ICC

INDUSTRIAL CONTROL COMMUNICATIONS, INC.

700 series

INVERTER
Plug-in option
FR-A7N-ETH
INSTRUCTION MANUAL

Ethernet multiprotocol communication interface

September 2007
ICC #10653-1.000-000

Thank you for choosing this ICC, Inc. plug-in option for the Mitsubishi 700 Series Inverter. This instruction manual provides handling information and precautions for use of this equipment. Incorrect handling may cause unexpected failures or damage. In order to ensure optimal performance, please read this manual carefully prior to use of the equipment. Please forward this manual to the end user of the equipment.

This section pertains specifically to safety issues

Do not attempt to install, operate, maintain or inspect this product until you have read through this instruction manual and any related documents carefully, and can use the equipment properly. Do not use this product until you have a full working knowledge of the equipment, safety information and instructions. In this instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION" levels.

⚠ **WARNING**	**Assumes that incorrect handling may cause hazardous conditions resulting in death or severe injury.**
⚠ **CAUTION**	**Assumes that incorrect handling may cause hazardous conditions resulting in moderate or slight injury, or may cause physical damage only.**

Please note that even the ⚠ CAUTION level may lead to serious consequence depending on conditions. Please be sure to follow the instructions of both levels as they are critical to personnel safety.

SAFETY INSTRUCTIONS

1. Electrical Shock Prevention

⚠ WARNING

- **Do not open the front cover of the inverter while power is on or while the inverter is running, as an electrical shock may result.**
- **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, resulting in an electrical shock.**
- **If power is off, do not remove the front cover except when necessary for wiring or periodic inspection. While the front cover is removed, accidental contact with exposed high-voltage terminals and internal components may occur, resulting in an electrical shock.**
- **Prior to starting wiring or inspection, confirm that input power to the inverter has been switched off via observation of the inverter's display panel. Additionally, wait for at least 10 minutes after removal of input power, and then confirm that all residual voltage has been dissipated by using a voltage meter. Internal DC bus capacitors may contain high voltages for several minutes after removal of input power, resulting in a dangerous situation should anything come into contact with them.**
- **All personnel involved in the installation or inspection of this equipment should be fully competent to perform the required work.**
- **Always install plug-in options prior to wiring main power.**
- **Do not touch the plug-in option with wet hands.**
- **Do not subject the cables to scratches, excessive stress, heavy loads or pinching.**

2. Injury Prevention

⚠ CAUTION

- To prevent explosions or similar damage, apply only the voltages specified in the instruction manual to each terminal.
- To prevent explosions or similar damage, ensure that all cables are properly connected to the correct terminals.
- To prevent explosions or similar damage, observe all wiring polarity indicators.
- To prevent burns from hot components, do not touch the inverter while power is on, or for some time after power is removed.

3. Additional Instructions

Please note the following points to prevent equipment damage, injury or electrical shock.

1) Transportation and Mounting

⚠ CAUTION

- Do not install or operate the plug-in option if it is damaged or has parts missing.
- Do not stand on or rest heavy objects on the equipment.
- Check that the mounting orientation is correct.
- Prevent conductive items such as screws and metal fragments, or flammable substances such as oil from entering the inverter.

2) Trial Run

⚠ CAUTION

- To prevent unexpected equipment movement, confirm and adjust all required parameters prior to starting operation.

3) Usage

⚠ WARNING

- Do not modify the equipment.
- Do not remove any inverter or option parts unless specifically instructed to do so in this manual.

⚠ CAUTION

- Performing a “parameter clear” or “all parameter clear” will reset all inverter parameters to their factory default settings. After performing one of these operations, remember to reenter any custom parameter values prior to starting operation.
- To prevent damage from electrostatic discharge, always touch a grounded piece of metal prior to touching any equipment.

4) Maintenance, Inspection and Parts Replacement

⚠ CAUTION

- Do perform hi-pot tests on the equipment.

5) Disposal

⚠ CAUTION

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

6) General Instructions

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.

– CONTENTS –

1 PRE-OPERATION INSTRUCTIONS

1.1 Product Overview

The FR-A7N-ETH Ethernet multiprotocol communication interface allows information to be transferred seamlessly between a 700-series inverter and several different Ethernet-based fieldbus networks with minimal configuration requirements. The interface installs directly onto the inverter's control board, and presents a standard 10/100BaseT Ethernet port for connection to the Ethernet network. In addition to the supported fieldbus protocols, the interface also hosts an embedded web server, which provides access to inverter information via a standard web browser for remote monitoring, configuration and control.

The option card communicates to the inverter via its built-in RS485 communication port, located in the upper-left hand corner of the inverter's control board. Note that because the inverter's RS485 port is used by the FR-A7N-ETH card, it is therefore unavailable for use by any other network when the FR-A7N-ETH interface is installed.

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 that the firmware version running on your interface must match this manual's respective revision in order for all documented aspects to apply.

The primary features of the FR-A7N-ETH are as follows:

Ethernet Port

IEEE 802.3 10/100BaseT Ethernet compliant. Shielded RJ45 connector accepts standard CAT5-type 8-conductor unshielded twisted-pair (UTP) patch cables. Supports multiple simultaneous protocols.

Supported Protocols

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

- Modbus TCP/IP
- Ethernet/IP
- BACnet/IP
- Profinet IO

Note that use of Profinet IO is mutually exclusive of the other supported protocols. In order to use Profinet IO, a separate application firmware file must be loaded into the interface (refer to section 7.6).

Macromedia® Flash-Enabled Embedded Web Server

Interface configuration and real-time inverter parameter monitoring & control are provided via an embedded web server. The interface's web server feature provides direct data access and control via standard web browsers such as Microsoft Internet Explorer and Netscape Navigator. The latest version of Macromedia Flash Player browser plug-in is required. Refer to section 5.

XML Configuration File Upload/Download

All interface configuration files are stored in the unit's internal filesystem in XML format. These files can be transferred to/from a PC via the FTP protocol, which provides the capability for PC-based file backup and easy configuration copying to multiple units. Configuration files can also be viewed and edited via standard text editors, XML editors and web browsers. Refer to section 7.

Field-Upgradeable

As new firmware becomes available, the interface can be upgraded in the field by the end-user. Refer to section 7.6 for more information.

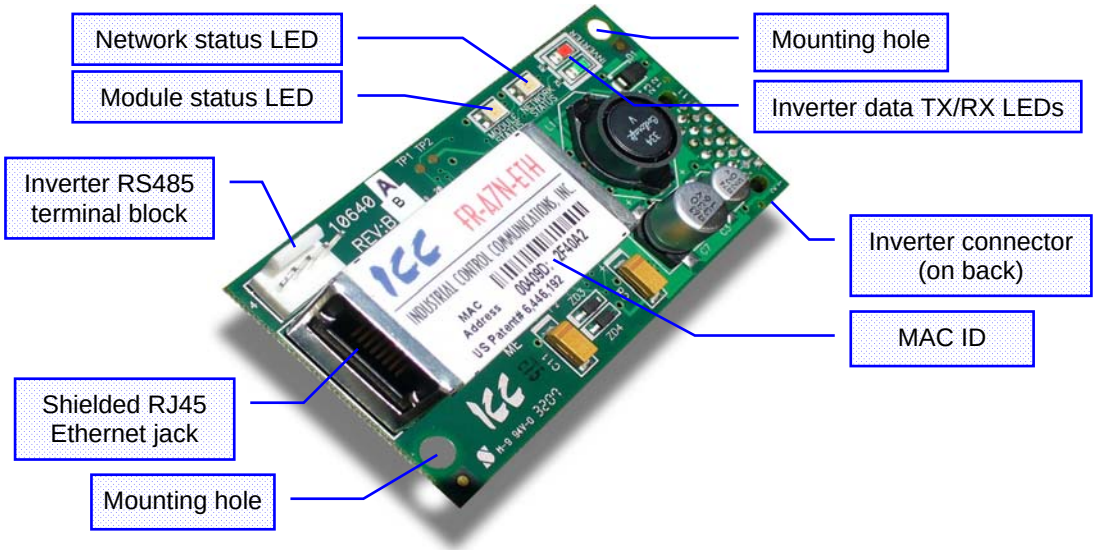
1.2 Unpacking and Product Confirmation

1.2.1 Shipment Confirmation

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

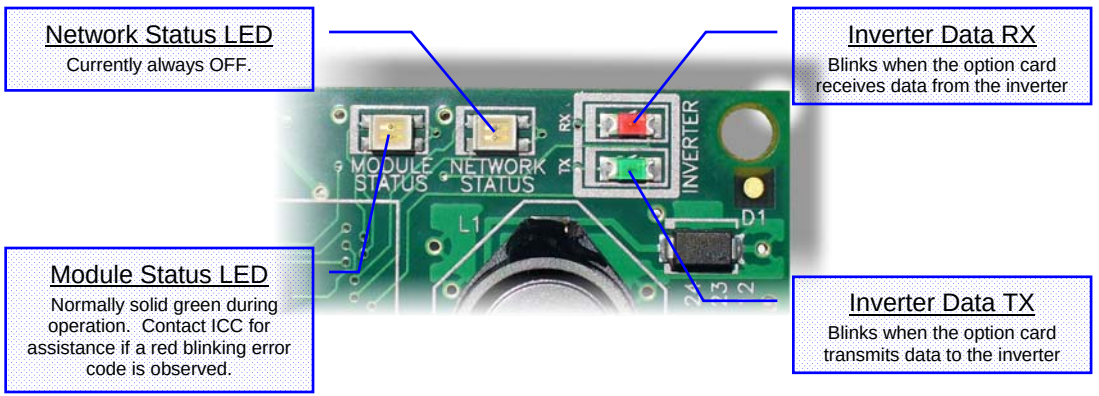
 Plug-in option (P/N 10640A): qty. 1	 RS485 cable (P/N 10621): qty. 1
 Hex-head standoff (5.5mm): qty. 1	 Mounting screws (M3 x 6mm): qty. 2

1.2.2 Component Overview



1.3 LED Indicators

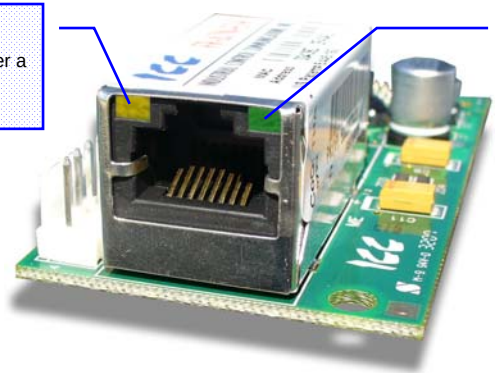
The upper right-hand corner of the option board contains several LEDs that provide a visual indication of the unit's overall status and communications activity with the inverter.



The Ethernet jack also contains two embedded LEDs that provide insight into the Ethernet network.

Ethernet Link LED

This amber LED is lit whenever a viable Ethernet network is connected to the port.



Ethernet Activity LED

This green LED blinks briefly when network packets are sent or received.

1.4 Environmental Specifications

Item	Specification
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)
Grounding	Referenced to inverter's 24V power supply / isolated from inverter control power common
Power supply	Supplied from inverter
Cooling Method	Self-cooled
Communication Speed	10/100BaseT auto sensing

The FR-A7N-ETH interface is lead-free / RoHS-compliant.

2 INSTALLATION

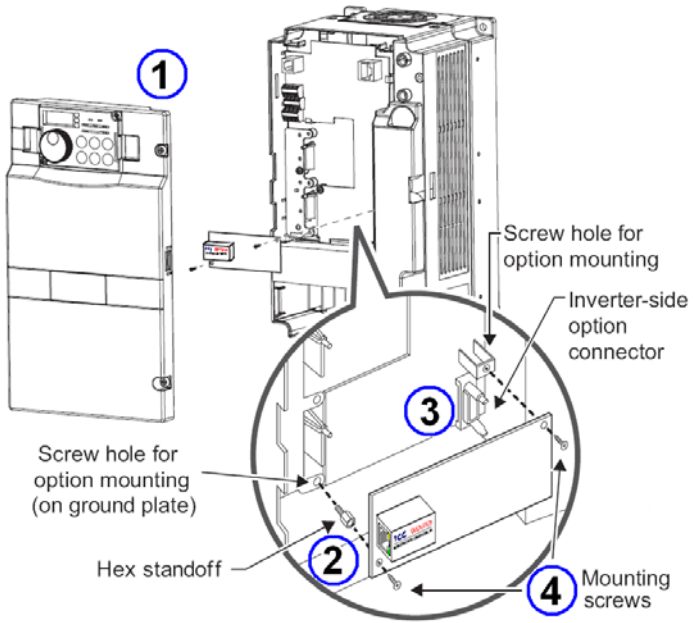
2.1 Pre-Installation Instructions

Make sure that the inverter's input power is off.

⚠ CAUTION
⚠ **To avoid damage to the inverter or plug-in option card, never install or remove a plug-in option card while the inverter's input power is on.**

Physical installation of the option card is a two-step process. First, the card will be mounted onto an available option connector on the inverter's control board. Second, the card will be connected to the inverter's RS485 communication port via the included #10621 RS485 cable.

2.2 Installation Procedure



1) Remove the inverter's front cover.

2) Locate an open option connector and screw the included 5.5mm hex standoff into the corresponding ground plate screw hole (rated torque 0.56N · m to 0.75N · m).

3) Securely attach the option card to the inverter's option connector. Ensure that the option card is fully seated on the inverter's option connector and the hex standoff.

4) Secure the upper-right and lower-left corners of the option card with the included M3x6mm mounting screws. If the screw holes do not line up, the option card connector may not be fully seated on the inverter's option connector and the hex standoff.

5) Connect the stripped-wire end of the #10621 RS485 cable to the inverter's RS485 terminal blocks, and set the termination switch located on the inverter's control board to the "OPEN" position. Each of the wires is individually labeled with the name of the terminal signal to which they must be connected, and are pre-stripped for ease of installation. Connect the TXD+ (green) and TXD- (white) wires to the "TXD" terminal block, positions 1 & 2, respectively. Then connect the RXD+ (black) and RXD- (red) wires to the "RXD" terminal block, positions 1 & 2, respectively. Refer to the following picture for a post-connection view of the wiring connections.

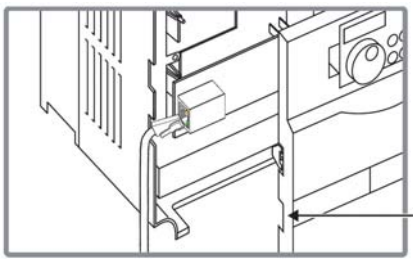
6) Connect the 4-position plug end of the #10621 RS485 cable to connector CN1 in the upper-left corner of the option board. Note that the connector is keyed to prevent the possibility of reverse installation. Refer to the following picture for a post-connection view.

REMOVAL

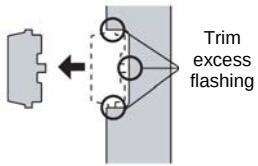
First disconnect the #10621 RS485 cable from connector CN1 on the option board. Next, remove the two M3x6mm mounting screws. Lastly, remove the option board by grasping it on its left and right side and pulling it straight away from the inverter. Note that the removal process may be easier by first removing the inverter's control circuit terminal block.

2.3 Wiring

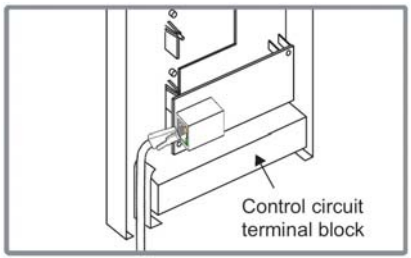
When installing the option card into an FR-A720-00900-NA (FR-A740-00440-NA) or smaller inverter, remove the wiring access knockout on the front cover and route the network cable through the opening. When installing the option card into an FR-A720-01150-NA (FR-A740-00570-NA) or larger inverter, route the network cable through the space adjacent to the control circuit terminal block.



FR-A720-00900-NA (FR-A740-00440-NA) and smaller



Remove front cover wiring access knockout and trim any excess flashing that may cause cable damage



FR-A720-01150-NA (FR-A740-00570-NA) and larger

NOTE: If the front cover wiring access knockout is removed, the protective structure (JEM1030) changes to open type (IP00).

⚠ CAUTION

⚠ Use caution during wiring to prevent any cable fragments and wire strands from falling into the inverter. Equipment damage may result if power is applied to the inverter in the presence of conductive debris.

3 INVERTER SETTINGS

The inverter parameters listed in the following table are critical for overall operation of the end-to-end communication system. Some of these parameters must be set to specific values, and some may have multiple allowable settings depending on the desired operation of the overall application. Although there may be many other inverter parameters that will require configuration for your specific application, it is important to understand the manner in which the following parameters will impact successful communications with, and control of the inverter.

Parameter Number	Name	Setting Range	Default Value	Refer to Page
79	Operation mode selection	0 to 4, 6, 7	0	19
331	RS-485 communication station	0 to 247	0	15
332	RS-485 communication speed	3, 6,12, 24, 48, 96, 92, 384	96	16
334	RS-485 communication parity check selection	0 to 2	2	16
338	Communication operation command source	0, 1	0	24
339	Communication speed command source	0, 1, 2	0	24
340	Communication startup mode selection	0, 1, 2, 10, 12	0	19
342	Communication EEPROM write selection	0, 1	0	27
549	Protocol selection	0, 1	1	17
550	NET mode control source selection	0, 1, 9999	9999	23

3.1 RS-485 Communication Settings

Because the FR-A7N-ETH option card communicates with the inverter via the inverter's on-board RS-485 port, certain RS-485 -related inverter parameters must be set appropriately in order to allow the option card to successfully exchange data with the inverter. If any one of these parameters is not correctly configured, the FR-A7N-ETH card will not be able to communicate with the inverter.

REMARKS

Whenever any of the RS-485 communication setting parameters is changed, power to the inverter must be cycled to validate the changes and allow the inverter to begin communicating at the new settings.

3.1.1 RS-485 Communication Station (Pr. 331)

Typically, *Pr. 331* would set the inverter's station number on an RS-485 network. When using the FR-A7N-ETH option card, however, *Pr. 331* must be set to a specific value so that the option card can communicate with the inverter.

Parameter Number	Name	Default Value	Setting Range	Description
331	RS-485 communication station	0	0 to 247	Must be set to a value of "1" in order to allow the option card to communicate with the inverter.

3.1.2 RS-485 Communication Speed (Pr. 332)

Pr. 332 determines the data rate at which the option card will communicate with the inverter.

Parameter Number	Name	Default Value	Setting Range	Description
332	RS-485 communication speed	96	3, 6,12, 24, 48, 96, 92, 384	Must be set to a value of “384” (38.4kbaud), which will allow the option card to communicate with the inverter at the fastest possible rate.

3.1.3 RS-485 Communication Parity Check Selection (Pr. 334)

Pr. 334 determines the parity & stop bit(s) which the inverter and option card will use when communicating with each other.

Parameter Number	Name	Default Value	Setting Range	Description
334	RS-485 communication parity check selection	2	0 to 2	Must be set to a value of “2” (even parity, 1 stop bit)

3.1.4 Protocol Selection (Pr. 549)

Pr.549 determines whether the inverter's RS-485 port will communicate using the Mitsubishi computer-link protocol, or the Modbus RTU protocol (default).

Parameter Number	Name	Default Value	Setting Range	Description
549	Protocol selection	1	0, 1	Must be set to a value of "1" to enable the option card to communicate to the inverter via the Modbus RTU protocol.

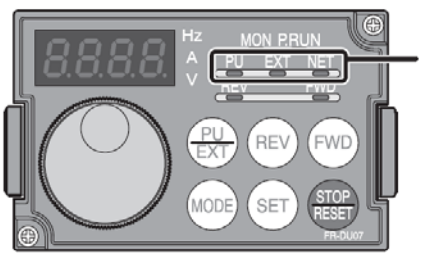
3.2 Operation Mode Setting

Three operation modes are available when a communication option card is installed into an inverter.

1. PU operation [PU] ..... The inverter is controlled by the operating panel (FR-DU07).
2. External operation [EXT] ... The inverter is controlled by the ON/OFF switching of external signals connected to the control circuit terminals (factory default.)
3. Network operation [NET] ... The inverter is controlled from the network via the communication option card (the operating commands and frequency command can be input via the control circuit terminals depending on the settings of *Pr. 338 Communication operation command source* and *Pr. 339 Communication speed command source*. Refer to page 24.)

3.2.1 Operation Mode Indication

FR-DU07



Operation mode indication (the inverter operates in accordance with the indicated LED.)
PU: PU operation mode
EXT: External operation mode
NET: Network operation mode

3.2.2 Operation mode switching & comm. startup mode (Pr. 79, Pr. 340)

(1) Operation mode switching conditions

Prior to switching the operation mode, confirm that:

1) The inverter is stopped
2) Both the STF and STR signals are off
3) The *Pr. 79 Operation mode selection* setting is correct. Refer to the appropriate inverter *user's manual (applied)* for further information regarding *Pr. 79*.

(2) Operation mode selection at power on and after recovery from a momentary power failure

The operation mode at power on and after recovery from a momentary power failure can be selected via *Pr. 340*. A value other than "0" will select network operation mode. After activating network operation mode, parameter writes from the network are enabled.

REMARKS

1. When *Pr. 340* is changed, the new setting is validated after powering on or resetting the inverter.
2. *Pr. 340* can be changed via the operation panel regardless of the operation mode.

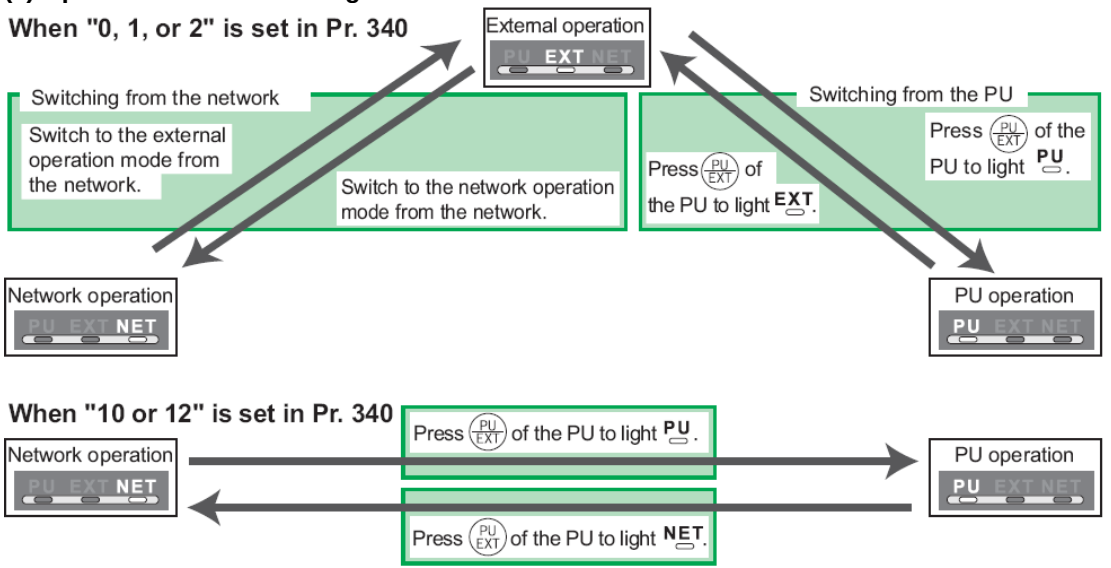
Pr. 340 Setting	*Pr. 79* Setting	Operation Mode at Power-On or Power Recovery	Operation Mode Switchover
0 (default)	0 (default)	External operation mode	Switching among external, PU, and NET operation modes is enabled *1
	1	PU operation mode	PU operation mode fixed
	2	External operation mode	Switching between external and NET operation modes is enabled, switching to PU operation mode is disallowed
	3, 4	External/PU combined operation mode	Operation mode switching is disallowed
	6	External operation mode	Switching among external, PU, and NET operation modes is enabled while running.
	7	X12 (MRS) signal ON.....external operation mode	Switching among external, PU, and NET operation modes is enabled *1
		X12 (MRS) signal OFF...external operation mode	External operation mode fixed (forcibly switched to external operation mode.)
1, 2 *2	0	NET operation mode	Same as when *Pr. 340* = "0"
	1	PU operation mode	
	2	NET operation mode	
	3, 4	External/PU combined operation mode	
	6	NET operation mode	
	7	X12 (MRS) signal ON....NET operation mode	
		X12 (MRS) signal OFF...external operation mode	
10, 12 *2	0	NET operation mode	Switching between PU and NET operation modes is enabled *3
	1	PU operation mode	Same as when *Pr. 340* = "0"
	2	NET operation mode	NET operation mode fixed
	3, 4	External/PU combined operation mode	Same as when *Pr. 340* = "0"
	6	NET operation mode	Switching between PU and NET operation modes is enabled while running *3
	7	External operation mode	Same as when *Pr. 340* = "0"

*1 The operation mode can not be directly changed between PU mode and NET mode.

*2 *Pr. 340* settings "2" and "12" are mainly used for communication operation using the inverter's RS-485 port. When a value other than "9999" (automatic restart after momentary power failure) is set in *Pr. 57 Restart coasting time*, the inverter will resume the same operation state which it was in prior to a momentary power failure is such a failure occurs. When *Pr. 340* is set to "1" or "10" and a start command is active, then the start command will be deactivated if a momentary power failure occurs.

*3 The operation mode can be changed between PU mode and NET mode with the PU/EXT key on the operating panel (FR-DU07) and X65 signal.

(3) Operation mode switching method



For a switching method via external terminal input signals, refer to the inverter's *user's manual (applied).*

CAUTION	• When starting the inverter in NET mode upon powering-up or after an inverter reset, set a value other than 0 in *Pr. 340*. (Refer to page 19). • When setting a value other than 0 in *Pr. 340*, make sure that the initial settings of the inverter are correct.

3.3 Operation & Speed Command Source (Pr.338, Pr.339, Pr.550)

(1) Select control source for NET mode (*Pr. 550*)

The control location for NET mode can be selected to be from either the inverter's RS-485 port or a plug-on communication option card. Although the option card physically plugs into the inverter's option card slot, it actually communicates to the inverter via the inverter's RS-485 port. Therefore, to control the inverter via the option card, *Pr. 550* must be set to either "9999" (default) or "1" (RS-485 input valid).

Parameter Number	Name	Default Value	Setting Range	Description
550	NET mode operation command source selection	9999	0	Communication option card control is valid (FR-A7N-ETH control via the inverter's RS-485 port is invalid.)
			1	FR-A7N-ETH control via the inverter's RS-485 port is valid (communication option card control is invalid.)
			9999	Communication option automatic recognition. Normally, control via the inverter's RS-485 port is valid, which includes the situation when an FR-A7N-ETH card is installed. When a non-FR-A7N-ETH communication option card is installed, that communication option card's control is made valid instead of the inverter's RS-485 port.

Refer to the inverter's *user's manual (applied)* for further details.

(2) Selection of control source for NET mode (*Pr. 338*, *Pr. 339*)

Control sources can be subdivided into two separate realms: 1) operation commands such as start/stop signals, etc. and 2) the speed command source that determines the inverter's frequency command. The various combinations of these realms that can be configured are summarized in the following table.

Control Location Selection				*Pr. 338 Communication operation command source* *Pr. 339 Communication speed command source*	0:NET			1:External			Remarks
					0:NET	1: External	2: External	0:NET	1: External	2: External	
Fixed functions (Functions equivalent to terminals)				Running frequency from communication	NET	—	NET	NET	—	NET	
				Terminal 2	—	External	—	—	External	—	
				Terminal 4	—	External		—	External		
				Terminal 1	Compensation						
Selective functions	*Pr. 178 to Pr. 189* settings	0	RL	Low-speed operation command/ remote setting clear	NET	External		NET	External		*Pr. 59* = "0" (multi-speed) *Pr. 59* = "1, 2" (remote)
		1	RM	Middle-speed operation command/ remote setting deceleration	NET	External		NET	External		
		2	RH	High-speed operation command/ remote setting acceleration	NET	External		NET	External		
		3	RT	Second function selection	NET			External			
		4	AU	Terminal 4 input selection	—	Combined		—	Combined		
		5	JOG	Jog operation selection	—			External			
		6	CS	Automatic restart after instantaneous power failure selection	External						
		7	OH	External thermal relay input	External						
		8	REX	15-speed selection	NET	External		NET	External		*Pr. 59* = "0" (multi-speed)
		9	X9	Third function	NET			External			
		10	X10	Inverter operation enable signal	External						

Control Location Selection				*Pr. 338 Communication operation command source* / *Pr. 339 Communication speed command source*	0:NET			1:External			Remarks
					0:NET	1: External	2: External	0:NET	1: External	2: External	
Selective functions	*Pr. 178 to Pr. 189* settings	11	X11	FR-HC connection, instantaneous power failure detection	External						
		12	X12	PU operation external interlock	External						
		13	X13	External DC injection brake operation is started	NET			External			
		14	X14	PID control valid terminal	NET	External		NET	External		
		15	BRI	Brake opening completion signal	NET			External			
		16	X16	PU operation-external operation switching	External						
		17	X17	Load pattern selection forward rotation reverse rotation boost	NET			External			
		18	X18	V/F swichover	NET			External			
		19	X19	Load torque high speed frequency	NET			External			
		20	X20	S-pattern acceleration/deceleration C switching terminal	NET			External			
		22	X22	Orientation command *1	NET			External			
		23	LX	Pre-excitation	NET			External			
		24	MRS	Output stop	Combined			External			*Pr. 79* ≠ "7"
				PU operation interlock	External						*Pr. 79* = "7" When the X12 signal is not assigned
		25	STOP	Start self-holding selection	—			External			
		26	MC	Control mode swichover	NET			External			
		27	TL	Torque limit selection	NET			External			
		28	X28	Start time tuning	NET			External			
		37	X37	Traverse function selection	NET			External			
		42	X42	Torque bias selection 1 *1	NET			External			
		43	X43	Torque bias selection 2 *1	NET			External			
		44	X44	P/PI control switchover	NET			External			

Control Location Selection			*Pr. 338 Communication operation command source* / *Pr. 339 Communication speed command source*		0:NET			1:External			Remarks
					0:NET	1: External	2: External	0:NET	1: External	2: External	
Selective functions	*Pr. 178 to Pr. 189* settings	50	SQ	Sequence start	Combined			External			
		60	STF	Forward rotation command	NET			External			
		61	STR	Reverse rotation command	NET			External			
		62	RES	Reset	External						
		63	PTC	PTC thermistor selection	External						
		64	X64	PID forward rotation action switchover	NET	External		NET	External		
		65	X65	PU/NET operation switchover	External						
		66	X66	NET/external operation switchover	External						
		67	X67	Command source switchover	External						
		68	NP	Conditional position pulse train sign *1	External						
		69	CLR	Conditional position droop pulse clear *1	External						
		70	X70	DC feeding operation permission	NET			External			
		71	X71	DC feeding cancel	NET			External			

*1: Available only when used with the FR-A7AP.

[Table explanation]
External ..... Only external terminal input control is valid.
NET ..... Only network control is valid.
Combined ..... Either external terminal input control or network control is valid.
- ..... Both external terminal input control and network control are invalid.
Compensation ..... External terminal input control is only valid if Pr. 28 Multi-speed input compensation is set to "1".

3.4 Communication EEPROM write selection (Pr. 342)

When parameters are written via communications, by default both volatile RAM and nonvolatile EEPROM contents are modified. Due to the limited write cycle lifetime of EEPROM memory, however, it may be desirable to modify only the contents of RAM when frequent parameter writes via communications are necessary.

Parameter Number	Name	Default Value	Setting Range	Description
342	Communication EEPROM write selection	0	0	Parameter values modified via communications are written to both EEPROM and RAM.
			1	Parameter values modified via communications are written only to RAM.

When frequently modifying parameter values via communications, change the value of *Pr. 342* to a "1" in order to write them only to RAM. Performing frequent parameter writes to EEPROM will shorten the lifetime of the component.

REMARKS

When *Pr. 342* is set to a value of "1" (write to RAM only), powering off the inverter will erase the changed parameter values. Therefore, the parameter values available when power is switched on again are those that were previously stored in EEPROM.

4 FINDER APPLICATION

4.1 Overview

The “ICC Finder” application is a simple Windows PC program (just a single .exe file, no installations, DLL’s etc.), which when executed discovers all ICC communication interfaces on the current Ethernet subnet, regardless of whether or not their network parameters are currently compatible with the subnet upon which they reside. Refer to Figure 1.

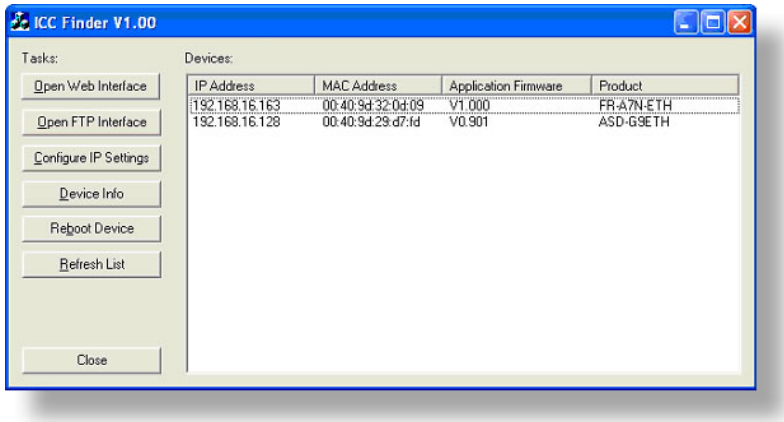


Figure 1: ICC Finder Discovery Utility

All discovered devices can be organized in ascending or descending order by clicking on the desired sort header (IP Address, MAC Address, Application Firmware or Product). The buttons on the left side of the window perform the following actions:

Open Web Interface: Opens a web browser page of the selected device. Refer to section 5.

Open FTP Interface: Opens the computer's default FTP application, which could be either Windows Explorer, a web browser, or a 3rd-party FTP program (whatever the computer/operating system is configured for by default). This allows you to interact directly with the unit's on-board flash filesystem, enabling you to drag and drop files to/from the unit and upload new firmware. Refer to section 7.

Configure IP Settings: Allows configuration of whether the device will use static IP parameters or will obtain its IP parameters via DHCP. Refer to section 4.2 for more information.

Device Info: Opens a dialog box containing relevant device information.

Reboot Device: Opens a dialog box which prompts for a password to reboot the interface. Enter the case-sensitive system password (icc), then click **Reboot**. The reboot cycle has completed when the displayed status changes from "Rebooting" to "Ready" (note that this may require 30s or more to complete.) Clicking **Close** will then close the dialog box and cause the discovery utility to automatically rescan the network.

Refresh List: Causes the discovery utility to rescan the network.

Close: Closes the discovery utility.

4.2 Configuring the Unit's IP Address

Before you can access the interface from your web browser or begin using it as a part of your automation network, you must know its IP address. The interface comes from the factory configured to obtain an IP address dynamically (DHCP/BOOTP). You can determine the interface's current IP address using the *ICC Finder* application included on the CD provided with the interface, or available from the ICC website at http://www.iccdesigns.com.

To configure the interface to use a static IP address:

1. Connect the interface to your network and apply power to the inverter. When the interface boots up, it will attempt to obtain an IP address from a DHCP server or, failing that, will fallback to a default static IP address of 192.168.16.102.
2. To determine the initial IP address of your interface, start the `ICC FINDER.EXE` discovery utility.
3. The discovery utility scans the network for ICC devices and then lists each device's **IP Address**, **MAC Address**, **Firmware Version** and **Product ID**. Refer to Figure 1 on page 28. Identify your device by its unique MAC address (printed on a label on the top of the Ethernet network jack).
4. To change the IP address, select the device in the list of detected devices and click the **Configure IP Settings** button.
5. In the dialog that appears, select **Manually configure network settings**.
6. Enter the desired **IP Address**, **Subnet Mask**, **Default Gateway** and case-sensitive system password (icc) in the appropriate boxes, then click **Apply**.

7. Click **Reboot Device**. Rebooting may require 30s or more to complete. When the device status indicates “Ready”, click **Close**.
8. The discovery utility will automatically rescan the network. Confirm that the new IP address has been accepted by the device.

5 EMBEDDED WEB SERVER

5.1 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, configured and controlled from across the room or from across the globe.

In order to view the interface's web page, the free Adobe (formerly Macromedia) Flash Player browser plug-in is required. If the plug-in is not already installed on your computer, then your browser will automatically be redirected to the appropriate Adobe download web site when you initially attempt to access the interface's web page. Alternatively, the plug-in can be downloaded directly by going to http://www.adobe.com, and choosing the "get Adobe Flash Player" link. Always ensure that you have the latest version of the Flash Player installed: if some aspect of the web page does not appear to be displayed properly, installing the latest Flash Player update usually resolves the problem.

To access an interface's embedded web server, either use the finder application (refer to section 4) and select the "Open Web Interface" button when the target unit is highlighted, or just directly enter the target unit's IP address into the address (URL) field of your web browser. Refer to Figure 2 for a representative screenshot of the web server interface.

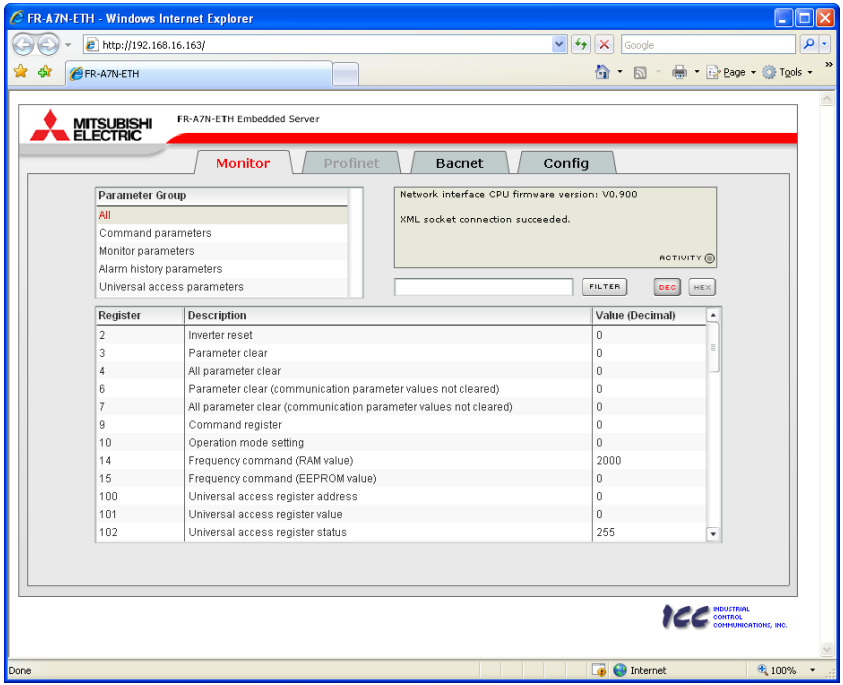


Figure 2: Embedded Web Server

In order to access the web server and view the parameter values, destination TCP ports 80 and 2000 must be accessible from the client computer. If an "XML socket connection failed" error message is displayed in the information window, and no parameter values are shown, this is typically indicative of port 2000 being blocked by a firewall or Ethernet router situated between the client computer and the interface card.

5.2 Authentication

For security, the interface requires valid user authentication whenever the web page is accessed. The authentication request will appear as a browser popup box that will request entry of a user name and password. Refer to Figure 3.

The required user name is "root", and the password is "icc". Note that the username and password are case-sensitive, and that once authenticated, the authentication will remain in effect from that point until all browser windows are closed.

Figure 3: Web Server Authentication

5.3 Page Select Tabs

The web interface is subdivided into several different “tabs” of associated information, much the same as how folders in a filing cabinet are arranged. Refer to Figure 4. To change tabs, just click on the tab you wish to view. The title of the currently-selected tab is red. Note that because different protocols are supported by the interface with different firmware images, not all tabs may be accessible with the firmware image currently loaded. The titles of tabs that are not accessible are grayed-out, and clicking them has no effect.

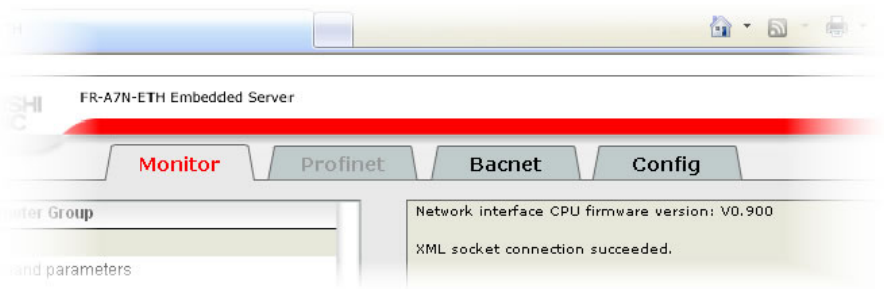


Figure 4: Page Select Tabs

5.4 Monitor Tab

5.4.1 Information Window

Figure 5 shows the Information Window, which is located in the upper-right hand corner of the monitor tab. This window displays various informational 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, which 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, select "refresh" on your web browser.

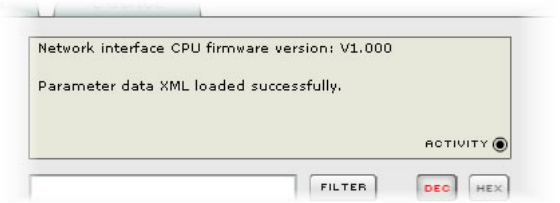


Figure 5: Monitor Tab Information Window

5.4.2 Parameter Group Selection List

The Parameter Group Selection List is located in the upper-left hand corner of the Monitor Tab. Refer to Figure 6. When a parameter group is selected, the parameters contained in that parameter group are displayed in the Parameter List (refer to section 5.4.3). The following parameter groups are available:

All: All parameters are available (command, monitor and universal access parameters).

Command parameters: Only inverter command parameters are available.

Monitor parameters: Only inverter monitor parameters are available.

Alarm history parameters: Only inverter alarm history parameters are available.

Universal access parameters: Only the interface card's "universal access parameters" are available (refer to section 6.4 for an explanation of the universal access parameters).

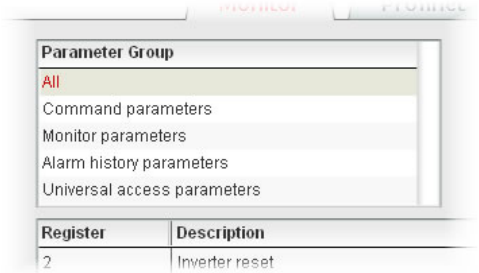
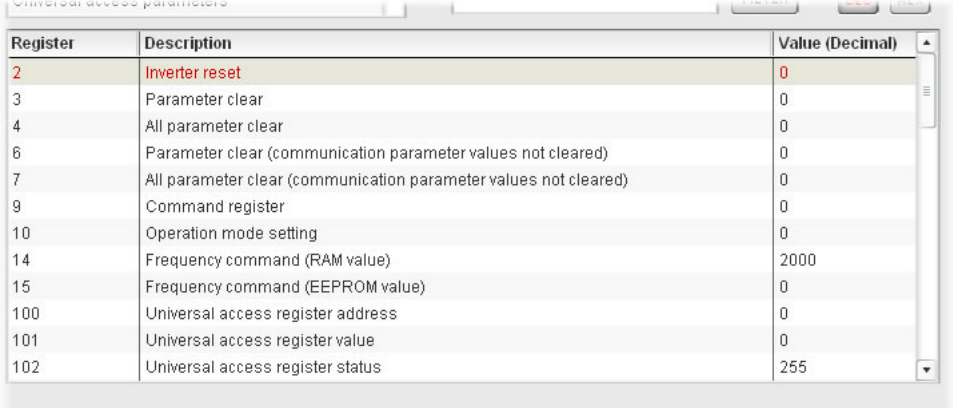


Figure 6: Parameter Group Selection List

5.4.3 Parameter List

The bottom half of the Monitor tab contains the parameter list (refer to Figure 7). The parameters that are displayed in the list at any given time depend on the parameter group that is currently selected (refer to section 5.4.2), as well as whether or not any filters have been applied (refer to section 5.4.4).

The first column of the Parameter List shows the register number that provides access to that parameter (refer to section 6). The second column contains the parameter descriptions, which are used by the filter function. The last column performs two functions: it displays the current value of the parameter, and (for writable parameters) also allows changing the parameter's value by clicking on the number in the value column and entering the new value.



Register	Description	Value (Decimal)
2	Inverter reset	0
3	Parameter clear	0
4	All parameter clear	0
6	Parameter clear (communication parameter values not cleared)	0
7	All parameter clear (communication parameter values not cleared)	0
9	Command register	0
10	Operation mode setting	0
14	Frequency command (RAM value)	2000
15	Frequency command (EEPROM value)	0
100	Universal access register address	0
101	Universal access register value	0
102	Universal access register status	255

Figure 7: Parameter List

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

- When entering new parameter values, be sure that the number being entered is appropriate for the currently-selected radix (refer to section 5.4.5): for example, an entered value of “1000” in hexadecimal is equal to 4096 in decimal.
- If desired, the column widths can be changed by dragging the vertical bars that separate the header row’s cells to a different position.

- If you begin changing a parameter value and then decide to abandon the change, pressing the ESC key on your keyboard will abandon the change and redisplay the current parameter value.
- When editing a parameter value, clicking someplace off the entry cell is equivalent to hitting the ENTER key.

5.4.4 Parameter List Filter

A filter function provides Parameter 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 8.

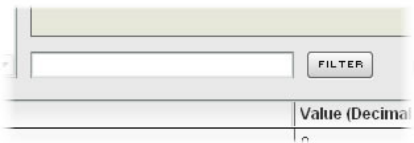


Figure 8: Parameter List Filter

The filter will then display only those parameters currently available in the Parameter List that satisfy the search criteria. For example, to find all monitor parameters that contain some derivative of the word “volt” (such as “voltage” or “volts”), select the “Monitor parameters” group, enter “volt” in the filter entry box, and then click the “filter” button.

Once a filter has been entered, it will continue to be applied to all information normally displayed in the Parameter List for as long as the filter term is left in the filter entry box. Continuing the previous example where we filtered on the root term “volt” in the monitor parameters, we can then easily apply this filter to all available parameters simply by selecting the “All” parameter group. The Parameter List will now display all command, monitor, alarm history etc. parameters that contain the root term “volt”.

To remove the filter, delete any characters contained in the filter entry box and then click the “filter” button.

5.4.5 Radix Selection

Figure 9 shows the radix selection buttons. These selection buttons allow changing the Parameter List “value” column data display and entry radix between decimal and hexadecimal formats.

Figure 9: Radix Selection

When “DEC” is selected, the “value” column heading will be “*Value (Decimal)*”, current parameter values will be displayed in decimal, and values to be written to parameters 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 parameter values will be displayed in hexadecimal, and values to be written to parameters must be entered in hexadecimal format. For example, to turn on bit #12 in the inverter’s command word (reset), enter the hexadecimal number 1000.

5.5 Profinet Tab

This section is only applicable when the Profinet firmware is loaded onto the interface card. The Profinet tab provides for the configuration of the device on a Profinet network. Refer to Figure 10.

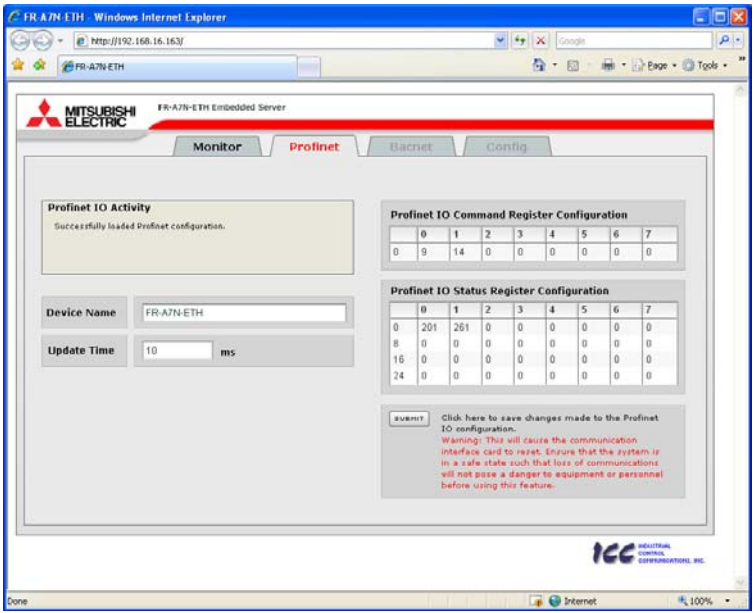


Figure 10: Profinet Tab

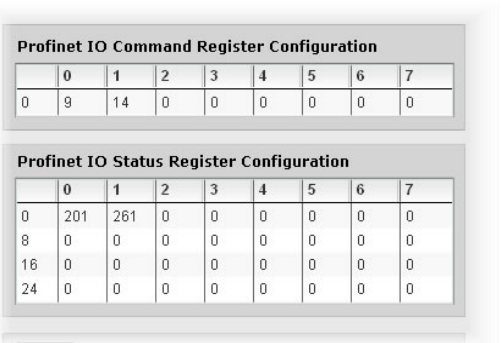
5.5.1 Information Window

Figure 11 shows the Information Window, which is located in the upper-left hand corner of the Profinet tab. This window displays various informational messages regarding the status of the Profinet configuration (loading or submitting).

Figure 11: Profinet Tab Information Window

5.5.2 I/O Data Configuration Arrays

The I/O data configuration arrays consist of two separate elements (refer to Figure 12.) The command register configuration defines the structure of the command data sent from the Profinet controller to the inverter, and the status register configuration defines the structure of the status data sent from the inverter back to the controller. These arrays allow the creation of custom-built I/O data. Up to 8 command registers can be sent to the inverter, and up to 32 status registers can be sent back to the controller. Each box in an array is capable of containing a register number. Because all inverter registers are 16-bit data elements, each box therefore represents two bytes of input or output data.



Profinet IO Command Register Configuration

	0	1	2	3	4	5	6	7
0	9	14	0	0	0	0	0	0

Profinet IO Status Register Configuration

	0	1	2	3	4	5	6	7
0	201	261	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0

Figure 12: I/O Data Configuration

The command register array locations are numbered 0-7, and traverse from left to right. The status register array locations are numbered 0-31, and traverse from left to right across each row, and then increment to the left-most position on the next row. Clicking on a box in an array allows the user to enter a register number that will be referenced at that location when data is either received from or sent to the controller. A value of 0 indicates that no register is referenced at that location, which will cause corresponding command data to be ignored and status data to be a default value of 0.

As an example, looking at the default configuration shown in Figure 12, we can see that each array contains two defined registers. Therefore, up to 4 “meaningful” bytes of data can be both received and sent (the qualifier “meaningful” is used here because the module currently selected by the controller may require larger input and/or output data sizes, but all unreferenced command data will be ignored, and all unreferenced status data will contain dummy “0” values). The first word (two bytes) of command data will be written to register 9 (command register) and the second word will be written to register 14 (frequency command). Similarly, the first word of status data will contain the value of register 201 (output frequency) and the second word will contain the value of register 261 (status register).

5.5.3 Device Identification and Configuration

There are several identification and configuration items available for setting various characteristics of the Profinet device. These items are shown in Figure 13 and are explained in further detail below.

A Profinet device’s name (station name) must be unique across the entire Profinet network because it is used by controllers to uniquely identify Profinet devices. The **Device Name** text entry box is used to configure this unique device identifier on every inverter.

The **Update Time** field is a configuration item which changes the frequency with which command and status data updates take place internally in the device. This setting is not related to the frequency with which data communications take place on the Ethernet network. This time setting is a 32-bit value adjustable in 1ms increments. Typically, this value should not need to be changed from its default value of 10ms.

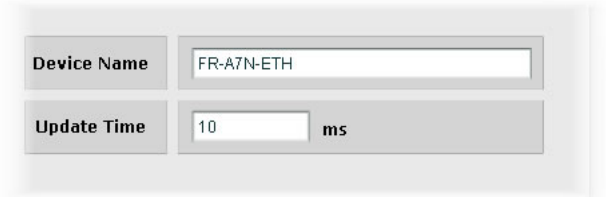


Figure 13: Profinet Device Identification and Configuration

5.5.4 Submitting Changes

Whenever any of the Profinet configuration elements (I/O array configuration, Device Name, etc.) have been changed, the “submit” button located in the lower right-hand portion of the web page must be clicked in order to write these settings to the interface card’s filesystem.

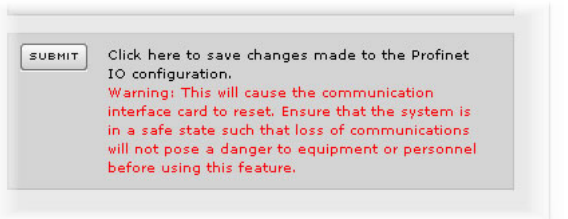


Figure 14: Submit Profinet Changes

Note that because these configuration elements are read from the filesystem only when the interface card boots up, the act of submitting configuration changes will also reset the interface card. Please allow 30 to 60 seconds for the interface

card to reboot, at which time it will then be operating with the recently-submitted configuration. Refer to Figure 14.

5.6 Bacnet Tab

The Bacnet tab provides for the configuration of the device on a Bacnet/IP network. Refer to Figure 15.

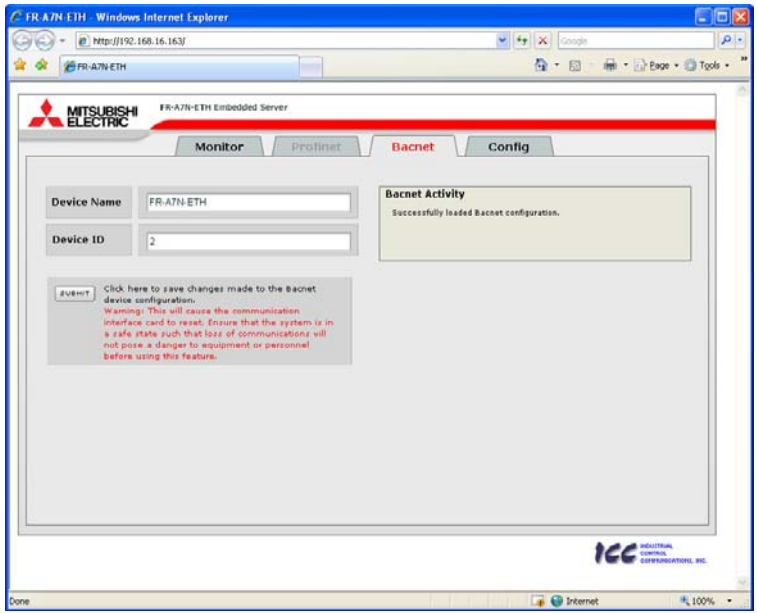


Figure 15: Bacnet Tab

5.6.1 Information Window

Figure 16 shows the Information Window, which is located in the upper-right hand corner of the Bacnet tab. This window displays various informational messages regarding the status of the Bacnet configuration (loading or submitting).

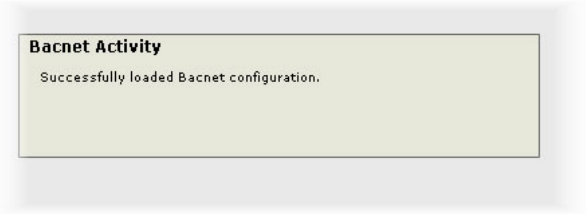


Figure 16: Bacnet Tab Information Window

5.6.2 Device Identifiers

A Bacnet device's name and ID (the Object_Name and Object_Identifier properties, respectively, of the Device Object) must be unique across the entire Bacnet network because they are used to uniquely identify Bacnet devices. The text entry boxes shown in Figure 17 are used to configure these unique device identifiers on every inverter.

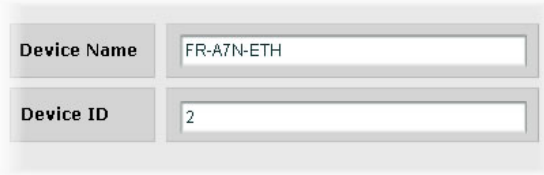


Figure 17: Bacnet Device Identifiers

5.6.3 Submitting Changes

Whenever either of the Bacnet configuration elements (Device Name or Device ID) has been changed, the “submit” button located in the left-hand portion of the web page must be clicked in order to write these settings to the interface card’s filesystem.

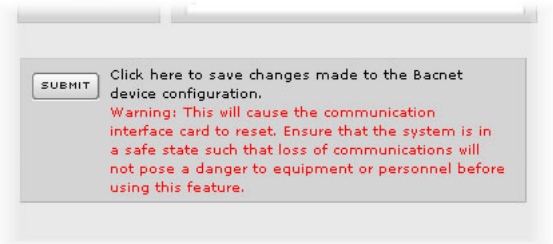


Figure 18: Submit Bacnet Changes

Note that because these configuration elements are read from the filesystem only when the interface card boots up, the act of submitting configuration changes will also reset the interface card. Please allow 30 to 60 seconds for the interface card to reboot, at which time it will then be operating with the recently-submitted configuration. Refer to Figure 18.

5.7 Config Tab

The Config tab provides access to various configuration items. Refer to Figure 19.

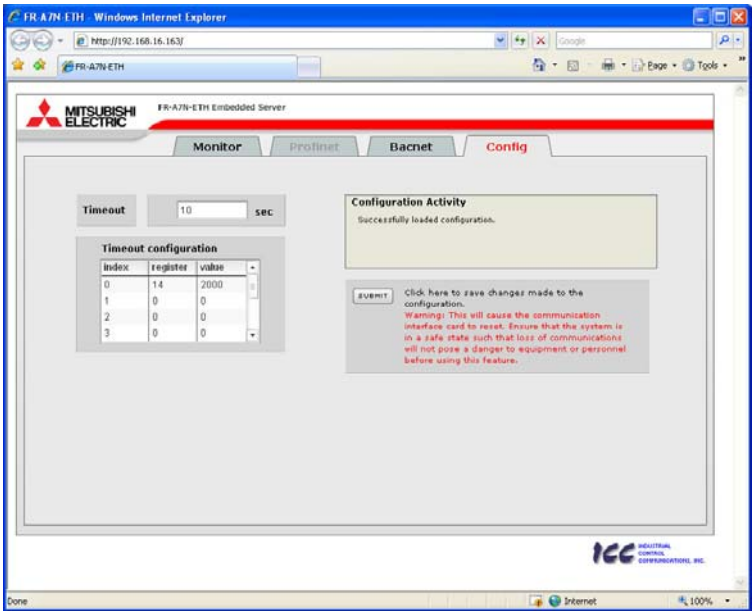


Figure 19: Config Tab

5.7.1 Information Window

Figure 20 shows the Information Window, which is located in the upper-right hand corner of the Config tab. This window displays various informational messages regarding the status of the configuration parameters (loading or submitting).

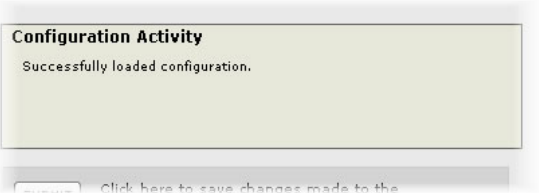


Figure 20: Config Tab Information Window

5.7.2 Timeout Configuration

The interface can be configured to perform a specific set of actions when network communications are lost. 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 (refer to Figure 21):

- The timeout time
- The timeout configuration array

The ***timeout time*** is adjustable from 1 to 4294967295 (2^{32}-1) seconds. This time setting is used by certain protocols in order to determine abnormal loss-of-communications conditions and, optionally, to trigger a timeout processing

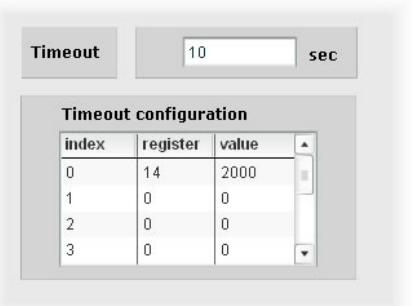


Figure 21: Timeout Configuration

event. The default timeout time is 10s.

The ***timeout configuration array*** allows up to 10 register/value pairs (indexes 0..9) to be designated by the user. When a timeout event is triggered by a protocol, the timeout configuration array indexes are parsed. If the "register" field for an index is set to 0, then this index is "disabled" and therefore ignored. If, on the other hand, the "register" field is non-zero, then the value contained in the "value" field is automatically written to the designated register. This flexible mechanism allows up to 10 designated inverter registers to have their own unique "fail-safe" conditions in the event of a network interruption.

For example, Figure 21 shows a timeout time of 10s, and one timeout entry assignment. If a protocol that makes use of timeout processing triggers a timeout event, then a value of 2000 will automatically be written to inverter register 14 (the frequency command). Provided the inverter has a valid "run" command and is currently configured to use the network frequency command as its master frequency command, it will ramp to 20.00Hz.

If timeout/failsafe processing is not desired, just set the "register" fields for all indexes to 0 (disabled). This is the default condition.

5.7.3 Submitting Changes

Whenever any of the configuration elements has been changed, the “submit” button located in the right-hand portion of the web page must be clicked in order to write these settings to the interface card’s filesystem.

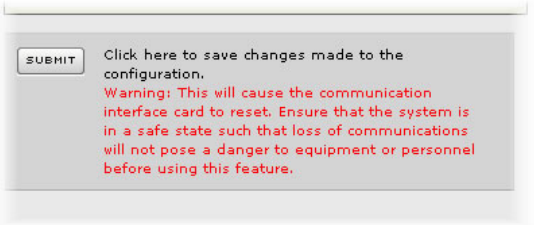


Figure 22: Submit Configuration Changes

Note that because these configuration elements are read from the filesystem only when the interface card boots up, the act of submitting configuration changes will also reset the interface card. Please allow 30 to 60 seconds for the interface card to reboot, at which time it will then be operating with the recently-submitted configuration. Refer to Figure 22.

6 PARAMETER NUMBERING AND BEHAVIOR

6.1 Register numbers

All accessible inverter parameters are referenced by their Modbus register indexes, as defined in the appropriate Mitsubishi inverter user's manual. Refer to the applicable inverter user's manual for further details pertaining to each register/parameter. These same register numbers are used when accessing and configuring parameters via an Ethernet protocol.

Note that although 508 total registers are available in the interface card's register space, not all of those registers have corresponding parameters that exist in the inverter. In other words, if a read from or write to a register that does not correspond to an existing inverter parameter takes place, the read/write will be successful, 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 parameters and some of which do not), while only manipulating those in your local programming that are known to exist.

6.2 Inverter command and status register

Inspection of the 700-series inverter user's manual reveals that the inverter has a combined command/status register located at register index 40009 (Modbus holding register 9). When writing to inverter register 9, the inverter uses the written value as its command word. When reading from register 9, however, the returned data actually represents the inverter's status. To more clearly differentiate the

command word from the status word, the interface card separates this combined command/status register into two separate registers. Register 9 is still the inverter's command word, but the inverter status word must be accessed by requesting read-only register 261 from the interface card.

One side-effect of this combined inverter command/status word is that because the current value of the inverter's command word cannot be read by the interface card, there are no guarantees that the interface card's local value matches the current command word value in the inverter. Resetting a faulted inverter, for example, will clear its internal command word, but the command word residing in the interface card will be unchanged from the last written value in such a scenario. It is important to remember, therefore, that the interface card only has knowledge of the last written command word value, which may or may not equal the inverter's current command word value.

6.3 Inverter operation mode setting and status register

Inspection of the 700-series inverter user's manual reveals that the inverter has a combined operation mode/inverter setting register located at register index 40010 (Modbus holding register 10). When writing to inverter register 10, the inverter uses the written value as a command to change the current operation mode. When reading from register 10, however, the returned data actually represents the inverter's current operation mode. To more clearly differentiate the operation mode (commanded) from the inverter's current setting, the interface card separates this combined command/status register into two separate registers. Register 10 is still the inverter's operation mode (commanded), but the inverter's current mode setting must be accessed by requesting read-only register 262 from the interface card.

One side-effect of this combined inverter mode command/setting status word is that because the current value of the inverter's operation mode (commanded) cannot be read by the interface card, there are no guarantees that the interface card's local value matches the current mode command value in the inverter. Resetting a faulted inverter, for example, may change its internal operation mode (commanded), but the operation mode (commanded) residing in the interface card will be unchanged from the last written value in such a scenario. It is important to remember, therefore, that the interface card only has knowledge of the last written operation mode (commanded), which may or may not equal the inverter's current operation mode (commanded).

6.4 Universal Access Registers

6.4.1 Overview

Due to bandwidth considerations between the interface card and the inverter, it is not practical to provide direct access to all available inverter configuration parameters. To maximize the performance of the critical inverter command and monitor registers, therefore, the interface provides direct access to all available monitor and command parameters, while enabling access to all configuration parameters via a mechanism called "universal access registers".

The universal access register set is comprised of the following three registers:

- An address register accessible via interface card register 100 (Universal Access Register Address, or ***UARA*** for short),
- A value register accessible via interface card register 101 (Universal Access Register Value, or ***UARV*** for short), and

- A status register accessible via interface card register 102 (Universal Access Register Status, or ***UARS*** for short.)

The essential concept of using this powerful feature is to just set the UARA to the inverter register number that you wish to access (e.g. acceleration time is located at inverter register 1007), and then perform the desired operation ("read" to read the designated parameter and "write" to change it) on the UARV. The operation on the UARV will be directly performed on the inverter parameter indicated by the UARA. In this manner, any available inverter parameter can be read from or written to.

Refer to the appropriate inverter user's manual for detailed information on available inverter registers, their allowable adjustment ranges, and any scaling factors that may apply.

The UARS exists to support the universal register architecture. This 16-bit status word is divided into two 8-bit status codes: the lower byte represents the read status, and the upper byte represents the write status.

6.4.2 Universal Access Reads

When a new register number is entered into the UARA, it takes a certain amount of time for the UARV to reflect the value of this newly-entered register number. To indicate when the UARV has been updated with the value of the desired parameter, the read status (UARS low byte) is initialized to 0xFF whenever the UARA is changed. This code represents "not ready", and is used to indicate that the value currently contained in the UARV is not yet the value of the parameter indicated in the UARA. Once the value of the parameter indicated in the UARA has been retrieved from the inverter, this "not ready" status will be replaced by one of the read codes indicated in Table 1. As long as the UARA is not changed, the indicated parameter will then be continuously read from the inverter, and the read code updated if a status change occurs.

Table 1: UARS Read Codes

Code	Meaning
0x00	Read successful (value in UARV)
0x02	Invalid parameter targeted
0x07	Communication to inverter lost
0x0A	Other / unclassified error
0xFF	Not ready (ignore UARV)

In summary, the procedure for reading an inverter parameter via the universal access registers is as follows:

1. Write the Modbus register value of the parameter to be accessed to the UARA. The UARV will immediately be set to 0, and the read status will immediately be set to 0xFF (not ready).
2. Poll the read status until it is no longer 0xFF.
3. If the read status transitioned to a value of 0, the UARV now contains the value of the desired parameter. This value will be continuously read & updated as long as the UARA is not changed.

4. If the read status transitioned to a nonzero value, then this value represents an error code obtained during the transaction with the inverter. The read attempt from this parameter will be continually repeated as long as the UARA is not changed

6.4.3 Universal Access Writes

When a new value is written to the UARV, it takes a certain amount of time for the write transaction with the inverter to be completed and the status to be known. To indicate when the write transaction has been completed, the write status (UARS high byte) is initialized to 0xFF whenever a write operation is performed on the UARV. This code represents "write pending", and is used to indicate that the write transaction has not yet been completed. Once the write transaction completes and the success/failure outcome is known by the interface board, this "write pending" status will be replaced by one of the write codes indicate in Table 2. From that point on, as long as the UARA is not changed, the parameter indicated in the UARA will then be continuously read from the inverter, and the read code updated if a status change occurs. The write code, however, will not change unless another value is written to the UARV, or unless the UARA is changed.

Table 2: UARS Write Codes

Code	Meaning
0x00	Write successful
0x02	Invalid parameter targeted
0x03	Invalid data value / write to read-only parameter
0x07	Communication to inverter lost
0x0A	Other / unclassified error
0xFF	Write pending

In summary, the procedure for writing an inverter parameter via the universal access registers is as follows:

1. With the UARA already set to the Modbus register value of the parameter to be accessed, write the new parameter value to the UARV. The write status will immediately be set to 0xFF (write pending.)
2. Poll the write status until it is no longer 0xFF.
3. If the write status transitioned to a value of 0, the write was successful.
4. If the write status transitioned to a nonzero value, then this value represents an error code obtained during the transaction with the inverter. The write transaction will not be automatically retried by the interface card.
5. The interface card will return to continuously reading the parameter indicated by the UARA.

6.4.4 Disabling

Disabling universal access reads & writes can be accomplished by setting the UARA to 0. Whenever the UARA is 0, the UARV will also be 0, and the UARS will contain 0x00FF, which indicates “not ready”. This is the default initial condition of the universal access registers.

7 FILESYSTEM & FIRMWARE

7.1 Overview

The interface card's on-board filesystem is used to store files for use by the application firmware. Currently, the application firmware's main use of the filesystem is to store XML-encoded configuration files that dictate the characteristics of the various protocols. Each protocol that requires configuration will have its own XML file stored on the filesystem. For easy identification, the filename will begin with the corresponding protocol which it configures. For example, a BACnet configuration file's filename will begin with "bacnet", and a Profinet I/O file will begin with "pnio".

Whenever the configuration for a specific protocol is completed, it is suggested that a backup copy of the configuration file be downloaded from the unit to a PC. One reason for this is in case it becomes necessary to restore a previous configuration at a later time. Another reason is that it may be desirable to load multiple units with the same configuration, as a downloaded configuration file can be uploaded again to any compatible unit, allowing the user to easily clone multiple units with the same configuration.

Each time the interface card boots up, it will interrogate the filesystem for the configuration files required by the protocols currently operating in the unit. If it does not find a required file, it will create one and initialize it with factory-default values. Therefore, if it is ever desired to reset a protocol's configuration to factory-default values, this can be easily accomplished by simply deleting the appropriate configuration file from the filesystem and rebooting the unit.

Note that the application firmware uses specific filenames for the configuration files. This means that if a file with a different filename is loaded onto the unit, it will be stored correctly, but will not be used by the

application firmware. Similarly, if an existing configuration file's filename is changed, then the unit will again create a default configuration file at next boot-up, which will be stored in the filesystem alongside the file with the changed name.

Configuration files are only read by the protocol drivers at unit boot-up. Therefore, if a new configuration file is loaded onto a unit's filesystem, that unit must be rebooted for the configuration file's settings to take effect. Rebooting a unit can be performed by power-cycling the inverter in which the card is installed, or by selecting the "Reboot Device" button in the Finder application.

Interacting with the filesystem is performed by use of the File Transfer Protocol (FTP). Using FTP allows the user to interact with the files on the interface card's filesystem in the same manner as though they were traditional files stored on a local or remote PC. While there are many different FTP applications available, the following sections will provide general examples of using some of the most commonly-available ones.

7.2 Initiating FTP via the Finder Utility

After discovering all interface cards on the current subnet as described in section 4, select the target interface card and then click on the “Open FTP Interface” button. This will open the computer’s default FTP application, which could be Windows Explorer, a web browser, or a 3rd-party FTP program (whatever the computer/operating system is configured for by default). This example will assume that a web browser (Microsoft Internet Explorer) is configured as the default FTP application.

An authentication dialog will appear (refer to Figure 23.) Enter the user name “root” and case-sensitive password “icc”, then click “Log On.”

The web browser will then display the filesystem’s contents (refer to Figure 24.) FTP access via a web browser allows viewing and downloading files to a computer, but does not allow advanced file manipulation such as cut, paste, drag-and-drop, etc. For advanced file manipulation abilities, use of a different FTP application is required.

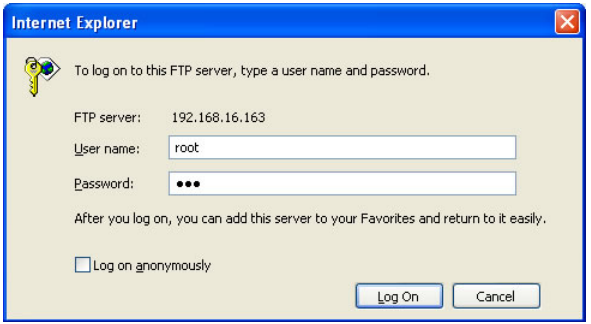


Figure 23: FTP Authentication

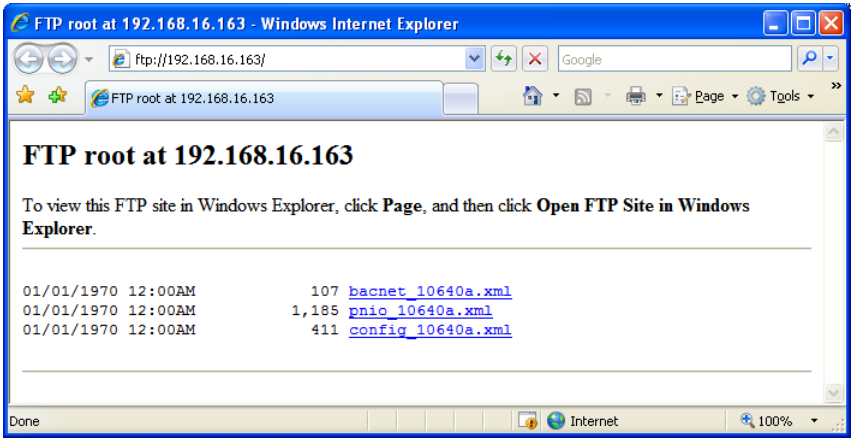


Figure 24: FTP Navigation with Internet Explorer

7.3 Using FTP with Windows Explorer

To use FTP with Microsoft Windows Explorer, first open either “Windows Explorer” or “My Computer”. Refer to Figure 25. 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://root@” and then the IP address of the target interface card. Refer to Figure 26.

Figure 25: Accessing Windows Explorer

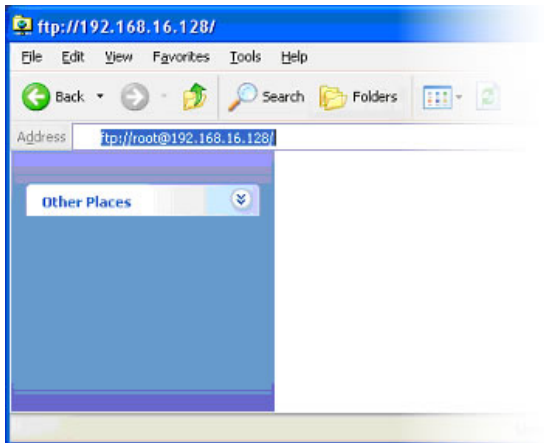


Figure 26: FTP Navigation with Windows Explorer

You will then be presented with an authentication dialog (refer to Figure 27.) The user name “root” will already be filled-in. Enter the case-sensitive password (icc) and click “Log On.”

Windows Explorer will then display the filesystem’s contents (refer to Figure 28.) You can now perform normal file manipulation actions on the available files (cut, copy, paste, open, rename, drag-and-drop transfers etc.) in the same manner as though you were manipulating any traditional file stored on your computer’s hard drive.

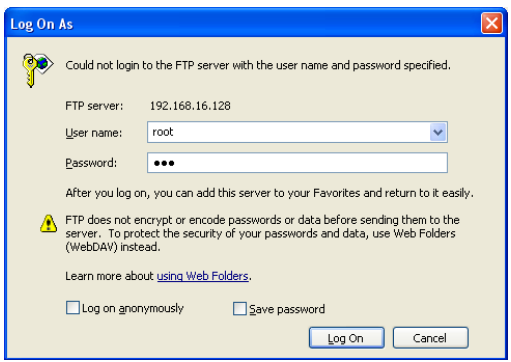


Figure 27: FTP Authentication

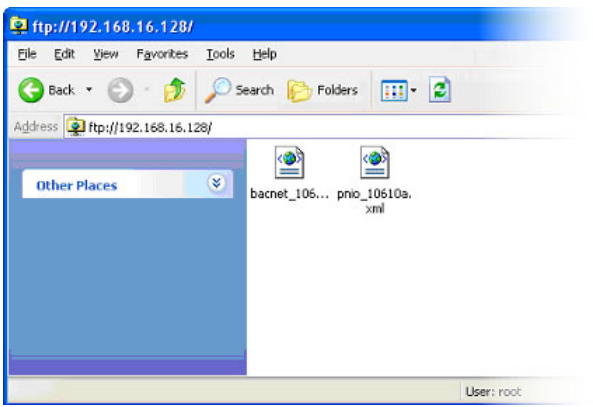


Figure 28: File Access via Windows Explorer

7.4 Using FTP with a Windows Command Prompt

To use FTP with a Windows command (DOS) prompt, first open a command prompt by either selecting *Start …All Programs …Accessories …Command Prompt*, or by selecting *Start …Run* and typing “cmd” in the “Run” dialog.

Once the command prompt opens, type “ftp” and the IP address of the target interface card. The FTP client will connect to the unit and then prompt for a username (“root”) and case-sensitive password (“icc”). Upon successful entry of the authentication information, you will be presented with an “ftp>” prompt. Refer to Figure 29.

At this point, you can use standard Unix-style file and directory manipulation commands to perform such actions as listing files (Figure 30), copying files to your computer (Figure 31), and copying files to the unit (Figure 32).

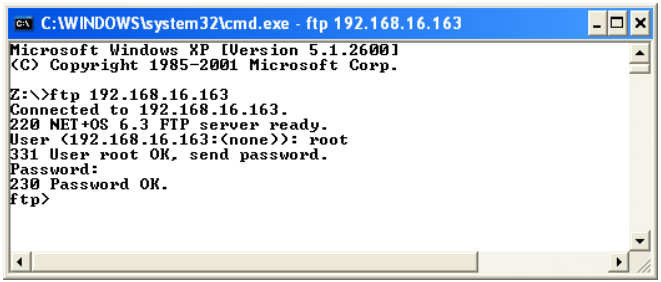


Figure 29: FTP Initiation and Authentication

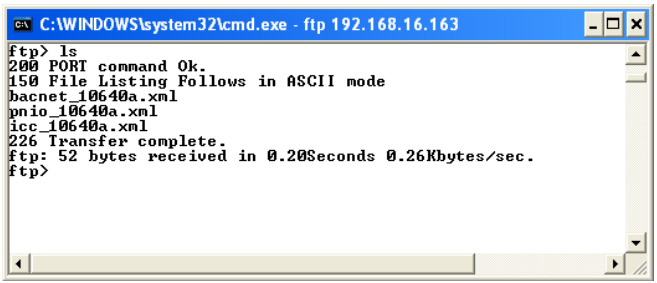


Figure 30: Listing Files With "ls" Command

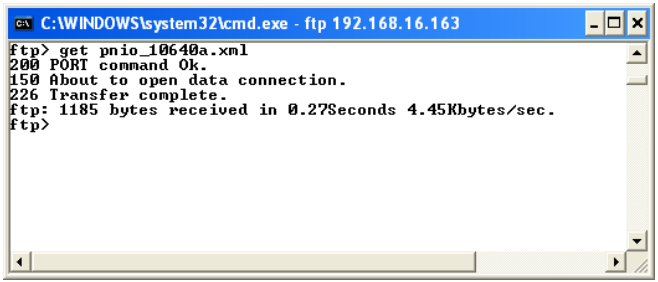


Figure 31: Copying a File From The Unit With "get" Command

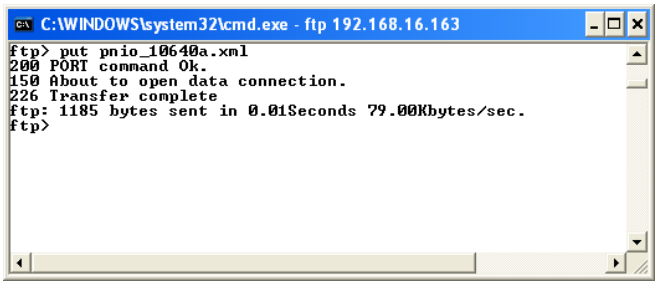


Figure 32: Copying a File To The Unit With "put" Command

7.5 Using FTP With Core FTP LE

Core FTP LE (Lite) is a 3rd-party FTP application that can be downloaded for free from http://www.coreftp.com. Core FTP is just one example of the various commercial and freeware FTP client applications available on the internet.

After installing Core FTP LE, run the program. If the "Site Manager" window (Figure 33) does not automatically open, open it by choosing "File…connect".

Click on the "New Site" button, then enter a Site Name, IP Address, username ("root") and case-sensitive password ("icc"). The "Port", "Timeout", and "Retries" fields should already contain the default values. Click the "Connect" button when done.

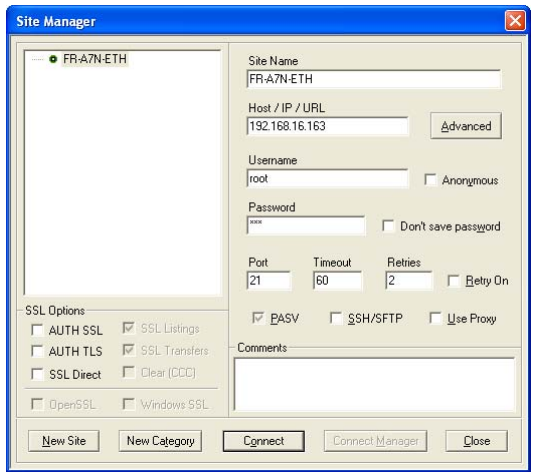


Figure 33: Core FTP Site Manager

Core FTP LE will then try to connect and authenticate to the FTP server, and if successful, will populate the right-hand side of the main page with the unit's filesystem contents. Refer to Figure 34.

Files can be easily downloaded from the unit by choosing the appropriate destination folder on your computer in the left-hand side of the main page, choosing the file to download, and then clicking the

"download" button in the right-hand (source) side. Similarly, files can be easily uploaded to the unit by choosing the file to upload and then clicking the "upload" button in the left-hand (source) side of the main page.

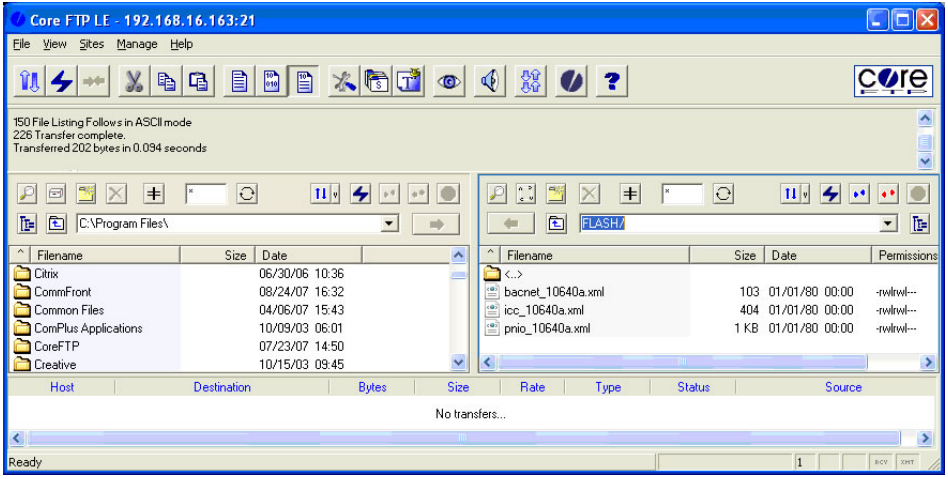


Figure 34: Core FTP in "Connected" State

Like most 3rd-party FTP client applications, Core FTP LE has a wide array of configuration and file management capabilities, which are beyond the scope of this manual. Refer to the program's Help file for more detailed instructions.

7.6 Loading New Application Firmware

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 (such as Profinet I/O).

ICC is continually striving to enhance the functionality and flexibility of our products, and we therefore periodically release new embedded firmware to achieve these goals and meet customer requests. Flash firmware files and all related documentation (such as updated user manuals) can be downloaded from http://www.iccdesigns.com. It is suggested that users check this Internet site prior to installation, and then periodically afterwards to determine if new firmware has been released and is available to upgrade their units.

Besides the new firmware file, firmware updates require only a PC with the same FTP client capabilities as described earlier in this section. The new firmware is loaded on the unit via the FTP protocol in the same manner as uploading a configuration (.XML) file. Some notes on uploading new firmware via FTP are:

- 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. For example, upgrading to a new firmware version may affect user-defined configuration files: prior to starting an update procedure always back up your configuration file to a PC for later recovery if necessary.

- Because the FTP application firmware in the unit distinguishes application firmware files from XML configuration files by virtue of the filename, don't change the default name of the firmware file to be uploaded to the unit.
- Although the firmware file is uploaded from your PC to the unit in the same manner as configuration files are uploaded, the firmware cannot be downloaded from the unit, because the firmware does not reside in the unit's filesystem like configuration files do.
- After the firmware upload process has been completed (typically requiring 30-45 seconds), the unit will reset automatically 10s after the FTP connection is closed. When the unit boots up again, it will be running the new application firmware, which can be confirmed by observing the version displayed in the web server's information window (refer to section 5.4.1).

8 PROTOCOL-SPECIFIC INFORMATION

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

8.1 Modbus TCP

8.1.1 Overview

The interface card supports Schneider Electric's Modbus TCP protocol, release 1.0. The interface is conformance class 0 and partial class 1 and class 2 compliant, and allows up to 8 simultaneous Modbus TCP client connections (sockets). Other notes of interest are:

- Supported Modbus TCP functions are indicated in Table 3.
- Inverter registers can be addressed as holding registers (4X references) or coils (0X references). For example, accessing the frequency command involves accessing holding register 40014 (i.e. offset 14).
- Because the transaction is handled locally within the interface card,

Table 3: Supported Modbus TCP Functions

Function Code	Function	Modbus TCP Class
1	Read coils	1
3	Read multiple registers	0
5	Write coil	1
6	Write single register	1
15	Force multiple coils	2
16	Write multiple registers	0

write data checking is not available. For example, if a write is performed to a register with a data value that is out-of-range of the corresponding parameter object, no Modbus exception will be immediately returned.

- The “unit identifier” (UI) field of the request packets is ignored.
- The socket timeout time is determined by the “timeout” setting on the web server’s “Config” tab (refer to section 5.7.2). This means that if a particular open socket experiences no activity for more than the timeout time setting, then the interface assumes that the client or network has experienced some sort of unexpected problem, and will close that socket.
- Because the socket timeout determination is performed on a per-socket basis, note that a certain degree of caution must be exercised when using the network timeout feature to avoid “nuisance” timeouts from occurring. Specifically, do not perform inadvisable behavior such as sending a request from the master device to the interface, and then closing the socket prior to successfully receiving the unit’s response. The reason for this is because the interface will then experience an error when attempting to respond via the now-closed socket, which will immediately trigger the timeout action. Always be sure to manage socket life cycles “gracefully”, and do not abandon outstanding requests.
- If a socket timeout occurs (regardless of whether it was due to a communication lapse or abnormal socket error), the driver will trigger a timeout event as described in section 5.7.2.

8.1.2 Coil Mappings

The Modbus TCP driver provides read/write support for coils (0X references). Accessing coils does not reference any new physical data: coils are simply indexes into various bits of existing registers. What this means is that when a coil is accessed, that coil is resolved by the interface into a specific register, and a specific bit within that register. The pattern of coil-to-register/bit relationships can be described as follows:

Coils 1...16 map to register #1, bit0...bit15 (bit0=LSB, bit15=MSB)
Coils 17...32 map to register #2, bit0...bit15, and so on.

Arithmetically, the coil-to-register/bit relationship can be described as follows: For any given coil, the register in which that coil resides can be determined by:

$$register = \left\lfloor \frac{coil + 15}{16} \right\rfloor$$ *…Equation 1*

Where the bracket symbols "⌊ ⌋" indicate the "floor" function, which means that any fractional result (or "remainder") is to be discarded, with only the integer value being retained.

Also, for any given coil, the targeted bit in the register in which that coil resides can be determined by:

$$bit = (coil - 1)\ \%\ 16$$ *…Equation 2*

Where “coil” $\in$[1…65535], “bit” $\in$[0…15], and “%” is the modulus operator, which means that any fractional result (or “remainder”) is to be retained, with the integer value being discarded (i.e. it is the opposite of the “floor” function).

For clarity, let’s use Equation 1 and Equation 2 in a calculation example. Say, for instance, that we are going to read coil #34. Using Equation 1, we can determine that coil #34 resides in register #3, as $\lfloor 3.0625 \rfloor = \lfloor 3\ r1 \rfloor = 3$. Then, using Equation 2, we can determine that the bit within register #3 that coil #34 targets is (34-1)%16 = 1, as 33%16 = mod(3 r1) = 1. Therefore, reading coil #34 will return the value of register #3, bit #1.

8.2 Ethernet/IP

The Ethernet/IP protocol is an application-level protocol implemented on top of the Ethernet TCP/IP and UDP/IP layers. It shares its object model with ControlNet and DeviceNet through the common Control and Information Protocol (CIP). This protocol allows the transfer of data and I/O over Ethernet.

Ethernet/IP incorporates the TCP and UDP layers of the Ethernet protocol in the transmission of data. Because TCP/IP is a point-to-point topology, Ethernet/IP uses this layer only for explicit messaging; i.e. those messages in which the data field carries both protocol information and instructions for service performance. With explicit messaging, nodes must interpret each message, execute the requested task and generate responses. These types of messages can be used to transmit configuration, control and monitor data.

The interface card supports explicit messages from client devices (such as a PLC). The card also provides support for legacy devices (such as PLC5 or SLC PLCs) that only support the PCCC protocol.

- The interface card supports the Ethernet/IP protocol (release 1.0), administered by the Open DeviceNet Vendor Association (ODVA).
- The interface card's product type code is 12 (communications adapter.)
- Supports unconnected messages (UCMM), and up to 32 simultaneous class 3 connections.
- The Ethernet/IP driver does not trigger timeout events (section 5.7.2).

The following sections demonstrate specific examples of how to configure and use Ethernet/IP to transfer data between the inverter and Allen-Bradley PLCs.

8.2.1 Tag Reference

Register contents are read from and written to the interface card via Ethernet/IP by reference to "Tag Names". Tags are read via the Ethernet/IP "data table read" service, and tags are written via the Ethernet/IP "data table write" service. Different tags exist for reading vs. writing. Refer to Table 4 and Table 5.

Table 4: Read Tag Reference

Service	Tag Name	Register Start	Length
Data table read	rd_uar_addr	100	1
Data table read	rd_uar_val	101	1
Data table read	rd_uar_stat	102	1
Data table read	rd_reg_monitor	201	62
Data table read	rd_freq_out	201	1
Data table read	rd_inv_stat	261	1
Data table read	rd_op_mode_stat	262	1
Data table read	rd_reg_alarm_history	501	8

Table 5: Write Tag Reference

Service	Tag Name	Register Start	Length
Data table write	wr_inv_rst	2	1
Data table write	wr_param_clr1	3	1
Data table write	wr_all_param_clr1	4	1
Data table write	wr_param_clr2	6	1
Data table write	wr_all_param_clr2	7	1
Data table write	wr_cmd_reg	9	1
Data table write	wr_op_mode	10	1
Data table write	wr_freq_cmd	14	1
Data table write	wr_freq_cmd_eeprom	15	1
Data table write	wr_uar_addr	100	1
Data table write	wr_uar_val	101	1
Data table write	wr_reg_alarm_history1	501	1

To read data from the interface card, the application PLC program will need to reference a “source element” from which to start reading and the “number of elements” to read. The “source element” will be constructed from one of the tags indicated in Table 4. The “source element” can be either a base tag (such as “rd_freq_out”, which starts at register 201), or an offset from a base tag (such as “rd_reg_monitor[5]”, which starts at register 201+5 = register 206, the inverter’s running speed).

The “number of elements” to read can be any quantity of registers from 1 to the maximum length of a tag.

In addition to block read tags which provide access to multiple registers per block, a number of discrete read tags also exist. For convenience, these discrete read tags allow direct access to the most commonly-monitored parameters. In the case of output frequency, for example, it does not matter if a request is made to read source element “rd_freq_out”, “rd_reg_monitor”, or “rd_reg_monitor[0]”: these source elements will all return the inverter’s output frequency (register 201).

In a similar manner, to write data to the interface card, the application PLC program will need to reference a “destination element” to which to start writing and the “number of elements” to write. In this case, the “destination element” will be constructed from one of the tags indicated in Table 5. For convenience, discrete write tags also exist to directly access the inverter’s writable registers.

8.2.2 ControlLogix Example: Setup

This section will demonstrate how to initially setup a ControlLogix PLC (such as a 1756-L61) coupled with a 1756-ENBT communications bridge. Later sections will provide specific read/write examples using this configuration. All data in the following examples will be transferred via MSG instructions.

1) Run RSLogix 5000, and create a new configuration.

2) Add a 1756-ENET/B to your I/O configuration.

a) Right click on the I/O Configuration node in the controller organizer view and choose “New Module…”

b) The “Select Module” window will open.

c) Under “Communications”, select “1756-ENET/B”, and click OK. Refer to Figure 35.

d) The “New Module” window will open. Refer to Figure 36.

e) Assign the Ethernet module a name (we will use “EIP”) and an IP address, deselect “Open Module Properties”, and click OK.

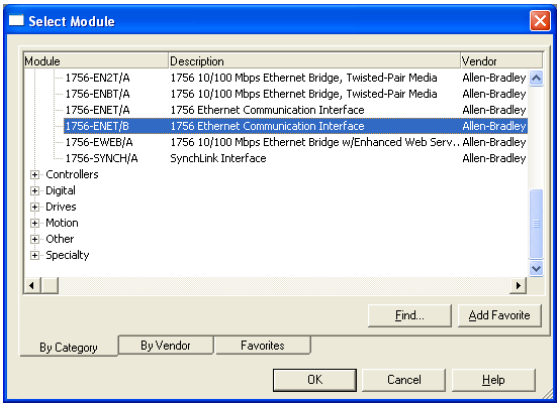


Figure 35: Adding a New Module

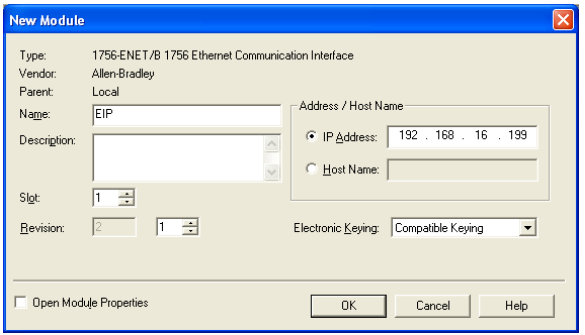


Figure 36: Identifying the New Module

8.2.3 ControlLogix Example: Read a Register Block

This example program will show how to continuously read a block of registers from the inverter with a single MSG instruction. Only one read request is outstanding at any given time.

1) Create new Tags.

a) Double click “Controller Tags” in the controller organizer view.

b) The “Controller Tags” window appears. Refer to Figure 37.

c) Select the “Edit Tags” tab at the bottom.

d) Create a new tag by entering “connection” in the first blank Name field, and change its Data Type to “MESSAGE”. This tag will contain configuration information for the MSG instruction.

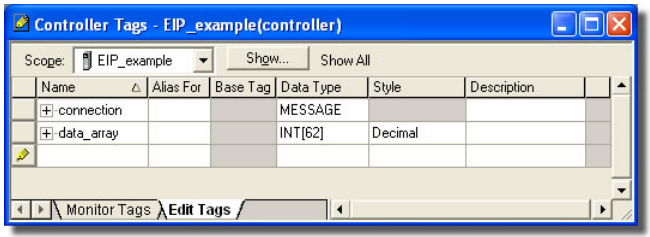


Figure 37: Create New Tags

e) Select the “Monitor Tags” tab. Expand the “connection” tag by clicking on the “+” sign next to the tag name. Scroll down to the connection.UnconnectedTimeout field and change its value from the default 30000000 (30s in 1uS increments) to 1000000 (1s). This value determines how long to wait before timing out and retransmitting a connection request if a connection failure occurs. Refer to Figure 38.

f) Collapse the “connection” tag again by clicking on the “-“ sign next to the tag name.

g) Select the "Edit Tags" tab again. Create another new tag by entering "data_array" in the next blank Name field, and change its Data Type by typing in "INT[62]" in the Data Type field. This tag is an array of INTs that will be able to hold up to 62 16-bit registers from the inverter. Always make sure that the destination tag size is large enough to hold all elements to be read.

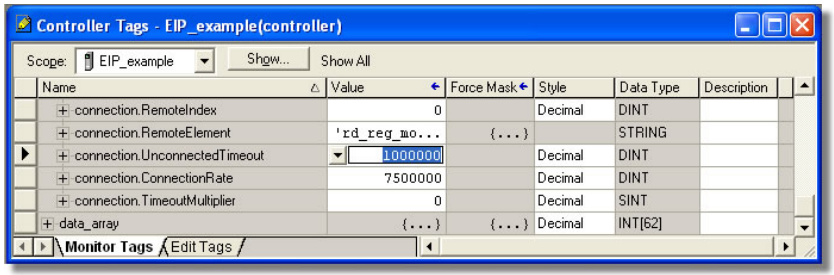


Figure 38: Reduce the UnconnecteTimeout Value

2) Add a MSG instruction to the main program.

a) Double click "MainRoutine" under Tasks …MainTask …MainProgram in the controller organizer view.

b) Right click on the first ladder logic rung in the MainRoutine window and select "Add Ladder Element..."

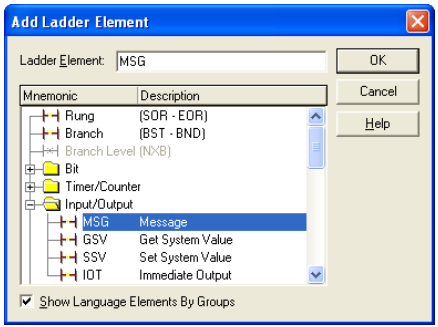


Figure 39: Adding a MSG Instruction

c) The “Add Ladder Element” window appears.

d) Select the “MSG” instruction in the Input/Output folder. Refer to Figure 39.

e) Click OK.

3) Add an XIO element to the main program.

a) Right click on the ladder logic rung containing the MSG instruction in the MainRoutine window and select “Add Ladder Element...” again.

b) The “Add Ladder Element” window appears.

c) Select the “XIO” element in the Bit folder. Refer to Figure 40.

d) Click OK.

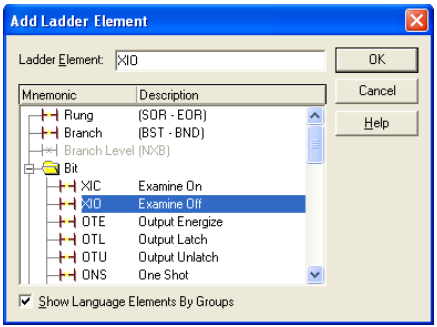


Figure 40: Adding an XIO Element

4) Configure the MSG instruction.

a) Edit the “Message Control” field on the MSG instruction to use the previously-created “connection” tag. Refer to Figure 41.

b) Click the message configuration button (“…”) in the MSG

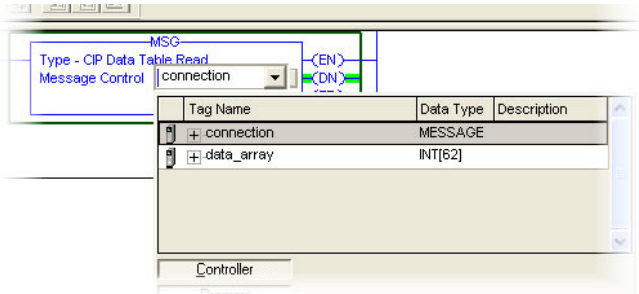


Figure 41: MSG Instruction Tag Assignment

instruction. The “Message Configuration” window will open. Refer to Figure 42.

Figure 42: MSG Instruction Configuration

c) “Configuration” tab settings:

i) Change the “Message Type” to “CIP Data Table Read”.

ii) In the "Source Element” field, enter the read tag you wish to access (refer to Table 4.) In this example, we will be reading a total of 25 registers beginning at rd_reg_monitor[10]. Offset 10 in the interface card’s rd_reg_monitor root tag (which starts at register 201) refers to 201+10 = register 211 (output current peak value).

iii) Enter the Number Of Elements to read. In this example, we will read 25 registers.

iv) For the Destination Element, either directly type in “data_array[10]”, or select element #10 in the data_array tag via the drop-down box (refer to Figure 43). The destination could be any offset in the data_array tag, as long as the offset plus the Number Of Elements (25) does not exceed the tag size (62).

d) “Communication” tab settings (refer to Figure 44):

i) Enter the Path to the interface card. A typical path is formatted as “*Local_ENB,2,target_IP_address*”, where:

- *Local_ENB* is the name of the 1756-ENBx module in the local chassis,
- *2* is the Ethernet port of the 1756-ENBx module in the local chassis, and
- *target_IP_address* is the IP address of the target node.

In our example, this path would be entered as “EIP,2,192.168.16.163”.

ii) If “Cache Connections” is enabled (checked), the connection remains open after transmission. If disabled (unchecked), the connection is opened before and closed after every transmission. For efficiency, it is recommended to enable “Cache Connections”.

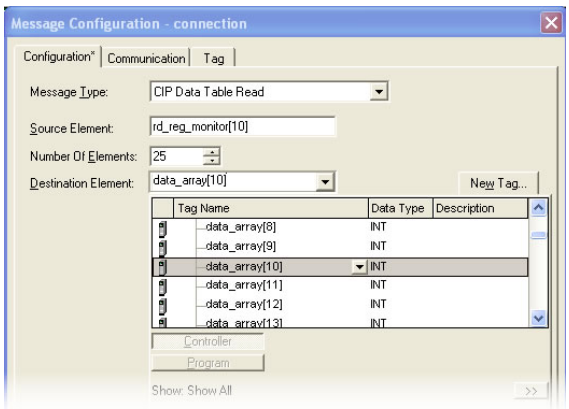


Figure 43: Selecting the Destination Element

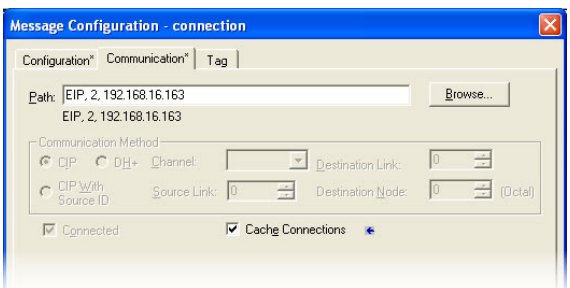


Figure 44: Setting the Communication Path

e) Click “OK” to close the MSG Configuration dialog. At this stage, MainRoutine should look like Figure 45.

5) Assign a tag to the XIO element.

a) Double-click on the XIO element located to the left of the MSG block. In the drop-down box, double-click on the “connection.EN” field. Refer to Figure 46. This configuration causes the MSG instruction to automatically retrigger itself when it completes. While this is acceptable for the purposes of this example, it can produce high network utilization. In actual practice, it may be desirable to incorporate additional logic elements to allow triggering the MSG instruction at a specific rate or under specific conditions.

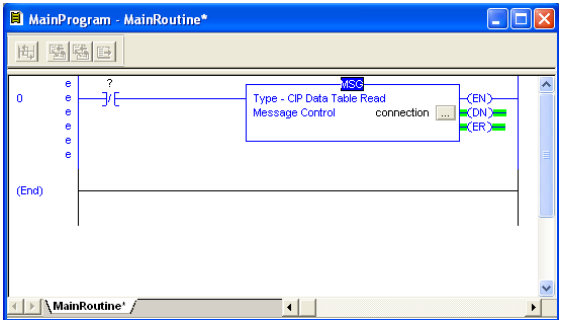


Figure 45: MainRoutine

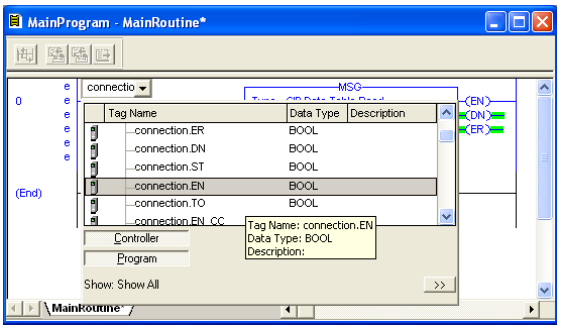


Figure 46: Configure XIO Element

6) The program is now complete. Refer to Figure 47.

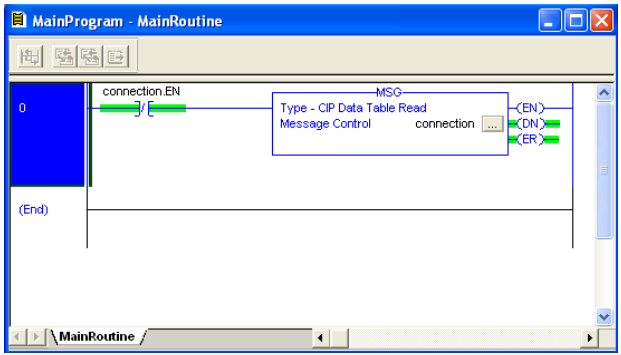


Figure 47: Complete Program

7) Save, download and run the program.

a) To view the values of the registers being read from the interface card, double-click “Controller Tags” in the controller organizer view.

b) Select the “Monitor Tags” tab.

c) Expand the data_array tag. Refer to Figure 48.

d) 25 register values starting at register #211 are being continuously read from the interface card and placed in the 25 sequential offsets of data_array starting at the 11th offset (data_array[10]). In Figure 48, we can see that data_array[11] (register 212 / converter output voltage peak value) has a value of 3190 (319.0V), data_array[15] (register 216 / output terminal status) has a value of 19, etc.

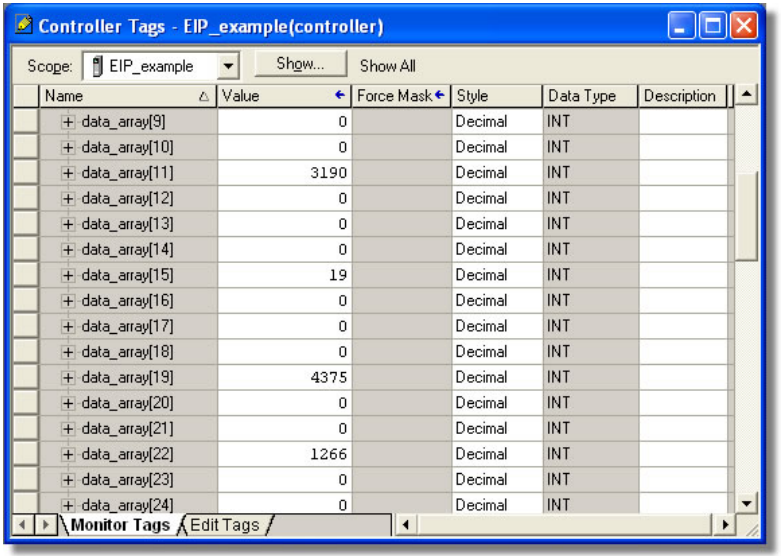


Figure 48: Viewing the Register Values

8.2.4 ControlLogix Example: Read a Single Register

The configuration and execution for reading a single register is in general identical to that required for reading a block of registers as detailed in section 8.2.3. The only difference is in the configuration of the MSG instruction. Figure 49 shows an example MSG instruction's Configuration tab, which will read a single tag (rd_inv_stat, the inverter's status register) and place it in the first element (offset 0) of data_array.

Figure 49: Read the Inverter's Status Register

8.2.5 ControlLogix Example: Multiple MSG Instructions

At times, reading from different groups of registers may be necessary. For example, a specific application may require access to the universal access registers and some other monitor registers. To accomplish this task, multiple MSG instructions will need to be implemented in the PLC program.

The configuration and execution for implementing multiple MSG instructions is in general identical to that required for implementing just one MSG instruction. Each MSG instruction will require its own message controller tag. In the case of read MSG instructions, more than one instruction may use the same Destination Element tag, but the storage locations must not overlap. Figure 50 shows an example of two MSG instructions, each accessing different read tags. It is evident from this logic that

"rd_connection" and "rd_connection2" are the two independent message controller tags created for these instructions.

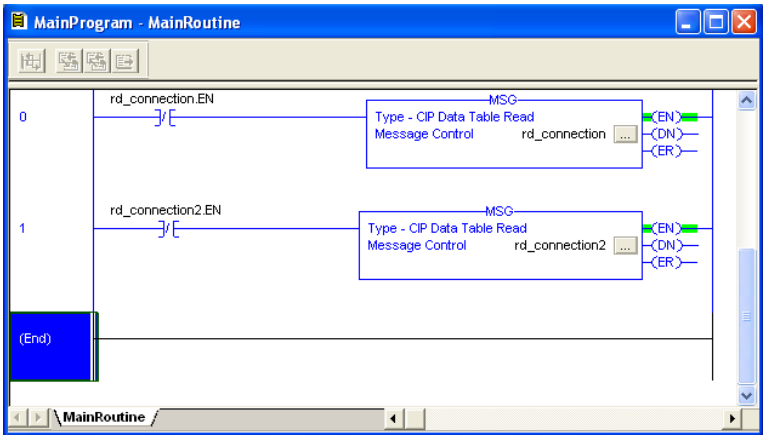


Figure 50: Reading Via Multiple MSG Instructions

8.2.6 ControlLogix Example: Reading and Writing

Often times, applications may need to both read data from and write data to the inverter. At a minimum, this will require two MSG instructions and two message controller tags. Figure 51 shows an example of three MSG instructions, one for reading and two for writing (the inverter's frequency command and command word). The only item of note that differentiates this example from the multiple-read example in section 8.2.5 is the addition of the en_xx_wr XIC elements. The reason for the addition of these elements is that while reading from a remote device is often continuously performed (monitoring), data is typically written to the remote device only when necessary (i.e. when the value to write has changed). This conserves both network bandwidth and potentially EEPROM lifespans on the target device. The en_xx_wr elements in

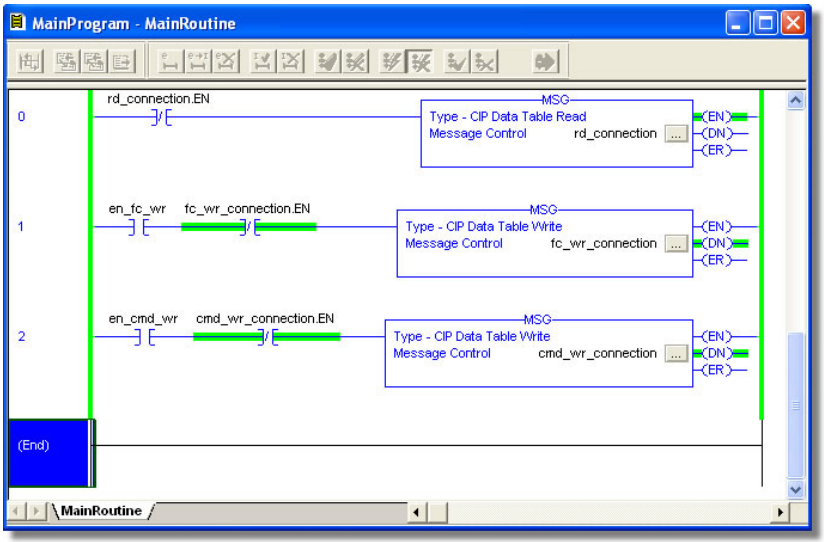


Figure 51: Reading and Writing via MSG Instructions

this example, therefore, would typically be replaced in an actual application program by user-provided logic that controls the conditions under which write operations would be performed.

Figure 52 shows the configuration details of the example fc_wr_connection MSG instruction. Note that the chosen “Message Type” is “CIP Data Table Write”, and that this instruction will only be writing to one inverter register: namely, the frequency command (Destination Element is wr_freq_cmd). Refer to Table 5 for a list of available write tags. The Source Element in this case is the 2nd element (starting from index 0) of an INT array tag named “wr_data”.

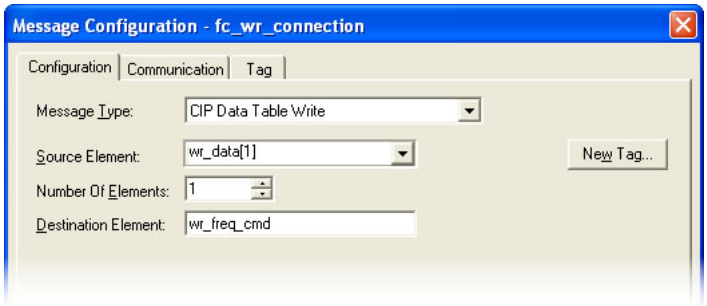


Figure 52: MSG Configuration for Writing

8.3 BACnet

- The interface card supports the BACnet/IP (Annex J) protocol over Ethernet via UDP port 47808.
- The BACnet driver does not trigger timeout events (section 5.7.2).

8.3.1 Protocol Implementation Conformance Statement

BACnet Protocol

Date:	August 1, 2007
Vendor Name:	ICC, Inc.
Product Name:	Mitsubishi Inverter FR-700
Product Model Number:	FR-A7N-ETH
Applications Software Version:	V1.15i (A)
Firmware Revision:	V1.000
BACnet Protocol Revision:	1

Product Description:

The Mitsubishi 700-series inverter family represents inverters featuring reduced high-frequency noise, reduced harmonics, and high-precision and high-speed torque control with or without sensors.

BACnet Standard Device Profile (Annex L):

☐ BACnet Operator Workstation (B-OWS)

☐ BACnet Building Controller (B-BC)
☐ BACnet Advanced Application Controller (B-AAC)
☒ BACnet Application Specific Controller (B-ASC)
☐ BACnet Smart Sensor (B-SS)
☐ BACnet Smart Actuator (B-SA)

BACnet Interoperability Building Blocks Supported (Annex K):

☒ Data Sharing – ReadProperty-B (DS-RP-B)
☒ Data Sharing – ReadPropertyMultiple-B (DS-RPM-B)
☒ Data Sharing – WriteProperty-B (DS-WP-B)
☒ Device Management – Dynamic Device Binding-B (DM-DDB-B)
☒ Device Management – Dynamic Object Binding-B (DM-DOB-B)

Segmentation Capability:

None

☐ Segmented requests supported Window Size _____
☐ Segmented responses supported Window Size _____

Standard Object Types Supported:

See “Object Types/Property Support Table”.

Data Link Layer Options:

☒ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s) _____
☐ MS/TP master (Clause 9), baud rate(s): 9600, 19200, 38400, 76800
☐ MS/TP slave (Clause 9), baud rate(s): _____
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s): _____
☐ Point-To-Point, modem, (Clause 10), baud rate(s): _____
☐ LonTalk, (Clause 11), medium: _____
☐ Other: _____

Device Address Binding:

Is static device binding supported? (This is currently for two-way communication with MS/TP slaves and certain other devise.) ☐ Yes ☒ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations
☐ Annex H, BACnet Tunneling Router over IP

☐ BACnet/IP Broadcast Management Device (BBMD)
Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

☒ ANSI X3.4	☐ IBM™/Microsoft™ DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports: N/A

Object Types/Property Support Table

Table 6: BACNet Object Types /Properties Supported

Property	Object Type				
	Device	Binary Input	Binary Output	Analog Input	Analog Output
Object Identifier	R	R	R	R	R
Object Name	R	R	R	R	R
Object Type	R	R	R	R	R
System Status	R				
Vendor Name	R				
Vendor Identifier	R				
Model Name	R				
Firmware Revision	R				
Appl Software Revision	R				
Protocol Version	R				
Protocol Revision	R				
Services Supported	R				
Object Types Supported	R				
Object List	R				
Max APDU Length	R				
Segmentation Support	R				

Property	Object Type				
	Device	Binary Input	Binary Output	Analog Input	Analog Output
APDU Timeout	R				
Number APDU Retries	R				
Max Master					
Max Info Frames					
Device Address Binding	R				
Database Revision	R				
Present Value		R	W	R	W
Status Flags		R	R	R	R
Event State		R	R	R	R
Reliability		R	R	R	R
Out-of-Service		R	R	R	R
Units				R	R
Priority Array			R		R
Relinquish Default			R		R
Polarity		R	R		
Active Text		R	R		
Inactive Text		R	R		

R – readable using BACnet services
W – readable and writable using BACnet services

8.3.2 Supported Objects

Table 7: Binary Input Object Instance Summary

Instance ID	Object Name	Description	Active/ Inactive Text
BI1	RUN_STOP_STATUS	Run/stop status	running/stopped
BI2	FOR_ROT_STATUS	Forward rotation status	forward/off
BI3	REV_ROT_STATUS	Reverse rotation status	reverse/off
BI4	SU_STATUS	Up to frequency	on/off
BI5	OVERLOAD_STATUS	Overload status	on/off
BI6	IPF_STATUS	Instantaneous power failure	on/off
BI7	FU_STATUS	Frequency detection	on/off
BI8	ABC1_STATUS	Terminal function selection status	on/off
BI9	ABC2_STATUS	Terminal function selection status	on/off
BI10	ALARM_OCC_STATUS	Alarm occurrence status	on/off

Table 8: Binary Output Object Instance Summary

Instance ID	Object Name	Description	Active/ Inactive Text
BO1	STOP_CMD	Stop command	stop/no action
BO2	FOR_ROT_CMD	Forward rotation command	forward/off
BO3	REV_ROT_CMD	Reverse rotation command	reverse/off
BO4	RH_CMD	High speed operation command	on/off
BO5	RM_CMD	Medium speed operation command	on/off
BO6	RL_CMD	Low speed cooperation command	on/off
BO7	JOG_OP	Jog	on/off
BO8	RT_SEL	Second function selection	on/off
BO9	AU_SEL	Current input selection	on/off
BO10	CS_SEL	Auto restart selection after IPF	on/off
BO11	MRS	Output stop	on/off
BO12	STOP_HOLDING	Start self-holding	on/off
BO13	RESET	Reset	on/off

Table 9: Analog Input Object Instance Summary

Instance ID	Object Name	Description	Units
AI1	OUTPUT_FREQ	Output frequency	Hz
AI2	OUTPUT_CURRENT	Output current	Amps
AI3	OUTPUT_VOLTAGE	Output voltage	Voltage
AI4	INPUT_POWER	Input power	kW
AI5	OUTPUT_POWER	Output power	kW
AI6	CUMULATIVE_POWER	Energy consumption	kWh
AI7	OP_MODE_STATUS	Op mode status	None
AI8	UAR_STATUS	Universal access register status	None
AI9	PID_SET_POINT	PID set point	%
AI10	PID_MEASURED_VALUE	PID measured value	%
AI11	PID_DEVIATION_VALUE	PID deviation value	%

Table 10: Analog Output Object Instance Summary

Instance ID	Object Name	Description	Units
AO1	INVERTER_RESET	Reset	None
AO2	PARAM_CLEAR1	Clear parameters	None
AO3	ALL_PARAM_CLEAR1	Clear all parameters	None
AO4	PARAM_CLEAR2	Clear parameters except communication parameters	None
AO5	ALL_PARAM_CLEAR2	Clear all parameters except communication parameters	None
AO6	OPERATION_MODE	Operation mode register	None
AO7	FREQ_CMD_REG	Frequency command register	Hz
AO8	FREQ_CMD_EEPROM_REG	EEPROM Frequency command register	Hz
AO9	UAR_ADDRESS	Universal address register address	None
AO10	UAR_VALUE	Universal address register value	None

8.3.3 Supported Object Details

Binary Input Objects

BI1 .....Indicates the status of the RUN output terminal function configured by *Pr. 190 RUN terminal function selection*. Corresponds to register 261, bit 0.

BI2 .....Indicates whether the inverter is running forward, or stopped. Corresponds to register 261, bit 1.

BI3 .....Indicates whether the inverter is running reverse, or stopped. Corresponds to register 261, bit 2.

BI4 .....Indicates the status of the SU output terminal function configured by *Pr. 191 SU terminal function selection*. Corresponds to register 261, bit 3.

BI5 .....Indicates the status of the OL output terminal function configured by *Pr. 193 OL terminal function selection*. Corresponds to register 261, bit 4.

BI6 .....Indicates the status of the IPF output terminal function configured by *Pr. 192 IPF terminal function selection*. Corresponds to register 261, bit 5.

BI7 .....Indicates the status of the FU output terminal function configured by *Pr. 194 FU terminal function selection*. Corresponds to register 261, bit 6.

BI8 .....Indicates the status of the ABC1 output terminal function configured by *Pr. 195 ABC1 terminal function selection*. Corresponds to register 261, bit 7.

BI9 .....Indicates the status of the ABC2 output terminal function configured by *Pr. 196 ABC2 terminal function selection*. Corresponds to register 261, bit 8.

BI10 .....Indicates whether or not the inverter is in an alarm condition. Corresponds to register 261, bit 15.

Binary Output Objects

BO1.....Stop command. Corresponds to register 9, bit 0.

BO2.....Forward command. Corresponds to register 9, bit 1.

BO3.....Reverse command. Corresponds to register 9, bit 2.

BO4.....Activates the RH input terminal function configured by *Pr. 182 RH terminal function selection*. Corresponds to register 9, bit 3.

BO5.....Activates the RM input terminal function configured by *Pr. 181 RM terminal function selection*. Corresponds to register 9, bit 4.

BO6.....Activates the RL input terminal function configured by *Pr. 180 RL terminal function selection*. Corresponds to register 9, bit 5.

BO7.....Activates the JOG input terminal function configured by *Pr. 185 JOG terminal function selection*. Corresponds to register 9, bit 6.

BO8.....Activates the RT input terminal function configured by *Pr. 183 RT terminal function selection*. Corresponds to register 9, bit 7.

BO9.....Activates the AU input terminal function configured by *Pr. 184 AU terminal function selection*. Corresponds to register 9, bit 8.

BO10....Activates the CS input terminal function configured by *Pr. 186 CS terminal function selection*. Corresponds to register 9, bit 9.

BO11....Activates the MRS input terminal function configured by *Pr. 187 MRS terminal function selection*. Corresponds to register 9, bit 10.

BO12....Activates the STOP input terminal function configured by *Pr. 188 STOP terminal function selection*. Corresponds to register 9, bit 11.

BO13....Activates the RES input terminal function configured by *Pr. 189 RES terminal function selection*. Corresponds to register 9, bit 12.

Analog Input Objects

AI1 .....The output frequency of the inverter in 0.01 Hertz units (6000=60.00Hz). Corresponds to register 201.

AI2 .....The output current of the inverter in 0.1 or 0.01 Amp units (depends on inverter capacity). Corresponds to register 202.

AI3 .....The output voltage of the inverter in 0.1 Volt units (1000=100.0V). Corresponds to register 203.

AI4 .....Input power of the inverter in 0.1 or 0.01 kW units (depends on inverter capacity). Corresponds to register 213.

AI5 .....Output power of the inverter in 0.1 or 0.01 kW units (depends on inverter capacity). Corresponds to register 214.

AI6 .....Energy consumption in kWh. Corresponds to register 225.

AI7 .....Inverter operation mode status. Corresponds to register 262.

AI8 .....Universal Access Register Status (UARS). Corresponds to register 102.

AI9 .....PID set point monitor in 0.1% units. Corresponds to register 252.

AI10 ....PID measurement value monitor in 0.1% units. Corresponds to register 253.

AI11 ....PID deviation value monitor in 0.1% units. Corresponds to register 254.

Analog Output Objects

AO1.....Inverter fault reset command. Corresponds to register 2.

AO2.....Parameter clear command. Corresponds to register 3.

AO3.....All parameter clear command. Corresponds to register 4.

AO4.....Parameter clear command (communication parameters are not cleared). Corresponds to register 6.

AO5.....All parameter clear command (communication parameters are not cleared). Corresponds to register 7.

AO6.....Selects the operation mode of the inverter. Corresponds to register 10.

AO7.....The frequency command (RAM) of the inverter in 0.01 Hertz units. Corresponds to register 14.

AO8.....The frequency command (EEPROM) of the inverter in 0.01 Hertz units. Corresponds to register 15.

AO9.....Universal Access Register Address (UARA). Corresponds to register 100.

AO10....Universal Access Register Value (UARV). Corresponds to register 101.

8.4 Profinet IO

- Up to 8 command registers can be sent to the inverter, and up to 32 status registers can be retrieved from the inverter.
- A total of 84 modules are available for selection by the controller. Refer to the GSDML file specific module information.
- The Profinet IO driver does not trigger timeout events (section 5.7.2).

9 TROUBLESHOOTING

Although by no means exhaustive, the following table provides possible causes behind some of the most common errors experienced when using the FR-A7N-ETH interface.

Problem	Symptom	Solution
No communications between FR-A7N-ETH and the inverter	The FR-A7N-ETH's "INVERTER" TX and RX LEDs are blinking slowly, sporadically, or not at all	• Check connections and orientation of the #10621 cable between the FR-A7N-ETH and the inverter. • Confirm that the inverter's station ID (*Pr. 331*), baud rate (*Pr. 332*) and parity (*Pr. 334*) are set to 1, 38400 and even, respectively. • Confirm that the inverter's RS-485 protocol selection is set to Modbus (*Pr. 549* = 1).
No communications between the network and the FR-A7N-ETH	Communications cannot be established, or the Ethernet "activity" LED flashes only infrequently or not at all	• Confirm that the destination IP address programmed into the controller equipment or computer matches that of the interface card, as displayed by the finder utility. • Confirm that intermediate firewalls or routers have been configured to allow access to the interface via the applicable TCP/UDP ports. • 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.

Problem	Symptom	Solution
Firmware-generated error	"MODULE STATUS" LED is flashing red. The number of times the LED flashes indicates an error code.	Contact ICC for further assistance.
XML socket connection failed	Message on a web server tab information window	TCP port 2000 is blocked by a firewall, router or some other intermediate network equipment.
Unable to control the inverter via network communications	Cannot write to command parameters via network communications, or writing to these parameters has no apparent effect	Set the inverter to NET mode. The inverter will reject all command and parameter write requests from the network if it is not in NET mode.

REVISIONS

Date	Manual Number	Details
Sept. 2007	10653-1.000-000	Initial release

ICC

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