical shock, do not operate switches with wet hands.
- If the inverter’s function codes are incorrectly configured, or configured without adequate understanding of the appropriate inverter Instruction Manual and User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine. Confirm the settings of all function codes prior to running the inverter.

Maintenance, inspection, and parts replacement

⚠WARNING

- To avoid electrical shock, remove all power from the inverter and wait at least five minutes prior to starting inspection. Additionally, confirm that the DC link bus voltage as measured between the P (+) and N (-) terminals is less than 25 VDC.
- Maintenance, inspection, and parts replacement should be performed only by qualified personnel.
- Remove all watches, rings and other metallic objects prior to starting work.
- To avoid electrical shock or other injuries, always use insulated tools.

Disposal

⚠CAUTION

- Contact the local or state environmental agency in your area for details on the disposal of electrical components and packaging.

Other

⚠WARNING

- Do not attempt to modify the equipment: doing so may cause electrical shock or injuries.
- For clarity purposes, illustrations in this manual may be drawn with covers or safety guards removed. Ensure all covers and safety guards are properly installed prior to starting operation.
- Do not perform hi-pot tests on the equipment.
- Performing a data initialization (function code H03) may reset all inverter function codes to their factory default settings. After performing this operation, remember to reenter any custom function code values prior to starting operation.

Icons

The following icons are used throughout this manual:

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 may result in accidents.

Indicates information that can prove handy when performing certain settings or operations.

Indicates a reference to more detailed information.

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1 PRE-OPERATION INSTRUCTIONS

1.1 Product Overview

The OPC-PRT2 PROFINET IO interface allows information to be transferred seamlessly between a FRENIC-MEGA or FRENIC-HVAC inverter and a PROFINET controller with minimal configuration requirements. The interface installs directly onto the inverter, and presents two RJ-45 jacks with an embedded 10/100BaseT Ethernet switch for connection to the Ethernet network. In addition to the supported fieldbus protocols, the interface also hosts a fully-customizable embedded web server, which provides access to inverter information via a standard web browser for remote monitoring and control.

Before using the interface, please familiarize yourself with the product and be sure to thoroughly read the instructions and precautions contained in this manual. In addition, please make sure that this instruction manual is delivered to the end user of the interface, and keep this instruction manual in a safe place for future reference or unit inspection.

Note that different interface firmware versions may provide varying levels of support for the various protocols. When using this manual, therefore, always keep in mind the release date of the firmware version running on your interface as it must correspond to this manual's respective release date in order for all documented aspects to apply.

Supported Protocols

The interface currently provides server support for the following fieldbus protocols:

- PROFINET IO Device (MRP client)

1.2 Features and Specifications

Table 1: Features

Item	Description
Simultaneous Protocols	Supports all standard unmodified Ethernet (SUE) protocols simultaneously
Fuji Configuration Studio	Graphical user interface for discovery, configuration, and firmware update
WEB Server (HTTP)	Access all parameters, dashboard with gauges, customizable with XTPro
Communication Loss Detection	Configurable actions for "fail-safe" conditions
Field Upgradeable	Firmware updates automatically handled by the studio
Parameter Management	Advanced management of parameter access and scan priority
Parameter Backup and Restore	Drive cloning

Table 2: General Hardware Specifications

Item	Description
Power Supply	Directly powered by the inverter
LED Indicators	Module Status, Network Status, 2 x Ethernet Link/Activity
USB Port	USB 2.0, mini-B 5-pin

Table 3: Ethernet Hardware Specifications

Item	Description
Number of Ports	2 (internal switch)
Standard	IEEE 802.3 10/100BaseT Ethernet compliant
Communication Speed and Duplex	10Mbps half/full, 100Mbps half/full (auto sense optimal speed and duplex)
Connector Type	RJ-45 Shielded
Auto MDI-X	Yes (supports all straight-through and cross-over cables)
Cable Type	CAT5-type 8-conductor UTP patch cables
Cable Length	100m per segment max
Topologies	Star/Tree, Linear/Bus/Daisy-chain, Ring (MRP)

Table 4: PROFINET Specifications

Item	Description
Protocol Level	RT (real-time)
RT Conformance Class	Class A
I/O Cycle Time	Min 1ms
I/O Input Size	Max 32 input words, user configurable
I/O Output Size	Max 32 output words, user configurable
MRP	Media Redundancy Protocol Client
DCP	Discovery, set station name, set IP address
LLDP	Yes
I&M	I&M0
Alarms	Plug, Pull
Number of Controllers	Allows access to only 1 controller

Table 5: Applicable Inverters

Series	Type	Capacity	ROM version
FRENIC-MEGA	FRN□□□G1□-□□	All capacities	1000 or higher
FRENIC-HVAC	FRN□□□AR1□-□□	All capacities	1100 or higher

Table 6: Environmental Specifications

Item	Description
Operating Environment	Indoors, less than 1000m above sea level, do not expose to direct sunlight or corrosive / explosive gasses
Operating Temperature	-10 ~ +50°C (+14 ~ +122°F)
Storage Temperature	-40 ~ +85°C (-40 ~ +185°F)
Relative Humidity	20% ~ 90% (without condensation)
Vibration	5.9m/s^2 (0.6G) or less (10 ~ 55Hz)
Cooling Method	Self-cooled
RoHS (Lead free)	Yes

1.3 Unpacking and Product Confirmation

1.3.1 Shipment Confirmation

Check the enclosed items. Confirm that the correct quantity of each item was received, and that no damage occurred during shipment.

- OPC-PRT2 interface board with spacer and captive M3 x 25mm screw in lower-right corner (see Figure 1).
- One separate M3 x 6mm mounting screw (see Figure 2).
- Type A male to mini-B male USB interface cable (see Figure 3).

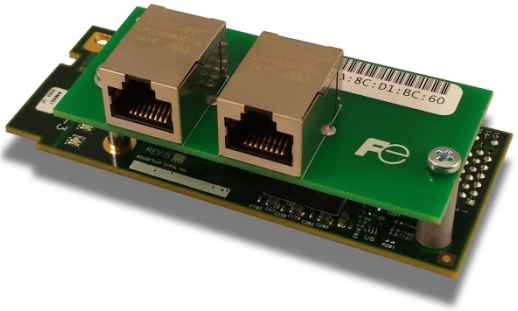


Figure 1: OPC-PRT2 Interface Board

Figure 2: M3 x 6mm Mounting Screw

Figure 3: USB Interface Cable

1.3.2 Component Overview

Figure 5 and Figure 6 provide an overview of the important interface card components.

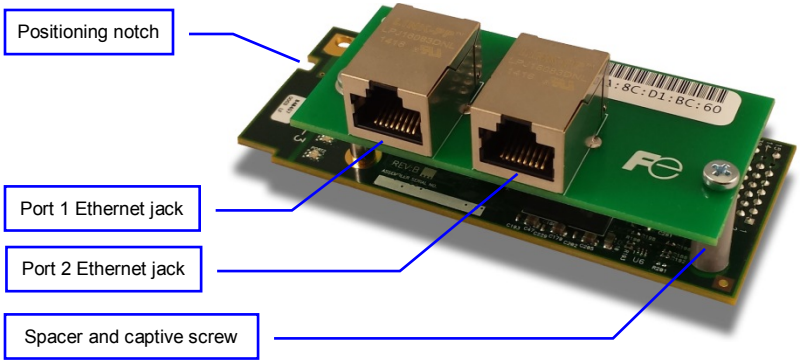


Figure 4: OPC-PRT2 Component Overview (Front View)

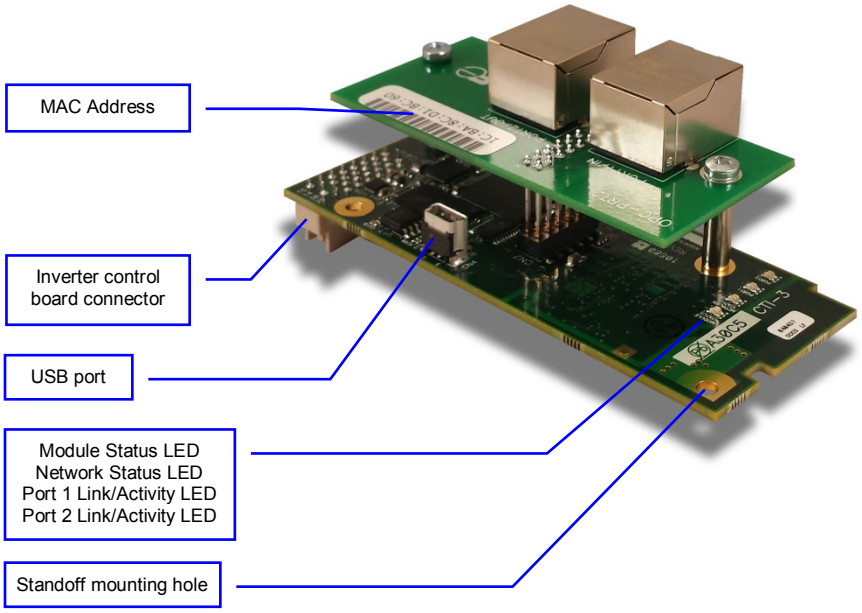


Figure 5: OPC-PRT2 Component Overview (Reverse View)

Positioning Notch

Aligns with the positioning key on the inverter chassis to ensure that the interface card is installed into the correct communication port (refer to section 2.2).

Port 1 and Port 2 Ethernet Jacks

Either jack can freely be used in star topology networks (with external switch). In linear topologies, a series of cards can be connected together by daisy-chaining one of the ports to the next inverter in line. In ring topologies, MRP (Media Redundancy Protocol) must be supported by all devices on the network.

Standoff Mounting Hardware

The provided M3 x 25mm and M3 x 6mm screws are used to secure the card to the standoffs located on the inverter's control board. Refer to section 2.2.

Inverter Control Board Connector

Attaches to the "A-port" on the inverter's control board.

USB Port

USB 2.0 port with mini-B connector. Used to access the card via the Fuji Configuration Studio (refer to section 5) and as a USB flash drive (refer to section 7.1).

Module Status and Network Status LEDs

These LEDs indicate the current status of the interface card and protocols in use. Refer to section 1.4.

Ethernet Link and Activity LEDs

One set of LEDs are provided for each Ethernet port. These LEDs provide insight into the Ethernet network's status and activity. Refer to section 1.4.

1.4 LED Indicators

1.4.1 Network Status LED

LED Activity	Status	Note
Off	No Connection	PROFINET connection is not established
Green Blink / Red Blink	Startup	Startup blink sequence
Green On	Connection Established	PROFINET connection is established

1.4.2 Module Status LED

LED Activity	Status	Note
Off	Device Off	The inverter power is off
Green Blink / Red Blink	Startup	Startup blink sequence
Green On	Device On	Normal status
Green Blink	Discovery identification	PROFINET discovery and identification (DCP)
Red Blink	Error Code	Record the error code sequence and contact technical support

1.4.3 Ethernet Link/Activity LEDs

LED Activity	Status	Note
Green On	Link	A valid Ethernet link exists: communication is possible on this port
Green Off	No Link	A valid Ethernet link does not exist: communication is not possible on this port
Red Blink	Activity	Indicates when a packet is transmitted or received on this port

2 INSTALLATION

2.1 Pre-Installation Instructions

⚠WARNING

- To avoid electrical shock, remove all power from the inverter and wait at least five minutes prior to starting installation. Additionally, confirm that the DC link bus voltage as measured between the P (+) and N (-) terminals is less than 25 VDC.
- Installation should be performed only by qualified personnel.
- To avoid electrical shock, do not operate the inverter with the front cover or wiring cover removed, as accidental contact with exposed high-voltage terminals and internal components may occur.
- To prevent explosions or similar damage, ensure that all cables are properly connected to the correct terminals, and observe all wiring polarity indicators.
- Only one additional option card may be used when the OPC-PRT2 is installed in the inverter. If two additional option cards are required, please consult with the factory first to confirm compatibility.

2.2 Installation Procedure

Note Before installing the interface card, perform all wiring for the main circuit terminals and control circuit terminals.

1. Remove the front cover from the inverter to expose the control printed circuit board (control PCB). As shown in Figure 6, there are three option connection ports (A-port, B-port and C-port). The card is mechanically keyed for, and can only be installed into, the A-port (bottom-most) position.

   To remove the front cover, refer to the FRENIC-MEGA Instruction Manual, Chapter 2, Section 2.3 or FRENIC-HVAC Instruction Manual, Chapter 2, Section 2.2.

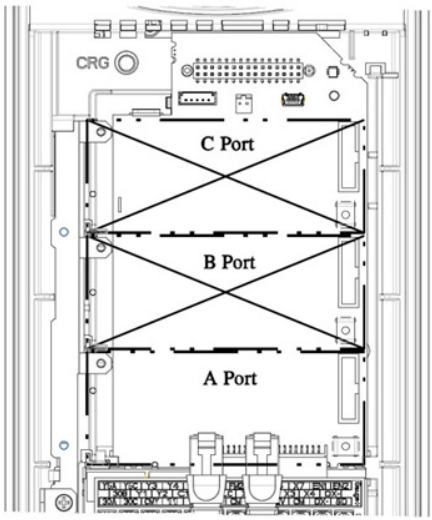


Figure 6: Option Port Locations on 0.4 kW Inverter

2. Rest the left-hand side of the interface card on the control PCB's A-port mounting support. Align the positioning notch on the interface card with the A-port positioning key, and then slide the interface card to the left to engage the key into the notch. Refer to step ① in Figure 7.

3. Rotate the right-hand side of the interface card downward to engage connector CN1 (on the back of the interface card) into the A-port connector (CN4) on the inverter's control PCB. Ensure that the connectors are fully engaged. Refer to step ② in Figure 7.

Note To ensure that the interface card is fully aligned and seated into the communication port, be sure to perform steps ① and ② in the proper order. Failure to do so may lead to insufficient connector insertion and result in contact failure.

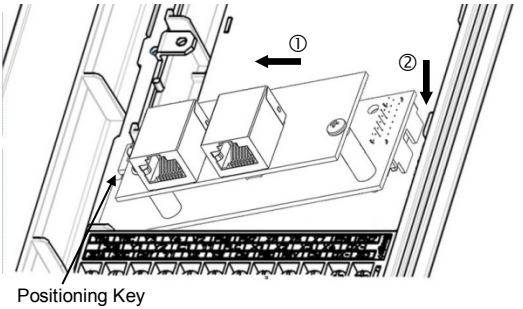


Figure 7: Mounting the Interface Card

4. Secure the interface card to the control board PCB by first tightening the captive M3 x 25mm screw into the inverter standoff located at the lower-right hand corner of the interface card. Next, install and tighten the included M3 x 6mm screw into the standoff mounting hole located at the upper-left hand corner of the interface card. Refer to Figure 8.

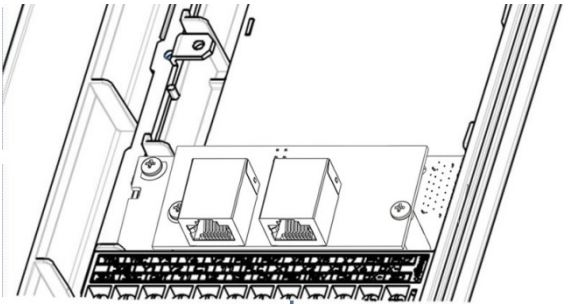


Figure 8: Interface Card Mounting Completed

5. Connect the network cables as necessary. Insert the Ethernet cables into the Ethernet jacks, making sure that they are fully seated. Ensure that the cables are routed in such a way that they will not be pinched and are not located near any power-carrying wiring, such as the inverter's input power or motor wires.

6. Reinstall all covers removed in step 1. Take a moment to confirm that the Ethernet cables are not being pinched and are not routed near any power-carrying wiring.

📖 For reinstallation instructions, refer to the FRENIC-MEGA Instruction Manual, Chapter 2, Section 2.3 or FRENIC-HVAC Instruction Manual, Chapter 2, Section 2.2.

3 INVERTER FUNCTION CODE SETTINGS

Depending on the desired operation of the overall application, the inverter function codes listed in Table 7 are important for proper operation of the end-to-end communication system. Although there may be many other function codes that will require configuration for your specific application, it is important to understand the manner in which the following function codes will impact successful control of the inverter.

For further details regarding these function codes, please refer to the **FRENIC-MEGA Instruction Manual (INR-SI47-1457-E)** or **FRENIC-HVAC Instruction Manual (INR-SI47-1610-E)**, Chapter 5 "FUNCTION CODES", **FRENIC-MEGA User's Manual (MEHT536)** or **FRENIC-HVAC User's Manual (24A7-E-0069)**, "y codes: Link Functions", and **RS-485 Communication User's Manual (24A7-E-0082)**, Chapter 5, Section 5.2 "Data Formats."

Table 7: Function Code Settings Overview

Code	Name	Setting Range	Required Value
Y98	Bus Link Function (Mode Selection)	0 to 3	3

3.1 Inverter Control-Related Settings

The following function codes relate to whether or not the inverter is to be controlled (command word and/or frequency command) from the network, or whether the inverter will be locally-controlled (and therefore only monitored and/or configured via the network.)

Bus Link Function (Mode Selection) (y98)

If the inverter is to be controlled from the network, then set the value of y98 to 3 (fieldbus option). A setting of 3 for y98 may also be appropriate even if H30 is configured for an alternate (local) control scheme.

When the inverter is controlled from the network, a selection of reference commands (S## function codes as defined in Table 8) are available for controlling the inverter's speed. If multiple reference commands are being modified from the network, then the interface card invokes a hierarchy to determine which reference is to be passed to the inverter as its main reference command.

The S## function code hierarchy is listed from highest to lowest priority in Table 8.

Table 8: S## Function Code Hierarchy

S## Function Code	Hierarchy Priority	Description
S01	Highest	frequency reference / per-unit
S05	2nd Highest	frequency reference / Hz
S19	3rd Highest	speed command
S02	4th Highest	torque command
S03	5th Highest	torque current command
S13	Lowest	PID command

The highest-priority S## function code with a non-zero value will be used as the inverter's main reference command.

3.2 Inverter Reaction to Network Timeout Conditions

Function codes o27 and o28 specify the inverter's reaction when a network timeout occurs. Table 9 lists the settings for o27 and o28.

Table 9: Inverter Reaction to Network Timeout Conditions (Function Codes o27 and o28)

o27 Value	o28 Value	Inverter reaction when a timeout occurs	Remarks
0, 4 to 9	---	Immediately coast to a stop and trip ErS.	
1	0.0s to 60.0s	After the time specified by o28, coast to a stop and trip ErS.	
2	0.0s to 60.0s	If the communications link is restored within the time specified by o28, ignore the communications error. After the timeout, coast to a stop and trip ErS.	
3, 13 to 15	---	Maintain present operation, ignoring the communications error (no ErS trip).	
10	---	Immediately decelerate to a stop. Trip ErS after stopping.	Inverter function code F08 specifies the deceleration time
11	0.0s to 60.0s	After the time specified by o28, decelerate to a stop. Trip ErS after stopping.	Same as above
12	0.0s to 60.0s	If the communications link is restored within the time specified by o28, ignore the communications error. After the timeout, decelerate to a stop and trip ErS.	Same as above

For details regarding the interface-specific timeout behavior and configuration, please refer to section 5.4.1.

4 FUNCTION CODE NUMBERING AND BEHAVIOR

4.1 Register Numbers

All accessible inverter function codes can be referenced by their Modbus register indexes, as defined in the **RS-485 Communication User's Manual (24A7-E-0082)**, section 3 (Table 3.2). These same register numbers are used when accessing function codes via certain Ethernet protocols. The terms "function code" and "register" refer to data stored on the inverter and will be used interchangeably throughout this documentation. The max supported register number is 13668. Because the RS-485 User's Manual contains information for several Fuji inverter families, the relevant information will be paraphrased here for the specific case of the FRENIC-MEGA and FRENIC-HVAC.

All inverter function codes are exposed as register indexes according to a mathematical conversion formula which combines two elements (a function code group number and function code offset) to create a unique register number for each function code. Each function code group ("E" / Extension Terminal Functions, for example) is assigned a specific function code group number (refer to Table 10). Each function code also has an offset number, which is the function code without the leading letter (the offset number for function code E05, for example, is 5). To determine the register number for a given function code, therefore, the group number is first multiplied by 256, then added to the offset number plus 1. This operation is expressed mathematically via Equation 1.

$$register = (group\ number\ x\ 256) + offset\ number + 1 \qquad \textbf{Equation 1}$$

As an example, let's calculate the register number for output frequency (function code M09). According to Table 10, the group number for the "M" function code group is 8. It is also evident that the offset number for M09 is 9. Inserting the group number and offset number into Equation 1, we arrive at the result indicated in Equation 2.

$$(8\ x\ 256) + 9 + 1 = 2058 \qquad \textbf{Equation 2}$$

While manually calculating all of the register numbers for the function codes of interest is certainly possible by using Equation 1, it may be more convenient to simply reference the "Register" column on the monitor tab of the default web interface (refer to section 6.2.3).

Note that not all of the available registers that exist in the interface card's register map have corresponding function codes that exist in the inverter. In other words, if a read from or write to a register number that does not correspond to an existing inverter function code takes place, the read/write may be successful (depending on the specific register accessed; refer to section 4.2), but the data will have no meaning. This feature is beneficial in situations where the accessing of non-contiguous registers can be made more efficient by accessing an all-inclusive block of registers (some of which correspond to inverter function codes and some of which do not), while only manipulating those in your local programming that are known to exist.

Table 10: Function Code-to-Register Conversion Examples

Function Code Group		Group Number	Register Example Using Equation 1
Code	Name		
F	Fundamental Functions	0	F00: (0 x 256) + 0 + 1 = 1 … F07 (acceleration time 1): (0 x 256) + 7 + 1 = 8 … F99: (0 x 256) + 99 + 1 = 100
E	Extension Terminal Functions	1	E00: (1 x 256) + 0 + 1 = 257 … E98 (terminal [FWD] function): (1 x 256) + 98 + 1 = 355 E99: (1 x 256) + 99 + 1 = 356
C	Control Functions	2	C00: (2 x 256) + 0 + 1 = 513 … C20 (jogging frequency): (2 x 256) + 20 + 1 = 533 … C99: (2 x 256) + 99 + 1 = 612
P	Motor 1 Parameters	3	P00: (3 x 256) + 0 + 1 = 769 … P03 (motor 1 rated current): (3 x 256) + 3 + 1 = 772 … P99: (3 x 256) + 99 + 1 = 868
H	High Performance Functions	4	H00: (4 x 256) + 0 + 1 = 1025 … H11 (deceleration mode): (4 x 256) + 11 + 1 = 1036 … H99 (4 x 256) + 99 + 1 = 1124
A	Motor 2 Parameters	5	A00: (5 x 256) + 0 + 1 = 1281 … A05 (motor 2 torque boost): (5 x 256) + 5 + 1 = 1286 … A99: (5 x 256) + 99 + 1 = 1380
o	Operational Functions	6	o00: (6 x 256) + 0 + 1 = 1537 o01: (6 x 256) + 1 + 1 = 1538 … o99: (6 x 256) + 99 + 1 = 1636
S	Command Data	7	S00: (7 x 256) + 0 + 1 = 1793 … S05 (frequency command): (7 x 256) + 5 + 1 = 1798 … S99: (7 x 256) + 99 + 1 = 1892
M	Monitor Data 1	8	M00: (8 x 256) + 0 + 1 = 2049 … M09 (output frequency): (8 x 256) + 9 + 1 = 2058 … M99: (8 x 256) + 9 + 1 = 2148
r	Motor 4 Parameters	10	r00: (10 x 256) + 0 + 1 = 2561 … r02 (motor 2 base frequency): (10 x 256) + 6 + 1 = 2563 … r99: (10 x 256) + 99 + 1 = 2660

Function Code Group		Group Number	Register Example Using Equation 1
Code	Name		
J	Application Functions 1	13	J00: (13 x 256) + 0 + 1 = 3329 … J03 (PID proportional gain): (13 x 256) + 3 + 1 = 3332 … J99: (13 x 256) + 99 + 1 = 3428
y	Link Functions	14	y00: (14 x 256) + 0 + 1 = 3585 … y98 (bus link function): (14 x 256) + 98 + 1 = 3683 y99: (14 x 256) + 99 + 1 = 3684
W	Monitor Data 2	15	W00: (15 x 256) + 0 + 1 = 3841 … W32 (PID output): (15 x 256) + 32 + 1 = 3873 … W99 (15 x 256) + 99 + 1 = 3940
X	Alarm Data 1	16	X00 (alarm history / latest): (16 x 256) + 0 + 1 = 4097 … X99: (16 x 256) + 99 + 1 = 4196
Z	Alarm Data 2	17	Z00: (17 x 256) + 0 + 1 = 4353 … Z53 (3rd last alarm torque): (17 x 256) + 53 + 1 = 4406 … Z99: (17 x 256) + 99 + 1 = 4452
b	Motor 3 Parameters	18	b00: (18 x 256) + 0 + 1 = 4609 … b12 (motor 3 starting frequency): (18 x 256) + 12 + 1 = 4621 … b99: (18 x 256) + 99 + 1 = 4708
d	Application Functions 2	19	d00: (19 x 256) + 0 + 1 = 4865 … d24 (zero speed control): (19 x 256) + 24 + 1 = 4889 … d99: (19 x 256) + 99 + 1 = 4964

4.2 Scanned Function Codes

The interface card provides network access to the specified list of function codes contained in the *param.xml* file located in the "*WEB*" folder of the interface card's file system. These function codes are constantly being read and/or written (as applicable), and their current values are therefore mirrored in the interface card's internal memory. Only those function codes specified in the *param.xml* file will represent meaningful values.

The principle disadvantage of scanned function codes is that write data checking is not available. This means that when the value of a scanned function code is modified via a network protocol or via the web browser's monitor tab, the interface card itself is not able to determine if the new value will be accepted by the inverter (the value may be out-of-range, or the inverter may be in a state in which it will not accept new values being written via communications, etc.) For example, if a write is performed to a scanned command function code with a data value that is out-of-range, the interface card will not generate a corresponding error. However, if end-to-end confirmation of such data writes is required, then the function code can be read over the network at a later time to confirm that the written value "took hold" in the inverter.

Accesses to any function code (?00…?99, where "?" is any valid function code group letter from Table 10) will always be successful. Even if an inverter function code corresponding to a given register does not exist in the *param.xml* file, the interface card still maintains a placeholder location in its internal mirroring memory for that function code. This feature allows for the block access of non-contiguous registers (function codes) as described in section 4.1. Care must be taken to utilize only the function codes that are known to exist and that are also specified in the *param.xml* file.

4.3 Commonly Used Function Codes

For a complete listing of all available function codes, their bit mappings, scaling values, etc., please refer to the **Fuji FRENIC-MEGA Instruction Manual (INR-S147-1457-E)** or **Fuji FRENIC-HVAC Instruction Manual (INR-S147-1610-E)** and the **RS-485 Communication User's Manual (24A7-E-0082)**. As a user convenience, the structures of the commonly-used "Operation command" (function code S06), "Operation status" (function code M14) and "Rotation Speed" (function code W08) are replicated here (refer to Table 11, Table 12 and Table 13, respectively).

Table 11: Structure of "Operation command" (Function code S06)

Data format [14] Operation command

15	14	13	12	11*1	10	9	8	7	6	5	4	3	2	1	0
RST	XR (REV)	XF (FWD)	0	EN	X9	X8	X7	X6	X5	X4	X3	X2	X1	REV	FWD
↑	General-purpose input		Unused	EN terminal	General-purpose input									FWD: Forward command	
Alarm reset														REV: Reverse command	

*1 bit11: The EN terminal is a bit dedicated for monitor and the terminal command cannot be input through communications. (Applicable only with FRN☐☐G1☐-☐E and FRN☐☐G1☐-☐A.)

(All bits are turned ON when set to 1.)

(Example) When S06 (operation command) = FWD, X1 = ON

$0000\ 0000\ 0000\ 0101_b = 0005_H$ Consequently, ⇒

00_H	05_H

Table 12: Structure of "Operation status" (Function code M14)

Data format [16] Operation status

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BUSY	0	0	RL	ALM	DEC	ACC	IL	VL	0	NUV	BRK	INT	EXT	REV	FWD

(All bits are turned ON or become active when set to 1.)

Bit	Symbol	Description	Support*1				Bit	Symbol	Description	Support*1			
			Mini	Eco	Multi	MEGA				Mini	Eco	Multi	MEGA
0	FWD	During forward rotation	O	O	O	O	8	IL	During current limiting	O	O	O	O
1	REV	During reverse rotation	O	O	O	O	9	ACC	During acceleration	O	O	O	O
2	EXT	During DC braking (or during pre-exciting)	O	O	O	O	10	DEC	During deceleration	O	O	O	O
3	INT	Inverter shut down	O	O	O	O	11	ALM	Alarm relay (for any fault)	O	O	O	O
4	BRK	During braking (fixed to 0 for FRENIC-Mini)	×	O	O	O	12	RL	Communicati ons effective	O	O	O	O
5	NUV	DC link circuit voltage established (0 = undervoltage)	O	O	O	O	13	0	–	×	×	×	×
6	TL	During torque limiting	×	×	O	O	14	0	–	×	×	×	×
7	VL	During voltage limiting	O	O	O	O	15	BUSY	During function code data writing	O	O	O	O

*1 The "Support" column indicates whether each inverter type supports the corresponding bit or not. The symbol "O" means the code is supported and the symbol "X" means that the code is not supported (fixed to 0).

Table 13: Structure of "Rotation Speed" (Function code W08)

Data format [37] Floating point data (load rotation speed, etc.)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Exponent		Mantissa													

Exponent: 0-3 Mantissa: 1 to 9999

The value expressed by this format = the mantissa × $10^{(\text{exponent-2})}$

Numeric value	Mantissa	Exponent	$10^{(\text{exponent-2})}$
0.01 to 99.99	1 to 9999	0	0.01
100.0 to 999.9	1000 to 9999	1	0.1
1000 to 9999	1000 to 9999	2	1
10000 to 99990	1000 to 9999	3	10

5 FUJI CONFIGURATION STUDIO

5.1 Overview

The interface card is discovered, configured and updated by the Fuji Configuration Studio PC application (refer to Figure 9). The studio must be installed prior to connecting an interface card to the computer in order to ensure that the appropriate USB drivers are installed. The studio requires a USB connection for reading/writing a configuration and updating the firmware. Depending on the currently-active drivers, remote discovery, network setting, configuration, and firmware updates are also possible via Ethernet. To obtain the latest release of the Configuration Studio, please contact technical support. The remainder of this section will provide only a brief introduction to the configuration concepts. For protocol specific configuration, refer to the relevant protocol section.

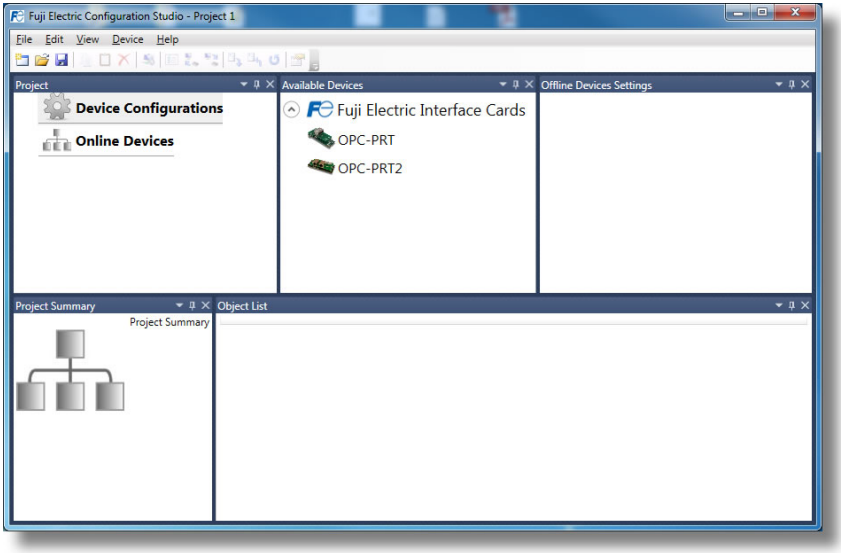


Figure 9: Fuji Configuration Studio

Creating a Device Configuration

A device can be added to the **Project** panel for configuration by first selecting the **Device Configurations** list heading and then:

- Double-clicking on the device in the **Available Devices** panel.
- Right-clicking on the device in the **Available Devices** panel and choosing **Add** from the context-sensitive menu.
- Hitting the <ENTER> key on the keyboard when the device is selected in the **Available Devices** panel.
- Dragging the device from the **Available Devices** panel into the **Project** panel.
- Selecting it and selecting **Add Selected Device** from the **Edit** menu.
- Selecting it and clicking the **Add** button in the toolbar.

The device will then be added to the list of **Device Configurations**.

Going Online with a Device

All connected devices are automatically added to the **Discovered Devices** panel. This panel is shown by selecting the **Online Devices** list heading in the **Project** panel. To go online with a device:

- Double-click on it in the **Discovered Devices** panel.
- Right-click on it in the **Discovered Devices** panel and choose **Go Online** from the context-sensitive menu.

- Hit the <ENTER> key on the keyboard when the device is selected in the **Discovered Devices** panel.
- Drag it from the **Discovered Devices** panel into the **Project** panel.
- Select it and select **Go Online with Device** from the **Edit** menu.
- Select it and click the **Go Online** button in the toolbar.

When the studio goes online with a device, its configuration is automatically read. While the studio is online with a device, it will appear in green text in the **Discovered Devices** panel. The studio may be online with multiple devices simultaneously.

Uploading a Device's Configuration into a Project

The current configuration of an online device can be uploaded into the **Project** panel by selecting a device under the **Online Devices** list heading and then:

- Right-clicking on it and choosing **Upload Configuration** from the context-sensitive menu.
- Dragging it from the **Online Devices** heading into the **Device Configurations** heading.
- Selecting it and selecting **Upload Configuration to Project** from the **Device** menu.
- Selecting it and clicking the **Upload Configuration** button in the toolbar.

The device's configuration will then be added to the list of **Device Configurations**. Once the configuration is uploaded into the project, it may be modified.

Removing a Device Configuration from a Project

A configuration can be removed from a project by:

- Selecting the device in the **Project** panel and dragging it. A trash can icon will appear at the bottom of the **Project** panel, and dragging and dropping the device in the trash will remove it from the project.
- Hitting the <DELETE> key on the keyboard when the device is selected in the **Project** panel.
- Right-clicking on the device in the **Project** panel and choosing **Remove** from the context-sensitive menu.
- Selecting **Remove Selected Item** from the **Edit** menu when the device is selected.
- Clicking on the **Remove** button in the toolbar when the device is selected.

Going Offline with a Device

To go offline with a device:

- Select the device in the **Project** panel and drag it. A trash can icon will appear at the bottom of the **Project** panel, and dragging and dropping the device in the trash will go offline with it.
- Hit the <DELETE> key on the keyboard when the device is selected in the **Project** panel.
- Right-click on the device in the **Project** panel and choose **Go Offline** from the context-sensitive menu.
- Select **Go Offline with Device** from the **Edit** menu when the device is selected.
- Click on the **Go Offline** button in the toolbar when the device is selected.

Downloading a Configuration to a Device

To download a configuration to an online device, first select the device under the **Device Configurations** heading in the **Project** panel, and then navigate to **Device…Download Configuration to Device**. If the studio is currently online with only one compatible device, then the configuration will be downloaded to the online device. Otherwise, a device selection prompt is displayed to select which device to download the configuration to. Do not power off the device or interrupt the connection once the download is in progress as this may corrupt the firmware and/or the configuration.

Stop all other communication to the device when downloading.

Updating Firmware

The studio automatically manages firmware updates when going online with a device and downloading a configuration to a device. Download the latest studio to obtain the latest firmware. Do not power off the

device or interrupt the connection once the update is in progress as this may corrupt the firmware and/or the configuration.

Resetting an Online Device

To reset an online device, first select the device in the **Project** panel and then navigate to **Device…Reset Device**.

General Configuration Process

To configure a device, add the desired protocol(s) and configure any objects associated with the respective protocol(s). Any changes will take effect once the configuration is downloaded to a device.

Note that numeric values can be entered not only in decimal but also in hexadecimal by including "0x" before the hexadecimal number.

5.2 General Object Editing Activities

The following editing activities apply for all types of configuration objects and project elements.

Adding an Object

To add an object, click on an item (protocol driver or Node, for example) in the **Project** panel. Any available objects for that item will be listed in the **Available Objects** panel (the panel title depends on the currently-selected item). An object can then be added to the item by:

- Double-clicking on it.
- Right-clicking on it and choosing **Add** from the context-sensitive menu.
- Hitting the <ENTER> key on the keyboard when the object is selected.
- Dragging it into the **Project** panel.
- Selecting it and selecting **Add Selected Device** from the **Edit** menu.
- Selecting it and clicking the **Add** button in the toolbar.

The object's configurable fields can then be populated with valid values (where applicable).

Viewing an Object

In the **Project** panel, select a parent object to display a summary of all its child objects. For example, selecting a protocol driver will display the driver's configuration in the **Summary** panel and list of current objects in the **Object List** panel.

Updating an Object

To update an object, select the object in the **Project** panel and make any required changes in the **Settings** panel.

Deleting an Object

An object can be deleted by performing one of the three following actions:

- Selecting the object in the **Project** panel and dragging it. A trash can icon will appear at the bottom of the **Project** panel, and dragging the object to the trash will then delete it from the project.
- Hitting the <DELETE> key on the keyboard when the object is selected in the **Project** panel.
- Right-clicking on the object in the **Project** panel and choosing **Remove** from the context-sensitive menu.
- Selecting **Remove Selected Item** from the **Edit** menu when the object is selected.
- Clicking on the **Remove** button in the toolbar when the object is selected.

Note that this action cannot be undone. Deleting an object will also delete all of its child objects.

Copying and Pasting an Object

To copy an object, first click on an item in the **Project** panel. An object can then be copied by:

- Right-clicking on it and choosing **Copy** from the context-sensitive menu.
- Pressing the <CTRL+C> keys on the keyboard.
- Holding the <CTRL> key and dragging the item to the desired location in the **Project** panel.

- Dragging the item to a new location under a different parent object in the **Project** panel.
- Selecting **Copy Selected Item** from the **Edit** menu.
- Clicking on the **Copy** button in the toolbar.

To paste an object, first click on an item at the desired location in the **Project** panel. An object can then be pasted by:

- Right-clicking on it and choosing **Paste** from the context-sensitive menu.
- Pressing the <CTRL+V> keys on the keyboard.
- Dropping an item onto the desired location in the **Project** panel after holding the <CTRL> key and dragging the item.
- Dropping an item onto a new location under a different parent object in the **Project** panel after dragging the item.
- Selecting **Paste Item** from the **Edit** menu.
- Clicking on the **Paste** button in the toolbar.

After pasting an object, the object's configurable fields can then be modified with valid values (where applicable).

Note that the studio allows you to copy and paste items between different locations, including different devices. This is useful for copying partial configurations from one device to another.

Reordering Objects

Objects can be reordered in the **Project** panel by dragging the item to the desired location. If the item is dragged outside of the items in the project tree, it will be moved to the end.

5.3 Ethernet Settings

The **Ethernet Settings** panel contains Ethernet-related items that are not specific to any given protocol. These settings must be appropriately configured regardless of any Ethernet control protocols that may be enabled. The **Ethernet Settings** panel is then available whenever the **Ethernet** port is selected in the **Project** panel.

5.3.1 Authentication

Be sure to make a note of the new settings whenever authentication credentials are changed, as they must be entered whenever the web page is accessed or an FTP session is initiated.

User Name

The username is case-sensitive and can contain letters ("a...z" and "A...Z") and numbers ("0...9").

Password

The password is case-sensitive and can contain letters ("a...z" and "A...Z") and numbers ("0…9").

5.3.2 Network Configuration

The card supports a static IP address. The IP Address, Subnet Mask and Default Gateway fields must be configured. Please consult with your network administrator for the proper settings of these fields.

5.4 Internal Logic Settings

5.4.1 Fail-safe Values

5.4.1.1 Overview

The card can be configured to perform a specific set of actions when network communications are lost (timeout event). This allows each inverter parameter to have its own unique "fail-safe" condition in the event of network interruption. Support for this feature varies depending on the protocol: refer to the protocol-specific section of this manual for further information.

There are two separate elements that comprise the timeout configuration:

- The timeout time

- Timeout Object configuration

5.4.1.2 Timeout Time

The timeout time is the maximum number of milliseconds for a break in network communications before a timeout will be triggered. This timeout setting is configured at the protocol level as part of a driver's configuration, and used by the protocol drivers themselves to determine abnormal loss-of-communications conditions. These conditions then trigger timeout processing events. If it is not desired to have a certain protocol trigger timeout processing events, then the protocol's timeout time may be set to 0 (the default value) to disable this feature.

For some protocols, the timeout time is set by the master device (PLC, scanner, etc.), and a timeout time setting is therefore not provided in the Configuration Studio's driver configuration. Additionally, not all protocols support timeout detection: refer to the protocol-specific sections of this manual for more information.

5.4.1.3 Timeout Object Configuration

A timeout object is used as part of the timeout processing to set certain parameters to "fail-safe" values. When a timeout event is triggered by a protocol, the timeout objects are parsed and written to the corresponding function code(s). The timeout object(s) will be executed sequentially from first to last. To add a timeout object, select the device in the **Project** panel, then add **Internal Logic…Fail-safe Values…Timeout Object**. The following paragraphs describe the configurable fields of a timeout object:

Description

This field is strictly for user reference: it is not used at any time by the device.

Function Code

Enter the function code.

Data Type

This is the size of valid values and is fixed to "16-Bit Unsigned" allows for a range of timeout values between 0 and 65535.

Value

Enter the "fail-safe" timeout value that the function code encompassed by this timeout object will be automatically written with upon processing a timeout event triggered by a protocol.

5.4.2 Fail-safe Example

This example will demonstrate how to add one timeout object which will assign a value of 2000 (20.00Hz) to function code S05 (frequency command). In the **Project** panel, select the device and add **Internal Logic…Fail-safe Values…Timeout Object** as shown in Figure 10. The red error indicators are normal at this stage as the **Timeout Object Settings** have not yet been configured.

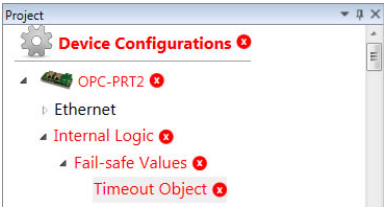


Figure 10: Timeout Object Project Panel

Next, configure the **Timeout Object Settings** as shown in Figure 11.

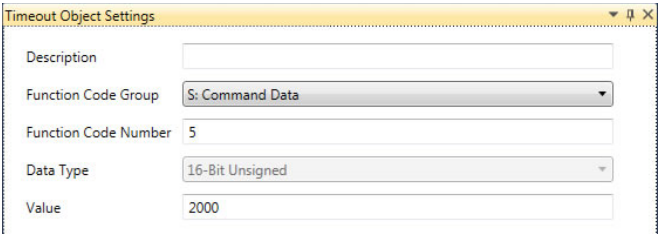


Figure 11: Timeout Object Settings

The example is complete.

5.5 Discovery over Ethernet

Depending on the currently-enabled driver, the Configuration Studio will automatically discover the device on the Ethernet network, regardless of whether or not the card's network settings are compatible with the subnet upon which they reside. All connected devices are automatically added to the **Discovered Devices** panel. This panel is shown by selecting the **Online Devices** list heading in the **Project** panel. In the **Discovered Devices** panel, discovered Ethernet devices will be listed under **Ethernet** and will display the firmware version in brackets and the current IP address in parentheses to the right of the device name (refer to Figure 12.)

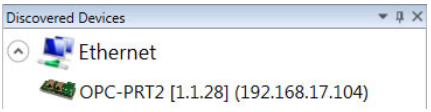


Figure 12: Configuration Studio Discovery over Ethernet

In order for the studio to discover devices, certain UDP Ethernet traffic (port 4334) must be allowed in and out of the computer, and firewall applications (such as Windows Firewall) are often configured to block such traffic by default. If the studio is unable to discover any devices on the current subnet, be sure to check the computer's firewall settings during troubleshooting, and add the studio as a program exception to the firewall configuration if necessary. It may be necessary to restart your PC before the new firewall configuration can take effect.

The network settings of a discovered card can be configured remotely by:

- Right-clicking on the device in the **Project** panel and choosing **Configure Network Settings…** from the context-sensitive menu.
- Selecting the device in the **Project** panel and navigating to **Device…Configure Network Settings...**

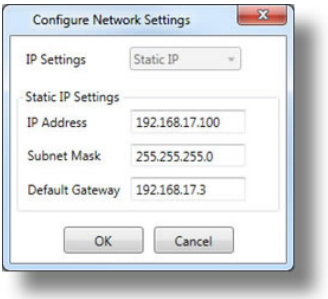


Figure 13: Remotely Configure Network Settings

The network settings pop-up should appear similar to Figure 13. Modify the network settings as necessary and click the OK button for the changes to take effect. Note that this will cause the device to become temporarily inaccessible and may trip the inverter.

5.6 Manage Device Parameters

The accessibility and scan priority of the inverter parameters can be adjusted (refer to Figure 14). This is an advanced feature and must only be used after consulting technical support to determine the appropriate settings for the target application. The **Manage Device Parameters** configuration window is found by:

- Right-clicking on the device in the **Project** panel and choosing **Manage Parameters…** from the context-sensitive menu.

- Selecting the device in the **Project** panel and navigating to **Device…Manage Device Parameters...**

A parameter is accessible and actively scanned (read from and written to the inverter) only if its corresponding checkbox is enabled. Likewise, a parameter is inaccessible if its checkbox is disabled.

Parameters that are accessed more frequently or require a faster update rate should be set to high priority. All other parameters should be set to low priority.

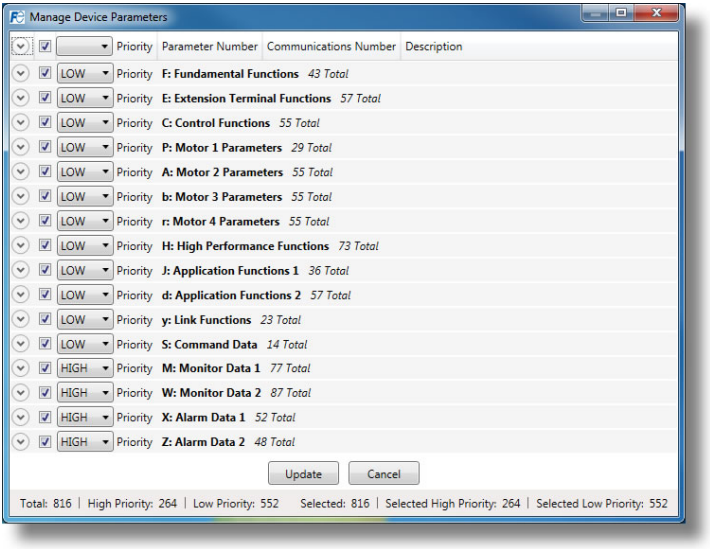


Figure 14: Manage Device Parameters

5.7 Backup and Restore Parameters

The parameter settings can be backed up from the inverter and restored to the inverter (refer to Figure 15 and Figure 16). This allows for easy inverter cloning. The backup parameter list is stored as a CSV file. A parameter can be excluded from the list by disabling the corresponding checkbox. The parameter setting value can also be modified before the backup and restore is executed. The backup and restore parameter configurations are found by:

- Right-clicking on the device in the **Project** panel and choosing **Backup Parameters…** or **Restore Parameters…** from the context-sensitive menu.
- Selecting the device in the **Project** panel and navigating to **Device…Backup Parameters from Device...** or **Restore Parameters to Device…**

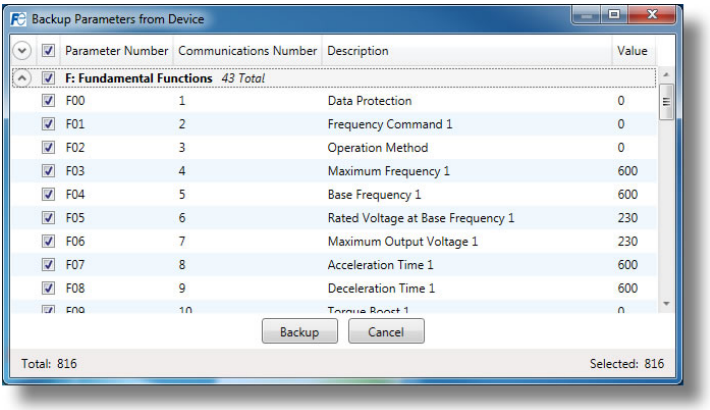


Figure 15: Backup Parameters

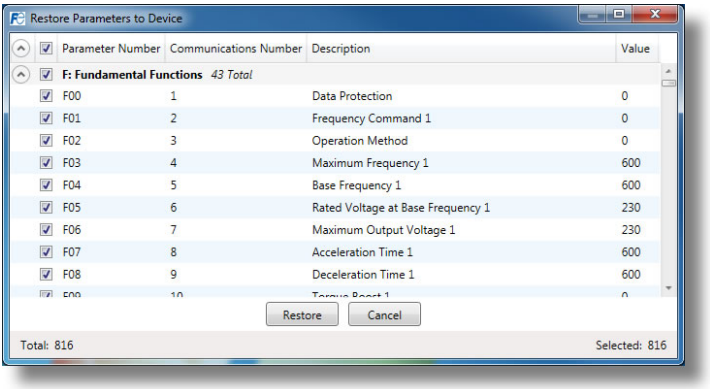


Figure 16: Restore Parameters

5.8 Restore Factory Settings

The interface card (connected via USB) can be restored to the factory settings. Note that the filesystem will be reformatted, which will destroy all custom modifications and configurations. Please backup the configuration before executing this feature. The factory settings can be restored by:

- Right-clicking on the device in the **Project** panel and choosing **Restore Factory Settings**.
- Selecting the device in the **Project** panel and navigating to **Restore Factory Settings**.

5.9 Help

Links to videos and documents can be found in the **Help** menu. Please review these links before contacting technical support for more in-depth assistance.

6 EMBEDDED WEB SERVER

6.1 Overview

The interface contains an embedded web server (also known as an HTTP server), which allows users to access the inverter's internal data in a graphical manner with web browsers such as Microsoft Internet Explorer or Mozilla Firefox. In this way, the inverter can be monitored and controlled from across the room or from across the globe. To access an interface's embedded web server, directly enter the target unit's IP address into the address (URL) field of your web browser. Refer to Figure 17 for a representative screenshot of the web server interface. In order to access the web server and view the parameter values, destination TCP ports 80 and 843 must be accessible from the client computer.

Note that in order to view the interface's web page, the free Adobe Flash Player browser plug-in is required. The plug-in can be downloaded from http://www.adobe.com.

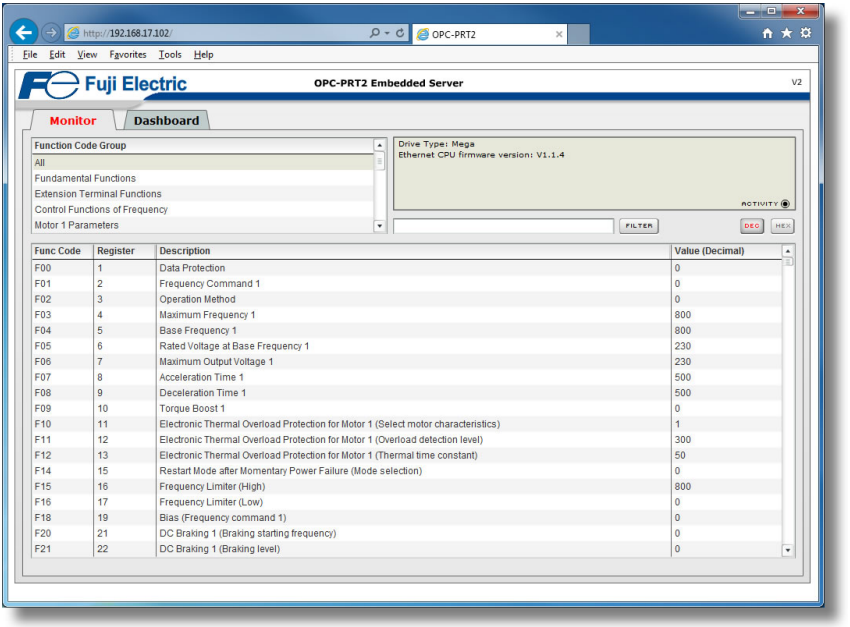


Figure 17: Embedded Web Server

6.2 Monitor Tab

6.2.1 Information Window

Figure 18 shows the Information Window that displays messages regarding the status of the interface card or web browser session. There is also an "ACTIVITY" indicator located in the lower-right hand corner of the Information Window that blinks periodically to show the status of data communication between the web browser and the interface card. If you do not observe the activity indicator blink at all for several seconds or more, it is possible that the web browser may have lost contact to the web server due to an inverter power cycle or a network problem. To reestablish communications, "refresh" your web browser.

Figure 18: Monitor Tab Information Window

6.2.2 Function Code Group Selection List

The Function Code Group Selection List is shown in Figure 19. Individual groups can be selected by clicking on the group name. Multiple groups may also be selected by holding down the CTRL key while clicking on the group names, or a range of groups can be selected by first selecting the starting group, and then holding down the SHIFT key while selecting the last group in the range. When a function code group is selected, the function codes contained in that group are displayed in the Function Code List (refer to section 6.2.3). The following function code groups are available:

Figure 19: Function Code Group Selection List

All: All function codes/registers are available.

Fundamental Functions: F function codes are available.

Extension Terminal Functions: E function codes are available.

Control Functions of Frequency: C function codes are available.

Motor 1 Parameters: P function codes are available.

Motor 2 Parameters: A function codes are available.

Motor 3 Parameters: b function codes are available.

Motor 4 Parameters: r function codes are available.

High Performance Functions: H function codes are available.

Application Functions 1: J function codes are available.

Application Functions 2: d function codes are available.

Link Functions: y function codes are available.

Command Data: S function codes are available.

Monitor Data 1: M function codes are available.

Monitor Data 2: W function codes are available.

Alarm Data 1: X function codes are available.

Alarm Data 2: Z function codes are available.

Operational Functions: o function codes are available.

6.2.3 Function Code List

The function code list is shown in Figure 20. The function codes that are displayed in the list at any given time depend on the function code groups that are currently selected (refer to section 6.2.2) and the filter (refer to section 6.2.4).

The first column of the Function Code List shows the inverter function code designation that is normally used when accessing a given function code via the inverter's keypad. Note that this column is for user convenience and inverter user's manual cross-reference.

The second column of the Function Code List shows the register number for the corresponding function code. Certain protocols require the use of a register number to access the function code (refer to section 4.1). The third column contains the function code descriptions, which are used by the filter function. The last column performs two functions: it displays the current value of the function code, and (for writable function codes) also allows changing the function code's value by clicking on the number in the value column and entering the new value.

Func Code	Register	Description	Value (Decimal)
F00	1	Data Protection	0
F01	2	Frequency Command 1	0
F02	3	Operation Method	0
F03	4	Maximum Frequency 1	600
F04	5	Base Frequency 1	600
F05	6	Rated Voltage at Base Frequency 1	230
F06	7	Maximum Output Voltage 1	230
F07	8	Acceleration Time 1	500
F08	9	Deceleration Time 1	500
F09	10	Torque Boost 1	0
F10	11	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics)	1
F11	12	Electronic Thermal Overload Protection for Motor 1 (Overload detection level)	300
F12	13	Electronic Thermal Overload Protection for Motor 1 (Thermal time constant)	50
F14	15	Restart Mode after Momentary Power Failure (Mode selection)	0
F15	16	Frequency Limiter (High)	700
F16	17	Frequency Limiter (Low)	0
F18	19	Bias (Frequency command 1)	0
F20	21	DC Braking 1 (Braking starting frequency)	0
F21	22	DC Braking 1 (Braking level)	0

Figure 20: Function Code List

Some items to keep in mind when interacting with the Function Code List are:

- When entering new function code values, be sure that the number being entered is appropriate for the currently-selected radix (refer to section 6.2.5).
- The column widths can be changed by dragging the vertical bars that separate the header row's cells.
- If you begin changing a function code value and then decide to abandon the change, pressing the ESC key on your keyboard will abandon the change and redisplay the current function code value.
- When editing a function code value, clicking someplace off the entry cell is equivalent to hitting the ENTER key.

6.2.4 Function Code List Filter

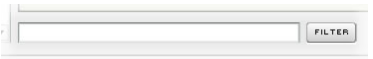


Figure 21: Function Code List Filter

A filter function provides Function Code List search capabilities. To use the filter function, simply type a word or portion of a word into the filter entry box and then click the "filter" button. Refer to Figure 21. The filter will then display only those function codes currently available in the Function Code List that satisfy the search criteria. Once a filter has been entered, it will continue to be applied to all information normally displayed in the Function Code List. To remove the filter, delete any characters contained in the filter entry box and then click the "filter" button.

6.2.5 Radix Selection

Figure 22 shows the radix selection buttons. These selection buttons allow changing the Function Code List "value" column data display and entry radix between decimal and hexadecimal formats.

Figure 22: Radix Selection

When "DEC" is selected, the "value" column heading will be "*Value (Decimal)*", current function code values will be displayed in decimal, and values to be written to function codes must be entered in decimal format. For example, to change the inverter's frequency command to 40.00Hz, enter the decimal value 4000.

Similarly, when “HEX” is selected, the “value” column heading will be “*Value (Hexadecimal)*”, current function code values will be displayed in hexadecimal, and values to be written to function codes must be entered in hexadecimal format. For example, to turn on bit #10 in the inverter’s operation command word, enter the hexadecimal number 0400.

6.3 Dashboard Tab

The Dashboard Tab provides access to a virtual keypad, as well as a variety of gauges, meters and graphs that can be configured to provide an at-a-glance graphical overview of critical application variables in real-time. A total of 10 gauge windows are available (two at a time), and each gauge window can be configured to display any scanned function code's value via one of six different gauge types. User-defined engineering units, scaling and range limits are also configurable. Refer to Figure 23.

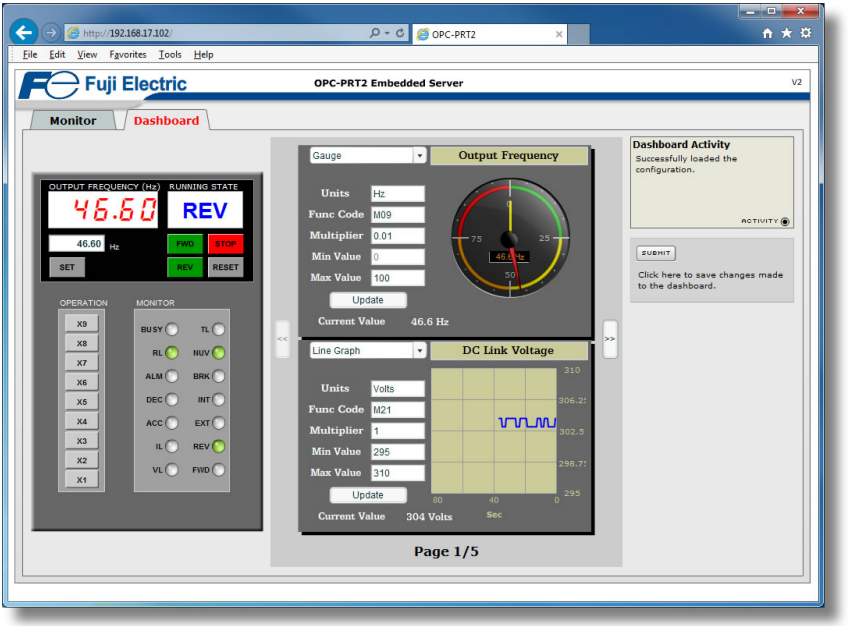


Figure 23: Dashboard Tab

6.3.1 Information Window

Figure 24 shows the Information Window, which displays various informational messages regarding the status of the Dashboard configuration parameters (loading or submitting).

Figure 24: Dashboard Tab Information Window

6.3.2 *Virtual Keypad*

A "virtual keypad" is displayed on the left-hand side of the dashboard tab, and acts as an interface for several useful pieces of control and monitor information. For an overview of the virtual keypad interface, refer to Figure 26. Note that it is recommended to suspend all external protocol-based communications with PLC's, etc. when using the virtual keypad, as other protocols may simultaneously be writing to the inverter's frequency command and operation command word, resulting in seemingly unpredictable behavior.

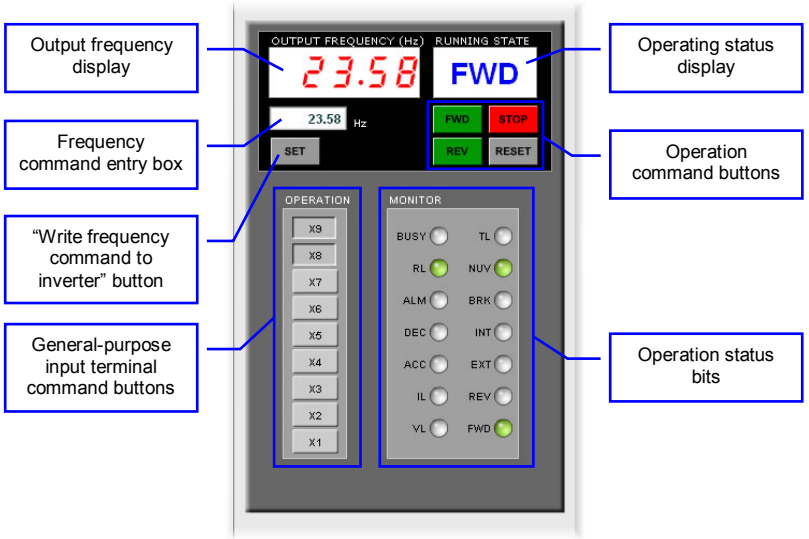


Figure 25: Virtual Keypad Overview

Output frequency display: Indicates the current output frequency of the inverter in large red numbers, as reported by inverter function code M09. The image in Figure 26 indicates that the associated inverter is currently running at 23.58Hz.

Frequency command entry box: Allows the user to enter a new frequency command for the inverter, which is subsequently scaled and written to inverter function code S05 when the "SET" button is clicked.

"SET" button: Clicking this button will scale and write the value contained in the frequency command entry box to inverter function code S05. Note that the inverter will use this frequency command as its master frequency reference only when configured accordingly (refer to section 3.1).

General-purpose input terminal command buttons: These buttons (labeled "X1" through "X9") map to the corresponding bits in the inverter's operation command word (function code S06, bit #2 ... bit #10). The usage of these bits varies depending on the configuration of inverter function codes E01 to E09. When a given button is clicked and shown in its depressed state, the corresponding bit is set to a "1". When clicked again (and therefore shown in its non-depressed state), the corresponding bit is set to a "0". As an example, the image in Figure 26 shows X1...X7 as OFF ("0"), and X8 and X9 as ON ("1"). Note that controlling these operation command word bits will only affect the inverter when it is configured accordingly (refer to section 3.1).

Operating status display: Indicates the current state of the inverter based on bits in the inverter operation status register (function code M14). Possible displays include "STOP", "FWD", "REV" and "FAULT".

Operation command buttons: Clicking on these buttons enables different control actions to be imposed on the inverter, as follows:

- FWD: sets bit #0 ("FWD") and clears bit #1 ("REV") in the operation command word (function code S06).

- REV: sets bit #1 (“REV”) and clears bit #0 (“FWD”) in the operation command word (function code S06).
- STOP: clears both bit #0 (“FWD”) and bit #1 (“REV”) in the operation command word (function code S06).
- RESET: writes a value of “1” to function code S14 (alarm reset command). This will reset a faulted inverter regardless of the current operation command mode (H30, Y98 etc.) Note that if the inverter was running (the “FWD” or “REV” buttons were the last buttons pressed on the virtual keypad before the fault occurred), the STOP button must be clicked prior to clicking the RESET button in order to clear the FWD and REV bits in the operation command word. The inverter will ignore reset commands issued through function code S14 as long as a valid run command still exists in the operation command word.

Note that the inverter will follow the FWD, REV and STOP button commands only when configured accordingly (refer to section 3.1).

Operation status bits: These “virtual LEDs” map to the corresponding bits of the same name in the inverter’s operation status word (function code M14). When a given bit in the status word is “1”, then its corresponding indicator will be lit. The indicator will not be lit if its status word bit is “0”. As an example, the image in Figure 26 shows FWD (bit #0), NUV (bit #5) and RL (bit #12) ON, and all other bits OFF.

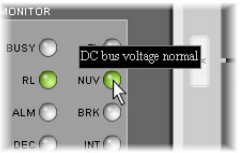


Figure 26: Virtual LED Tooltips

Tip Hovering the cursor over the virtual LEDs will bring up a tooltip which provides a brief summary of the indicated function. Refer to Figure 26.

6.3.3 Gauge Window Navigation

Figure 27 shows the two buttons that provide for navigation of the gauge windows. Gauge windows are displayed two at a time in the Dashboard Tab, and by clicking the “right” or “left” buttons, the gauge windows will scroll in the corresponding direction.

Figure 27: Gauge Window Navigation

6.3.4 Gauge Window Configuration

Each of the gauge windows can be independently configured to display a user-defined function code with a variety of flexible configuration options. While the behavior and presentation may vary slightly depending on the specific gauge chosen, all of the gauges share the following common elements (refer to Figure 28 for an example):

Gauge Selector: A drop-down selection box in the upper left-hand corner of the gauge window, which allows the user to select the type of gauge that will be displayed.

Title: A text entry box located above the gauge, in which the user can enter a descriptive gauge title comprised of up to 16 characters.

Units: A text entry box in which the user can enter an engineering units string comprised of up to 8 characters. This units string will be appended to all locations in the gauge window that display the designated function code’s current value.

Function Code: The designated function code whose value is to be reflected on the gauge. Note that only scanned function codes may be displayed in Dashboard gauges (refer to section 4.1 for a discussion of scanned function codes).

Multiplier: The multiplier value is a floating-point number that is used to scale the raw value of a function code. As its name suggests, the multiplier value is multiplied by the designated function code’s current raw value in order to calculate the gauge’s indicated value. Negative values can also be used if desired.

Min Value: The gauge’s minimum indicated value. Negative values can be used if desired (e.g. if a negative Multiplier attribute is used to generate a negative indicated value). Not all gauges allow adjustment of the min value.

Max Value: The gauge's maximum indicated value. Similar to the Min Value attribute, negative values can be used if desired. Indicated value characteristics can even be inverted by setting the Max Value attribute to a value less than the Min Value attribute.

Update Button: Clicking the update button will apply the current configuration attribute settings to the gauge. Note, however, that simply updating the gauge's current display properties does not write these settings to the interface card's file system. To save the current configuration of all the gauge windows to the file system, the Dashboard tab's "submit" button must be selected (refer to section 6.3.5).

Current Value: The current indicated value of the designated function code is numerically displayed with the configured Units string at the bottom of each gauge window.

The following is a summary of the different available gauge types:

Gauge: Refer to Figure 28. This type of meter implements a rotary dial-type display format. The indicated value and units are shown numerically on the face of the gauge, and via the red indicator needle. The yellow needle shows the previous indicated value, thereby providing a simple historical reference. The "Min Value" attribute is not configurable; this gauge always starts at 0.

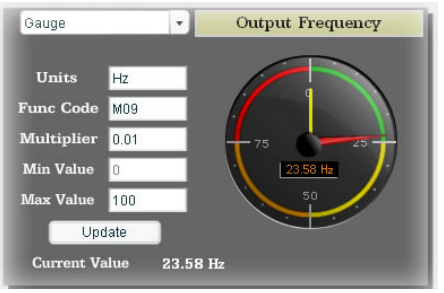


Figure 28: Gauge

BarGraph: Refer to Figure 29. This type of meter implements a linear bar graph display format. Hovering the mouse pointer over the red portion of the graph pops up a tooltip which displays the current indicated value and units.

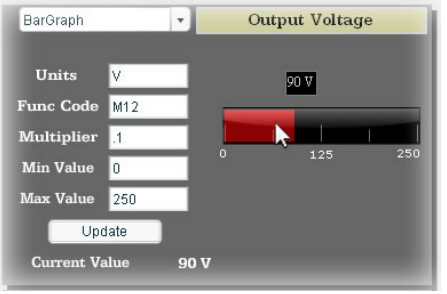


Figure 29: BarGraph

Meter: Refer to Figure 30. This type of meter implements a common panel meter-type display format. The units string is shown on the face of the meter. All raw function code values are interpreted as positive numbers (i.e. 0...0xFFFF equates to 0...65535_{10}.)

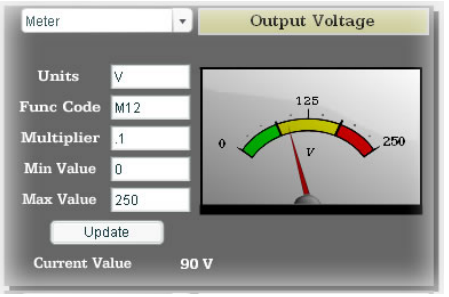


Figure 30: Meter

Pos/Neg Meter: Refer to Figure 31. Similar to the "meter" gauge, this type of meter also implements a common panel meter-type display format, but in this instance the indicated value can be positive or negative (two's complement interpretation). In other words, raw function code values of 0...0x7FFF equate to 0...32767_{10}, and values of 0x8000...0xFFFF equate to -32768...-1. Because the meter placard is always centered around zero, the "Min Value" attribute is not configurable, and the "Max Value" attribute is used for both the maximum positive indicated value as well as the maximum negative indicated value.

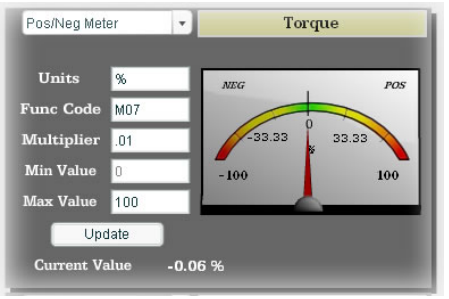


Figure 31: Pos/Neg Meter

Thermometer: Refer to Figure 32. This type of meter implements the universally-identifiable thermometer display format. Hovering the mouse pointer over the red "mercury" portion of the graph pops up a tooltip which displays the current indicated value and units.

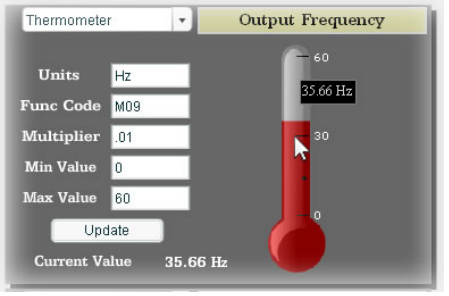


Figure 32: Thermometer

Line Graph: Refer to Figure 33. This type of graph implements a continuously-scrolling historical data logging line graph. Up to 80 seconds worth of historical data is available. Hovering the mouse pointer anywhere on the graph displays a vertical reference line at the corresponding time, and pops up a tooltip which displays the current indicated value at that time.

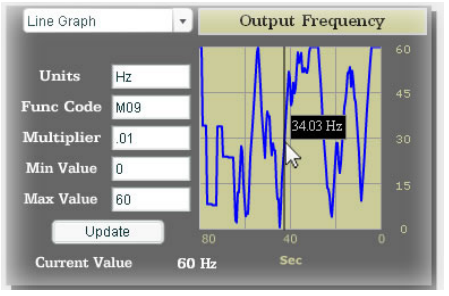


Figure 33: Line Graph

Tip

At times, it may be convenient to zoom in on a particular gauge or meter in order to more clearly see the indicator, or to fill the computer screen with a particular gauge's image. This can be easily accomplished with the web browser's Flash Player plug-in by right-clicking on the gauge and selecting the desired zoom level (refer to Figure 34).

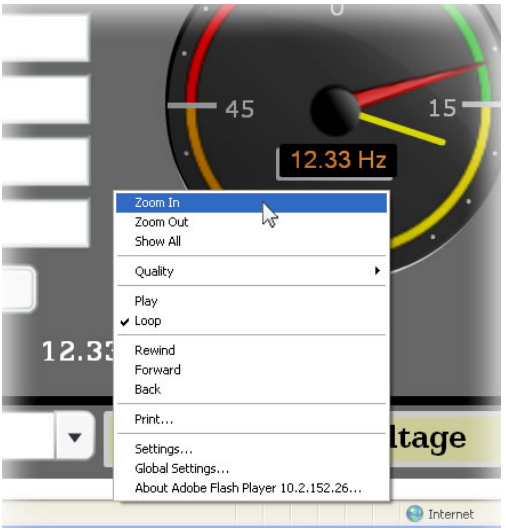


Figure 34: Zooming

6.3.5 Submitting Changes

Whenever any of the gauge window configuration items in the Dashboard Tab have been changed, the "submit" button located on the right-hand portion of the web page must be selected in order to write these settings to the interface card's file system. Refer to Figure 35. Note that submitting the Dashboard Tab configuration does not require rebooting of the interface card: the changes take effect immediately, and the interface card continues its operation without interruption.

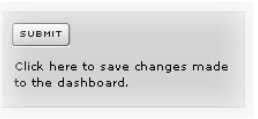


Figure 35: Submit Dashboard Changes

6.4 Customizing the Embedded Web Server

6.4.1 Customization Overview

It is possible for end-users to customize the embedded web server in order to create their own application-specific or corporate "look and feel". Knowledge of authoring dynamic web content is required. Using windows explorer, it is possible to load customized web server content into the "WEB" folder on the interface card's file system (refer to section 7.1.2). Usually, this web server content contains programming which implements the XML socket-based XTPro protocol (refer to section 6.4.2). Via XTPro, the embedded web server can gain access to any inverter parameter and the interface card file system resources, and manipulate them as required.

Notes

- There is an XML file located in the "WEB" folder called "*param.xml*", which contains definitions for all inverter function codes that are available via the interface card. This file must not be removed, as it contains the definition of all available parameters not only for active web server content, but also for the interface card itself. All other files in the "WEB" folder may be deleted or replaced if desired by the user.
- The default HTML file targeted by the web server is "index.htm". Therefore, when customizing the web server content, ensure that initial file "index.htm" exists.
- All files accessed by the web server itself must reside in the "WEB" folder. Note that this does not restrict active web server content to using only the "WEB" folder, however, as XTPro "read_file" and "write_file" commands can access any existing location on the file system.
- If the factory-default "WEB" folder contents need to be recovered (if they are accidentally deleted, for example), they can be downloaded from the device's product page on the internet.
- Two simultaneous web server sessions are supported. Note that the number of available simultaneous web server sessions is independent of the number of available simultaneous XTPro XML sockets.

6.4.2 XTPro Overview

XTPro is an acronym for **X**ML **T**CP/IP **Pro**tocol. The XTPro specification is an application-layer (positioned at level 7 of the OSI model) messaging protocol that provides XML-based client/server communication via TCP port 843. Typically, XTPro is used for the implementation of graphical user interfaces (GUIs), such as advanced web servers or HMIs that have the ability to request information via XML sockets, and then manipulate and/or display the information in a rich application-specific manner.

XTPro is a request/response protocol that provides services specified by commands. For more information on XTPro, refer to the separate XTPro Specification. This section will cover the device-specific implementation of the XTPro protocol.

6.4.3 XTPro Web Browser-Based Implementation

A representative implementation based upon using a web browser as the client is detailed in Figure 37. In this scenario, the client application is developed by using an active web server authoring tool (such as Adobe Flash®). The active content is then embedded into one or more HTML files and loaded onto the device's file system (refer to section 6.4.1 for detailed information regarding customization of the web server content). Accessing the device's web server via a standard web browser then loads the active content, which initiates communication with the server.

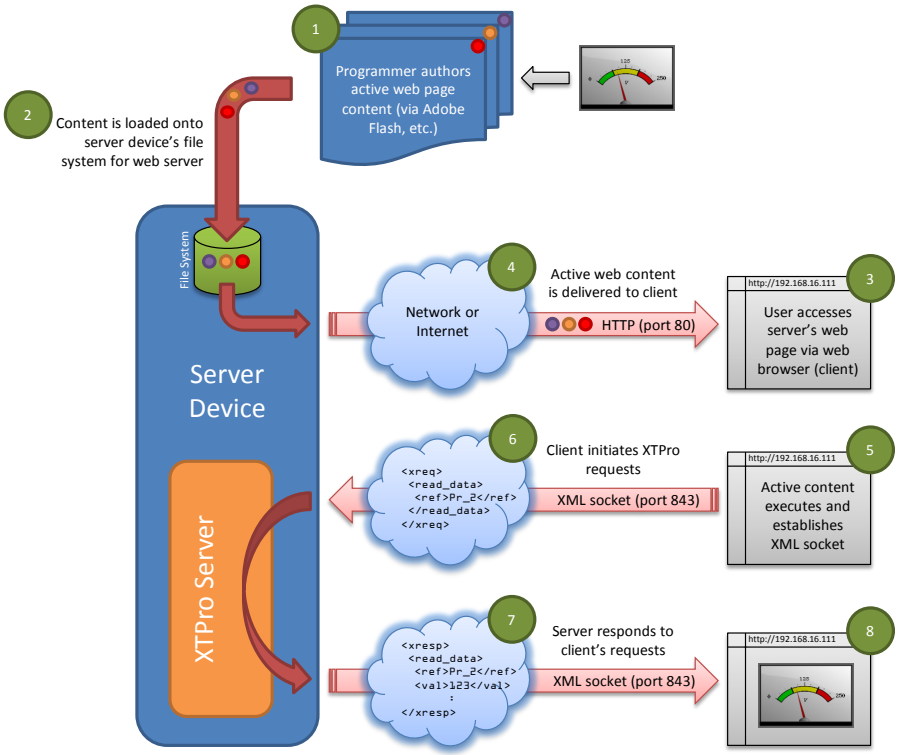


Figure 36: Web Browser-Based Implementation

6.4.4 XTPro HMI-Based Implementation

A representative implementation based upon a stand-alone HMI client is detailed in Figure 38. In this scenario, the client application is developed by using tools provided by the HMI manufacturer, and is hosted independently of the actual server device.

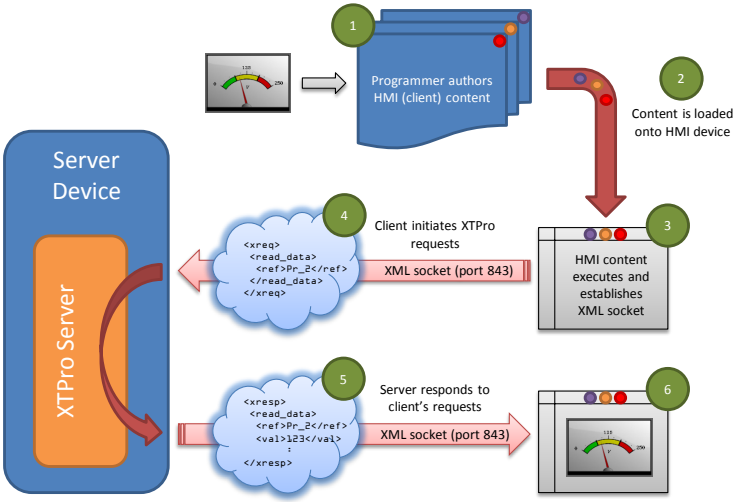


Figure 37: HMI-Based Implementation

6.4.5 XTPro Supported Commands

For a summary of XTPro commands, refer to Table 14.

Table 14: Supported XTPro Commands

Command	Supported	Notes
noop	Yes	-
vzn	Yes	Supports XTPro specification version 1
id	Yes	-
read_data	Yes	"reference" is the inverter's function code (e.g. "F07" for acceleration time #1), while "data_value" is a 16-bit hexadecimal value (e.g. "1F4" for a decimal value of 500)
write_data	Yes	
load_file	Yes	The absolute file path must start with a forward slash '/'
store_file	Yes	
reinit	No	Reinitializes only the configurable drivers and services (does not perform a complete device soft reboot)
auth	Yes	Authorization is not required
cov	Yes	COV notification messages are sent every 200ms

Notes

- Two simultaneous XTPro connections are available.

7 FILE SYSTEM & FIRMWARE

7.1 File System

7.1.1 Overview

The interface card's on-board file system is used by the application firmware. Currently, the application firmware's main use of the file system is to store XML-encoded configuration files and the embedded web server. The studio must be used to manage the configuration via USB or FTP. Do not manually access the configuration files unless instructed by technical support.

The configuration is only read at unit boot-up. Therefore, if a new configuration file is loaded, that unit must be rebooted for the new configuration take effect. Rebooting a unit can be performed by power-cycling the inverter in which the card is installed.

The embedded web server is customizable and is located in the "*WEB*" folder. All web page related items should reside in the "*WEB*" folder.

Interacting with the file system can be performed via USB (using a mini-B USB cable) as the interface card enumerates as a standard USB mass storage device ("flash drive"). The file system can also be accessed via FTP if the card has compatible network settings. Users can interact with the files on the interface card's file system in the same manner as though they were traditional files stored on a local or remote PC.

Note that the USB and FTP connection will prevent the file system from being accessed by other interfaces, such as the web server. Therefore, USB and FTP should only be connected when performing maintenance and configuration. USB and FTP should be disconnected while the card is running normally in a production environment.

7.1.2 USB with Windows Explorer

To use Microsoft Windows Explorer, first open either "Windows Explorer" or "My Computer". Refer to Figure 38. Note that the indicated procedure, prompts and capabilities outlined here can vary depending on such factors as the installed operating system and service packs.

The interface card will typically be displayed as a removable medium such as a "Removable Disk". Refer to Figure 39.

Figure 38: Accessing Windows Explorer

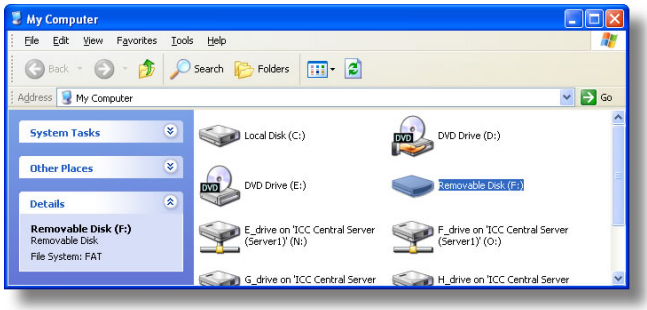


Figure 39: Removable Disk with Windows Explorer

Windows Explorer will then display the file system's contents (refer to Figure 40.) You can now perform normal file manipulation actions on the available files and folders (cut, copy, paste, open, rename, drag-and-drop transfers etc.) in the same manner as though you were manipulating any traditional file and folder stored on your computer's hard drive.

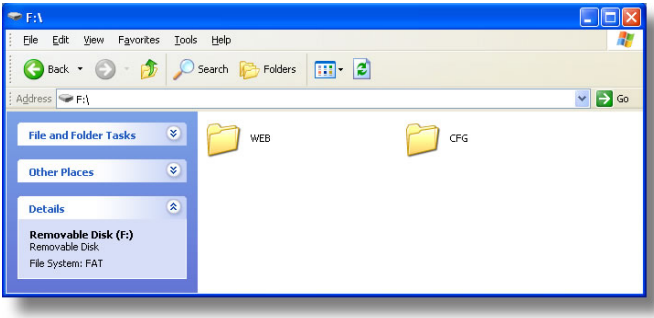


Figure 40: USB File Access via Windows Explorer

7.1.3 FTP with Windows Explorer

To use FTP with Microsoft Windows Explorer, first open either “Windows Explorer” or “My Computer”. Please note that the indicated procedure, prompts and capabilities outlined here can vary depending on such factors as the installed operating system, firewalls and service packs.

In the “Address” field, type in “ftp://admin:admin@” and then the IP address of the target interface card (if the user name and password have been changed from its default, then replace the first “admin” with the new user name and the second “admin” with the password.) Refer to Figure 41.

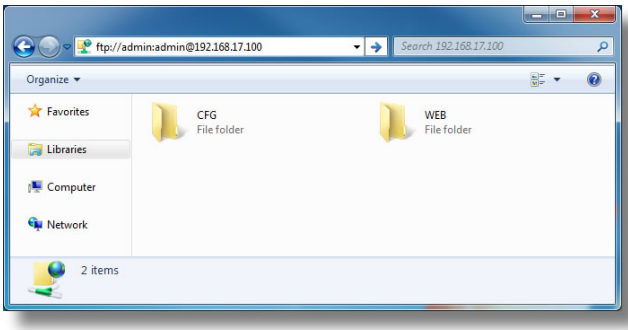


Figure 41: FTP via Windows Explorer

Note that the behavior of Windows Explorer FTP will vary from PC to PC. If you are having issues connecting FTP, there are other FTP client tools available such as Windows Command Prompt, Core FTP, FileZilla, SmartFTP etc. that can also be used to reliably access the card’s file system.

7.1.4 Loading New Web Server Content

The interface card’s web server resides in the file system and can be updated in the field (refer to section 6.4). This section will discuss how to update the default web server. The update procedure similarly applies to a custom web server. Web server updates may be released for a variety of reasons, such as improvements and added functionality. When using the default web server, it is always recommended to use the latest release.

Treat web server updates independently of firmware updates since web server updates may or may not be related to firmware updates. The latest default web server can be requested from technical support. It is suggested that users first check with technical support, and then periodically afterwards to determine if a new default web server has been released and is available to update their units.

Besides the new “WEB” folder containing the new web server, the update requires a USB connection as described earlier in this section. To update the web server, complete the following steps:

1. Navigate to the card's file system (see section 7.1.2 or 7.1.3).
2. Backup the "WEB" folder if desired by copying it to the local computer.
3. Delete the "WEB" folder from the card's file system.
4. Copy the new "WEB" folder to the card's file system.
5. Although it is not typical, if your *param.xml* file was specially modified (for a custom application, for example), it may be necessary to re-apply those modifications. Please consult technical support for any questions related to customized versions of *param.xml*.
6. Clear your internet browser's cache to ensure that the new web server content will be properly loaded from the interface card.

7.2 Firmware

7.2.1 Overview

The interface card's embedded firmware resides in flash memory that can be updated in the field. Firmware updates may be released for a variety of reasons, such as custom firmware implementations, firmware improvements and added functionality as a result of user requests. Additionally, it may be necessary to load different firmware onto the unit in order to support various protocols. In order to ensure that the firmware update is successful, and in the interest of equipment and personnel safety, it is strongly recommended to stop all of the card's production activities prior to initiating the firmware update procedure.

7.2.2 Update Procedure

1. Always back up your configuration to a PC for later recovery if necessary.
2. Download and install the latest Configuration Studio, which can be obtained from technical support.
3. Please be sure to read the firmware release notes and updated user's manual for any important notices, behavior precautions or configuration requirements prior to updating your firmware.
4. Ensure that the device is in a safe state prior to initiating the firmware update. The card may be temporarily inaccessible during the firmware update process.
5. *Locally via USB:* Connect a USB cable between the card and the PC and open the studio. If the studio contains newer firmware, it will automatically prompt you to update the firmware. Proceed with the firmware update.
6. *Remotely Via FTP:* Connect an Ethernet cable and ensure that the card has compatible network settings.
7. Once the firmware update process has started, do not interrupt the card as this may corrupt the firmware. Do NOT manually power-cycle the inverter or reboot the card. Do NOT disturb the USB or Ethernet (FTP) connection.
8. After the firmware update has been completed, the card will reset automatically. When the card boots up again, it will be running the new application firmware, which can be confirmed by observing the version displayed in **Device…Device Info** or the web server's information window (refer to section 6.2.1).
9. If new default web server content is available, load the new web server (refer to section 7.1.3).

8 PROTOCOL-SPECIFIC INFORMATION

This section will discuss topics that are specific to each of the supported protocols.

8.1 PROFINET IO

8.1.1 Overview

The PROFINET IO device driver allows a controller to interact with the interface card via cyclic data exchange and acyclic read/write requests. The I/O data is entirely user-configurable, and is utilized when a standard I/O module is chosen during network configuration.

Some other notes of interest include:

- Allows simultaneous access to only 1 PROFINET controller.
- Supports conformance class A and real time (RT) communication.
- Supports MRP (Media Redundancy Protocol) client.
- Supports DCP (Discovery Control Protocol).
- Supports alarms.
- Supports I&M.
- The lowest supported I/O Cycle Update Time (in STEP 7 or an equivalent hardware configuration tool) is 1ms.
- The GSDML file can be obtained from technical support.
- Supports several user-configurable I/O modules with up to 32 input words and 32 output words.
- Supports the PROFIdrive profile version 4.1.
- No explicit module selection is required on the interface card: the module will be selected automatically according to the controller's configuration.
- If a timeout occurs on the RT connection, the driver can be configured to trigger a timeout event as described in section 5.4.1. The timeout value is dictated by the PROFINET controller and is at least three times the IO Cycle update time. The timeout value is also known as the "IO Cycle Watchdog" time.

8.1.2 Device Settings

In the studio's **Project** panel, navigate to **OPC-PRT2…Ethernet…PROFINET IO**.

Device Name

The device name / station name must be unique across the entire PROFINET network, because it is used by controllers to uniquely identify PROFINET devices. This string must conform to the device name requirements contained in the PROFINET specification.

8.1.3 Connection Timeout Options

In the studio's **Project** panel, navigate to **OPC-PRT2…Ethernet…PROFINET IO**. The following configuration options will determine the actions to be taken by the card if the PROFINET IO connection is abnormally terminated or lost.

Timeout Action

Select an action from the drop down menu:

"None".....No effect. The inverter will continue to operate with the last available settings.

"Trigger Timeout Event".....Trigger a timeout event as described in section 5.4.1.

"Fault Drive" .....The behavior will depend on the timeout conditions set by the inverter (function codes o27 and o28), which may result in an Er5 fault. Refer to section 3.2.

Enable Drive Fault Reset

This will clear the Er5 fault once communication is re-established. This option is only available if the **Timeout Action** is set to "Fault Drive".

8.1.4 Cyclic I/O Produced and Consumed Data Access Settings

In the studio's **Project** panel, add **OPC-PRT2…Ethernet…PROFINET IO…Produced Data Word** and/or **Consumed Data Word**.

The Produced Data Word and Consumed Data Word objects are only applicable when using the I/O module "IN: 32 WORDS, OUT: 32 WORDS", which is typically the case. The Produced Data Word defines the structure of status data sent from the inverter to the controller. The Consumed Data Word objects will define the structure of the command data sent from the controller (for example, a Siemens PLC) to the inverter. These objects allow the creation of custom-built I/O data. Up to 32 "command" function code values can be sent to the inverter, and up to 32 "status" function code values can be sent back to the controller. Therefore, up to 32 Produced and 32 Consumed Data Word objects can be created. If a consumed word offset is not defined, that data will be ignored by the inverter. If a produce word offset is not defined, the value will default to 0. The size of the actual I/O produced and consumed data is determined by the PROFINET controller. The I/O data format is summarized in Table 15.

Description

This 32-character (max) field is strictly for user reference: it is not used at any time by the PROFINET driver.

Produced Data Word Offset

The value from the associated inverter function code will populate this word offset of the produced data that is to be sent to the controller. It is recommended to start at word offset 0.

Consumed Data Word Offset

The consumed data received from the controller at this word offset will contain the value to be written to the associated inverter function code. It is recommended to start at word offset 0.

Function Code

The inverter function code associated with the word offset. For the Produced Data Word object, enter a "status" function code to be monitored. For the Consumed Data Word object, enter a "command" function code that can be written.

Data Type

Each data word is fixed to 16-Bit Unsigned (equivalent to two bytes.) The data word is transferred in little endian format.

Table 15: User-Configurable Module I/O Data Format

Consumed Data (PLC to Inverter)		Produced Data (Inverter to PLC)	
Word Offset	**Function Code**	**Word Offset**	**Function Code**
0	Any	0	Any
1	Any	1	Any
:	Any	:	Any
30	Any	30	Any
31	Any	31	Any

The default I/O configuration is described in Table 16.

Note Always use the studio to confirm the configuration before commissioning the device.

Table 16: Default User-Configurable Module I/O Data Format

Consumed Data (PLC to Inverter)		Produced Data (Inverter to PLC)	
Word Offset	**Function Code**	**Word Offset**	**Function Code**
0	S06	0	M14
1	S05	1	M09
:	None	:	None
30	None	30	None
31	None	31	None

8.1.5 PROFIdrive Profile

For optimal interoperability, the interface card supports the PROFIdrive profile version 4.1. No special configuration of the interface card is required when using the PROFIdrive profile. The controller **must** support the PROFIdrive profile and **must** be configured to use the "Standard Telegram 1" module on the interface card. If the controller does not support the PROFIdrive profile, use the configurable I/O "IN: 32 WORDS, OUT: 32 WORDS" module. The PROFIdrive profile is only partially described in this manual due to its complexity. The complete PROFIdrive profile specifications can be obtained from http://www.profibus.com/.

Some other notes of interest include:

- Implements Application Class 1 (standard drive)
- Supports only Standard Telegram 1 (ST1, PZD-2/2) on slot 1 (similar to Profibus PPO type 3)
- Supports only Speed Control Mode

8.1.5.1 PROFIdrive standard telegram 1

The standard telegram 1 mapping is described in Table 17.

Table 17: Standard Telegram 1

IO Data Word Offset	Setpoint (PLC to Inverter)		Actual Value (Inverter to PLC)	
	Significance	**Description**	**Significance**	**Description**
0	STW1	Control word 1	ZSW1	Status word 1
1	NSOLL_A	Reference speed setpoint	NIST_A	Speed actual

8.1.5.2 PROFIdrive control and status words

The control word, STW1, is the principal means for controlling the drive. It is sent by the controller (PLC) to the device (inverter). The bitmapping for the control word is described in Table 18. The status word, ZSW1, returns status information from the inverter to the controller. The bitmapping for the status word is described in Table 19.

Table 18: STW1 Control Word Mapping

Bit	Value	Significance	Description
0	1	ON	Run command ON
	0	OFF	Run command OFF
1	1	ON2	No coast stop
	0	OFF2	Coast to a stop
2	1	ON3	No quick stop
	0	OFF3	Quick stop
3	1	Enable Operation	Enable inverter operation
	0	Disable Operation	Disable inverter operation
4	1	Enable Ramp Generator	Enable the ramp frequency generator (RFG)
	0	Disable Ramp Generator	Hold the output frequency to 0 Hz
5	1	Unfreeze Ramp Generator	Unfreeze the RFG
	0	Freeze Ramp Generator	Freeze the RFG with the current output frequency
6	1	Enable Setpoint	Enable command
	0	Disable Setpoint	Disable command

Bit	Value	Significance	Description
7	1	Fault Acknowledge	Reset the alarm on a positive edge (0→1 transition)
	0	No significance	Do not reset the alarm
8 - 9	Not used	---	---
10	1	Control By PLC	Enable remote control. The IO process data is valid.
	0	No Control By PLC	Disable remote control. The IO process data is not valid.
11 - 15	Not used	---	---

Table 19: ZSW1 Status Word Mapping

Bit	Value	Significance	Description
0	1	Ready To Switch ON	Ready to run command ON
	0	Not Ready To Switch ON	Not ready to run command ON
1	1	Ready to Operate	Ready to run
	0	Not Ready To Operate	Not ready to run
2	1	Operation Enabled	Running
	0	Operation Disabled	Running disabled
3	1	Fault Present	Inverter tripped as indicated by ALM. Refer to function code M14 bit 11.
	0	No Fault	No trip present as indicated by ALM. Refer to function code M14 bit 11.
4	1	Coast Stop Not Activated	Follows STW1 bit 1, ON2 active
	0	Coast Stop Activated	Follows STW1 bit 1, OFF2 active
5	1	Quick Stop Not Activated	Follows STW1 bit 2, ON3 active
	0	Quick Stop Activated	Follows STW1 bit 2, OFF3 active
6	1	Switch ON Inhibited	Not ready to run command ON
	0	Switch ON Not Inhibited	Ready to run command ON
7	Not Used	---	---
8	1	Speed Within Tolerance	Actual value equals the reference value and is within the tolerance as indicated by FAR. Refer to function codes M70 bit 1 and E30.
	0	Speed Out Of Tolerance	Actual value differs from the reference value or is outside of the tolerance as indicated by FAR. Refer to function codes M70 bit 1 and E30.
9	1	Control Requested	Control by PLC is enabled as indicated by RL. Refer to function code M14 bit 12.
	0	No Control Requested	Control is not possible by the controller as indicated by RL. Refer to function code M14 bit 12.
10	1	Frequency Reached Or Exceeded	The actual value ≥ max reference value as indicated by FDT. Refer to function codes M70 bit 2 and E31.
	0	Frequency Not Reached	The actual value < max reference value as indicated by FDT. Refer to function codes M70 bit 2 and E31.
11 - 15	Not used	---	---

8.1.5.3 PROFIdrive reference speed setpoint and actual speed

The speed setpoint value, NSOLL_A, is the commanded speed reference (normalized) sent from the controller to the inverter. Similarly, the speed actual value, NIST_A, is the actual operating speed (normalized) of the inverter sent back to the controller. As the inverter natively operates in units of Hz, the following conversion equations are applied within the interface card:

NSOLL_A: The inverter reference speed setpoint is a normalized value. The interface card applies the Normalize-to-Hz conversion indicated in Equation 3 in order to determine the appropriate frequency command value (in units of Hz) to be written to function code S05 (frequency command).

$$\text{Hz} = \frac{\text{NSOLL\_A x Max Frequency}}{\text{0x4000}}$$

Equation 3

NIST_A: The inverter operating actual speed is a normalized value that is calculated from inverter function code M09 (output frequency). The interface card applies the Hz-to-Normalize conversion indicated in Equation 4 in order to determine the appropriate operating speed actual (normalized).

$$\text{NIST\_A} = \frac{\text{Hz x 0x4000}}{\text{Max Frequency}}$$ **Equation 4**

The "Max Frequency" term which appears in Equation 3 and Equation 4 is obtained from the setting of inverter function code F03 (maximum frequency 1).

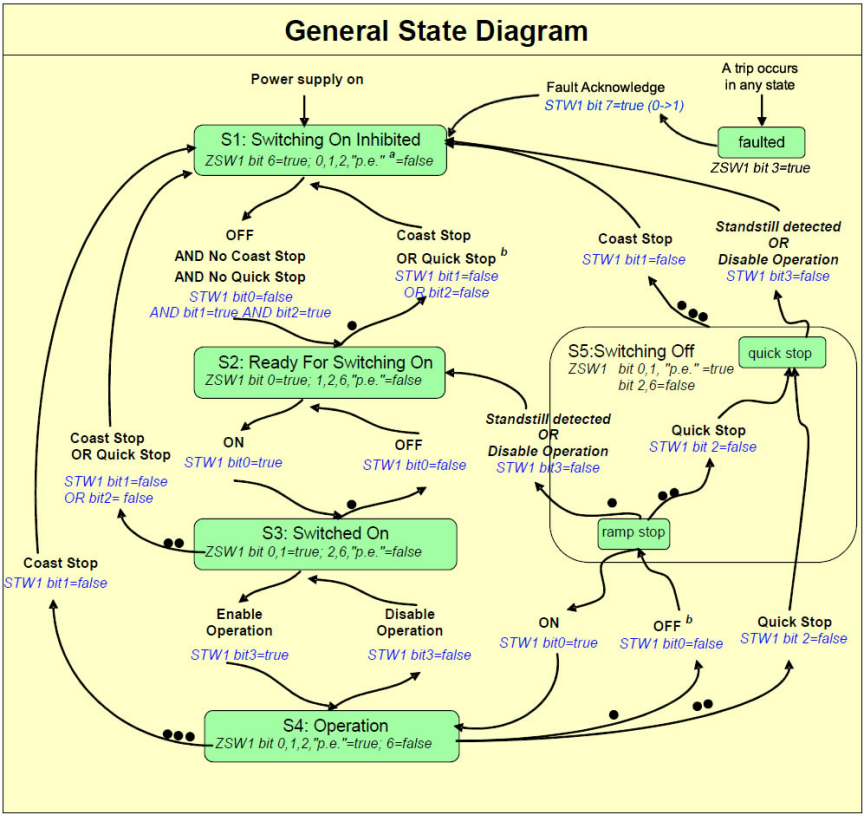
A normalized value of 0x4000 corresponds to 100% of the maximum frequency. A positive normalized value indicates forward rotation and a negative normalized value indicates reverse rotation.

Note The value of F03 is read by the interface card only at boot-up. If the value of this function code is changed, then the interface card must be rebooted in order for it to read the new value from the inverter.

8.1.5.4 PROFIdrive state diagram

The state diagram is displayed in Figure 42.

Figure 42: PROFIdrive State Diagram



8.1.5.5 PROFIdrive-specific parameters

The PROFIdrive-specific parameters are shown in Table 20. The parameters are read-only.

Table 20: PROFIdrive-Specific Parameters

PNU	Index	Description
711	None	NSOLL_A – Speed setpoint A
712	None	NIST_A – Speed actual A
833	None	STW1 – Control word 1
834	None	ZSW1 – Status word 1
922	None	Telegram selection = 1 (Standard telegram 1)
923	1,2,5,6	List of all parameters for signals
944	None	Fault message counter
947	0..3	Fault number (M16...M19)
964	0..6	Drive Unit identification
965	None	Profile identification number = Profile 3, Version 4.1
975	0..7	DO identification
980	0..5	Number list of defined parameter
1401	None	DO IO Data reference parameter

8.1.6 Acyclic Data Access

Any inverter function code can be accessed via PROFINET acyclic services. To accomplish this, set the API to 0, Slot to 1 and SubSlot to 1. The record number/index value is equivalent to the desired function code register number described in section 4.1. The length is specified according to the number of bytes to access. Since each register corresponds to 2 bytes of data, the length must be an even number.

8.1.7 STEP 7 Hardware Configuration Example

The following example will use STEP 7 to demonstrate the basic and typical hardware configuration procedure, which will apply to similar configuration software. The example will not cover all features of STEP 7. Any questions regarding STEP 7 (or similar configuration software) must be directed at the vendor of the software.

8.1.7.1 Register the GSDML file

Navigate to **Options…Install GSD File…** as shown in Figure 43.

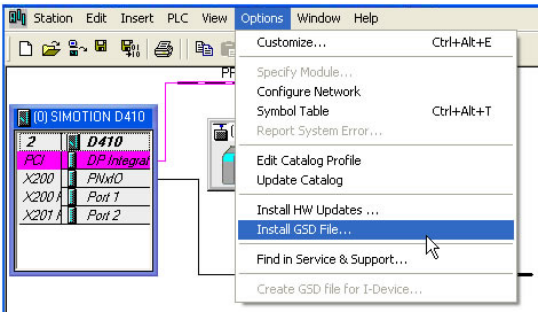


Figure 43: Install GSD File Menu Option

Locate and install the GSDML file as shown in Figure 44.

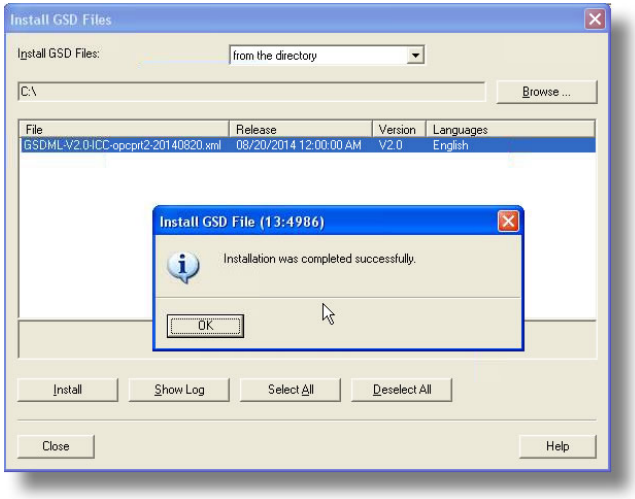


Figure 44: Successfully Installed GSDML File

Confirm that the device has been added to the catalog or device tree as shown in Figure 45.

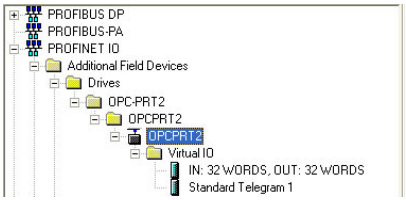


Figure 45: Updated GSDML Device Tree

8.1.7.2 Add the device to the configuration

Select the device in the device tree and drag the device onto the PROFINET IO system in the configuration as shown in Figure 46.

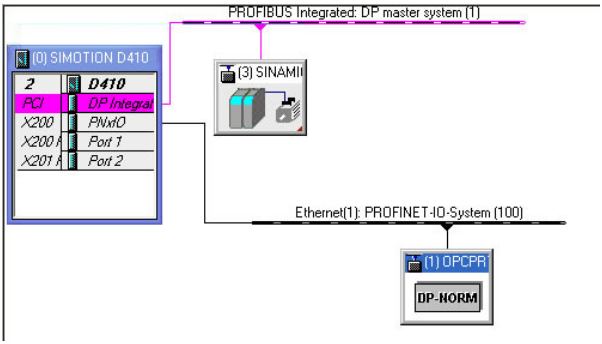


Figure 46: Add Device to Configuration

8.1.7.3 Configure the device properties

Open the device properties and assign a **unique** Device name as shown in Figure 47.

Figure 47: Assign Unique Device Name

Assign a **unique** and **compatible** IP address for your target network as shown in Figure 48.

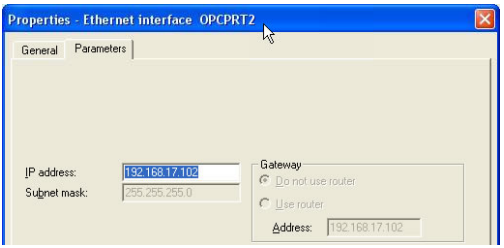


Figure 48: Assign Unique Compatible IP Address

Set the I/O Cycle Update Time as shown in Figure 49.

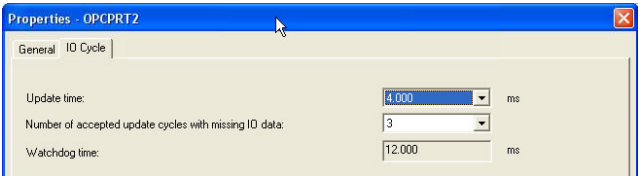


Figure 49: Set I/O Cycle Update Time

8.1.7.4 Assign the I/O module

In the device tree, expand the OPC-PRT2 module to view the available Virtual IO modules as shown in Figure 45. By default, there are two modules:

1) IN: 32 WORDS, OUT: 32 WORDS
    a. User-configurable (refer to section 8.1.3)
2) Standard Telegram 1
    a. PROFIdrive profile (refer to section 8.1.5)

First, select the OPC-PRT2 node in the configuration. Next, select an OPC-PRT2 Virtual IO module from the device tree and drag it into Slot 1 of the OPC-PRT2. In this example, the “IN: 32 WORDS, OUT: 32 WORDS” module was added to Slot 1 in the configuration as shown in Figure 50.

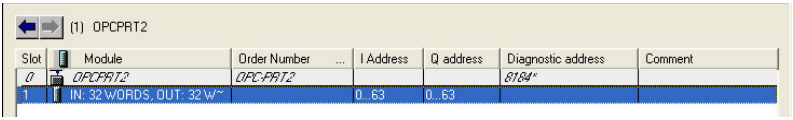


Figure 50: Add Module to Slot

8.1.7.5 Online device discovery and configuration

Navigate to **PLC…Ethernet…Edit Ethernet Node**. Click **Browse** to discover and view the online PROFINET devices on the network as shown in Figure 51.

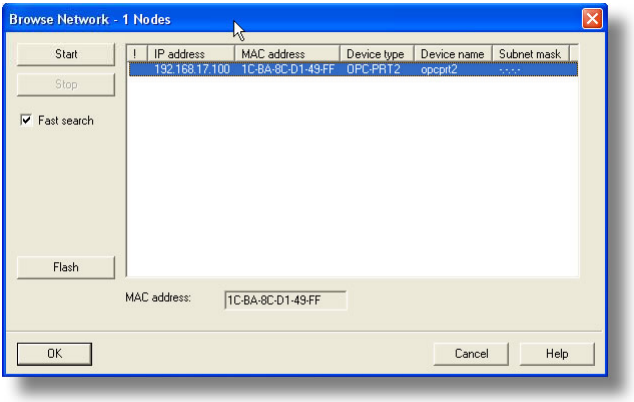


Figure 51: Discover PROFINET Devices on the Network

If the **Device name** and **IP address** do not match the values set in the configuration, select the device and click **OK**. Any non-matching value must be assigned to the device as shown in Figure 52.

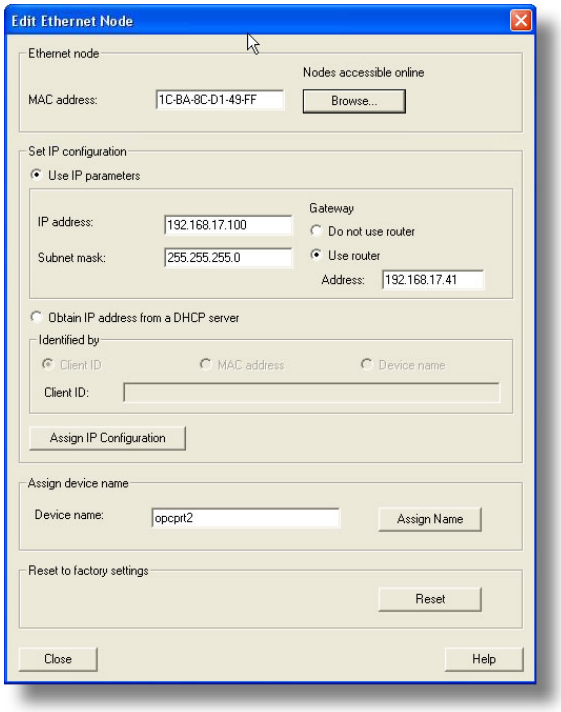


Figure 52: Configure Online Device

8.1.7.6 Save the configuration

The hardware configuration is now complete. Save and perform any necessary compilation of the configuration. The PLC application program can then be started. Please consult with the vendor of your PROFINET PLC software for additional configuration details.

9 TROUBLESHOOTING

Although by no means exhaustive, Table 21 provides possible causes behind some of the most common errors experienced when using the interface card.

Table 21: Troubleshooting

Problem	Symptom	Solution
No communications between the interface card and the inverter	Inverter displays "Er4" code	• Confirm that the interface card connector is properly seated. • Rebooting the interface card via the Fuji Configuration Studio disrupts the communication with the inverter. Reset the fault. • If the card is connected in a ring topology, the ring must support MRP. Otherwise a ring topology will result in an Ethernet loop.
No communications between the network and the interface card	Communications cannot be established, the Ethernet "link" LED is off, or the Ethernet "activity" LED flashes only infrequently or not at all	• Confirm that the card is running normally and connected to the local Ethernet network. • Ensure that the card is programmed with compatible network settings. Consult with your network administrator to determine the compatible settings. • Confirm that the destination IP address programmed into the controller equipment or computer matches that of the interface card, as displayed by the studio. • Confirm that intermediate firewalls or routers have been configured to allow access to the interface via the applicable TCP/UDP ports. • Try a known working Ethernet cable and switch. • If attempting to access the web server on a computer whose web browser is configured to use a proxy server, ensure that the proxy server is accessible to the computer, and that the interface card is accessible to the proxy server.
No PROFINET communication	PROFINET I/O communication cannot be established. The "Network Status" LED is not solid green.	• Confirm that the card's PROFINET device name matches the name assigned in the controller's configuration. • Confirm that the card's network settings match the settings assigned in the controller's configuration. • Confirm that the I/O cycle update time is set to 1ms or larger. • Ensure that the card is connected to a 100Mbps full duplex capable switch. • Ensure that the card can be discovered using the controller's discovery tool.
Unable to control the inverter via network communications	Writing to command and frequency function codes/registers has no apparent effect on inverter operation	• Confirm that the applicable inverter function codes are set to allow network control (refer to section 3.1). • If using the inverter's terminal contacts, refer to the inverter's instruction manual to determine the appropriate behavior and priority.

Problem	Symptom	Solution
XML socket connection failed	Message on a web server tab information window	TCP port 843 is blocked by a firewall, router or some other intermediate network equipment.
New web server content not loading after web server update	Old web server content is displayed	The internet browser has cached the old web server content. Clear the internet browser's cache before attempting to load the new web server content.
Web page does not display properly	Corrupt web server or outdated flash player plugin	• Ensure that USB and FTP are disconnected. • Download and install the latest flash player plugin from Adobe. • Delete the "WEB" folder from the card's file system and copy a valid default "WEB" folder to the card's file system.
Studio cannot discover the card	The studio does not display the card under "Online Devices"	• Confirm that the card is running normally and connected via USB or to the local Ethernet network. • Confirm that the module and network status LEDs blink the green/red startup sequence when power is first applied. • Add the studio as an exception to the computer's firewall. • Add UDP port 4334 as an exception to the firewall. • Temporarily disable the computer's firewall.
Studio cannot access file system	The studio displays an error when uploading and downloading the configuration.	If the studio continually displays an error regarding access to the file system, the file system may be corrupt. Please format the card's file system and then restore the configuration.
Firmware-generated error	"MODULE STATUS" LED is flashing red. The number of times the LED flashes indicates an error code.	Record the error code blinking pattern and contact technical support for further assistance.

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