
NETWORK GATEWAY SERIES

ICC

INDUSTRIAL CONTROL COMMUNICATIONS, INC.



XLTR-200

SERIAL MULTIPROTOCOL NETWORK GATEWAY



Introduction

Thank you for purchasing the ICC XLTR-200 Serial Multiprotocol Network Gateway. The XLTR-200 allows information to be transferred seamlessly between many different fieldbus networks with minimal configuration requirements. The XLTR-200 provides two RS485 ports, one RS232 port, and three common serial ports for direct connectivity to Toshiba 7-series, 9-series, 11-series or VF-nC1 Adjustable Speed Drives (ASDs). These various communication ports operate independently, and are configurable along with the unit's internal point database via a serial console interface.

The gateway currently provides support for the following protocols:

- ▶ Modbus RTU (RS485 master & slave)
- ▶ Modbus RTU (RS232 master & slave)
- ▶ Toshiba ASD (common serial master)
- ▶ Toshiba ASD (RS485 master)
- ▶ Toshiba 3-series ASD (RS232 master)
- ▶ Mitsubishi 500-series & 700-series ASD (RS485 master)
- ▶ Siemens FLN (RS485 slave)
- ▶ Johnson Controls, Inc. Metasys N2 (RS485 slave)

New network drivers are continuously being added, and can be downloaded for free from our web site.

Before using the XLTR-200 network gateway, 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 XLTR-200, and keep this instruction manual in a safe place for future reference or unit inspection.

This instruction manual describes the device specifications, wiring methods, maintenance procedures, supported functions and usage methods for the XLTR-200 network gateway.

For the latest information, support, firmware releases or product point files, please visit <http://www.iccdesigns.com>.

Before continuing, please take a moment to ensure that you have received all materials shipped with your kit. These items are:

- XLTR-200 gateway
- Panel-mount standoff kit
- Documentation CD-ROM

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**XLTR-200 Serial Multiprotocol Network Gateway
User's Manual**

Part Number 10604-1.100-000

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Notice to Users

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

Usage Precautions

Operating Environment

- Please use the gateway only when the ambient temperature of the environment into which the unit is installed is within the following specified temperature limits:
Operation: -10 ~ +50°C (+14 ~ +122°F)
Storage: -40 ~ +85°C (-40 ~ +185°F)
- Avoid installation locations that may be subjected to large shocks or vibrations.
- Avoid installation locations that may be subjected to rapid changes in temperature or humidity.

Installation and Wiring

- Proper ground connections are vital for both safety and signal reliability reasons. Ensure that all electrical equipment is properly grounded.
- Route all communication cables separate from high-voltage or noise-emitting cabling (such as ASD input/output power wiring).

ASD Connections

- Do not touch charged parts of the drive such as the terminal block while the drive's CHARGE lamp is lit. A charge will still be present in the drive's internal electrolytic capacitors, and therefore touching these areas may result in an electrical shock. Always turn all drive input power supplies OFF, and wait at least 5 minutes after the CHARGE lamp has gone out before connecting communication cables.
- To avoid misoperation, do not connect any gateway terminals to either the ASD's E/GND terminals, the motor, or to any other power ground.
- When making common serial connections between the gateway and Toshiba ASDs, do not use cables that exceed 5 meters in length.
- For further drive-specific precaution, safety and installation information, please refer to the appropriate documentation supplied with your drive.
- Internal ASD EEPROMs have a limited life span of write cycles. Observe all precautions contained in this manual and your ASD manual regarding which drive registers safely may and may not be repetitively written to.
- When used without an Auxiliary power source (Toshiba ASD common serial mode), the gateway derives its control power from the connected drives. Therefore, removing power to all connected drives will also cause the gateway to lose power.



TABLE OF CONTENTS

1.	The Network Gateway Series Concept.....	7
2.	Feature Summary.....	8
3.	Installing the Gateway.....	10
3.1	Mounting	10
3.1.1	Panel Mounting.....	10
3.1.2	SnapTrack™ Mounting	11
3.1.3	DIN Rail Mounting.....	11
3.2	Installation for Non-Toshiba ASD Networks	12
3.3	Toshiba Common Serial ASD Network Installation	12
3.3.1	Installation for G7 ASDs.....	13
3.3.2	Installation for S7, S9, S11, A7 and VF-nC1 ASDs.....	15
4.	RS485 Port Electrical Interfaces	17
5.	Environmental Specifications	18
6.	Maintenance and Inspection	19
7.	Storage and Warranty	20
7.1	Storage.....	20
7.2	Warranty.....	20
8.	LED Indicators	21
8.1	Toshiba ASD Common Serial Port Indicators	21
8.2	RS485 Port Indicators	21
9.	Configuration Switches	21
10.	Auxiliary Power Supply.....	22
11.	Unit Configuration Concepts.....	23
11.1	Port and Protocol Configuration	23
11.2	Timeout Configuration	23
11.3	Point Configuration.....	24
11.4	General Configuration Procedure.....	25
12.	Console Access	27
12.1	RS232.....	27
12.1.1	Requirements	27
12.1.2	Connection	27

12.1.3	<i>Application Configuration</i>	28
12.2	<i>Invocation</i>	30
12.3	<i>Main Menu</i>	31
12.3.1	<i>View/Edit Points</i>	32
12.3.2	<i>View/Edit Ports</i>	39
12.3.3	<i>Load Points</i>	41
12.3.4	<i>Xmodem Point File</i>	41
12.3.5	<i>XLTR-200 Information</i>	43
13.	 Protocol-Specific Information	44
13.1	<i>Modbus</i>	44
13.1.1	<i>Coil Mappings</i>	45
13.1.2	<i>Modbus RTU Slave</i>	46
13.1.3	<i>Modbus RTU Master</i>	46
13.2	<i>Metasys N2</i>	48
13.3	<i>Toshiba Common Serial ASD Protocol</i>	51
13.4	<i>Toshiba RS485 ASD Protocol</i>	51
13.5	<i>Mitsubishi ASD Protocol</i>	54
13.6	<i>Siemens FLN</i>	58
13.6.1	<i>Ports</i>	58
13.6.2	<i>Supported Subpoints</i>	59
13.6.3	<i>Subpoint Details</i>	60
13.7	<i>Toshiba 3-Series ASD Protocol</i>	63
13.7.1	<i>Command Parameters</i>	64
13.7.2	<i>Monitor Parameters</i>	65
13.7.3	<i>Fundamental Parameters #1</i>	69
13.7.4	<i>Fundamental Parameters #2</i>	70
13.7.5	<i>Panel Control Parameters</i>	70
13.7.6	<i>Terminal Selection Parameters</i>	71
13.7.7	<i>Special Control Parameters</i>	75
13.7.8	<i>Frequency Setting Parameters</i>	76
13.7.9	<i>Protection Function Parameters</i>	79
13.7.10	<i>Pattern Run Control Parameters</i>	81
13.7.11	<i>Feedback Control Parameters</i>	84
13.7.12	<i>Communication Setting Parameters</i>	85
13.7.13	<i>AM/FM Terminal Adjustment Parameters</i>	86
13.7.14	<i>Utility Parameters</i>	87
13.7.15	<i>Motor Rating Parameters</i>	89
13.7.16	<i>Inverter Fault Codes</i>	90
14.	 Firmware Updates	92
14.1	<i>Requirements</i>	92

14.2	Connection	92
14.3	Using the RFU Utility	93
14.3.1	<i>Required Files</i>	93
14.3.2	<i>First-Time Configuration</i>	93
14.3.3	<i>Transmitting Firmware Files</i>	94
14.4	Wrap-Up	96
15.	Notes	97

1. The Network Gateway Series Concept

The XLTR-200 is a member of the ICC Network Gateway Series product family. Members of this family are designed to provide a uniform interface, configuration and application experience. This commonality reduces the user's learning curve, reducing commissioning time while simplifying support. The XLTR-200 provides simultaneous support for many different communication protocols, allowing complex interchanges of data between otherwise incompatible networks.

The heart of the Network Gateway Series concept is an element called the "point database". The point database is entirely user-configurable, and provides the mapping information that allows requests from the various supported networks to be interpreted and stored in a common format. This allows data to be routed from any supported network to any other supported network.

Additionally, the point database provides the added benefit of "data mirroring", whereby current copies of point values (populated by a "source port" designation) are maintained locally within the gateway itself. This greatly reduces the request-to-response latency times on the various networks, as requests (read or write) can be entirely serviced locally, thereby eliminating the time required to execute a secondary transaction on a different network.

When properly configured, the gateway will become essentially "transparent" on the networks, and the various network devices can engage in seamless dialogs with each other.

2. Feature Summary

RS485 Ports

Two half-duplex 2-wire RS485 ports (A / B / Signal Ground / Shield). These ports allow a selection of various master and slave protocols.

RS232 Port

One RS232 port that can be used to configure the unit, update the internal firmware, upload/download files or act as a control protocol port.

Toshiba ASD Ports

Three common serial (aka logic level) ports for connection of Toshiba 7-series, 9-series, 11-series or VF-nC1 ASDs. ASD connections use the same standard RJ45 style 8-conductor UTP patch cables: any standard CAT5 Ethernet cable (found in most electronics stores) 5 meters or less in length can be used. ASD connections are automatically established and continuously monitored: no drive configuration needs to be performed to connect the unit to the drives. Just plug it in – it's that simple.

Power Supply

When connected to Toshiba ASDs via the ASD1 / ASD2 / ASD3 ports, can be either powered directly from the attached ASDs, or from the auxiliary power ("AUX PWR") input jack. All other non-Toshiba applications require the use of the AUX PWR input to supply power to the unit. When more than one power source is connected, the unit will draw its control power from the source with the highest supply voltage.

Supported Protocols

- ▶ Modbus RTU (RS485 master & slave)
- ▶ Modbus RTU (RS232 master & slave)
- ▶ Toshiba ASD (common serial master)
- ▶ Toshiba ASD (RS485 master)
- ▶ Toshiba 3-series ASD (RS232 master)
- ▶ Mitsubishi 500-series & 700-series ASD (RS485 master) (also used by MGI Technologies, Inc. ASDs)
- ▶ Siemens FLN (RS485 slave)
- ▶ Johnson Controls, Inc. Metasys N2 (RS485 slave)

New network drivers are continuously being added, and can be downloaded for free from our web site.

Text-Based Console Configuration

Unit configuration is performed via a text-based console interface, available locally over the RS232 port via a standard PC terminal program such as Microsoft Windows HyperTerminal®.

Configuration File Upload/Download

A unit's configuration can be uploaded from / downloaded to a PC, which provides the capability for PC-based file backup and easy configuration copying to multiple units. Sample configuration files and related documentation can also be downloaded from our web site, uploaded to a unit, and custom-modified to suit a specific application.

Network Timeout Action

A per-port and per-point 2-level configurable network timeout action can be programmed that allows each internal point to have its own unique "fail-safe" condition in the event of a network interruption.

Indicators

- 1 bicolor red/green "MS" LED that indicates module status information.
- 1 bicolor red/green "NS" LED that indicates network status information.
- 1 green "TX" and 1 red "RX" LED on each RS485 port.
- 1 green and 1 red LED on each of the Toshiba common serial ASD ports.

Refer to section 8 for more detailed information about the LED indicators and their meanings.

Field-Upgradeable

As new firmware becomes available, the unit can be upgraded in the field by the end-user. Refer to section 13.6 for more information.

Versatile Mounting Options

The unit can be panel-mounted with the included standoff kit, or snapped into existing 4" Augat SnapTrack™ (6TK series or equivalent). An optional mounting kit (ICC part number 10581) is also available for DIN-rail mount applications.

3. Installing the Gateway

The gateway's installation procedure will vary slightly depending on the chosen mounting method and the networks that will be used.

3.1 Mounting

3.1.1 Panel Mounting

The included standoff kit allows for panel mounting of the unit. The standoff kit is comprised of four 1" aluminum male/female standoffs and four #6 lock washers.

1. Remove one of the four cover standoff retention screws and its lock washer from the bottom side of the unit. DO NOT dispose of this screw and washer, as they will be used later to mount the unit to the panel.
2. Install one of the male/female standoffs and a #6 lock washer from the standoff kit through the unit's circuit board and into the bottom of the cover standoff. Refer to Figure 1.

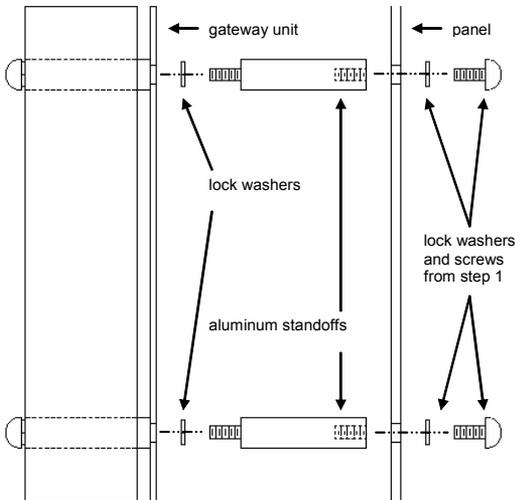


Figure 1: Standoff Kit Installation

3. Repeat steps 1 and 2 above to replace each of the three other cover standoff retention screws.

- Using the dimensions provided in Figure 2, drill four 0.150" diameter holes at the specified locations on the panel. As a convenient pattern guide, the unit with attached mounting standoffs can be held against the panel, and the four standoff locations marked with a pencil or scribe.

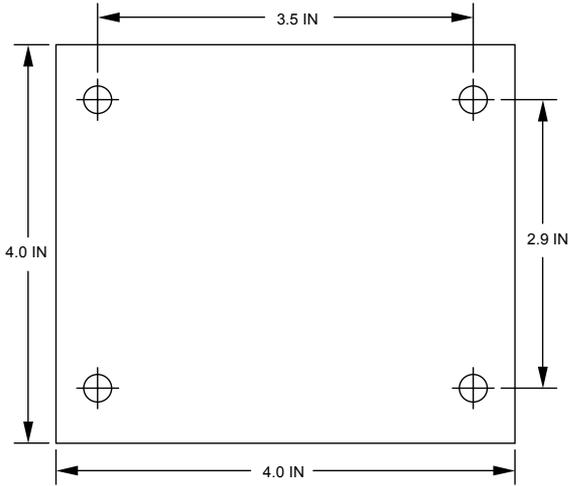


Figure 2: Standoff Hole Placement

- As shown in Figure 1, use the four screws and lock washers from step 1 to mount the unit from the back side of the panel.

3.1.2 SnapTrack™ Mounting

The unit footprint measures 4" x 4" square, and is designed to fit directly into existing 4" Augat SnapTrack™ (6TK series or equivalent). Carefully insert the unit into the SnapTrack™ by pressing firmly on the pan head screws located at the 4 corners of the unit's cover. DO NOT press directly on the aluminum cover, as this may damage the cover.

3.1.3 DIN Rail Mounting

An optional mounting kit (ICC part number 10581) allows DIN rail mounting of the unit. The mounting kit is comprised of a 4" section of Augat 6TK SnapTrack™ and two DIN rail clips.

- Carefully insert the unit into the SnapTrack™ by pressing firmly on the pan head screws located at the 4 corners of the unit's cover. DO NOT press directly on the aluminum cover, as this may damage the cover.
- Install the DIN rail clips into the openings on the bottom side of the SnapTrack™. Refer to Figure 3.

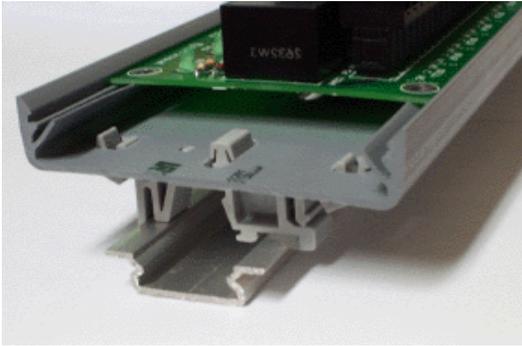


Figure 3: DIN Rail Mounting Kit Installation

3.2 Installation for Non-Toshiba ASD Networks

Note that in order to power the unit when not connecting to Toshiba ASDs via the common serial ports, the optional 120VAC/9VDC power supply (ICC part number 10456) or a user-supplied power source meeting the requirements outlined in section 10 must also be installed.

1. Mount the unit via the desired method (refer to section 3.1).
2. Connect the various networks to their respective plugs/terminal blocks. Ensure that any terminal blocks are fully seated into their respective headers, and route the network cables such that they are located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.
3. Take a moment to verify that the gateway and all network cables have sufficient clearance from electrical noise sources such as drives, motors, or power-carrying electrical wiring.
4. Connect the power supply to the gateway's "AUX PWR" jack.

3.3 Toshiba Common Serial ASD Network Installation

The gateway connects to each drive via the drive's common serial (logic level) communication port, typically located on either the main drive control board (G7, S11), on the front of the drive enclosure under a small snap-on cover (A7, S9), on the right-hand side of the drive enclosure under a small snap-on cover (S7), or on the bottom side of the drive enclosure (VF-nC1). Although in general no drive parameters need to be configured in order to use the gateway,

it is advantageous to check that the drive's common serial communication data rate is set to its maximum speed. Because the gateway will communicate to each drive only at the drive's configured data rate, this will provide the fastest response time for drive-to-network data transfers. For information on checking the drive's common serial communication data rate, refer to the appropriate manual supplied with your drive.

Note that the common serial communication parameters of each drive are handled independently by the gateway, which means that different drive families may be connected to different channels of the unit in any combination, and that the drives connected to each channel may simultaneously communicate to the unit at completely different baud rates, parity settings, etc.

Drives can be connected to the gateway on any ASD channel in any order or combination. When more than one drive is connected to the unit, or if the optional auxiliary power supply is used, the gateway will draw its control power from the source with the highest power supply voltage.

Installation of the gateway should only be performed by a qualified technician familiar with the maintenance and operation of the connected drives. To install the gateway, complete the steps outlined in the following sections related to your specific drive.

3.3.1 Installation for G7 ASDs

1. Mount the unit via the desired method (refer to section 3.1).
2.  **CAUTION!** Verify that all input power sources to the drives to be connected have been turned OFF and are locked and tagged out.
3.  **DANGER!**  Wait at least 5 minutes for the drive's electrolytic capacitors to discharge before proceeding to the next step. **Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.** Verify that the CHARGE LED has gone out before continuing the installation process.
4. Remove the drive's front cover / open the drive's cabinet door (refer to the appropriate drive manual for instructions how to do this).
5. The drive's LCD panel (also called the "Electronic Operator Interface" or "EOI") can communicate with the drive via either the RS485/RS232 channel (CNU1/CNU1A) or the common serial channel (CNU2/CNU2A). Because the gateway uses the common serial channel, the LCD panel must be configured to use the RS485/RS232 channel. If the drive to be connected is currently using CNU2 (on the drive control board) and CNU2A (on the LCD panel), then this connection must first be switched

over to CNU1 (on the drive control board) and CNU1A (on the LCD panel). Refer to Toshiba's documentation for any precautions or notices regarding this connection change. If the LCD panel is already connected via the RS485/RS232 channel, then no change is required.

6. Configure the drive's LCD panel to communicate via the RS485/RS232 channel by setting parameter "Communication Setting Parameters...Communication Settings...Select LCD Port Connection" to "RS485/232 serial".
7. Connect the drive's common serial communication port (CNU2) to one of the ASD channels of the gateway with the communication cable (communication cable is not included with the gateway kit). When choosing cables for this connection, standard 24 AWG category 5 (CAT5) unshielded twisted-pair (UTP) 8-conductor cables found in Ethernet networks in most office environments can be used. The maximum allowable length for these cables is 5 meters. Although there are many varieties and styles of CAT5 UTP cables available, ICC strongly recommends using only high-quality cables from reputable manufacturers to guarantee optimal noise immunity and cable longevity. Ensure that each end of the cable is fully seated into the modular connectors, and route the cable such that it is located well away from any drive input power or motor wiring. Also take care to route the cable away from any sharp edges or positions where it may be pinched.
8. Reinstall the drive's front cover / close the drive's cabinet door.
9. Repeat steps 2-8 to connect other drive(s) as needed.
10. Connect the other various networks to their respective plugs/terminal blocks. Ensure that any terminal blocks are fully seated into their respective headers, and route the network cables such that they are located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.
11. If an auxiliary power supply is going to be used, connect it to the gateway's "AUX PWR" jack.
12. Take a moment to verify that the gateway and all network cables have sufficient clearance from drives, motors, or power-carrying electrical wiring.
13. Turn the power sources to all connected drives ON, and verify that the drives function properly. If the drives do not appear to power up, or do not function properly, immediately turn power OFF. **Repeat steps 2 and 3 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

3.3.2 Installation for S7, S9, S11, A7 and VF-nC1 ASDs

1. Mount the unit via the desired method (refer to section 3.1).
2.  **CAUTION!** Verify that all input power sources to the drives to be connected have been turned OFF and are locked and tagged out.
3.  **DANGER!**  Wait at least 5 minutes for the drive's electrolytic capacitors to discharge before proceeding to the next step. **Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.** Verify that the CHARGE LED has gone out before continuing the installation process.
4. Remove the drive's common serial communication port cover if it has one (refer to the appropriate drive manual for instructions how to do this). Do not discard this cover, as it should be reinstalled to minimize contamination of the port's electrical contacts if the gateway is ever disconnected from the drive.
5. Connect the drive's common serial communication port to one of the ASD channels of the gateway with the communication cable (communication cable is not included with the gateway kit). When choosing cables for this connection, standard 24 AWG category 5 (CAT5) unshielded twisted-pair (UTP) 8-conductor cables found in Ethernet networks in most office environments can be used. The maximum allowable length for these cables is 5 meters. Although there are many varieties and styles of CAT5 UTP cables available, ICC strongly recommends using only high-quality cables from reputable manufacturers to guarantee optimal noise immunity and cable longevity. Ensure that each end of the cable is fully seated into the modular connectors, and route the cable such that it is located well away from any drive input power or motor wiring. Also take care to route the cable away from any sharp edges or positions where it may be pinched.
6. Repeat steps 2-5 to connect other drive(s) as needed.
7. Connect the other various networks to their respective plugs/terminal blocks. Ensure that any terminal blocks are fully seated into their respective headers, and route the network cables such that they are located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.
8. If an auxiliary power supply is going to be used, connect it to the gateway's "AUX PWR" jack.
9. Take a moment to verify that the gateway and all network cables have sufficient clearance from drives, motors, or power-carrying electrical wiring.

10. Turn the power sources to all connected drives ON, and verify that the drives function properly. If the drives do not appear to power up, or do not function properly, immediately turn power OFF. **Repeat steps 2 and 3 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

4. RS485 Port Electrical Interfaces

In order to ensure appropriate network conditions (signal voltage levels, etc.) when using the gateway's RS485 ports, some knowledge of the network interface circuitry is required. Refer to Figure 4 for a simplified network schematic of the RS485 interface circuitry. Note that the "Shield" terminal has no internal connection: its purpose is simply to provide a cable shield chaining location between devices. The shield is then typically connected to ground at one location only.

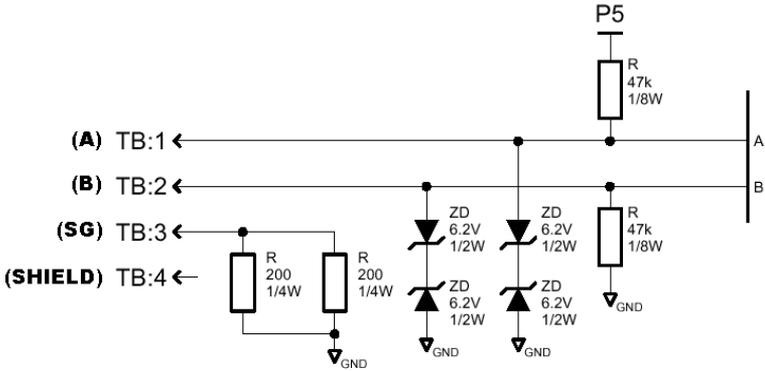


Figure 4: RS485 Interface Circuitry Schematic

Figure 5 details the specific network connections to the RS485 terminal block. This connection scheme applies equally to both RS485 ports.

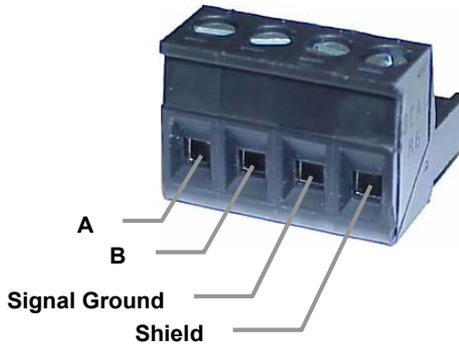


Figure 5: RS485 Terminal Block Connections

5. 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	Non-isolated, referenced to power source ground
Cooling Method	Self-cooled

6. Maintenance and Inspection

Preventive maintenance and inspection is required to maintain the gateway in its optimal condition, and to ensure a long operational lifetime. Depending on usage and operating conditions, perform a periodic inspection once every three to six months. Before starting inspections, disconnect all power sources.

Inspection Points

- Check that the network cable(s) are properly terminated in the terminal block(s), and ensure that pluggable terminal blocks are fully seated in their headers. Reseat if necessary.
- Check that there are no defects in any attached wire terminal crimp points. Visually check that the crimp points are not damaged or loose.
- Visually check all wiring and cables for damage. Replace as necessary.
- Clean off any accumulated dust and dirt.
- If use of the gateway is discontinued for extended periods of time, apply power at least once every two years and confirm that the unit still functions properly.
- Do not perform hi-pot tests on the gateway, as they may damage the unit.

Please pay close attention to all periodic inspection points and maintain a good operating environment.

7. Storage and Warranty

7.1 Storage

Observe the following points when the gateway is not used immediately after purchase or when it is not used for an extended period of time.

- Avoid storing the unit in places that are hot or humid, or that contain large quantities of dust or metallic dust. Store the unit in a well-ventilated location.
- When not using the unit for an extended period of time, apply power at least once every two years and confirm that it still functions properly.

7.2 Warranty

The gateway is covered under warranty by ICC, Inc. for a period of 12 months from the date of installation, but not to exceed 18 months from the date of shipment from the factory. For further warranty or service information, please contact Industrial Control Communications, Inc. or your local distributor.

8. LED Indicators

The gateway contains several different LED indicators, each of which conveys important information about the status of the unit and connected networks. These LEDs and their functions are summarized here.

8.1 Toshiba ASD Common Serial Port Indicators

Each Toshiba ASD common serial port RJ45 connector has two LEDs positioned immediately above them (1 green and 1 red).

Green LED.....Indicates “drive link”. Solid green when a logical connection exists with the attached drive (i.e. the gateway is reading data from the drive).

Red LEDData write. Flashes briefly when data is written to the drive from the point database.

8.2 RS485 Port Indicators

Each RS485 port has one red and one green LED situated next to its respective terminal block.

Green LED.....Lights when the gateway is transmitting data on the port.

Red LEDLights when the gateway is receiving data on the port (note that this does not indicate the validity of the data with respect to a particular protocol: only that data exists and is being detected.)

9. Configuration Switches

There are two configuration DIP switches (marked “CFG”) located on the unit near the RS232 port.

Switch #1Firmware update switch. Place in “OFF” position for normal operation, and in the “ON” position only when new firmware is to be downloaded to the unit. Refer to section 14 for more information.

Switch #2RS232 port selection switch. When “OFF” at unit startup, the RS232 port will act as the serial console, regardless of the port’s configuration or protocol assignment (refer to section 12 for more information on the serial console). When “ON” at unit startup, the RS232 port carries whatever protocol (if any) was assigned to it at configuration time. Note that the state of this switch is only detected when the gateway boots up.

10. Auxiliary Power Supply

The ICC part #10456 120VAC/9VDC power supply can be used to power the unit via the AUX PWR input. If providing your own auxiliary power supply, ensure that it adheres to the following specifications:



Connection diagram
Voltage rating 9 - 40VDC
Current rating 500mA (@9VDC)

The gateway's AUX PWR input uses the CUI, Inc. PJ-002A (2.1mm x 5.5mm) or equivalent DC power jack, which mates with the PP-002A (2.1mm x 5.5mm) or equivalent power plug.

11. Unit Configuration Concepts

11.1 Port and Protocol Configuration

Each of the communication ports can be individually configured or enabled/disabled. It is important to note that the ports function independent of one another, and can operate simultaneously. For example, a Modbus RTU slave request on RS485A, and an ASD1 request can simultaneously access the same internal point.

Although each communication port can be configured via the serial console interface, their configuration selections vary slightly. The Toshiba ASD common serial ports have a simple enable/disable selection. The RS232 and RS485 ports can be disabled, or can have one of a selection of control protocols assigned to them.

Along with the protocol selection for the RS232/RS485 ports, each of these ports also has a corresponding baudrate, parity, address assignment and timeout time assignment. Note that not all assignable protocols support the same range of configuration options: therefore be sure to assign a valid entry in all cases (for example, a Modbus RTU slave's "address" assignment must be in the range 1-247 to comply with the Modbus specification). Also note that certain protocols may not make use of all available configuration options (e.g. certain protocols operate only at one specified baudrate regardless of the "baudrate" selection value). The protocol-specific sections of this manual will document these cases.

11.2 Timeout Configuration

The gateway's points can be configured to perform a specific set of actions when primary communications are lost on one or more of its various networks. This allows each point to have its own unique "fail-safe" condition in the event of a network interruption. There are three separate elements that define the network timeout behavior:

- A port's network timeout time
- A point's "Timeout Enable" selection
- A point's "Timeout Value" setting

The **timeout time** is adjustable in 1s increments from 0 to 500s.

The default timeout time in all cases is 0, which disables network timeout handling. When nonzero, timeout processing does not begin until after a valid network packet has been received by the unit on that port.

When the timeout time is nonzero and a communication interruption is detected, the **timeout enable** selections for each point are inspected. Those

points that are found to have their timeout enable selections set to “enabled” will then have their configured **timeout values** automatically written to their assigned “source port” objects. This mechanism provides for a flexible set of device failsafe conditions to be established on a point-by-point basis.

11.3 Point Configuration

As mentioned in section 1, the Network Gateway Series concept revolves around a central “point database”, containing the value and access characteristics for each network. With respect to the Network Gateway Series, a “point” is simply an object that defines some sort of network access, mapping and configuration data, as well as a single “value” attribute that can be read from or written to by various communication ports or protocols.

The only restriction placed on this “central clearinghouse” concept is that only one port can autonomously update the point’s value, “mirroring” its designated object for other protocols to access. What this means is that although any protocol can read from or write to a point’s internal value, most of the time that point’s value will simply be mirroring a remote data object that resides on one of the gateway’s subnets. The selection of what a specific point is to mirror is performed via its “source port” selection.

For example, a point may be configured to contain Toshiba ASD parameter mapping and Modbus master ID and holding register mapping information. However, because both of these protocols act as “master” protocols, only one of them can be allowed to continuously update the point’s value. If both master protocols could simultaneously update the point’s internal value, it would erratically alternate back and forth between the values designated by the Toshiba parameter and Modbus holding register objects. Any “slave” protocol (Modbus RTU slave, Metasys N2 etc.) can read from or write to a point at any time, but only the protocol designated by the point’s “source port” assignment will autonomously update the point’s value independent of any other protocol traffic.

The “source port” designation also determines where a new point value will be written to when a “slave” protocol writes a new value to the point. For example, if a Modbus RTU slave connection is used to write new data that changes the value of a point, how do we know where this new value will exit the gateway to arrive at its final destination? The answer is that any new point values written by “slave” protocols will generate “write” transactions only on the “source port”.

This concept may best be further explained by way of a representative scenario. For example, let’s assume that the gateway’s RS485A port has been designated to be a Modbus Master. Let’s further assume that the “Modbus Master” portion of point #5 indicates an “Address” value of 8 and “Register” value of 14, and that point #5’s “Source Port” selection is set to “RS485A”. What this means is that independent of any other gateway traffic, point #5 will continuously attempt to update its internal value by making requests to the

RS485A port. And, because the RS485A port has been designated as a Modbus Master, then the “Modbus Master” portion of point #5’s configuration will be referenced by the update task, and point #5’s value will therefore always be mirroring the value of holding register #14 of remote Modbus station address #8 connected to the Modbus subnet attached to the gateway’s RS485A port. Perhaps holding register #14 of Modbus station address #8 is a monitor item, indicating the pressure in compressor tank. Whenever the tank’s pressure changes, therefore, the value of point #5 will automatically update to reflect the new value read from the remote device. Once the tank’s pressure reading has been brought into the gateway, it can then be retrieved by any protocol (or ALL the protocols) currently assigned to the gateway’s other communication ports.

As a modification to the previous example, let’s assume this time that holding register #14 of Modbus remote station address #8 is the speed command of a conveyor belt. In this case, point #5 of the gateway will be mirroring the current speed command of the conveyor, in a similar fashion to how it previously mirrored the compressor tank’s pressure. This time, however, the speed command represents something that can also be written to. Therefore, any new data value that is written to point #5 from any other port connection will automatically cause a “write holding register” transaction to occur on the RS485A Modbus master port, updating the value of holding register #14 on remote Modbus station #8, causing the conveyor to accelerate (or decelerate) to the new speed.

Note that it is also perfectly acceptable to have a point’s “source port” assigned to “NONE”. All this means that this point will not be autonomously updated (i.e. that it will not automatically mirror anything.) In a sense, it will simply be “scratchpad memory” that the various ports and protocols can use to exchange information among themselves.

Although the various configuration possibilities may seem overwhelming at first, it is clear that the gateway can perform powerful and flexible routing algorithms. Through configuration experience, the “in” and “out” data flows will become more clear.

11.4 General Configuration Procedure

Now that we have had a brief tutorial on port and point configuration, we can proceed on to how these elements fit into the overall configuration procedure. The general configuration procedure steps can be summarized as follows:

1. Access the serial console configuration interface via Hyperterminal or other text-based console program.
2. Assign (or enable/disable) the desired protocols and their characteristics to the specific communication ports.
3. Perform the desired per-protocol mapping and definition assignments for each point, including the name, timeout and “source port” assignments.
4. Exit the serial console, which will update the gateway’s internal configuration file and reboot the unit.

5. Download a copy of the unit's configuration file to your PC for backup purposes

Of course, it is possible to simplify or even eliminate some of these steps by starting your configuration from a pre-existing point database file (either downloaded from the internet or previously-created by the user), and then simply modifying those elements necessary to match your application.

12. Console Access

12.1 RS232

The console is accessible via an RS232 interface for direct connection to a computer's serial (COM) port. This is performed by connecting the unit's RS232 port to the computer's serial port via a standard straight-thru serial cable.

12.1.1 Requirements

All that is needed is a computer with a serial (COM) port containing some sort of communications software (such as HyperTerminal, included with Microsoft Windows operating systems) and a straight-thru serial cable, such as the Belkin 6' serial extension cable (Belkin part #F2N209-06). Refer to Figure 6 for a representative example cable. Any communications software and PC will work, provided they support ASCII communications at 38.4kbaud.



Figure 6: A Typical Serial Extension Cable

12.1.2 Connection

Connect one end of the serial cable to the gateway's RS232 port, and connect the other end to the computer's serial port. Make sure that CFG DIP switch #2 is in the "OFF" (left) position to force the RS232 port to act as the serial console. If the unit is currently using the RS232 port for control protocol communication, then it must be rebooted (powered down and then back up again) with CFG switch #2 in the OFF position to enable the serial console on the RS232 port.

12.1.3 Application Configuration

As previously mentioned, any PC communication software and PC serial port can be used. The software configuration example given here will be for Windows HyperTerminal communicating via COM1.

Figure 7 shows the “Connect To” tab of the properties window for COM1. Figure 8 shows the window that appears when “Configure” is selected in the “Connect To” tab. Figure 9 shows the “Settings” tab of the properties window. Most of these settings are their default values: usually the only change needed is the “Bits per second” setting shown in Figure 8.

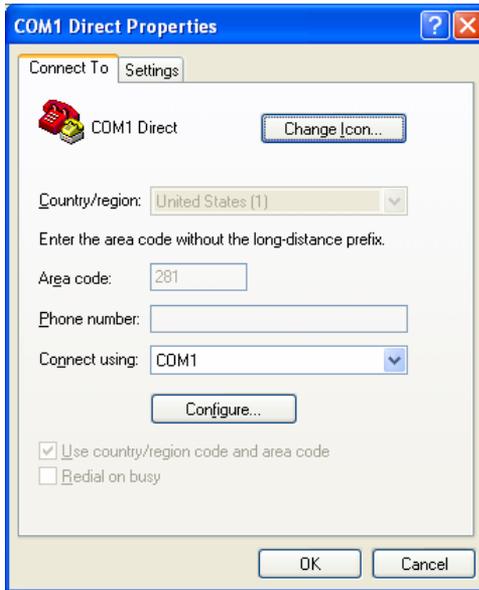


Figure 7: HyperTerminal Properties...Connect To

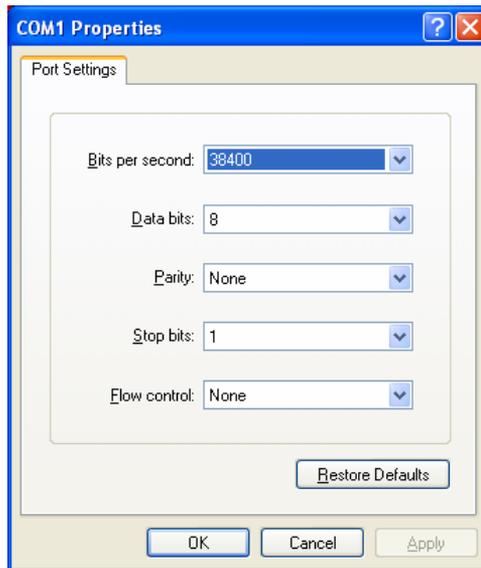


Figure 8: HyperTerminal Properties...Connect To...Configure

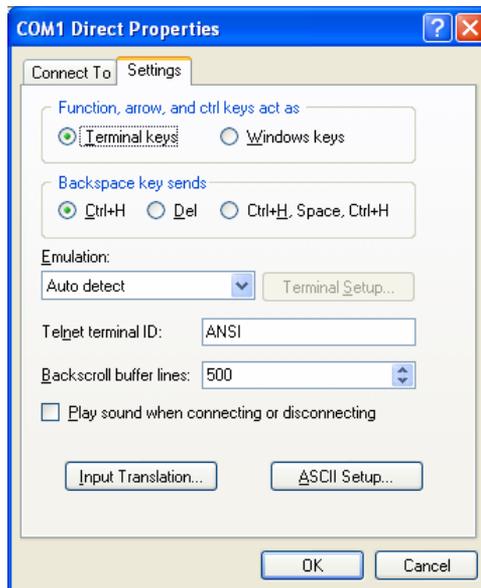


Figure 9: HyperTerminal Properties...Settings

12.2 Invocation

The console provides standard access and editing methods for the various configuration items (ports, points and their associated attributes). It is important to note that whenever you modify the point database and are ready to restart the gateway (“exit”), you must save the database to the internal file system prior to restarting or your changes will be lost. The console will automatically ask you if you would like to save the database to the file system every time you exit even if you did not modify it. If the database was unchanged, then saving is not required. Before modifying the configuration, it is a recommended practice to download a configuration file to your PC for backup purposes, so that the original configuration can be restored if any unintended changes are made.

To enter the console, simply type “menu” and press the Enter key. You will then be notified that all communication tasks will be terminated for the duration of the editing (refer to Figure 10). It is important to ensure that all connected devices are in a safe state such that loss of communications will not pose a danger to equipment or personnel. Exiting the console will reset the gateway and restart network communications using the current configuration data.

At most console prompt locations, typing “x” will return you to the previous menu, and typing “menu” will return you to the main menu. Also note that console commands are not case-sensitive.

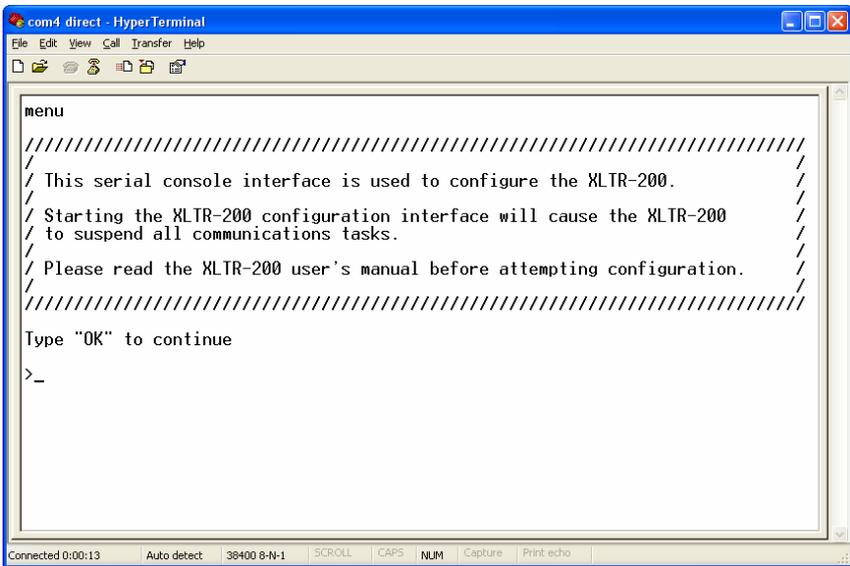
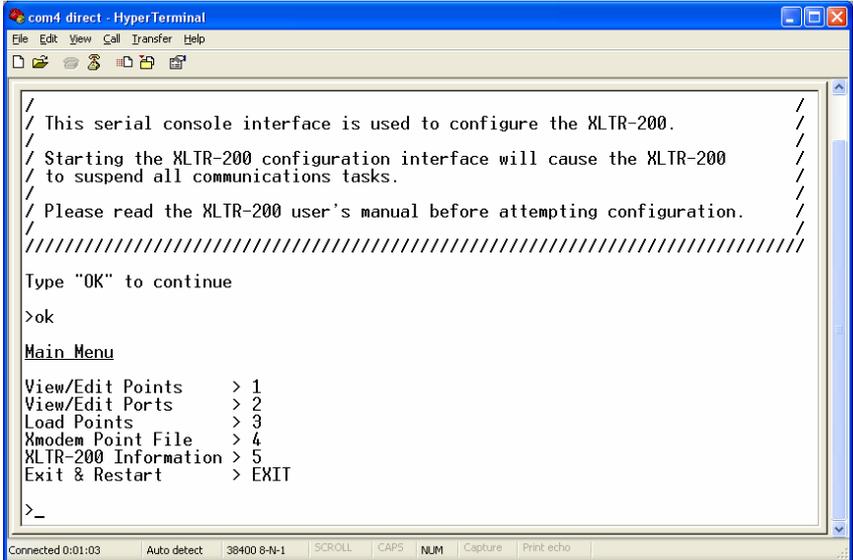


Figure 10: Console Invocation

12.3 Main Menu

The main menu is shown in Figure 11. All gateway configuration is performed by “drilling down” into progressively lower-level menus.



```

com4 direct - HyperTerminal
File Edit View Call Transfer Help
[Icons]
/
/ This serial console interface is used to configure the XLTR-200.
/
/ Starting the XLTR-200 configuration interface will cause the XLTR-200
/ to suspend all communications tasks.
/
/ Please read the XLTR-200 user's manual before attempting configuration.
/
/
/
/
/
Type "OK" to continue
>ok
Main Menu
View/Edit Points > 1
View/Edit Ports > 2
Load Points > 3
Xmodem Point File > 4
XLTR-200 Information > 5
Exit & Restart > EXIT
>_
Connected 0:01:03 Auto detect 38400 8-N-1 SCROLL CAPS NUM Capture Print echo

```

Figure 11: Console Main Menu

All navigation and data entry commands are input by simply entering the menu selection number to the right of the “>” symbol along with any required data fields at the console prompt. In Figure 11, for example, entering the menu selection number “1” (without the quotation marks) will bring up the View/Edit Points submenu. Throughout this manual, example console entry strings will be provided enclosed in quotation marks to delineate them from the description text: whenever actually entering the console strings, however, do not include the quotation marks.

When additional data fields are required with a data entry command, they will be indicated by square brackets (“[...]”) after the menu selection number. All data entry commands and data fields must be separated by spaces. Because data entry commands and data fields are delineated by spaces, spaces are therefore not allowed within data fields (such as name strings). In these cases, it is usually convenient to use an underscore “_” in place of a space. For example, attempting to enter a point’s name as “My point” would result in an error, but “My_point” would be perfectly acceptable.

12.3.1 View/Edit Points

Main menu selection number 1 displays a screen which shows a summary of the current point configuration (see Figure 12). This screen only displays the point number and the point name: in order to access more detailed point information, menu selection number 1 “Edit/View a Point” must be entered with the additional argument of the targeted point’s number. The syntax used to edit/view point #1 is shown at the bottom of Figure 12.

Only 10 points are shown at a time (of 100 total available in the unit). Menu selection 2 “More Points” allows the next 10 points to be viewed.

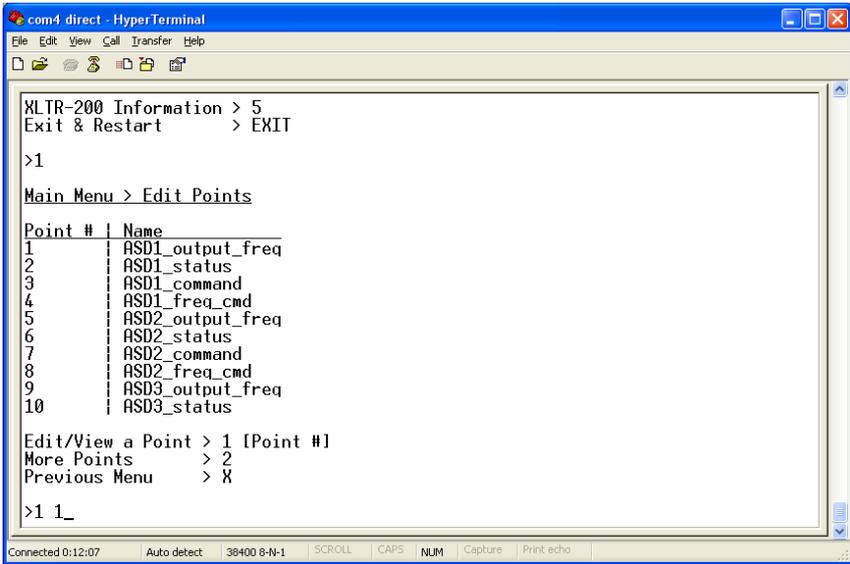


Figure 12: View/Edit Points

Entering “1” with a point’s number (such as “1 1”, as shown at the bottom of Figure 12) at the Edit Points submenu will display and allow editing of that point’s mapping and definition information. Refer to Figure 13 for an example.

When editing a point, the top half of the screen (menu selections 1-4) contains point definitions that are protocol-independent. The bottom half of the screen (menu selections 5-9) contains the menu options for editing point definitions that are protocol-specific.

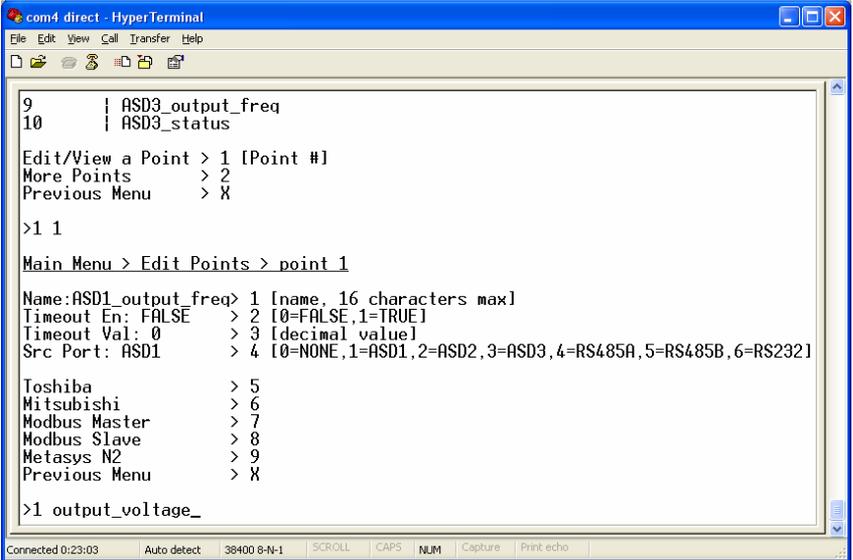


Figure 13: Edit a Point

- **Edit Name:** Menu selection number 1 allows you to change the point's name. For example, the bottom of Figure 13 shows an example of changing point #1's name to output_vo1tage. The point's name is purely for user recognition of a point, and has no bearing upon communications functionality. To clear the point's name field, just enter the menu selection ("1") with no additional argument.
- **Edit Timeout Enable:** Menu selection number 2 allows you to change the point's timeout enable selection. Refer to section 11.2 for more information about timeout processing.
- **Edit Timeout value:** Menu selection number 3 allows you to change the point's timeout data value. Refer to section 11.2 for more information about timeout processing.
- **Edit Source Port:** Menu selection 4 allows you to change the point's source port. Refer to section 11.3 for more information about source ports.
- **Edit Toshiba, Mitsubishi, Modbus, Metasys:** Menu selections 5-9 allow you to edit/view protocol-specific point attributes. Enter the menu selection corresponding to the protocol you wish to edit/view.

Toshiba Point Attributes

```

COM1 Direct - HyperTerminal
File Edit View Call Transfer Help
Main Menu > Edit Points > point 3
Name:ASD1_command > 1 [name, 16 characters max]
Timeout En: FALSE > 2 [0=FALSE,1=TRUE]
Timeout Val: 0 > 3 [decimal value]
Src Port: RS485A > 4 [0=NONE,1=ASD1,2=ASD2,3=ASD3,4=RS485A,5=RS485B,6=RS232]

Toshiba > 5
Mitsubishi > 6
Modbus Master > 7
Modbus Slave > 8
Metasys N2 > 9
Previous Menu > X

>5
Main Menu > Edit Points > point 3 > Toshiba
Address: 1 > 1 [decimal value]
Parameter: FA00 > 2 [hexadecimal value]
Previous Menu > X

>2 FA04_

```

Figure 14: Edit Toshiba Attributes

- Edit Address:** Menu selection 1 allows you to edit the network address of the Toshiba ASD that this point refers to. This address field is only used in conjunction with the Toshiba RS485 protocol: Toshiba common-serial port connections are point-to-point, and therefore do not require targeting a drive at a specific address.
- Edit Parameter:** Menu selection 2 allows you to edit the Toshiba ASD parameter that this point will access. Figure 14 shows an example of how to change the current setting of FA00 to FA04 (which would be a typical change if the Toshiba RS485 protocol were to be used with this point). Note that Toshiba parameter values must be entered in hexadecimal format.

Mitsubishi Point Attributes

```

com4 direct - HyperTerminal
File Edit View Call Transfer Help
Main Menu > Edit Points > point 1
Name:ASD1_output freq> 1 [name, 16 characters max]
Timeout En: FALSE > 2 [0=FALSE,1=TRUE]
Timeout Val: 0 > 3 [decimal value]
Src Port: ASD1 > 4 [0=NONE,1=ASD1,2=ASD2,3=ASD3,4=RS485A,5=RS485B,6=RS232]

Toshiba > 5
Mitsubishi > 6
Modbus Master > 7
Modbus Slave > 8
Metasys N2 > 9
Previous Menu > X

>6
Main Menu > Edit Points > point 1 > Mitsubishi
Address: 1 > 1 [decimal value]
Parameter: 1 > 2 [decimal value]
Previous Menu > X

>2 1001

```

Connected 0:51:06 Auto detect 38400 8-N-1 SCROLL CAPS NUM Capture Print echo

Figure 15: Edit Mitsubishi Attributes

- **Edit Address:** Menu selection 1 allows you to edit the network address of the Mitsubishi ASD that this point refers to.
- **Edit Parameter:** Menu selection 2 allows you to edit the Mitsubishi ASD parameter that this point will access. Figure 15 shows an example of how to change the current setting of 1 to 1001.

Modbus Master Point Attributes

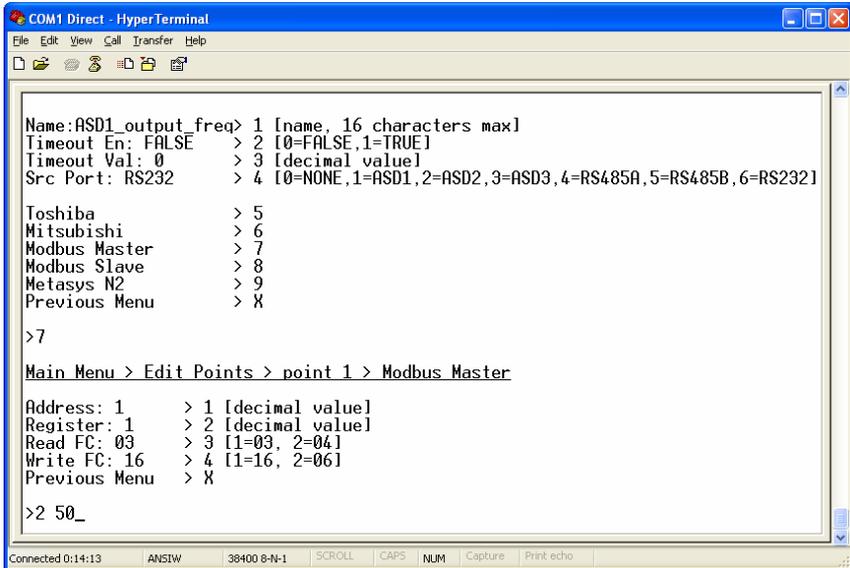


Figure 16: Edit Modbus Master Attributes

- **Edit Address:** Menu selection 1 allows you to edit the network address of the Modbus slave that this point refers to.
- **Edit Register:** Menu selection 2 allows you to edit the Modbus holding register or input register that this point will access. The type of register accessed (holding or input) will be determined on the basis of the “Read FC” setting (see below). Figure 16 shows an example of how to change the current setting of holding register 1 to holding register 50.
- **Read FC:** Menu selection 3 allows you to choose the Modbus “read” function code that will be used to read from the designated register. The default setting of function code 03 (read holding registers) will access a holding register on the remote device. By selecting function code 04 (read input registers), a Modbus input register will be accessed instead.
- **Write FC:** Menu selection 4 allows you to choose the Modbus “write” function code that will be used to write to the designated holding register (this setting does not apply to input registers, as they are read-only). The default setting is function code 16 (preset multiple registers). Alternatively, this setting can be changed to function code 06 (preset single register) in order to connect to those Modbus slave devices that do not support function code 16.

Modbus Slave Point Attributes

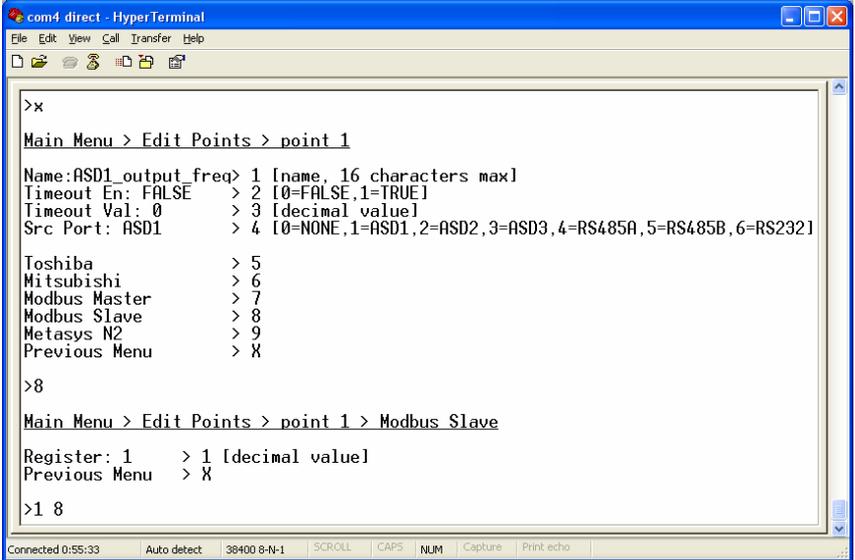


Figure 17: Edit Modbus Slave Attributes

- Edit Register:** Menu selection 1 allows you assign a Modbus holding register to this point. Figure 17 shows an example of how to change the current setting of 1 to 8.

Metasys N2 Point Attributes

```

com4 direct - HyperTerminal
File Edit View Call Transfer Help
Name:ASD1_output freq> 1 [name, 16 characters max]
Timeout En: FALSE > 2 [0=FALSE,1=TRUE]
Timeout Val: 0 > 3 [decimal value]
Src Port: ASD1 > 4 [0=NONE,1=ASD1,2=ASD2,3=ASD3,4=RS485A,5=RS485B,6=RS232]

Toshiba > 5
Mitsubishi > 6
Modbus Master > 7
Modbus Slave > 8
Metasys N2 > 9
Previous Menu > X

>9

Main Menu > Edit Points > point 1 > Metasys N2

Object Type: AI > 1 [0=NONE,1=AI,2=BI,3=AO,4=BO]
Object Num: 1 > 2 [decimal value]
Multiplier: 0.01 > 3 [float value]
Bit Mask: 0 > 4 [hex value]
Previous Menu > X

>1 3_

```

Figure 18: Edit Metasys N2 Attributes

- **Edit Object Type:** Menu selection 1 allows modification of the object type. Figure 18 shows an example of how to change the current setting of AI to AO.
- **Edit Object Number:** Menu selection 2 allows modification of the object number. The current configuration as indicated in Figure 18 shows that point #1 is configured to be AI #1.
- **Edit Multiplier:** Menu selection 3 allows modification of the multiplier to be used with analog (AI or AO) objects. This setting has no effect when the point is configured to be a binary (BI or BO) object.
- **Edit Bit Mask:** Menu selection 4 allows modification of the bit mask to be used with binary (BI or BO) objects. This setting has no effect when the point is configured to be an analog (AI or AO) object. Note that the bit mask is displayed and entered as a hexadecimal value (e.g. to mask bits #15 and #10, a value of “8400” must be entered).

12.3.2 View/Edit Ports

Main menu selection number 2 displays a screen which shows a summary of the current port configuration (see Figure 19). This screen only displays the current protocol selected for each port: in order to access more detailed port information, select the menu number corresponding to the desired port. Menu selections 1-3 correspond to the Toshiba ASD ports, and these contain no other port configuration other than enable/disable. The syntax used to disable port ASD1 is shown at the bottom of Figure 19.

```

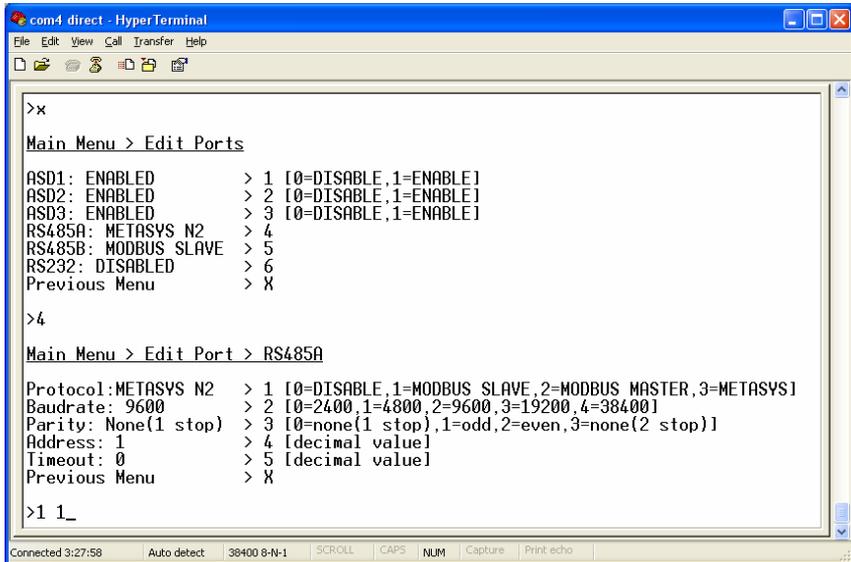
com4 direct - HyperTerminal
File Edit View Call Transfer Help
Main Menu
View/Edit Points > 1
View/Edit Ports > 2
Load Points > 3
Xmodem Point File > 4
XLTR-200 Information > 5
Exit & Restart > EXIT
>2
Main Menu > Edit Ports
ASD1: ENABLED > 1 [0=DISABLE,1=ENABLE]
ASD2: ENABLED > 2 [0=DISABLE,1=ENABLE]
ASD3: ENABLED > 3 [0=DISABLE,1=ENABLE]
RS485A: METASYS N2 > 4
RS485B: MODBUS SLAVE > 5
RS232: DISABLED > 6
Previous Menu > X
>1 0_

```

Connected 1:26:51 | Auto detect | 38400 8-N-1 | SCROLL | CAPS | NUM | Capture | Print echo

Figure 19: View/Edit Ports

RS485/232 Port Configuration



```

com4 direct - HyperTerminal
File Edit View Call Transfer Help
Main Menu > Edit Ports
ASD1: ENABLED > 1 [0=DISABLE,1=ENABLE]
ASD2: ENABLED > 2 [0=DISABLE,1=ENABLE]
ASD3: ENABLED > 3 [0=DISABLE,1=ENABLE]
RS485A: METASYS N2 > 4
RS485B: MODBUS SLAVE > 5
RS232: DISABLED > 6
Previous Menu > X
>4
Main Menu > Edit Port > RS485A
Protocol:METASYS N2 > 1 [0=DISABLE,1=MODBUS SLAVE,2=MODBUS MASTER,3=METASYS]
Baudrate: 9600 > 2 [0=2400,1=4800,2=9600,3=19200,4=38400]
Parity: None(1 stop) > 3 [0=none(1 stop),1=odd,2=even,3=none(2 stop)]
Address: 1 > 4 [decimal value]
Timeout: 0 > 5 [decimal value]
Previous Menu > X
>1 1_

```

Figure 20: Edit Port Configuration

- Edit Protocol Selection:** Menu selection 1 allows you to change what serial protocol is running on the selected port. Note that not all ports run the same protocols. Figure 20 shows how to change the protocol selection from the current setting of Metasys N2 to Modbus slave.
- Edit Baudrate:** Menu selection 2 allows you to change the baudrate for the selected port. Note that the baudrate for some protocols is determined by the specification, and these will therefore ignore this setting.
- Edit Parity:** Menu selection 3 allows you to change the parity for the selected port. Note that the parity for some protocols is determined by the specification, and these will therefore ignore this setting.
- Edit address:** Menu selection 4 allows you to edit the network address that the selected port will respond to. This setting is applicable for slave protocols only.
- Edit Timeout:** Menu selection 5 allows you to edit the timeout time for the selected port. Refer to section 11.2 for more information on timeout processing.

12.3.3 Load Points

Main menu selection number 3 allows the retrieval of a predefined configuration into working memory and the flash file system (see Figure 21). Loading one of these configurations overwrites the existing point configuration.

The FLN application listed in menu selection 1 loads the predefined configuration detailed in section 13.6. Menu selection 2 returns the gateway's configuration to its factory default state.

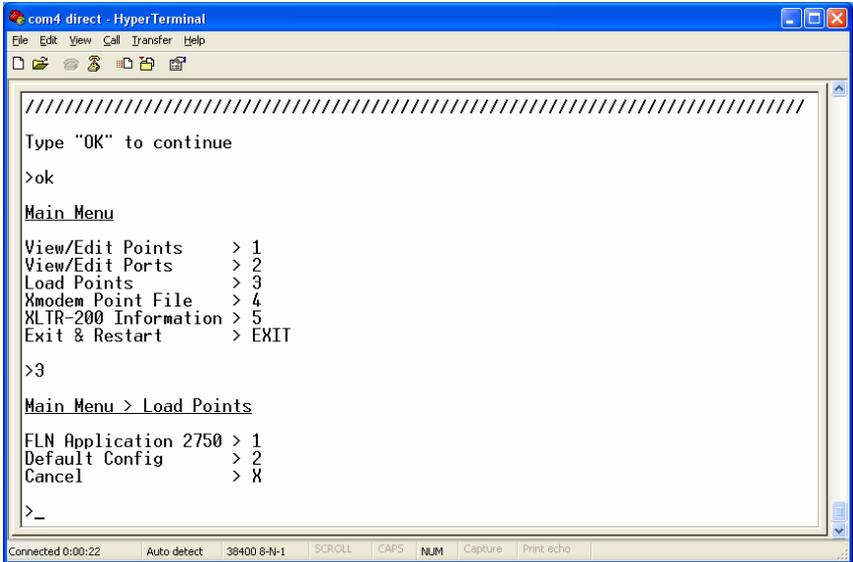


Figure 21: Loading a Point File

12.3.4 Xmodem Point File

Main menu selection number 4 gives access to the “xmodem” command, which allows unit configuration files to be transferred between the gateway and a PC. Whenever unit configuration is completed, it is strongly recommended 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. Configuration files contain all point and port settings. A downloaded configuration file can be uploaded to any compatible XLTR-200, allowing the user to clone multiple units with the same configuration.

Two different variations of the Xmodem protocol are supported (CRC and Checksum) for those serial communication packages that only support one or the other. However, some programs can automatically adapt to the user's

selection, making the specific Xmodem protocol selection arbitrary. The first argument of the xmodem command indicates the mode, and must be set to either "/crc" for Xmodem CRC mode, or "/cs" for Xmodem checksum mode.

As mentioned above, configuration files can be both downloaded and uploaded. The second argument in the xmodem command indicates the action to take, and must be set to either "/d" to download the configuration file from the unit, or "/u" to upload a configuration file to the unit.

Figure 22 shows an example of initiating an Xmodem download in CRC mode. Once the message "The XLTR-200 is ready to send its configuration file via Xmodem...Download the file now" appears, the user has 30 seconds to start the Xmodem download. This can be performed in HyperTerminal by clicking the "receive" button (📁) on the tool bar. Figure 23 shows the dialog box that will appear after clicking the "receive" button. Specify the folder in which to place the received file, select Xmodem as the receiving protocol, and click "Receive". One last dialog box will prompt the user to name the received file, and then the transfer will begin. This will only take several seconds to complete, and at the conclusion the console will indicate the status of the transfer and return to the entry menu.

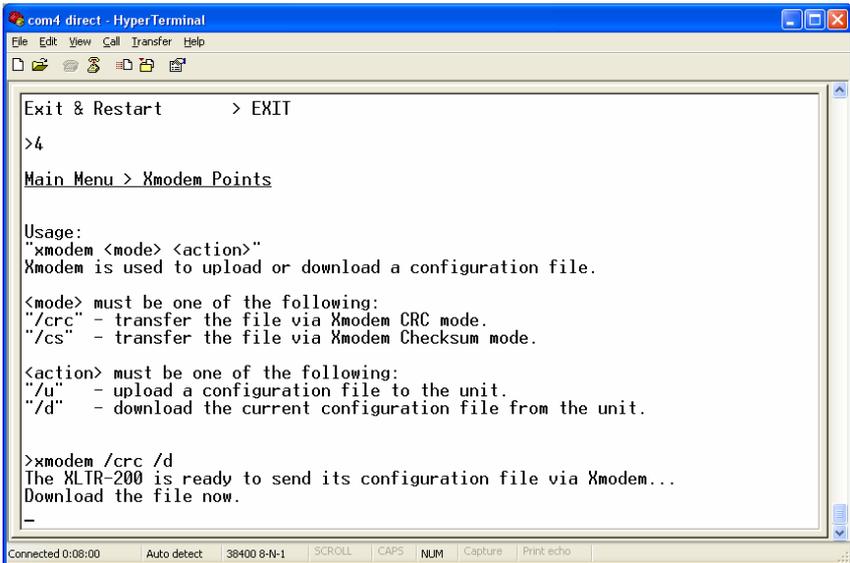


Figure 22: "Xmodem" Command Overview and Implementation



Figure 23: HyperTerminal receive file dialog box

When uploading a file, the procedure is similar to downloading. Enter “/u” instead of “/d” for the action parameter of the xmodem command. Once the xmodem upload command is entered, the user will have 30 seconds to click the “send” button (⏏) on the tool bar in HyperTerminal and initiate the Xmodem upload transaction. Upon successful completion of the Xmodem upload, the integrity of the file will be checked and, if valid, will be copied to both the unit’s working memory and flash file system. The previous configuration cannot be recovered (unless a corresponding configuration file exists, of course).

12.3.5 XLTR-200 Information

Main menu selection 5 provides some basic information about the gateway, such as firmware version (see Figure 24).

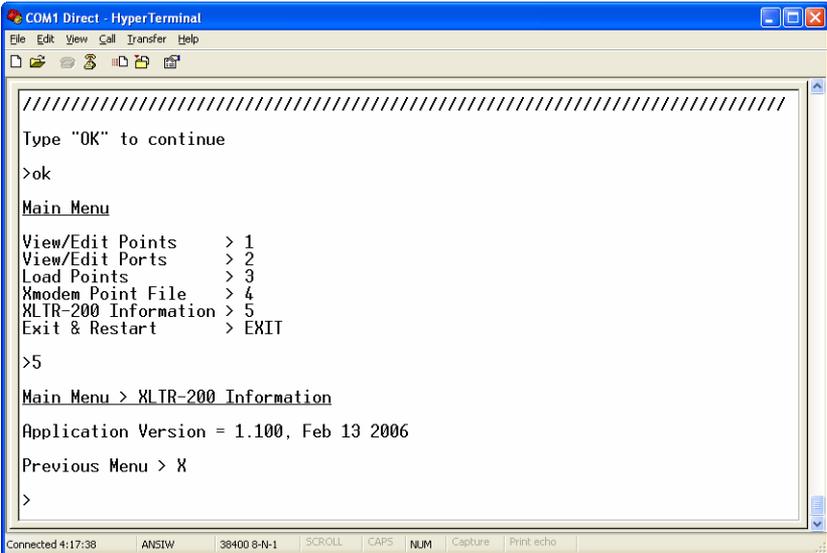


Figure 24: XLTR-200 Information

13. Protocol-Specific Information

This section will discuss topics that are specific to each of the available network selections.

13.1 Modbus

The gateway supports Modbus slave and master functionality via Modbus RTU. The slave implementations share common access methods, which is to say they support the same functions and reference the internal points via a common “Modbus Slave” holding register assignment. Other notes of interest are:

- Points are addressed by their assigned holding register (4X reference) via Modbus slave protocols.
- Points can access both holding registers (4X references) and input registers (3X references) via Modbus master protocols.
- Supported Modbus slave functions are indicated in Table 1.

Table 1: Supported Modbus Slave Functions

Function Code	Function
1	Read coils
3	Read multiple registers
5	Write coil
6	Write single register
15	Force multiple coils
16	Write multiple registers

- Register number entry radix is decimal (e.g. 10 = 10₁₀)
- Configuration tip: Improved network utilization may be obtained by appropriately grouping points into blocks having contiguous holding register assignments. In this way, the “read multiple registers” and “write multiple registers” functions can be used to perform transfers of larger blocks of registers using fewer Modbus transactions compared to a situation where the read/write registers were arranged in an alternating or scattered fashion.
- Because the transaction is handled locally within the gateway, 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 “source port”

object, no Modbus exception will be immediately returned. However, the point will always reflect the “source port” status and object value. In other words, if such an out-of-range write attempt is performed, the unsuccessful “source port” network write can be observed by reading the current (unchanged) value of the point during a subsequent Modbus transaction.

13.1.1 Coil Mappings

The Modbus slave implementation 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 Modbus holding registers. What this means is that when a coil is accessed, that coil is resolved by the gateway into a specific holding register, and a specific bit within that holding register. The pattern of coil-to-register/bit relationships can be described as follows:

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

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

$$\text{holding register} = \left\lfloor \frac{\text{coil} + 15}{16} \right\rfloor \quad \dots \text{Equation 1}$$

Where the bracket symbols “ $\lfloor \]$ ” 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 holding register in which that coil resides can be determined by:

$$\text{bit} = (\text{coil} - 1) \% 16 \quad \dots \text{Equation 2}$$

Where “coil” $\in [1 \dots 65535]$, “bit” $\in [0 \dots 15]$, 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).

From these equations, it can be seen that the largest holding register number that can be accessed via this coil-to-register mapping method is 4096 (which contains coil 65535).

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 holding register #3, as $\lfloor 3.0625 \rfloor = \lfloor 3 \text{ r}1 \rfloor = 3$. Then, using Equation 2, we can determine that the bit within holding register #3 that coil #34 targets is $(34-1)\%16 = 1$, as $33\%16 = \text{mod}(3 \text{ r}1) = 1$. Therefore, reading coil #34 will return the value of holding register #3, bit #1.

Note that this coil-to-register/bit relationship holds true regardless of whether or not holding register #3 is assigned to a point. If holding register #3 is not assigned to a point, then a Modbus exception will be returned. Either way, coil #34 will always access holding register #3, bit #1.

13.1.2 Modbus RTU Slave

- Broadcast (for functions 5, 6, 15 and 16) is supported.
- Network characteristics selections
 - Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
 - Parity: odd / even / none (1 stop bit) / none (2 stop bits)

13.1.3 Modbus RTU Master

- Supported Modbus master functions are indicated in Table 2. These functions are automatically invoked by the gateway in response to point read or write requests. The specific read or write function code used depends on the point’s assigned configuration.

Table 2: Supported Modbus Master Functions

Function Code	Function
3	Read multiple registers
4	Read input registers
6	Write single register
16	Write multiple registers

- The slave response timeout (in seconds) is assigned via the designated port’s “Timeout” selection. If “0” is chosen (an invalid timeout time), the gateway will use a 2s timeout by default.
- Network characteristics selections
 - Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
 - Parity: odd / even / none (1 stop bit) / none (2 stop bits)
- Note that various manufacturers will document their Modbus slave products in different ways. In particular, according to the Modbus specification, registers have two different indices at which they can be referenced: their “known as” value (which starts at number 1) and their “addressed as” value (which is always 1 less than the “known as” value). The “known as” value is typically the number that is presented for human entry or consumption, while the “addressed as” value is the number that appears “on the wire” when the Modbus packet is sent from master to

slave. This gateway follows this generally-accepted industry paradigm, where a point's configured Modbus master "register" value is decremented by 1 before it is placed "on the wire". Some vendors, however, will document their slave device's "addressed as" values in their literature, which means that these register indices must have 1 added to them when entered into the gateway's "Modbus master register" field.

For example, the Toshiba VF-AS1 drive's Modbus RTU slave protocol implementation & corresponding user's manual references all internal ASD parameters using "addressed as" values. This means that (in addition to the required conversion from Toshiba's native hexadecimal radix to the Modbus protocol's natural decimal radix) these parameter values must have 1 added to them when they are to be accessed via an ICC gateway executing the Modbus RTU master protocol.

e.g VF-AS1 "command 1" parameter is documented to be FA00 in the Toshiba literature. Converting this to decimal, we arrive at a value of 64000. To allow a point in the gateway's database to correctly access the "command 1" parameter via Modbus RTU, therefore, that point's Modbus master "register" attribute must be set to 64001 (which will result in an address value of 64000 (0xFA00) "on the wire").

13.2 Metasys N2

- The gateway acts as a Johnson Controls Metasys N2 slave, and supports N2 analog input, analog output, binary input and binary output object types.
- **Analog input (AI)** objects are used for monitoring analog status items. AI objects support low alarm limits, low warning limits, high warning limits, high alarm limits and differential values. Change of state (COS), alarm and warning functions can also be enabled. An AI object will accept an override command, but will not change its actual value or indicate override active. A “multiplier value” is associated with the object, and is multiplied to the point’s value to produce the floating-point AI value sent to the NCU (AI value = [point data value] X multiplier).
- **Analog output (AO)** objects are used for setting and monitoring analog control and configuration items. An AO value can be modified by issuing an override command. Issuing a release command will not cause the AO to automatically return to its pre-override value, nor will the AO automatically return to its pre-override value after a certain time period of no communication. A “multiplier value” is associated with the object, and the floating-point AO value is divided by this multiplier to produce the result that is passed on to a point’s value (point data value = [AO value] / multiplier).
- **Binary input (BI)** objects are used for monitoring discrete (digital) status items. BI objects support COS, alarm enabling and normal/alarm status indications. A BI object will accept an override command, but will not change its actual value or indicate override active. A “bit mask” is associated with the object, and is used to determine the current state of the BI by inspecting the point’s data at the bit location(s) indicated in the bit mask. If all of the bit locations of the point’s data value indicated by a “1” in the bit mask are set, then the BI’s current state is set to “1”. Else, it is set to “0”. The point data’s least-significant bit (LSB) is bit #0, and the most-significant bit (MSB) is bit #15.
- **Binary output (BO)** points are used for setting and monitoring discrete control and configuration items. A BO value can be modified by issuing an override command. Issuing a release command will not cause the BO to automatically return to its pre-override value, nor will the BO return to its pre-override value after a certain time period of no communication. A “bit mask” is associated with the object, and is used to determine the current state of the BO by modifying the point’s data at the bit location(s) indicated in the bit mask. When the BO’s current state is set to “1” by the NCU, then the bit(s) of the point’s data indicated by a “1” in the bit mask are set. Similarly, when the BO’s current state is set to “0” by the NCU, then the bit(s) of the point’s data indicated by a “1” in the bit mask are cleared. The point data’s least-significant bit (LSB) is bit #0, and the most-significant bit (MSB) is bit #15.

- The Metasys device type for the gateway is VND.
- Because the Metasys N2 protocol specifies strict response timing requirements, all accessible data objects must be designated as points, thereby making use of data mirroring.
- Network characteristics selections: not configurable according to the Metasys N2 specification.
- Because all transactions are handled locally within the gateway, write data checking is not available. For example, if a write to an object is performed, and the write data is out-of-range of the corresponding secondary network object, no N2 error will be immediately returned. However, the N2 object will always reflect the network status and data object value. In other words, if such an out-of-range write is performed, the unsuccessful write will be detected and the N2 object's value corrected. If COS is enabled for that object, the correction will be reported to the NCU upon the next COS poll request.
- The gateway can be configured to perform a specific set of actions for each AO or BO point when Metasys communications are lost. Metasys communications are said to be "lost" when the gateway does not receive any Metasys packets for a specified period of time, causing a "network timeout". Refer to section 11.2 for more information about configuring network timeout parameters.
- The gateway's RS485A port can be directly connected to the N2 bus by using twisted-pair cable connected as shown in Figure 25. Connect the N2+ wire to terminal "A", the N2- wire to terminal "B", and the cable shield to terminal "SHLD" on the gateway's terminal block. Although not available on all devices, it is also recommended to connect a network ground wire whenever possible. Continue this connection scheme throughout the remainder of the network. Always connect each unit in a daisy-chain fashion, without drop lines, star configurations, etc. For further N2 network wiring requirements and procedures, please refer to the appropriate JCI network installation documentation.

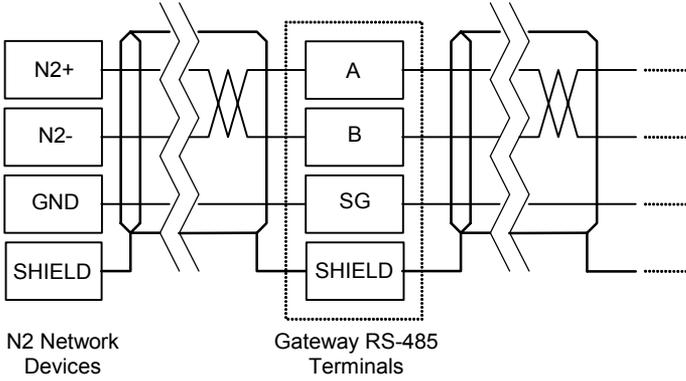


Figure 25: N2 Bus Cable Connection

13.3 Toshiba Common Serial ASD Protocol

- The gateway can act as a Toshiba ASD master via the dedicated common serial port connections. All Toshiba ASDs that include a common serial port are supported.
- No configuration is necessary, as the gateway automatically adapts to the ASD's configured characteristics.
- All parameter writes use the drive's RAM / EEPROM data write ("W") command. For all writes that target the drive's EEPROM, be sure to follow Toshiba's guidelines regarding the number of times a specific parameter can be written without risk of EEPROM damage.
- Point parameter number entry radix is hexadecimal (e.g. 10 = 0x0010 or 16₁₀)

13.4 Toshiba RS485 ASD Protocol

- The gateway can act as a Toshiba ASD master via its RS485 ports. All Toshiba drives that implement the Toshiba protocol and provide either a built-in or option-based RS485 port are supported.
- Because the gateway implements a 2-wire (half-duplex) RS485 network, the drive(s) involved must also be connected via 2-wire mode. Optionally, it is also possible to convert the gateway's network from 2-wire (half-duplex) to 4-wire (half-duplex) via an external repeater such as the 485OPIN from B&B Electronics (<http://www.bb-elec.com>).
- Note that Toshiba 7-series drives configured for 2-wire mode (F821=0) shipped prior to early 2006 may exhibit an issue that can cause their RS485 ports to stop communicating after a certain amount of time. Please contact Toshiba technical support to confirm your configuration prior to using 2-wire RS485 mode on these drives.
- The required drive configuration will vary depending on the specific drive(s) involved. In general, most parameters are freely configurable to match the gateway's port settings (baud rate, parity etc.) The most critical selection, however, is that if the drive is directly connected to the gateway via 2-wire mode, then the drive must be properly configured for 2-wire RS485. Note that this may involve hardware configuration in addition to parameter changes. For example, G7/Q7/H7-series drives have duplex selection jumpers located on the drive's control board near the communication ports. For these drives, both jumpers must be placed in the "HALF" position. Refer to Figure 26 for an example detailed view of correctly-positioned duplex selection jumpers.

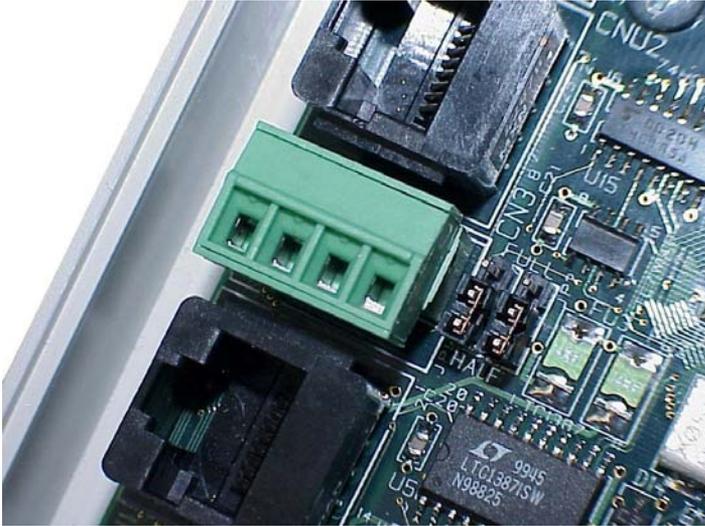


Figure 26: RS485 Terminal Block (CN3) and Duplex Selection Jumpers

- The Toshiba RS485 terminal block connections for G7/Q7/H7/W7 drives are shown in Figure 27 for reference only. Because there are many possible RS485 port configurations & options available for the various Toshiba drives, please refer to the relevant Toshiba documentation for your drive.

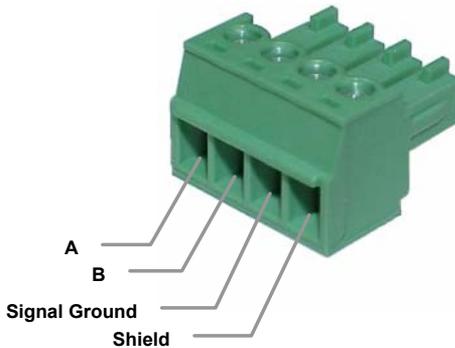


Figure 27: G7/Q7/H7/W7 RS485 Terminal Block (CN3) Connections

- All parameter writes use the drive's RAM / EEPROM data write ("W") command. For all writes that target the drive's EEPROM, be sure to follow Toshiba's guidelines regarding the number of times a specific parameter can be written without risk of EEPROM damage.

- The drive response timeout (in seconds) is assigned via the designated port's "Timeout" selection. If "0" is chosen (an invalid timeout time), the gateway will use a 1s timeout by default.
- Network characteristics selections
 - Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
 - Parity: odd / even / none (1 stop bit) / none (2 stop bits)
- Point parameter number entry radix is hexadecimal (e.g. 10 = 0x0010 or 16₁₀)

13.5 Mitsubishi ASD Protocol

- The gateway acts as a Mitsubishi protocol master via its RS-485 ports. Adjustable speed drives such as the FR-A500/E500/F500 series and F700-series that support the Mitsubishi protocol can be accessed. Also supported are MGI Technologies, Inc. M3000, M4000 and M5000-series drives that support the Mitsubishi protocol.
- For 500-series drives, the gateway can connect to the ASD via either the PU (panel) connector, or via an optional FR-A5NR computer link board. Because the ASDs externally present a 4-wire RS-485 network, connecting them to the gateway requires jumpering the network wires for 2-wire format (i.e. connecting SDA-RDA and SDB-RDB).

When Using an FR-A5NR Card

Connect as shown in Figure 28.

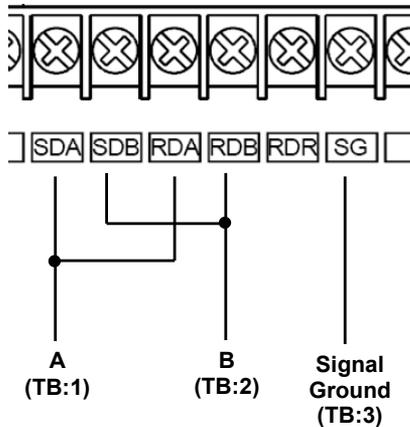


Figure 28: FR-A5NR Connections

When Using the PU Port

Connecting to the drive's RJ-45 PU port will likely require building a custom cable. For simplicity, a standard 8-conductor Ethernet patch cable can be used as a starting point. There are two standard color schemes for the wire pairs in such cables as defined by the Electronic Industry Association / Telecommunications Industry Association (EIA-TIA). These two standards are called T-568B and T-568A (refer to Figure 29). The most common color scheme is T-568B, and will therefore be the one used for this example connection. If starting with a cable wired according to the T-568A specification, just interchange the colors to achieve the same pin connections.

Connect as shown in Figure 30.

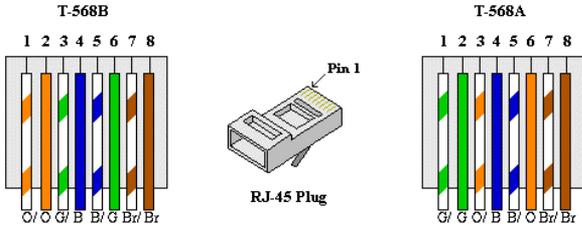


Figure 29: EIA/TIA Wiring Standards

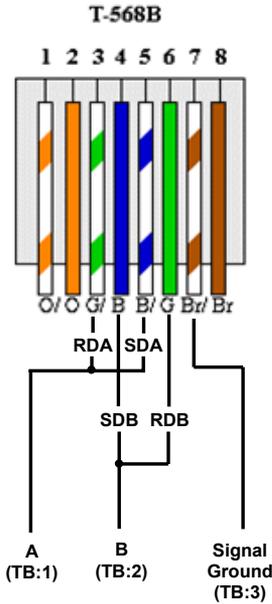


Figure 30: PU Port Connections

- For 700-series drives, the gateway can connect to the ASD via either the PU (panel) connector as indicated in Figure 30, or via the on-board RS-485 terminals. Because both of these ports externally present a 4-wire RS-485 network, connecting them to the gateway requires jumpering the network wires for 2-wire format (i.e. connecting SDA-RDA and SDB-RDB). When using the on-board RS-485 terminals, connect as shown in Figure 31.

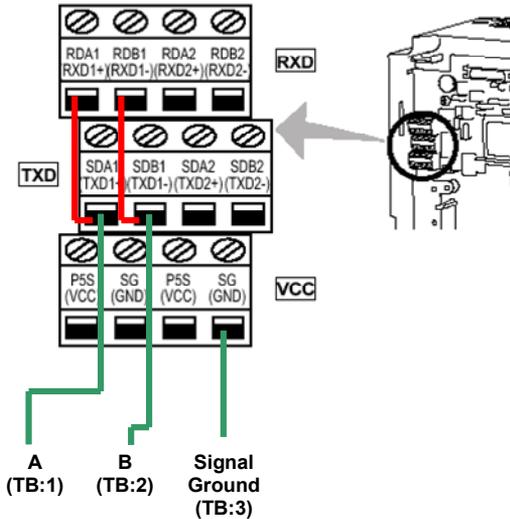


Figure 31: 700-Series ASD Connections

- Note that although the 700-series ASD also supports the Modbus RTU protocol, the initial ASD firmware did not support the Modbus RTU protocol in 2-wire format. Therefore, using the Mitsubishi protocol may be the only available method to communicate with the gateway (ASD parameter 549 must be “0”). Contact Mitsubishi Technical Support for more information.
- The slave response timeout is determined via the gateway’s RS-485 port timeout value setting. If the timeout value is set to 0, a default timeout time of 2s is used.
- ASD communication characteristics are dictated by parameters 117-124 (PU port) and 331-341 (RS-485 port). Most of these parameters can be set as desired by the user. However, the following parameters must be set as indicated to successfully connect to the gateway:

Parameter 119/333 (stop bits/data bits)*Must be set for 8 data bits*
 Parameter 123/337 (wait time setting).....*Must be set to 9999*
 Parameter 124/341 (CR/LF selection).....*Must be set to 1 (CR only)*

- ASD parameter number entry radix is decimal (e.g. 10 = 10₁₀)
- Any numerically-addressed parameter defined by the Mitsubishi protocol reference manual is directly accessible (base frequency = parameter #3, etc.). However, some ASD data objects do not have parameter numbers assigned by Mitsubishi. For these data objects, the additional parameter numbers indicated in Table 3 have been assigned. For further information

on these parameters, please refer to the relevant Mitsubishi documentation.

Table 3: Additional Mitsubishi Parameter Assignments

Parameter Number	Item
1000	Second parameter switch-over
1001	Frequency command (RAM)
1002	Frequency command (EEPROM)
1003	Frequency monitor
1004	Output current monitor
1005	Output voltage monitor
1006	Special monitor
1007	Special monitor selection number
1008	Most recent #1 and #2 alarms / alarm clear
1009	Most recent #3 and #4 alarms
1010	Most recent #5 and #6 alarms
1011	Most recent #7 and #8 alarms
1014	Inverter status monitor / operation command
1015	Operation mode acquisition
1016	All parameter clear
1017	Inverter reset

13.6 Siemens FLN

Currently, the XLTR-200 supports Siemens application number 2750. This application acts as an FLN to Mitsubishi gateway.

13.6.1 Ports

- For this application, the FLN network must be connected to XLTR-200 RS485 port A, and the Mitsubishi network must be connected to XLTR-200 RS485 port B.
- The FLN port (RS485 port A) requires no configuration other than the FLN node address, which has a valid address range of 0 – 98. **NOTE** that the factory default value is 99.
- The baudrate and parity settings of the Mitsubishi port (RS485B port B) must be configured to match the serial settings of the connected ASD. **NOTE** that the factory default values for these settings are 9600 baud, no parity (8 data bits, 1 stop bit).
- The ASD connected to RS485 port B must be configured as address #1 to allow the gateway to communicate with it (parameter 117 or 331 = 1).
- Refer to section 12.3.2 for information about using the serial console interface to configure XLTR-200 ports.

13.6.2 Supported Subpoints

This application contains a predefined set of FLN subpoints (refer to Table 4). These points are static for this application, and cannot be edited.

Table 4: Supported Subpoints

Point #	Point Type	Subpoint Name	Factory Default	Units	Slope	Intercept	On Text	Off Text
01	LAO	ADDRESS	99	-	1	0	-	-
02	LAO	APPLICATION	2750	-	1	0	-	-
03	LAI	FREQ OUTPUT	0	HZ	0.01	0	-	-
04	LAI	OUTPUT CUR	0	A	0.01	0	-	-
05	LAI	OUTPUT VOLT	0	V	0.1	0	-	-
06	LAI	SPECIAL MON	0	-	1	0	-	-
07	LAO	MON SELECT	0	-	1	0	-	-
08	LAO	ACCEL TIME	50	SEC	0.1	0	-	-
09	LAO	DECEL TIME	100	SEC	0.1	0	-	-
10	LDO	CMD FWD.STOP	STOP	-	1	0	FWD	STOP
11	LDO	CMD REV.STOP	STOP	-	1	0	REV	STOP
12	LAO	FREQ CMD	0	HZ	0.01	0	-	-
13	LAO	MIN FREQ	0	HZ	0.01	0	-	-
14	LAO	FREQ JUMP A	32767	HZ	0.01	0	-	-
15	LAO	FREQ JUMP B	32767	HZ	0.01	0	-	-
16	LDI	ALARM OUTPUT	0	-	1	0	ALARM	-
17	LDI	RUNNING	STOP	-	1	0	RUN	STOP
18	LAO	PID SET PNT	0	PCT	0.01	0	-	-
19	LDO	RESET CMD	0	-	1	0	RESET	-
20	LAO	OVRD TIME	1	HRS	1	0	-	-
21	LDI	ASD COMM	NO	-	1	0	YES	NO
22	LAO	OPER MODE	0	-	1	0	-	-
29	LDO	DAY.NIGHT	DAY	-	1	0	NIGHT	DAY
99	LAO	ERROR STATUS	0	-	1	0	-	-

Notes:

- Points not listed are not used in this application.
- All points have the same value for English units and SI units.

13.6.3 Subpoint Details

This section gives a brief overview of each subpoint, including any notable behavior or settings. Further information may be obtained by referring to applicable Mitsubishi ASD documentation.

1. ADDRESS

This is the FLN address of the drive. It can be changed via FLN or via the gateway's serial console.

2. APPLICATION

This is the Application ID for FLN on the A500/F700 drives. This ID is assigned by Siemens for each unique application, and correlates directly to a particular point list approved at the time of release. The Application ID assigned to the A500/F700 drives is 2750.

3. FREQ OUTPUT

The output frequency of the drive in Hertz. Corresponds to drive parameter 1003.

4. OUTPUT CUR

The output current of the drive in Amps. Corresponds to drive parameter 1004.

5. OUTPUT VOLT

The output voltage of the drive in Volts. Corresponds to drive parameter 1005.

6. SPECIAL MON

This is the point which allows monitoring of a selected special monitor item. The meaning of the value, scaling and engineering units displayed here depends on the setting of the MON SELECT item (point #7). Corresponds to drive parameter 1006.

7. MON SELECT

This point allows a selection of data codes to be written to it. Each designated code corresponds to a particular drive status item that will then be reflected in the SPECIAL MON item (point #6). Please refer to the applicable Mitsubishi documentation for a list of available codes. Corresponds to drive parameter 1007.

8. ACCEL TIME

Acceleration time in seconds. Corresponds to drive parameter 7.

9. DECEL TIME

Deceleration time in seconds. Corresponds to drive parameter 8.

10. CMD FWD.STOP

Commands the drive to run forward or stop. Note that commanding this point is effective only when the drive is configured for network start/stop control. Corresponds to drive command parameter 1014, bit #1.

11. CMD REV.STOP

Commands the drive to run reverse or stop. Note that commanding this point is effective only when the drive is configured for network start/stop control. Corresponds to drive command parameter 1014, bit #2.

12. FREQ CMD

The frequency command of the drive in Hertz. Note that commanding this point is effective only when the drive is configured for network frequency control. Corresponds to drive parameter 1001.

13. MIN FREQ

The drive's minimum allowable frequency in Hertz. Corresponds to drive parameter 2.

14. FREQ JUMP A

Sets the lower limit of the jump frequency for area #1. An FLN object value of 32767 for this point corresponds to an internal drive value of 9999 (disabled). Corresponds to drive parameter 31.

15. FREQ JUMP B

Sets the upper limit of the jump frequency for area #1. An FLN object value of 32767 for this point corresponds to an internal drive value of 9999 (disabled). Corresponds to drive parameter 32.

16. ALARM OUTPUT

Indicates whether or not the drive is in an alarm condition. Corresponds to drive status parameter 1014, bit #7.

17. RUNNING

Indicates whether or not the drive is running. Corresponds to drive status parameter 1014, bit #0.

18. PID SET PNT

PID set point. Note that commanding this point is effective only when the drive is in the PU operation or PU/external combined mode. Corresponds to drive parameter 133.

19. RESET CMD

Drive fault reset command. Corresponds to drive parameter 1017.

20. OVRD TIME

This is a mandatory FLN point required for compatibility with Siemens control systems. It has no effect in this application.

21. ASD COMM

Drive network communications health indicator. This point has a value of "YES" if the gateway is successfully communicating with the attached drive. Status points read from the gateway should be disregarded whenever this

point's value is "NO". The drive network wiring, etc., should also be inspected in such a condition in order to identify the cause of the communication outage.

22. OPER MODE

Drive operation mode. Corresponds to drive parameter 1015.

29. DAY.NIGHT

This is a mandatory FLN point required for compatibility with Siemens control systems. It has no effect in this application.

99. ERROR STATUS

This is a mandatory FLN point required for compatibility with Siemens control systems. It has no effect in this application.

13.7 Toshiba 3-Series ASD Protocol

- The gateway can act as an RS232 master for Toshiba 3-series ASDs (G3, H3, E3 etc.) Use of the ICC “*Toshiba 3-Series ASD Interface Cable*” (ICC part #10603) or an equivalent cable is required to connect the gateway’s RS232 port to the drive’s on-board RS232 port.
- The following ASD parameters (in `GROUP:COMMUNICATION SETTING PARAMETERS`) must be set as indicated:

```
RS232 BAUD RATE.....2 (9600 baud)
NUMBER OF DATA BITS.....1 (8 bits)
PARITY SETTING.....0 (even parity)
```

Remember that the drive must be reset whenever communication-related parameters are changed in order to activate the change.

- All parameter writes use the drive’s RAM / EEPROM data write (“W”) command. For all writes that target the drive’s EEPROM, be sure to follow Toshiba’s guidelines regarding the number of times a specific parameter can be written without risk of EEPROM damage.
- Point parameter number entry radix is hexadecimal (e.g. 10 = 0x0010 or 16₁₀).
- The available ASD parameters are as indicated in the tables starting in section 13.7.1. For further details on how to interpret these tables, please refer to the *Toshiba G3 RS232C Communications Manual* (Toshiba part number 42709) or the *Toshiba INV3-MODBUS-RTU Communications Manual* (ICC part number 10028).

13.7.1 Command Parameters

Parameter	Bit	Function	Bank	Mask	Adjustment Range	Multiplier
0001	word	Frequency command	0	FFFF	0.00 ~ 400.00Hz Actual frequency will be limited by LL, UL and Fmax.	0.01
0002	0	RUN command	0	—	0: Stop 1: Run	—
	1	Reserved			—	
	2	Forward • reverse run selection			0: reverse 1: forward	
	3	Acc/dec #1 / #2 selection			0: Acc / dec #1 1: Acc / dec #2	
	4	Reserved			—	
	5	Reserved			—	
	6	Reserved			—	
	7	Jog mode selection			0: Normal (acc/dec mode) 1: Jog mode	
	8	Feedback control			0: Feedback valid 1: Feedback invalid	
	9	Compulsory DC injection braking mode			0: No compulsory DC injection braking 1: Compulsory DC injection below DC INJECTION START FREQUENCY	
	A	Fundamental parameter switching			0: V/F #1 1: V/F #2	
	B	Gate block command (coast stop command)			0: Normal 1: Gate block	
	C	Emergency off command			0: Does nothing 1: Emergency off	
	D	Reset command (trip clear)			0: Does nothing 1: Reset	
E	Reserved	—				
F	Reserved	—				
0003	word	RS232 command / frequency selection	0	0003	0000: FREQUENCY MODE SELECTION, COMMAND MODE SELECTION settings 0001: RS232C commands valid 0002: RS232C frequency valid 0003: RS232C commands and frequency valid	—
0004	word	Preset speed run command	0	000F	0000: Output frequency selected by FREQUENCY MODE SELECTION 0001 ~ 000F: speeds 1 ~ 15	—

13.7.2 Monitor Parameters

Parameter	Bit	Function	Bank	Mask	Adjustment Range	Multiplier
0005	word	Output frequency monitor	0	FFFF	0.00 ~ 400.00Hz	0.01
0006	0	Run • stop status	0	—	0: Stopped 1: Running	—
	1	Reserved			—	
	2	Forward • reverse status			0: Reverse 1: Forward	
	3	Accel / decel #1 / #2 selection status			0: Accel / decel #1 1: Accel / decel #2	
	4	Reserved			—	
	5	Reserved			—	
	6	Reserved			—	
	7	Jog mode status			0: Normal (accel / decel mode) 1: Jog mode	
	8	Feedback enable status			0: Feedback invalid 1: Feedback valid	
	9	Compulsory DC injection braking mode			0: DC injection braking inactive 1: DC injection braking active	
	A	Fundamental parameter switching			0: V/F #1 1: V/F #2	
	B	Coast stop command status			0: Normal 1: Coast to stop	
	C	Emergency off command			0: Normal 1: Emergency off	
	D	Reserved			—	
E	Reserved	—				
F	Reserved	—				
0007	word	Output current monitor	0	00FF	0 ~ 255%	1
0008	word	Output voltage monitor (<i>Note 1</i>)	0	FFFF	0 ~ 232%	0.1
0009	word	IV terminal analog input value	0	FFFF	0000 ~ FFFF (0% ~ 100%)	1
000A	word	RX terminal analog input value	0	FFFF	0000 ~ 7FFF (-100% ~ 0%), 7FFF ~ FFFF (0% ~ 100%)	1
000B	word	Frequency command monitor	0	FFFF	0000 ~ 9C40 (0.00 ~ 400.00 Hz)	0.01
000C	word	Input voltage monitor (<i>Note 1</i>)	0	FFFF	0 ~ 255%	0.1
000D	word	Input terminal status monitor	0	FFFF	Refer to Table 5 (page 67)	—
000E	low byte	Output terminal status monitor	0	00FF	Refer to Table 6 (page 67)	—
	high byte	Inverter Status 2		FF00		
000F	word	Inverter Status 1	0	FFFF	Refer to Table 7 (page 68)	—
0010	word	Present trip	0	00FF	Refer to section 13.7.16 for fault codes	—
0011	high byte	4th Past trip (most recent)	0	7F00		—
	low byte	3rd past trip	0	007F		—

Parameter	Bit	Function	Bank	Mask	Adjustment Range	Multiplier
0012	high byte	2nd past trip	0	7F00		—
	low byte	1st past trip (oldest)		007F		
0013	word	Pre-compensation output frequency	0	FFFF	0000 ~ 9C40 (0.00 ~ 400.00 Hz)	0.01
0014	word	Post-compensation output frequency	0	FFFF	0000 ~ 9C40 (0.00 ~ 400.00 Hz)	0.01
0015	word	Torque current monitor	0	FFFF	(Note 2)	0.01
0016	low byte	Excitation current monitor	0	00FF	00 ~ FF (0 ~ 255%)	1
	high byte	Reserved	—	—	—	—
0017	word	PID feedback value	0	FFFF	(Note 2)	0.02
0018	word	Motor overload ratio	0	FFFF	0 ~ 65535	100/65535
0019	word	Inverter overload ratio	0	FFFF	0 ~ 65535	100/65535
001A	word	DBR overload ratio	0	FFFF	0 ~ 65535	100/65535
001B	word	Input power (%)	0	FFFF	0 ~ 6553.5	0.1
001C	word	Input power (kW)	0	FFFF	(Note 3)	
001D	word	Output power (%)	0	FFFF	(Note 2)	0.1
001E	word	Output power (kW)	0	FFFF	(Note 2, Note 3)	
001F	word	RR input	0	FFFF	0 ~ 65535	100/65535
0020	—	Reserved	—	—	—	—
0021	—	Reserved	—	—	—	—
0022	—	Reserved	—	—	—	—
0023	low byte	Inverter typeform monitor	0	00FF	Refer to Table 8 (page 68)	—
	8	Input / output power units	0	0100	0: 0.01kW 1: 0.1kW	—
	9,A	Command mode status	0	0600	00: terminal 01: panel 10: option 11: RS232C	—
	B,C	Frequency mode selection status	0	1800	00: terminal 01: panel 10: option 11: RS232C	—
	D,E,F	Reserved	—	—	—	—
0024	—	Reserved	—	—	—	—
0025	word	Output current (amps)	—	FFFF	0.0 ~ 6553.5 A	0.1

(Note 1).... These monitor voltage units are not affected by the setting of VOLTAGE UNITS SELECTION in GROUP:UTILITY PARAMETERS; they are always in units of %.

(Note 2).... These parameters use signed data (data values larger than 7FFFH are negative). If the parameter data is 8000H or larger, the actual value can be obtained by: **actual value = - [FFFFH - (parameter data) + 1]**.

(Note 3).... If the input / output power units data is 0, the monitored data is in 0.01kW units, and the multiplier is 0.01. If the input / output power units data is 1, the monitored data is in 0.1kW units, and the multiplier is 0.1. These values are automatically set according to the inverter's capacity.

Table 5: Input Terminal Status Monitor (parameter 000D)

Lower Byte	Bit	Input Terminal	0	1	Single-Bit Read Mask
	bit 0	F	terminal - CC open	terminal - CC shorted	0001
	bit 1	R	terminal - CC open	terminal - CC shorted	0002
	bit 2	S1	terminal - CC open	terminal - CC shorted	0004
	bit 3	S2	terminal - CC open	terminal - CC shorted	0008
	bit 4	S3	terminal - CC open	terminal - CC shorted	0010
	bit 5	S4	terminal - CC open	terminal - CC shorted	0020
	bit 6	S5 (option)	terminal - CC open	terminal - CC shorted	0040
bit 7	S6 (option)	terminal - CC open	terminal - CC shorted	0080	

Upper Byte	Bit	Input Terminal	0	1	Single-Bit Read Mask
	bit 0	unused (always 0)	—	—	—
	bit 1	unused (always 0)	—	—	—
	bit 2	unused (always 0)	—	—	—
	bit 3	unused (always 0)	—	—	—
	bit 4	unused (always 0)	—	—	—
	bit 5	S7 (option)	terminal - CC open	terminal - CC shorted	0020
	bit 6	RES	terminal - CC open	terminal - CC shorted	0040
bit 7	ST	terminal - CC open	terminal - CC shorted	0080	

Table 6: Output Terminal Status Monitor / Inverter Status 2 (parameter 000E)

Lower Byte	Bit	Output Terminal	0	1	Single-Bit Read Mask
	bit 0	unused (always 0)	—	—	—
	bit 1	unused (always 0)	—	—	—
	bit 2	FAN	OFF	ON	0004
	bit 3	FL	FLB-FLC shorted	FLA-FLC shorted	0008
	bit 4	MS relay	OFF	ON	0010
	bit 5	OUT (option)	OUTB-OUTC shorted	OUTA-OUTC shorted	0020
	bit 6	RCH	RCHA-RCHC open	RCHA-RCHC shorted	0040
bit 7	LOW	LOWA-LOWC open	LOWA-LOWC shorted	0080	

Upper Byte	Bit	Inverter Status	0	1	Single-Bit Read Mask
	bit 0	accelerating	not accelerating	accelerating	0001
	bit 1	decelerating	not decelerating	decelerating	0002
	bit 2	for inverter use	—	—	—
	bit 3	retry	not retrying	retrying	0008
	bit 4	running (including DC injection braking)	stopped	running	0010
	bit 5	for inverter use	—	—	—
	bit 6	for inverter use	—	—	—
bit 7	tripped	not tripped	tripped	0080	

Table 7: Inverter Status 1 (parameter 000F)

Lower Byte	Bit	Inverter Status	0	1	Single-Bit Read Mask
	bit 0	running (accel/decel)	—	running	0001
	bit 1	unused (always 0)	—	—	—
	bit 2	forward / reverse	reverse	forward	0004
	bit 3	accel/decel #1/#2	accel/decel #1	accel/decel #2	0008
	bit 4	for inverter use	—	—	—
	bit 5	for inverter use	—	—	—
	bit 6	for inverter use	—	—	—
bit 7	jog/normal mode	normal (accel/decel)	jog mode	0080	

Upper Byte	Bit	Inverter Status	0	1	Single-Bit Read Mask
	bit 0	feedback ON/OFF	OFF	feedback active	0001
	bit 1	DC injection braking	OFF	DC inj. braking active	0002
	bit 2	V/F #1/#2	V/F #1	V/F #2	0004
	bit 3	coasting	not coasting	coasting	0008
	bit 4	emergency off	not in emergency off	in emergency off	0010
	bit 5	for inverter use	—	—	—
	bit 6	for inverter use	—	—	—
bit 7	for inverter use	—	—	—	

Table 8: Inverter Typeform Codes

230v Class	
Inverter Model	Typeform Data (Hex)
G3-2010	xx21
G3-2015	xx22
G3-2025	xx23
G3-2035	xx24
G3-2055	xx25
G3-2080	xx26
G3-2110	xx27
G3-2160	xx28
G3-2220	xx29
G3-2270	xx2A
G3-2330	xx2B
G3-2400	xx2C

460v Class	
Inverter Model	Typeform Data (Hex)
G3-4015	xx42
G3-4025	xx43
G3-4035	xx44
G3-4055	xx45
G3-4080	xx46
G3-4110	xx47
G3-4160	xx48
G3-4220	xx49
G3-4270	xx4A
G3-4330	xx4B
G3-4400	xx4C
G3-4500	xx4D
G3-4600	xx4E
G3-4750	xx4F
G3-410K	xx50
G3-412K	xx51
G3-415K	xx52
G3-420K	xx53
G3-425K	xx54
G3-430K	xx55

575v Class	
Inverter Model	Typeform Data (Hex)
G3-6060	xx65
G3-6120	xx67
G3-6160	xx68
G3-6220	xx69
G3-6270	xx6A
G3-6330	xx6B
G3-6400	xx6C
G3-6500	xx6D
G3-6600	xx6E
G3-6750	xx6F
G3-610K	xx70
G3-612K	xx71
G3-615K	xx72
G3-620K	xx73

13.7.3 Fundamental Parameters #1

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0026	MAXIMUM OUTPUT FREQUENCY (*)		0 / 1	FFFF	0BB8 ~ 9C40 (30.00~400.00)	0.01
0027	BASE FREQUENCY #1		0 / 1	FFFF	09C4 ~ 9C40 (25.00~400.00)	0.01
0028	BASE FREQUENCY VOLTAGE SELECT (*)		0 / 1	0030	0000: Input voltage level (0) 0020: Automatic setting (1) 0030: Stationary setting (2)	—
0029	MAXIMUM OUTPUT VOLTAGE #1		0 / 1	FFFF	0000 ~ 0258 (0 ~ 600)	1
002A	REVERSE OPERATION DISABLE SELECT		0 / 1	0020	0000: Reverse allowed (0) 0020: Reverse not allowed (1)	—
002B	UPPER LIMIT FREQUENCY		0 / 1	FFFF	0000 ~ Fmax	0.01
002C	LOWER LIMIT FREQUENCY		0 / 1	FFFF	0000 ~ UL, Fmax	0.01
002D	VOLTS PER HERTZ PATTERN (*)		0 / 1	000F	0000: Constant torque (1) 0001: Variable torque (2) 0002: Auto. torque boost (3) 0006: #3 w/ auto. energy savings (4) 000A: Vector control (5) 000E: #5 w/ auto. energy savings (6)	—
002E	1, 2	VOLTAGE BOOST #1	0 / 1	FFFF	0000 ~ 012C (0.0 ~ 30.0)	0.1
002F	ACCELERATION TIME #1		0 / 1	FFFF	0001 ~ EA60 (0.01~ 600.00) 0001 ~ EA60 (0.1~ 6000.0)	0.01 0.1
0030	DECELERATION TIME #1		0 / 1	FFFF	0001 ~ EA60 (0.01~ 600.00) 0001 ~ EA60 (0.1~ 6000.0)	0.01 0.1
0031	ACC/DEC PATTERN #1 SELECTION		0 / 1	0030	0000: Linear (0) 0010: Self-adjusting (1) 0020: S-Pattern #1 (2) 0030: S-Pattern #2 (3)	—
0032	ACCEL/DECEL PATTERN ADJUST LOW		0 / 1	00FF	0003 ~ 00FD (0 ~ 50) (Note 1)	1
0033	ACCEL/DECEL PATTERN ADJUST HIGH		0 / 1	00FF	0003 ~ 00FD (0 ~ 50) (Note 1)	1

Note 1: Parameter data = (desired setting x 5 + 3), converted to hexadecimal

13.7.4 Fundamental Parameters #2

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0034	BASE FREQUENCY #2	0 / 1	FFFF	09C4 ~ 9C40 (25.00 ~ 400.00)	0.01
0035	MAXIMUM OUTPUT VOLTAGE #2	0 / 1	FFFF	0000 ~ 0258 (0 ~ 600)	1
0036	VOLTAGE BOOST #2	0 / 1	FFFF	0000 ~ 012C (0.0 ~ 30.0)	0.1
0037	ELECTRONIC THERMAL PROTECT LVL #2	0 / 1	00FF	000A ~ 0064 (10 ~ 100)	1
0038	STALL PROTECTION SELECTION #2	0 / 1	0040	0000: ON (0) 0040: OFF (1)	—
0039	0 STALL PROTECTION LEVEL #2	0 / 1	00FF	000A ~ 00D7 (10 ~ 215)	1
003A	ACCELERATION TIME #2	0 / 1	FFFF	0001 ~ EA60 (0.1~ 6000.0) 0001 ~ EA60 (0.01~ 600.00)	0.1 0.01
003B	DECELERATION TIME #2	0 / 1	FFFF	0001 ~ EA60 (0.1~ 6000.0) 0001 ~ EA60 (0.01~ 600.00)	0.1 0.01
003C	ACC/DEC PATTERN #2 SELECTION	0 / 1	0030	0000: Linear (0) 0010: Self-adjusting (1) 0020: S-Pattern #1 (2) 0030: S-Pattern #2 (3)	—
003D	ACC/DEC #1/#2 SWITCH FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01

13.7.5 Panel Control Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
003E	DIRECTION SELECTION (FORWARD/REV)	0 / 1	0004	0000: Reverse (0) 0004: Forward (1)	—
003F	STOP PATTERN SELECTION	0 / 1	0040	0000: Decelerated stop (0) 0040: Coast stop (1)	—
0040	FUNDAMENTAL PARAM SWITCHING	0 / 1	0004	0000: V/F #1 (1) 0004: V/F #2 (2)	—
0041	ACCEL/DECEL #1/#2 SELECTION	0 / 1	0008	0000: Accel / decel #1 (1) 0008: Accel / decel #2 (2)	—
0042	PANEL RESET SELECTION	0 / 1	0030	0000: All possible (0) 0010: OL only (1) 0020: OL, OC only (2)	—
0043	PANEL FEEDBACK CONTROL	0 / 1	0001	0000: Feedback valid (0) 0001: Feedback invalid (1)	—

13.7.6 Terminal Selection Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0044	INPUT TERMINAL SELECTION	0 / 1	0001	0000: Standard functions (0) 0001: Individual selections (1)	—
0045	"R" INPUT TERMINAL FUNCTION	0 / 1	FFFF	0000 ~ FFFF (0 ~ 54) Refer to Table 9 (page 73)	—
0046	"S1" INPUT TERMINAL FUNCTION				
0047	"S2" INPUT TERMINAL FUNCTION				
0048	"S3" INPUT TERMINAL FUNCTION				
0049	"S4" INPUT TERMINAL FUNCTION				
004A	"F" INPUT TERMINAL FUNCTION				
004B	"RES" INPUT TERMINAL FUNCTION				
004C	"ST" INPUT TERMINAL FUNCTION				
004D	"S5" INPUT TERMINAL FUNCTION				
004E	"S6" INPUT TERMINAL FUNCTION				
004F	"S7" INPUT TERMINAL FUNCTION				
0050	POTENTIAL TERMINAL FUNCTION				
0051	R, S1-S7 TERMINAL RESPONSE TIME				
0052	F INPUT TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0053	RES INPUT TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0054	ST INPUT TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0055	"RCH" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 74)	—
0056	"RCH" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0057	"RCH" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0058	"LOW" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 74)	—
0059	"LOW" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005A	"LOW" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005B	"FL" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 74)	—
005C	"FL" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005D	"FL" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005E	"OUT" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 74)	—
005F	"OUT" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0060	"OUT" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0061	LOW SPEED SIGNAL OUTPUT FREQ		0 / 1	FFFF	0 ~ Fmax	0.01
0062	ACC/DEC COMPLETE DETECT BAND		0 / 1	FFFF	0 ~ Fmax	0.01
0063	SPEED REACH MAXIMUM FREQUENCY		0 / 1	FFFF	0 ~ Fmax	0.01
0064	SPEED REACH MINIMUM FREQUENCY		0 / 1	FFFF	0 ~ Fmax	0.01
0065	COMMERCIAL POWER/INV SWITCHING OUTPUT		0 / 1	00C0	0000: OFF (0) 0040: Auto switch on trip (1) 0080: At COMMERCIAL POWER/ INV SWITCH FREQ (2) 00C0: Both (1) and (2) (3)	—
0066	2, 3	COMMERCIAL POWER/INV SWITCH FREQ	0 / 1	FFFF	0 ~ Fmax	0.01
0067	"FP" OUTPUT TERMINAL PULSE FREQUENCY		0 / 1	0003	0000: 48f (0) 0001: 96f (1) 0002: 360f (2)	—
0068	RR INPUT SPECIAL FUNCTION SELECT		0 / 1	00E0	0000: Standard (0) 0040: Fmax (1) 0080: TACC/TDEC multiplier (2) 00C0: VB multiplication factor (3) 0020: CL multiplication factor (4)	—

Table 9: Input Terminal Selections

Setting Value	Data (Hex)	Function	Setting Value	Data (Hex)	Function
0	10C8	R (reverse run)	28	04AF	Binary bit #6
1	011C	SS1 (preset speed selection)	29	08AF	Binary bit #7
2	021C	SS2 (preset speed selection)	30	10AF	Binary bit #8
3	041C	SS3 (preset speed selection)	31	20AF	Binary bit #9
4	081C	SS4 (preset speed selection)	32	40AF	Binary bit #10
5	20C8	F (forward run)	33	04CE	No effect
6	201B	RES (fault reset)	34	01C7	UP/DOWN frequency setting (UP)
7	C0C9	ST (gate ON/OFF)	35	02C7	UP/DOWN frequency setting (DOWN)
8	0CC8	JOG selection	36	04C7	UP/DOWN frequency clear
9	081A	Accel / decel #1/#2 selection	37	08C7	PUSH-type RUN key
10	101B	Emergency off	38	10C7	PUSH-type STOP key
11	021B	DC injection braking ON/OFF	39	02B9	No effect
12	041B	Fundamental parameter switching (V/F #2)	40	C0C8	Forward/reverse run selection
13	011B	Feedback control ON/OFF	41	20C7	RUN
14	10CE	Pattern run selection #1	42	30C9	Binary data write
15	20CE	Pattern run selection #2	43	0198	[LOCAL/REMOTE] key
16	40CE	Pattern run selection #3	44	0298	[MON] key
17	80CE	Pattern run selection #4	45	0498	[PRG] key
18	02CE	Pattern run continue signal	46	0898	[UP] key
19	01CE	Pattern run step trigger signal	47	1098	[DOWN] key
20	0AC9	JOG forward run	48	2098	[READ/WRITE] key
21	06C9	JOG reverse run	49	4098	[RUN] key
22	10AE	Binary bit #0	50	8098	[STOP/CLEAR] key
23	20AE	Binary bit #1	51	08CE	Commercial power / inverter switching signal
24	40AE	Binary bit #2	52	40C7	Reserved for option use
25	80AE	Binary bit #3	53	10CB	RR frequency switching input
26	01AF	Binary bit #4	54	20CB	IV frequency switching input
27	02AF	Binary bit #5			

Note: In order for binary bit #0 ~ #10 (setting values 22 ~ 32) and UP/DOWN frequency setting (setting values 34 & 35) inputs to be valid, parameter FREQUENCY PRIORITY SELECTION #1 or FREQUENCY PRIORITY SELECTION #2 in GROUP:FREQUENCY SETTING PARAMETERS must be set to 5 (BIN (binary setting or UP/DOWN setting)).

Table 10: Output Terminal Selections (RCH, LOW, FL, OUT relay contacts)

Setting Value	Data (Hex)	Function	Setting Value	Data (Hex)	Function
0	0000	Lower limit frequency	32	C5B7	Executing emergency off
1	0100	/Lower limit frequency	33	CDB7	/Executing emergency off
2	0200	Upper limit frequency	34	B5BB	Executing retry
3	0300	/Upper limit frequency	35	BDBB	/Executing retry
4	0400	Low speed signal	36	D5CF	Pattern run switching output
5	0500	/Low speed signal	37	DDCF	/Pattern run switching output
6	0600	Accel/decel complete	38	D5D8	PID deviation limit
7	0700	/Accel/decel complete	39	DDD8	/PID deviation limit
8	0800	Selected speed reach signal	40	C5BB	Run/stop
9	0900	/Selected speed reach signal	41	CDBB	/Run/stop
10	0A00	Fault	42	1400	Severe fault (armature short, load-end short, open phase, output error, earth fault)
11	0B00	/Fault	43	1500	/Severe fault (armature short, load-end short, open phase, output error, earth fault)
12	0C00	Fault other than earth fault or load-end overcurrent	44	1600	Non-severe fault (overload, overcurrent, overvoltage)
13	0D00	/Fault other than earth fault or load-end overcurrent	45	1700	/Non-severe fault (overload, overcurrent, overvoltage)
14	95B5	Overcurrent pre-alarm	46	E5D8	Commercial power / inverter switching output #1
15	9DB5	/Overcurrent pre-alarm	47	EDD8	/Commercial power / inverter switching output #1
16	85C5	Inverter overload pre-alarm	48	F5D8	Commercial power / inverter switching output #2
17	8DC5	/Inverter overload pre-alarm	49	FDD8	/Commercial power / inverter switching output #2
18	95C5	Motor overload pre-alarm	50	85C0	Fan ON/OFF
19	9DC5	/Motor overload pre-alarm	51	8DC0	/Fan ON/OFF
20	D5C5	Overheat pre-alarm	52	F5B6	Executing JOG
21	DDC5	/Overheat pre-alarm	53	FDB6	/Executing JOG
22	A5B4	Overvoltage pre-alarm	54	1800	Local/remote operation
23	ADB4	/Overvoltage pre-alarm	55	1900	/Local/remote operation
24	E5B4	Undervoltage alarm	56	A5D1	Cumulative timer alarm
25	EDB4	/Undervoltage alarm	57	ADD1	/Cumulative timer alarm
26	85B5	Undercurrent alarm	58	1A00	Communication error alarm
27	8DB5	/Undercurrent alarm	59	1B00	/Communication error alarm
28	85D1	Overtorque alarm	60	A5B6	F/R
29	8DD1	/Overtorque alarm	61	ADB6	/F/R
30	E5BB	Braking resistor OL pre-alarm	62	1E00	Run preparation complete
31	EDBB	/Braking resistor OL pre-alarm	63	1F00	/Run preparation complete

13.7.7 Special Control Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier	
0069	START-UP FREQUENCY	0 / 1	FFFF	0000 ~ 03E8 (0.00 ~ 10.00)	0.01	
006A ~ 006F	Reserved	—	—	—	—	
0070	END FREQUENCY	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01	
0071	RUN FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01	
0072	RUN FREQUENCY HYSTERESIS	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01	
0073	ENABLE JUMP FREQUENCIES	0 / 1	0080	0000: Function OFF (0) 0080: Function ON (1)	—	
0074	1	JUMP FREQUENCY #1	0 / 1	FFFF	0000 ~ Fmax	0.01
0075		JUMP FREQUENCY #1 BANDWIDTH	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0076		JUMP FREQUENCY #2	0 / 1	FFFF	0000 ~ Fmax	0.01
0077		JUMP FREQUENCY #2 BANDWIDTH	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0078		JUMP FREQUENCY #3	0 / 1	FFFF	0000 ~ Fmax	0.01
0079		JUMP FREQUENCY #3 BANDWIDTH	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
007A ~ 007F	Reserved	—	—	—	—	
0080	PWM CARRIER FREQUENCY (Note 1)	0 / 1	00FF	0005 ~ 0064 (0.5 ~ 10.0)	0.1	

Note 1: Actual adjustment range depends on inverter rating.

13.7.8 Frequency Setting Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier	
0081	FREQUENCY PRIORITY SELECTION #1	0 / 1	0007	0001: RR (1) 0002: IV (2) 0003: RX (3) 0004: PG (4) 0005: BIN (5)	—	
0082	FREQUENCY PRIORITY SELECTION #2	0 / 1	0038	0008: RR (1) 0010: IV (2) 0018: RX (3) 0020: PG (4) 0028: BIN (5)	—	
0083	ANALOG INPUT FILTER	0 / 1	0003	0000: No filter (0) 0001: Small filter (1) 0002: Medium filter (2) 0003: Large filter (3)	—	
0084	RR TERMINAL STANDARD OR ADJUSTABLE	0 / 1	0002	0000: Standard (0) 0002: Adjustable (1)	—	
0085	1	RR REFERENCE SETTING POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0086		RR REF POINT #1 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01
0087		RR REFERENCE SETTING POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0088		RR REF POINT #2 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01
0089	IV TERMINAL STANDARD OR ADJUSTABLE	0 / 1	0004	0000: Standard (0) 0004: Adjustable (1)	—	
008A	1	IV REFERENCE SETTING POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
008B		IV REF POINT #1 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01
008C		IV REFERENCE SETTING POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
008D		IV REF POINT #2 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01
008E	RX TERMINAL STANDARD OR ADJUSTABLE	0 / 1	0008	0000: Standard (0) 0008: Adjustable (1)	—	
008F	1	RX REFERENCE SETTING POINT #1	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)	1
0090		RX REF POINT #1 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
0091		RX REFERENCE SETTING POINT #2	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)	1
0092		RX REF POINT #2 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
0093	PG TERMINAL STANDARD OR ADJUSTABLE	0 / 1	0010	0000: Standard (0) 0010: Adjustable (1)	—	
0094	1	PG REFERENCE SETTING POINT #1	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)	1
0095		PG REF POINT #1 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
0096		PG REFERENCE SETTING POINT #2	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)	1
0097		PG REF POINT #2 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0098	BINARY INPUT STD OR ADJUSTABLE		0 / 1	0001	0000: Standard (0) 0001: Adjustable (1)	—
0099	1	BINARY REF SETTING POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
009A		BINARY REF POINT #1 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
009B		BINARY REF SETTING POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
009C		BINARY REF POINT #2 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
009D	JOG RUN FREQUENCY		0 / 1	FFFF	0000 ~ 07D0 (0.00 ~ 20.00)	0.01
009E	Other than 0	JOG STOP METHOD	0 / 1	00C0	0000: Decelerated stop (0) 0040: Coast stop (1) 0080: DC injection stop (2)	—
009F	PRESET SPEED SELECTION		0 / 1	000F	0000 ~ 000F (0 ~ 15)	1
00A0 ~ 00FF	Reserved		—	—	—	—
0100	Other than 0	PRESET SPEED MODE ACTIVATION	0 / 1	0004	0000: Deactivated (0) 0004: Activated (1)	—
0101		PRESET SPEED #1 FREQUENCY	1	FFFF	LL ~ UL	0.01
0102		PRESET SPEED #1 OPERATING MODE	1	040C	0004: (0) 0000: (1) 000C: (2) 0008: (3) 0404: (4) 0400: (5) 040C: (6) 0408: (7)	1
0103		PRESET SPEED #2 FREQUENCY	1	FFFF	LL ~ UL	0.01
0104		PRESET SPEED #2 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0105		PRESET SPEED #3 FREQUENCY	1	FFFF	LL ~ UL	0.01
0106		PRESET SPEED #3 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0107		PRESET SPEED #4 FREQUENCY	1	FFFF	LL ~ UL	0.01
0108		PRESET SPEED #4 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0109		PRESET SPEED #5 FREQUENCY	1	FFFF	LL ~ UL	0.01
010A	PRESET SPEED #5 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1	
010B	PRESET SPEED #6 FREQUENCY	1	FFFF	LL ~ UL	0.01	
010C	PRESET SPEED #6 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1	
010D	PRESET SPEED #7 FREQUENCY	1	FFFF	LL ~ UL	0.01	
010E	PRESET SPEED #7 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1	
010F	PRESET SPEED #8 FREQUENCY	1	FFFF	LL ~ UL	0.01	

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier	
0110	higher	PRESET SPEED #8 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0111	9 or higher	PRESET SPEED #9 FREQUENCY	1	FFFF	LL ~ UL	0.01
0112		PRESET SPEED #9 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0113	10 or higher	PRESET SPEED #10 FREQUENCY	1	FFFF	LL ~ UL	0.01
0114		PRESET SPEED #10 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0115	11 or higher	PRESET SPEED #11 FREQUENCY	1	FFFF	LL ~ UL	0.01
0116		PRESET SPEED #11 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0117	12 or higher	PRESET SPEED #12 FREQUENCY	1	FFFF	LL ~ UL	0.01
0118		PRESET SPEED #12 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0119	13 or higher	PRESET SPEED #13 FREQUENCY	1	FFFF	LL ~ UL	0.01
011A		PRESET SPEED #13 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
011B	14 or higher	PRESET SPEED #14 FREQUENCY	1	FFFF	LL ~ UL	0.01
011C		PRESET SPEED #14 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
011D	15	PRESET SPEED #15 FREQUENCY	1	FFFF	LL ~ UL	0.01
011E		PRESET SPEED #15 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1

13.7.9 Protection Function Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
011F	DYNAMIC BRAKING SELECTION		0 / 1	0003	0000: no dynamic braking (0) 0001: with dynamic braking, no DBR overload trip (1) 0003: with dynamic braking and DBR overload trip (2)	—
0120	2	BRAKING RESISTOR VALUE	0 / 1	FFFF	000A ~ 2710 (1.0 ~ 1000)	0.1
0121		BRAKING RESISTOR POWER RATING	0 / 1	FFFF	0001 ~ EA60 (0.01 ~ 600.00)	0.01
0122	OVERVOLTAGE STALL PROTECTION		0 / 1	0004	0000: ON (0) 0004: OFF (1)	—
0123	DC INJECTION START FREQUENCY		0 / 1	FFFF	0000 ~ 2EE0 (0.00 ~ 120.00)	0.01
0124	Other than 0	DC INJECTION CURRENT MAGNITUDE	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0125		DC INJECTION TIME	0 / 1	00FF	0000 ~ 0064 (0.0 ~ 10.0)	0.1
0126	FWD/REV DC INJECTION PRIORITY CTRL		0 / 1	0040	0000: OFF (0) 0040: ON (1)	—
0127	MOTOR SHAFT STATIONARY CTRL		0 / 1	0080	0000: OFF (0) 0080: ON (1)	—
0128	EMERGENCY OFF MODE SELECTION		0 / 1	0030	0000: Coast stop (0) 0010: Decelerated stop (1) 0020: DC injection stop (2)	—
0129	2	EMERGENCY OFF DC INJECTION TIME	0 / 1	00FF	0000 ~ 0064 (0.0 ~ 10.0)	0.1
012A	NUMBER OF RETRY ATTEMPTS		0 / 1	00FF	0000 ~ 000A (0 ~ 10)	1
012B	Other than 0	TIME BETWEEN RETRY ATTEMPTS	0 / 1	00FF	0000 ~ 0064 (0.0 ~ 10.0)	0.1
012C	REGENERATION POWER RIDE-THROUGH		0 / 1	0008	0000: OFF (0) 0008: ON (1)	—
012D	1	REGENERATION RIDE-THROUGH TIME	0 / 1	00FF	0000 ~ 00FA (0.0 ~ 25.0)	0.1
012E	AUTO-RESTART (MOTOR SPEED SEARCH)		0 / 1	0018	0000: OFF (0) 0008: On power failure (1) 0010: On ST make/break (2) 0018: Both (1) and (2) (3)	—
012F	ELECTRONIC THERMAL PROTECT LVL #1		0 / 1	00FF	000A ~ 0064 (10 ~ 100)	1
0130	OVERLOAD REDUCTION START FREQ		0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0131	MOTOR 150% OVERLOAD TIME LIMIT		0 / 1	00FF	0001 ~ 00F0 (10 ~ 2400)	10
0132	OVERLOAD SELECTION		0 / 1	0030	0000: with motor overload trip, without soft-stall (0) 0010: with motor overload trip and soft-stall (1) 0020: without soft-stall or motor overload trip (2) 0030: with soft-stall, without motor overload trip (3)	—

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0133	STALL PROTECTION ENABLE	0 / 1	0040	0000: ON (0) 0040: OFF (1)	—
0134	0 STALL PROTECTION CURRENT LEVEL	0 / 1	00FF	000A ~ 00D7 (10 ~ 215)	1
0135	UNDERVOLTAGE TRIP SELECTION	0 / 1	0080	0000: Trip disabled (0) 0080: Trip (during run) (1)	—
0136	UNDERVOLTAGE DETECT TIME	0 / 1	FFFF	0000 ~ 03E8 (0.00 ~ 10.00)	0.01
0137	LOW CURRENT DETECT SELECTION	0 / 1	0008	0000: Trip disabled (0) 0008: Trip on detection (1)	—
0138	LOW CURRENT DETECT LEVEL	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0139	LOW CURRENT DETECTION TIME	0 / 1	00FF	0000 ~ 00FF (0 ~ 255)	1
0140	OUTPUT SHORT-CIRCUIT DETECTION SELECT	0 / 1	0003	0000: Standard motor (0) 0001: High-speed motor (1) 0002: Positioning use (standard motor) (2) 0003: Positioning use (high-speed motor) (3)	—
0141	OVERTORQUE TRIP SELECTION	0 / 1	0040	0000: Trip disabled (0) 0040: Trip enabled (1)	—
0142	OVERTORQUE TRIP LEVEL	0 / 1	00FF	0000 ~ 00C8 (0 ~ 200)	1
0143	FAULT TRIP EEPROM SAVE ENABLE	0 / 1	0002	0000: Data cleared when powered OFF (0) 0002: Data retained when powered OFF (1)	—
0144	COOLING FAN CONTROL SELECTION	0 / 1	0004	0000: Automatic (temperature detection) (0) 0004: Always ON (1)	—
0145	CUMULATIVE RUN TIMER ALARM SETTING	0 / 1	FFFF	0000 ~ C34B (0.00 ~ 999.90)	0.02

13.7.10 Pattern Run Control Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier				
0146	PATTERN RUN SELECTION		0 / 1	0008	0000: OFF (0) 0008: ON (1)	—				
0147	1	PATTERN RUN CONTINUE MODE	0 / 1	0001	0000: reset on stop (0) 0001: switch when done (1)	—				
0148		PATTERN GROUP #1 SPEED #0	1	00FF	0000: Skip (0) 0001 ~ 000F: Speeds 1 ~ 15	1				
0149		PATTERN GROUP #1 SPEED #1								
0150		PATTERN GROUP #1 SPEED #2								
0151		PATTERN GROUP #1 SPEED #3								
0152		PATTERN GROUP #1 SPEED #4								
0153		PATTERN GROUP #1 SPEED #5								
0154		PATTERN GROUP #1 SPEED #6								
0155		PATTERN GROUP #1 SPEED #7								
0156		PATTERN GROUP #1 NUMBER OF CYCLES					0 / 1	00FF	0001 ~ 00FF: 1 ~ 255	1
0157	1	PATTERN GROUP #2 SPEED #0					1	00FF	0000: Skip (0) 0001 ~ 000F: Speeds 1 ~ 15	1
0158		PATTERN GROUP #2 SPEED #1								
0159		PATTERN GROUP #2 SPEED #2								
015A		PATTERN GROUP #2 SPEED #3								
015B		PATTERN GROUP #2 SPEED #4								
015C		PATTERN GROUP #2 SPEED #5								
015D		PATTERN GROUP #2 SPEED #6								
015E		PATTERN GROUP #2 SPEED #7								
015F		PATTERN GROUP #2 NUMBER OF CYCLES	0 / 1	00FF	0001 ~ 00FF: 1 ~ 255	1				
0160		1	PATTERN GROUP #3 SPEED #0	1	00FF	0000: Skip (0) 0001 ~ 000F: Speeds 1 ~ 15				
0161	PATTERN GROUP #3 SPEED #1									
0162	PATTERN GROUP #3 SPEED #2									
0163	PATTERN GROUP #3 SPEED #3									
0164	PATTERN GROUP #3 SPEED #4									
0165	PATTERN GROUP #3 SPEED #5									
0166	PATTERN GROUP #3 SPEED #6									
0167	PATTERN GROUP #3 SPEED #7									
0168	PATTERN GROUP #3 NUMBER OF CYCLES		0 / 1				00FF	0001 ~ 00FF: 1 ~ 255	1	
0169	1		PATTERN GROUP #4 SPEED #0				1	00FF	0000: Skip (0)	1

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
016A	PATTERN GROUP #4 SPEED #1				0001 ~ 000F: Speeds 1 ~ 15	
016B	PATTERN GROUP #4 SPEED #2					
016C	PATTERN GROUP #4 SPEED #3					
016D	PATTERN GROUP #4 SPEED #4					
016E	PATTERN GROUP #4 SPEED #5					
016F	PATTERN GROUP #4 SPEED #6					
0170	PATTERN GROUP #4 SPEED #7					
0171	PATTERN GROUP #4 NUMBER OF CYCLES		0 / 1	00FF	0001 ~ 00FF: 1 ~ 255	1
0172	SPEED #1 CONTINUE MODE		1	00FF	0000: Count in seconds from time of activation (0) 0001: Count in minutes from time of activation (1) 0002: Count in seconds from speed reach (2) 0003: Count in minutes from speed reach (3) 0004: Non-stop (continue until STOP command) (4) 0005: Continue until next step command (5)	—
0173	< 4	SPEED #1 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0174	SPEED #2 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0175	< 4	SPEED #2 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0176	SPEED #3 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0177	< 4	SPEED #3 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0178	SPEED #4 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0179	< 4	SPEED #4 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
017A	SPEED #5 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
017B	< 4	SPEED #5 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
017C	SPEED #6 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
017D	< 4	SPEED #6 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
017E	SPEED #7 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
017F	< 4	SPEED #7 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0180	SPEED #8 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0181	< 4	SPEED #8 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0182	SPEED #9 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0183	< 4	SPEED #9 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0184	SPEED #10 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0185	< 4	SPEED #10 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0186	SPEED #11 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0187	< 4	SPEED #11 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0188	SPEED #12 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0189	< 4	SPEED #12 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
018A	SPEED #13 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
018B	< 4	SPEED #13 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
018C	SPEED #14 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
018D	< 4	SPEED #14 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
018E	SPEED #15 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
018F	< 4	SPEED #15 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1

13.7.11 Feedback Control Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0190	FEEDBACK CONTROL SELECTION	0 / 1	0060	0020: No feedback (0) 0040: PID control (1) 0060: Speed feedback (2)	—
0191	1, 2 FEEDBACK INPUT SIGNAL SELECTION	0 / 1	001C	0004: RR input (1) 0008: IV input (2) 000C: RX input (3) 0010: PG feedback (4) 0014: RS232C input (5) 0018: Communication/12-bit binary interface board (6) 001C: BIN input (7)	—
0192		0 / 1	00FF	0001 ~ 00FF (0.01 ~ 2.55)	0.01
0193		0 / 1	FFFF	0001 ~ 8CA0 (0.01 ~ 360.00)	0.01
0194		0 / 1	00FF	0000 ~ 00FF (0.0 ~ 25.5)	0.1
0195		0 / 1	00FF	0000 ~ 00FF (0 ~ 255)	1
0196		0 / 1	FFFF	0 ~ Fmax	0.01
0197		PID DEVIATION LIMIT SELECTION	0 / 1	0080	0000: No PID deviation limit (0) 0080: PID deviation limited (1)
0198	1 PID DEVIATION UPPER LIMIT	0 / 1	00FF	0000 ~ 0032 (0 ~ 50)	1
0199		PID DEVIATION LOWER LIMIT	0 / 1	00FF	0000 ~ 0032 (0 ~ 50)
019A	PG INPUT: NUMBER OF PULSES	0 / 1	FFFF	0001 ~ 270F (1 ~ 9999)	1
019B	PG INPUT: NUMBER OF PHASES	0 / 1	0001	0000: Single-phase input (1) 0001: Two-phase input (2)	—
019C	DROOPING CONTROL ENABLE	0 / 1	0002	0000: OFF (0) 0002: ON (1)	—
019D	1 DROOPING CONTROL AMOUNT	0 / 1	00FF	0000 ~ 0064 (0 ~ 10.0)	0.1
019E	OVERRIDE CONTROL SELECTION	0 / 1	0007	0000: OFF (0) 0001: FCRR (1) 0002: FCIV (2) 0003: FCRX (3) 0004: FCPG (4) 0005: FCPNL (5) 0006: FCOPT (6) 0007: FCMLT (7)	—
019F	7 OVERRIDE MULTIPLIER INPUT SELECTION	0 / 1	0038	0000: Reference (0) 0008: KRR (1) 0010: KIV (2) 0018: KRX (3) 0020: KBIN (4)	—
01A0		OVERRIDE CHANGE MULTIPLIER	0 / 1	FFFF	FC18 ~ 03E8 (-100.0 ~ 100.0)
01A1 ~ 0203	Reserved	—	—	—	—

13.7.12 Communication Setting Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0204	INVERTER ID NUMBER		1	00FF	0000 ~ 00FF (0 ~ 255)	1
0205	COMMUNICATION SELECTION		1	0007	0000: OFF (0) 0001: RS485 (1) 0002: Modbus, F10, DeviceNet (2) 0003: TOSLINE S-20 (3) 0004: 12 bit binary input (4) 0005: 3-digit BCD (0.1Hz) (5) 0006: 3-digit BCD (1Hz) (6)	—
0206	1	MASTER/SLAVE SELECTION	1	0018	0000: Slave (0) 0008: Master (freq. command) (1) 0010: Master (output frequency) (2)	—
0207		RS485 BAUD RATE	1	0004	0000: Normal mode (0) 0004: High-speed mode (1)	—
0208	2	TOSLINE-F10 COMMAND INPUT	1	0003	0000: OFF (0) 0001: Frequency command (1) 0002: Command input (2) 0003: Both (1) and (2) (3)	—
0209		TOSLINE-F10 MONITOR OUTPUT	1	003C	0000: (0) 0020: (8) 0004: (1) 0024: (9) 0008: (2) 0028: (10) 000C: (3) 002C: (11) 0010: (4) 0030: (12) 0014: (5) 0034: (13) 0018: (6) 0038: (14) 001C: (7) 003C: (15)	—
020A	TOSLINE-F10 COMM ERROR MODE		1	0080	0000: Data cleared (0) 0080: Data retained (1)	—
020B	3	TOSLINE-S20 RECEIVE ADDRESS	1	FFFF	0000 ~ 03FF (0 ~ 1023)	1
020C		TOSLINE-S20 TRANSMIT ADDRESS	1	FFFF	0000 ~ 03FF (0 ~ 1023)	1
020D		TOSLINE-S20 COMMAND INPUT	1	001F	0000 ~ 001F (0 ~ 31)	1
020E		TOSLINE-S20 MONITOR OUTPUT	1	001F	0000 ~ 001F (0 ~ 31)	1
020F		TOSLINE-S20 FREQ REF ADDR SELECT	1	0001	0000: Disable (0) 0001: Enable (1)	1
0210		1	TOSLINE-S20 FREQ REFERENCE ADDR	1	FFFF	0000 ~ 03FF (0 ~ 1023)
0211	TOSLINE-S20 COMM ERROR MODE		1	0002	0000: Data cleared (0) 0002: Data retained (1)	1
0212	TOSLINE-S20 COMM OPTION RESET		1	0004	0000: No effect (0) 0004: Reset (1)	1
0213	RS485/12-BIT BINARY BIAS, GAIN		0 / 1	0020	0000: OFF (0) 0020: ON (1)	—
0214	1	RS485/12-BIT BINARY POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0215		RS485/12-BIT BINARY PT. #1 FREQ	0 / 1	FFFF	0000 ~ Fmax (0 ~ Fmax)	0.01
0216		RS485/12-BIT BINARY POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0217		RS485/12-BIT BINARY PT. #2 FREQ	0 / 1	FFFF	0000 ~ Fmax (0 ~ Fmax)	0.01

13.7.13 AM/FM Terminal Adjustment Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0218	FM TERMINAL FUNCTION SELECTION	0 / 1	FFFF	1194: Pre-comp ref. frequency (0) 6686: Post-comp output freq. (1) 1500: Frequency setting (2) 2576: Output current (3) 2689: DC voltage (4) 5668: Output voltage (5) 3684: Torque current (6) 2688: Excitation current (7) 7506: PID feedback value (8) 0584: Motor overload ratio (9) 0586: Inverter overload ratio (10) 0588: DBR overload ratio (11) 835C: Input power (12) 835E: Output power (13) A000: Fixed output (14) 2304: Peak output current (15) 8302: Peak input voltage (16)	—
0219	FREQUENCY METER ADJUSTMENT	0 / 1	FFFF	0000 ~ FFFF	1
021A	AM TERMINAL FUNCTION SELECTION	0 / 1	FFFF	Same as FM TERMINAL FUNCTION SELECTION	—
021B	CURRENT METER ADJUSTMENT	0 / 1	FFFF	0000 ~ FFFF	1

13.7.14 Utility Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
021C	INDUSTRIAL APPLICATIONS (previous setting monitor for read use only)	0 / 1	00FF	0000: Standard shipment setting (0) 0001: Pump application (1) 0002: Fan application (2) 0003: Conveyor application (3) 0004: Hoist application (4) 0005: Textiles application (5) 0006: Machine tools application (6)	—
021D	INDUSTRIAL APPLICATIONS (for write use) (*)	0 / 1	00FF	0000: Does nothing (0) 0011: Pump application (1) 0012: Fan application (2) 0013: Conveyor application (3) 0014: Hoist application (4) 0015: Textiles application (5) 0016: Machine tools application (6)	—
021E	STANDARD SETTING MODE SELECTION (*)	0 / 1	00FF	0000: Does nothing (0) 0001: 50Hz standard settings (1) 0002: 60Hz standard settings (2) 0003: Factory settings (3) 0004: Trip clear (4) 0005: Save user-set parameters (5) 0006: TYPE 5 reset (6) 0007: Initialize typeform (7)	—
021F	COMMAND MODE SELECTION	0 / 1	0007	0000: Only RS232C valid (0) 0001: Terminal input valid (1) 0002: Panel input valid (2) 0003: Communication interface input valid (3) 0004: local/remote valid (4)	—
0220	FREQUENCY MODE SELECTION	0 / 1	0038	0000: Only RS232C valid (0) 0008: Terminal input valid (1) 0010: Panel input valid (2) 0018: Communication/12-bit binary interface input valid (3) 0020: local/remote valid (4)	—
0221	PANEL OPERATION MODE SELECTION	0 / 1	00FB	0000 ~ 003F (0 ~ 63) (except 0004, 0008, 000C....)	1
0222	PASS NUMBER	0 / 1	00FF	0000 ~ 0063 (0 ~ 99)	1
0223	CPU VERSION	2	FFFF	(Monitor only)	—
0224	ROM VERSION	3	FFFF	(Monitor only)	—
0225	EEPROM VERSION	1	FFFF	(Monitor only)	—
0226	INVERTER TYPEFORM	0	00FF	(Monitor only)	—
0227	STATUS MONITOR #1 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
0228	STATUS MONITOR #2 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
0229	STATUS MONITOR #3 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
022A	STATUS MONITOR #4 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
022B	FREQUENCY UNITS SCALE FACTOR	0 / 1	FFFF	0000 ~ 4E20 (0.00 ~ 200.00)	0.01
022C	FREQUENCY DISPLAY RESOLUTION	0 / 1	0003	0000: 1Hz (0) 0001: 0.1Hz (1) 0002: 0.01Hz (2)	—

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier	
022D	ACC/DEC TIME UNITS SELECTION	0 / 1	0004	0000: 0.1 sec. (0) 0004: 0.01 sec. (1)	—	
022E	CURRENT UNITS SELECTION	0 / 1	0008	0000: % (0) 0008: A (1)	—	
022F	VOLTAGE UNITS SELECTION	0 / 1	0010	0000: % (0) 0010: V (1)	—	
0230	BLIND FUNCTION SELECTION	0 / 1	0001	0000: Blind (0) 0001: Selective unblinding (1)	—	
0231	1	FUNDAMENTAL PARAMS #2 BLIND	0 / 1	0040	0000: Blind (0) 0040: Unblind (1)	—
0232		PANEL CONTROL PARAMS BLIND	0 / 1	0080	0000: Blind (0) 0080: Unblind (1)	—
0233		TERMINAL SELECTION PARAMS BLIND	0 / 1	0001	0000: Blind (0) 0001: Unblind (1)	—
0234		SPECIAL CONTROL PARAMS BLIND	0 / 1	0002	0000: Blind (0) 0002: Unblind (1)	—
0235		FREQUENCY SETTING PARAMS BLIND	0 / 1	0004	0000: Blind (0) 0004: Unblind (1)	—
0236		PROTECTION FUNCTION PARAMS BLIND	0 / 1	0008	0000: Blind (0) 0008: Unblind (1)	—
0237		PATTERN RUN CONTROL PARAMS BLIND	0 / 1	0010	0000: Blind (0) 0010: Unblind (1)	—
0238		FEEDBACK CONTROL PARAMS BLIND	0 / 1	0020	0000: Blind (0) 0020: Unblind (1)	—
0239		COMMUNICATION PARAMS BLIND	0 / 1	0040	0000: Blind (0) 0040: Unblind (1)	—
023A		INDUSTRIAL APPL:PUMP PARAMS BLIND	0 / 1	0080	0000: Blind (0) 0080: Unblind (1)	—
023B		INDUSTRIAL APPL:FAN PARAMS BLIND	0 / 1	0001	0000: Blind (0) 0001: Unblind (1)	—
023C		INDUSTRIAL APPL: CONVEYOR BLIND	0 / 1	0002	0000: Blind (0) 0002: Unblind (1)	—
023D		INDUSTRIAL APPL: HOIST BLIND	0 / 1	0004	0000: Blind (0) 0004: Unblind (1)	—
023E		INDUSTRIAL APPL: TEXTILES BLIND	0 / 1	0008	0000: Blind (0) 0008: Unblind (1)	—
023F		INDUST APPL:MACHINE TOOLS BLIND	0 / 1	0010	0000: Blind (0) 0010: Unblind (1)	—
0240	AM/FM ADJUSTMENT PARAMS BLIND	0 / 1	0001	0000: Blind (0) 0001: Unblind (1)	—	
0241	MOTOR PARAMETERS BLIND	0 / 1	0004	0000: Blind (0) 0004: Unblind (1)	—	

13.7.15 Motor Rating Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0242	NUMBER OF MOTOR POLES	0 / 1	00FF	0001: (2) 0002: (4) 0003: (6) 0004: (8) 0005: (10) 0006: (12) 0007: (14) 0008: (16)	2
0243	MOTOR RATED CAPACITY	0 / 1	FFFF	0001 ~ 270F (0.1 ~ 999.9)	0.1
0244	MOTOR TYPE	0 / 1	0030	0000:Toshiba EQPIII motor (0) 0010:Toshiba STD motor (1) 0020:Other (2)	—
0245	MOTOR RATED VOLTAGE (230 / 460v units) (575v units)	0 / 1	00FF	0012 ~ 0078 (90 ~ 600)	5
0246				001A ~ 00AC (130 ~ 860)	
0247	MOTOR RATED FREQUENCY	0 / 1	00FF	0000 ~ 00C8 (0 ~ 400)	2
0248	MOTOR RATED RPM	0 / 1	FFFF	0000 ~ 270F (0 ~ 9999)	1
0249	AUTO-TUNING ENABLE	0	0008	0000: Auto-tuning disabled (0) 0008: Auto-tuning enabled (1)	—
024A	LOAD MOMENT OF INERTIA	0 / 1	00C0	0000: Small (0) 0040: Medium (1) 0080: Large (2) 00C0: Very large (3)	—

13.7.16 Inverter Fault Codes

LCD Display Message	Data (Hex)	Explanation
NO ERROR	xx00	No error has been recorded since the last inverter reset or trip clear
OVERCURRENT (ACCEL) (PRESS CLEAR)	xx01	Overcurrent during acceleration
OVERCURRENT (DECEL) (PRESS CLEAR)	xx02	Overcurrent during deceleration
OVERCURRENT (RUN) (PRESS CLEAR)	xx03	Overcurrent during constant-speed run
LOAD-END OVERCURRENT (PRESS CLEAR)	xx04	Load-end overcurrent detected at start-up (output terminals, motor wiring etc.)
U-PHASE SHORT CKT (PRESS CLEAR)	xx05	U-phase armature short circuit
V-PHASE SHORT CKT (PRESS CLEAR)	xx06	V-phase armature short circuit
W-PHASE SHORT CKT (PRESS CLEAR)	xx07	W-phase armature short circuit
LOST INPUT PHASE (PRESS CLEAR)	xx08	Lost input phase (option)
LOST OUTPUT PHASE (PRESS CLEAR)	xx09	Lost output phase (option)
OVERVOLTAGE (ACCEL) (PRESS CLEAR)	xx0A	Overvoltage during acceleration
OVERVOLTAGE (DECEL) (PRESS CLEAR)	xx0B	Overvoltage during deceleration
OVERVOLTAGE (RUN) (PRESS CLEAR)	xx0C	Overvoltage during constant-speed run
INVERTER OVERLOAD (PRESS CLEAR)	xx0D	Inverter overload
MOTOR OVERLOAD (PRESS CLEAR)	xx0E	Motor overload
DBR OVERLOAD TRIP (PRESS CLEAR)	xx0F	Dynamic braking resistor overload
OVERHEAT TRIP (PRESS CLEAR)	xx10	Inverter overheat
EMERGENCY OFF (PRESS CLEAR)	xx11	Emergency off
EEPROM WRITE FAILURE (PRESS CLEAR)	xx12	EEPROM failure during write
EEPROM READ FAILURE (PRESS CLEAR)	xx13	EEPROM failure during initial read
—	xx14	Unused
RAM ERROR (PRESS CLEAR)	xx15	RAM error
ROM ERROR (PRESS CLEAR)	xx16	ROM error
CPU ERROR (PRESS CLEAR)	xx17	CPU error
COMMUNICATION ERROR (PRESS CLEAR)	xx18	RS232C timer time-out
GATE ARRAY FAULT (PRESS CLEAR)	xx19	Gate array error
CURRENT DETECT ERROR (PRESS CLEAR)	xx1A	Output current detection circuit error

LCD Display Message	Data (Hex)	Explanation
OPTION PCB ERROR (PRESS CLEAR)	xx1B	Option PCB error
OPTION ROM ERROR	xx1C	Option ROM error
LOW CURRENT TRIP (PRESS CLEAR)	xx1D	Low current
UNDERVOLTAGE TRIP (PRESS CLEAR)	xx1E	Main circuit undervoltage
—	xx1F	Unused
OVERTORQUE TRIP (PRESS CLEAR)	xx20	Overtorque
EARTH FAULT (SOFT) (PRESS CLEAR)	xx21	Earth fault (software)
EARTH FAULT (HARD) (PRESS CLEAR)	xx22	Earth fault (hardware)
OPEN FUSE TRIP (PRESS CLEAR)	xx23	Open fuse
DBR OVERCURRENT TRIP (PRESS CLEAR)	xx24	Dynamic braking resistor overcurrent
DC OVERCURRENT (ACC) (PRESS CLEAR)	xx25	Overcurrent in DC section during acceleration
DC OVERCURRENT (DEC) (PRESS CLEAR)	xx26	Overcurrent in DC section during deceleration
DC OVERCURRENT (RUN) (PRESS CLEAR)	xx27	Overcurrent in DC section during constant-speed run
AUTO-TUNING ERROR (PRESS CLEAR)	xx28	Auto-tuning error
INV TYPEFORM ERROR (PRESS READ/WRITE)	xx29	Inverter typeform error

14. Firmware Updates

The gateway'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.

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 as complete board support packages (referred to as BSPs) 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 support packages have been released and are available to upgrade their units.

14.1 Requirements

Besides the new firmware file, firmware updates require a PC with a Windows operating system (Windows 95 or newer) and a serial port, the RFU PC application (refer to section 14.3), and an appropriate cable to connect the RS232 port of the unit to the PC.

Please be sure to read the firmware release notes and updated user's manual (included with the BSP) 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.

14.2 Connection



IMPORTANT: Note that the gateway will not be operating its system control and communication tasks while its internal firmware is being updated. Therefore, be sure to shut down the system to a known safe state prior to initiating the firmware update procedure.

Connect the serial port cable between the RS232 port of the gateway and the computer's serial port. Move "CFG" switch #1 to the "ON" (right-hand) position: this will place the gateway into the "firmware download" mode. Whenever "CFG" switch #1 is "ON", the gateway can only download firmware to its flash memory: all other application functions (such as communications, console access etc.) will be disabled.

14.3 Using the RFU Utility

Support for downloading new application firmware to the gateway is provided by the free Rabbit Field Utility (RFU), which is a 32-bit application that runs on Microsoft Windows platforms. The RFU utility can be downloaded from ICC's home page at <http://www.iccdesigns.com>. When downloading a new gateway application BSP, always confirm that you also have the latest version of RFU, as new .BIN firmware files contained in BSPs may require functionality found only in the most recent RFU versions for successful downloading.

The remainder of this section will detail the RFU utility configuration and firmware download procedures.

14.3.1 Required Files

When first downloaded, the RFU utility files are compressed into one self-extracting .EXE distribution file. Create a folder (such as c:\RFU), place the distribution file in this folder, and then execute it. This will extract the compressed files into that same folder. The distribution file is then unneeded and can be deleted if desired. To run the RFU utility, double-click on the RFU.EXE file icon.

14.3.2 First-Time Configuration

The first time the RFU utility is run on a computer, several configuration items need to be confirmed. These configuration items are retained in the computer's registry from that point on, so reconfiguration is not required unless certain parameters (such as which serial port to use on the computer) are changed.

The two configuration items that need to be confirmed are the communications and bootstrap loaders path. First, select the "Setup...Communications" menu item (refer to Figure 32).

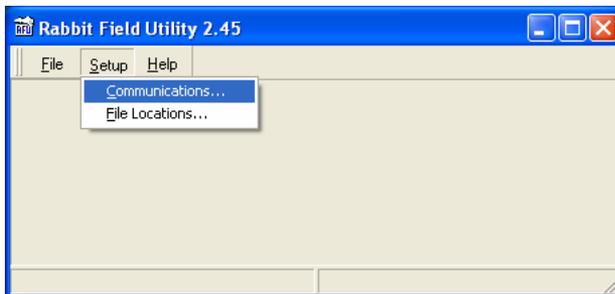


Figure 32: RFU Main Screen

The Communications Options window shown in Figure 33 then appears. Confirm that the settings are as shown, with the possible exception of the

“Comm Port” settings, which depends on the COM port you are using. Click “OK” when complete.

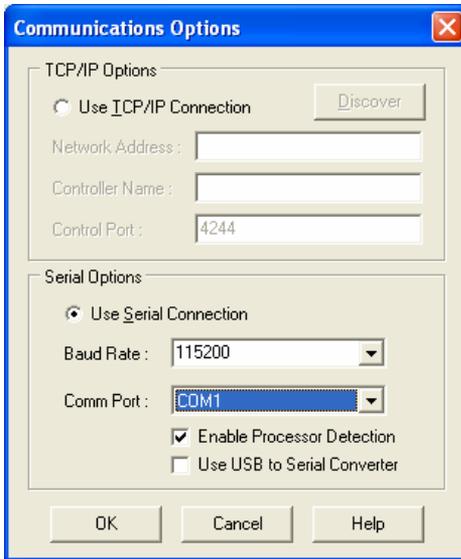


Figure 33: Communications Options Window

Next, select the “Setup...File Locations” menu item from the main screen. The “Choose File Locations” window shown in Figure 34 then appears. Confirm that the correct paths to the referenced files are entered. Enter the correct paths if necessary.

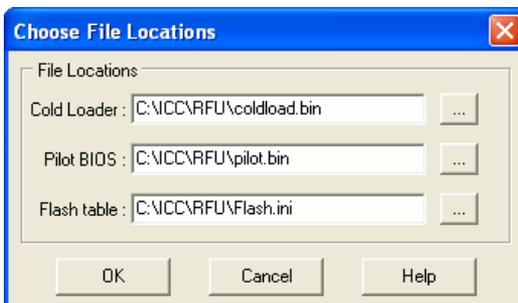


Figure 34: Choose File Locations Window

14.3.3 Transmitting Firmware Files

When a board support package (BSP) has been downloaded and unzipped, the flash firmware file will be the one with “.BIN” as its file name extension.

Once the RFU utility has been configured, the flash firmware files can be downloaded to the gateway by two different methods. The simplest way is to drag the application firmware .BIN file's icon and drop it onto the RFU utility's main screen. This will automatically initiate the download process.

Alternatively, select the "File...Load Flash Image" menu item (refer to Figure 35).

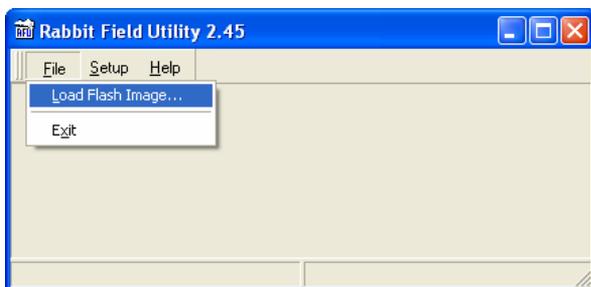


Figure 35: Load Flash Image Menu Selection

The flash image (.BIN file) selection window will then appear (refer to Figure 36). Browse to the location of the flash image file and select it. Clicking "OK" will then initiate the download process.

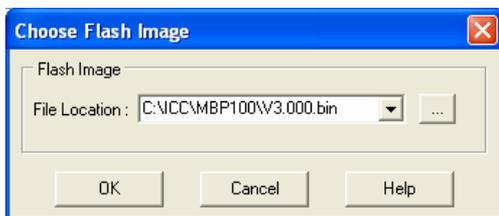


Figure 36: Flash File Selection Window

While downloading, the RFU utility will indicate the download status. Once complete, summary information will be displayed in the bottom status bar (see Figure 37).



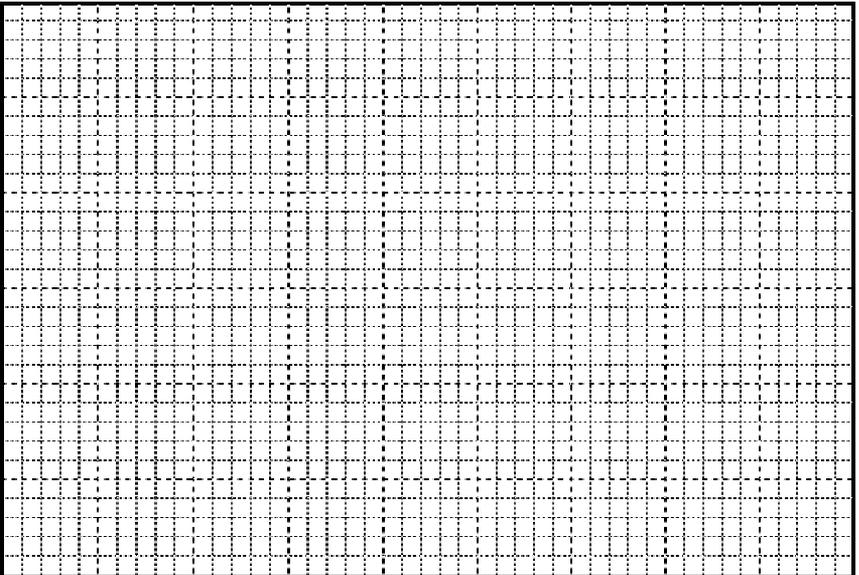
Figure 37: Summary Information

14.4 Wrap-Up

Once downloading is complete, close the RFU utility, move “CFG” switch #1 back to the “OFF” (left-hand) position to exit “firmware download” mode, and cycle power momentarily to the unit by either disconnecting the auxiliary power supply and/or powering down all connected drives or momentarily removing all drive communication cables from the unit.

When the unit powers up again, it will be running the new application firmware. If the new firmware version release notes indicated that the configuration file might need to be reloaded, then do so at this point.

15. Notes





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