NETWORK GATEWAY SERIES

INDUSTRIAL CONTROL COMMUNICATIONS, INC.

XLTR-100

RS-485 MULTIPROTOCOL NETWORK GATEWAY

December 2004
ICC #10484-2.100-000

Introduction

Thank you for purchasing the ICC XLTR (“Translator”) -100 RS-485 Multiprotocol Network Gateway. The XLTR-100 allows information to be transferred seamlessly between different fieldbus networks with minimal configuration requirements. The XLTR-100 provides dual RS-485 network connections (a primary/slave and a secondary/master port), as well as two independent 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 currently provide support for the following networks:

- Modbus RTU (RS-485 master and slave)
- Johnson Controls, Inc. Metasys N2 (RS-485 slave)
- Sullair Supervisor network (RS-485 master)
- Toshiba ASD (common serial master)
- Mitsubishi ASD (RS-485 master)

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

Before using the XLTR-100 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-100, 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, usage methods and firmware update procedures for the XLTR-100 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-100 interface in DIN rail mountable case
- 2 meter DB9-RJ45 MMI port cable (part number 10425)
- This manual

XLTR-100 RS-485 Multiprotocol Network Gateway
User's Manual

Part Number 10484-2.100-000
Printed in U.S.A.

Industrial Control Communications, Inc. reserves the right to make changes and improvements to its products without providing notice.

Notice to Users

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

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

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.

ICC

TABLE OF CONTENTS

1. The Network Gateway Series Concept

The XLTR-100 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 heart of the Network Gateway Series concept is an element called the "point database" (refer to Figure 1). The point database is entirely user-configurable, and provides the end-to-end mapping information that allows primary network requests to be routed to the correct locations on the secondary network, while at the same time ensuring that the content of the request will be understood once it gets there. Additionally, the point database provides the added benefit of "data mirroring", whereby current copies of point values (secondary network data objects) are maintained locally within the gateway itself. This greatly reduces the primary network's request-to-response latency time, as requests (read or write) can be entirely serviced locally, thereby eliminating the time required to execute a secondary network transaction.

When properly configured, the gateway will become essentially "transparent" on the networks, and the primary network master can engage in a seamless dialogue with one or more secondary network devices. This can all be accomplished without regard to the characteristics (physical layer or protocol) of the primary or secondary network.

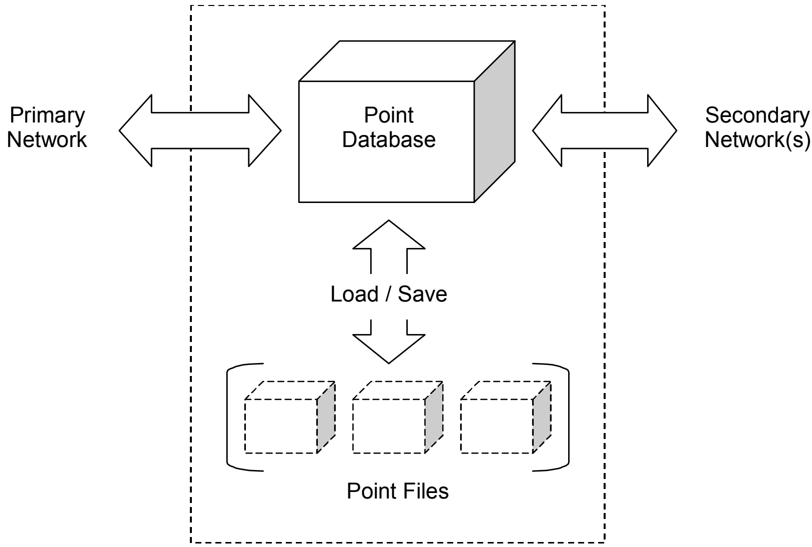

Figure 1: The Network Gateway Series Concept

2. Mechanical Diagrams

2.1 Enclosure

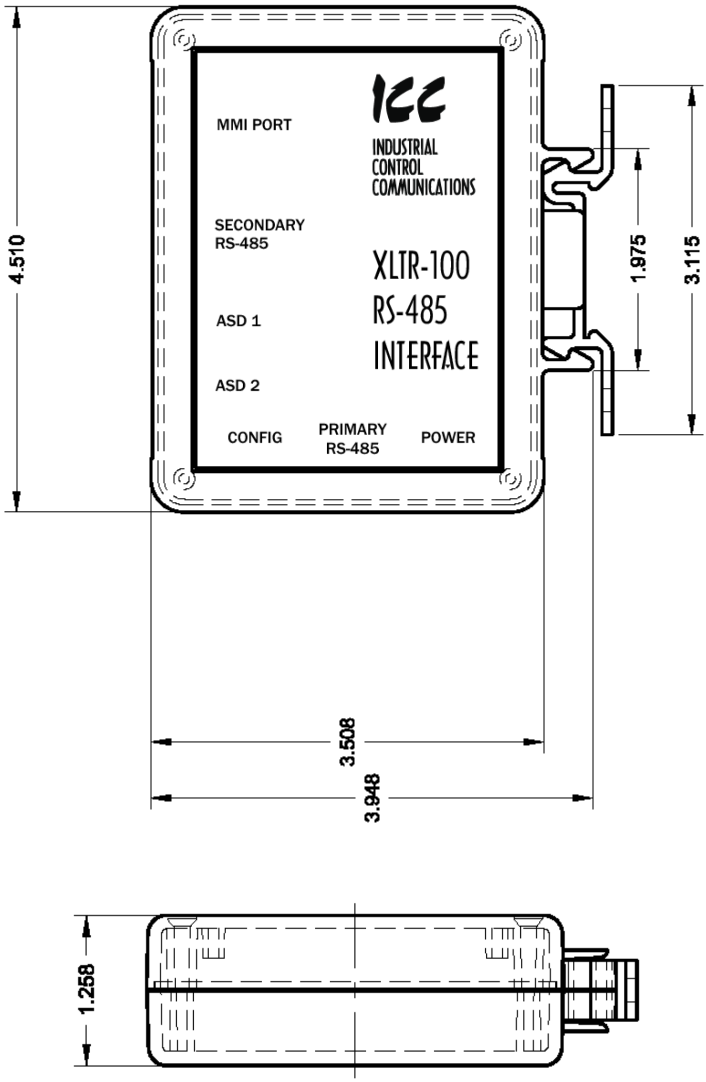

Figure 2: Enclosure Dimensions (units are inches)

2.2 Mounting Clip

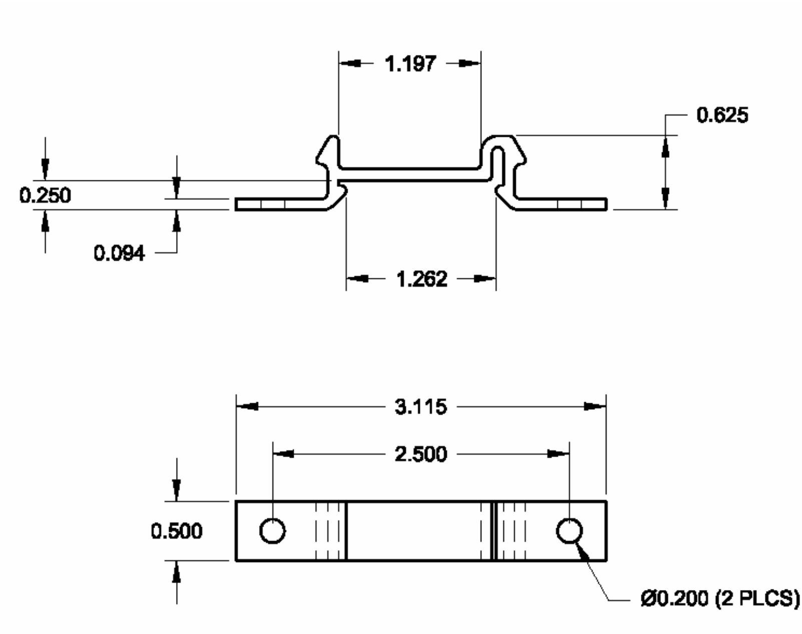

Figure 3: Mounting Clip Dimensions (units are inches)

2.3 External Interface

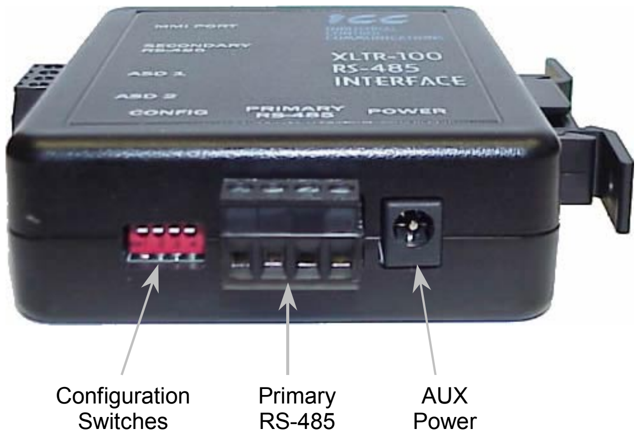

Figure 4: Bottom View

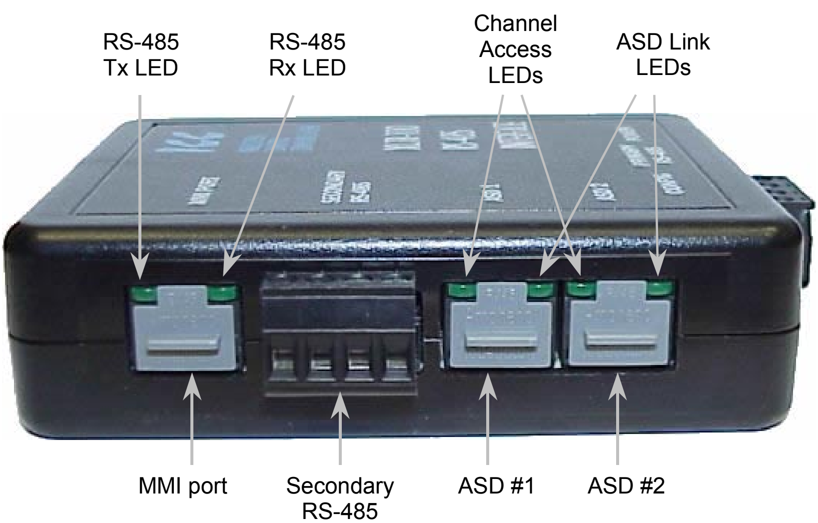

Figure 5: Front View

3. Feature Summary

Primary Network

Half-duplex RS-485 (A / B / Signal Ground / Shield)

Secondary Network

The XLTR-100 has two independent secondary networks, depending on the application:

- **Toshiba ASD common serial***:* The XLTR-100 provides support for simultaneous connection of two Toshiba 7-series, 9-series, 11-series or VF-nC1 ASDs via the drives' common serial (aka logic level) communication ports. 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 to connect the XLTR-100 to the drives.
- **RS-485**: Same properties as primary network

Power Supply

When connected to Toshiba ASDs via the ASD 1 / ASD 2 ports, can be either powered directly from the attached ASDs, or from the auxiliary "POWER" input jack. All other connections (RS-485 -to- RS-485) require the use of the auxiliary "POWER" input.

Supported Protocols

- Primary Network (RS-485)
  - Modbus RTU
  - Metasys N2
- Secondary Network
  - Toshiba ASD (common serial)
  - Modbus RTU (RS-485)
  - Sullair Supervisor (RS-485)
  - Mitsubishi ASD (RS-485)

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

Text-Based Console Configuration

The unit is configured via a text-based console interface, available over RS232 by using the included MMI cable and a standard PC terminal program such as Microsoft Windows HyperTerminal®.

Point File-Based Configuration

Up to 3 point files (primary / secondary network mapping definition files) can be stored in the unit's internal battery-backed file system. Point files can also be uploaded from / downloaded to a PC, which provides the capability for PC-based file backup and easy configuration copying to multiple units. Sample point files and related documentation can also be downloaded from our web site, uploaded to a unit, and custom-modified to suit a specific application.

Drive AutoScan Algorithm

Toshiba ASD common serial port connections are automatically established and continuously monitored (when points are defined for that drive). No drive configuration needs to be performed to connect the XLTR-100 to the drives. Just plug it in – it's that simple.

Network Timeout Action

A configurable network timeout function can be programmed that allows each internally-defined point to have its own unique "fail-safe" condition in the event of a primary network interruption.

Indicators

2 green LEDs exist on each of the Toshiba ASD ports and on the MMI port connector. Refer to section 9 for more detailed information about the LED indicators and their meanings.

MMI Port Connector

RS232-level. Use the DB9-to-RJ45 MMI cable supplied with the XLTR-100 kit to interface with the unit for either console-based configuration, point file upload/download, or flash firmware downloading.

Field-Upgradeable

As new firmware becomes available, the XLTR-100 unit can be upgraded in the field by the end-user. Refer to section 15 for more information.

Versatile 3-Way DIN-Rail Mounting System

The unit's enclosure is provided with a mounting clip attached to the rear of the unit. This clip allows the unit to be mounted 3 different ways:

- For DIN rail mounting, snap the mounting clip onto a standard DIN rail, and then snap the unit enclosure onto the clip's retaining tabs. This allows easy removal or repositioning of the unit on the DIN rail during wiring.
- For panel mounting, the mounting clip can be bolted directly to a flat panel via the two bolt holes at the top and bottom of the clip. Refer to section 2.2 for mounting clip mechanical details. Once the mounting clip is securely attached to the panel, the unit enclosure can be snapped onto the clip's retaining tabs.
- For fixed DIN rail mounting, a combination of the above two techniques can be employed. First, snap the mounting clip onto a DIN rail and position it in its desired location. Then, the mounting clip can be bolted to the DIN rail support panel, securing it in place. Lastly, the unit can be snapped onto the fixed mounting clip.

In all cases, the unit can be easily unsnapped from the mounting clip to temporarily provide easier access to the configuration switches or network connector.

4. Installing the Interface

The installation procedure of the XLTR-100 will vary slightly depending on the chosen secondary network.

4.1 RS-485 Secondary Network

Note that in order to power the unit when using the secondary RS-485 network, you must also purchase the optional 120VAC/9VDC power supply (ICC part number 10456).

1. Attach the mounting clip and unit enclosure in your desired manner (refer to page 11 for more information).
2. Connect the primary network to the “Primary RS-485” pluggable terminal block. Refer to section 5 for detailed connection information. Ensure that the terminal block is fully seated into the terminal block header, and route the network cable such that it is located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route the cable away from any sharp edges or positions where it may be pinched.
3. Repeat step 2 above to connect the secondary network to the “Secondary RS-485” terminal block.
4. 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.
5. Connect the power supply to the gateway’s “Power” jack.

4.2 Toshiba ASD (Common Serial) Secondary Network

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.

4.2.1 Installation for G7 ASDs

1. ⚠ **CAUTION!** Verify that all input power sources to the drives to be connected have been turned OFF and are locked and tagged out.
2. ⚠ **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.
3. Attach the mounting clip and gateway enclosure in your desired manner (refer to page 11 for more information).

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 1-8 to connect other drive(s) as needed.

10. Connect the primary network to the "Primary RS-485" pluggable terminal block. Refer to section 5 for detailed connection information. Ensure that the terminal block is fully seated into the terminal block header, and route the network 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.

11. If an auxiliary power supply is going to be used, connect it to the gateway's "Power" jack.

12. Take a moment to verify that the gateway and all primary and secondary 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 1 and 2 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

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

1. ⚠ **CAUTION!** Verify that all input power sources to the drives to be connected have been turned OFF and are locked and tagged out.
2. ⚠ **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.
3. Attach the mounting clip and gateway enclosure in your desired manner (refer to page 11 for more information).
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 1, 2, 4 and 5 to connect other drive(s) as needed.
7. Connect the primary network to the "Primary RS-485" pluggable terminal block. Refer to section 5 for detailed connection information. Ensure that the terminal block is fully seated into the terminal block header, and route the network 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. If an auxiliary power supply is going to be used, connect it to the gateway's "Power" jack.
9. Take a moment to verify that the gateway and all primary and secondary 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 1 and 2 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

5. RS-485 Electrical Interface

In order to ensure appropriate network conditions (signal voltage levels, etc.), some knowledge of the gateway's RS-485 network interface circuitry is required. Refer to Figure 6 for a simplified network schematic of both the primary and secondary RS-485 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.

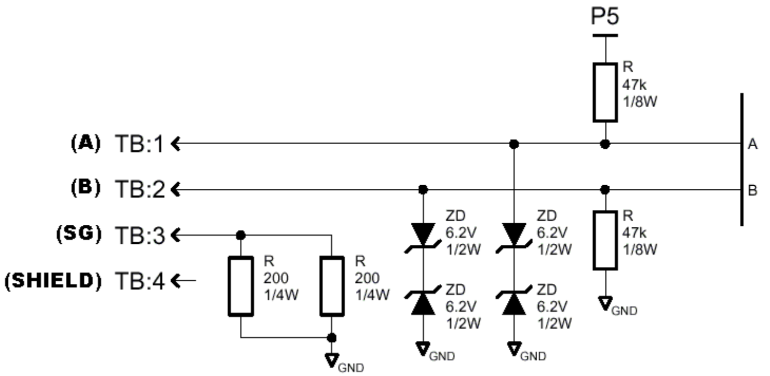

Figure 6: RS-485 Interface Circuitry Schematic

Figure 7 details the specific network connections to the RS-485 terminal block. This connection scheme applies equally to the primary as well as secondary networks.

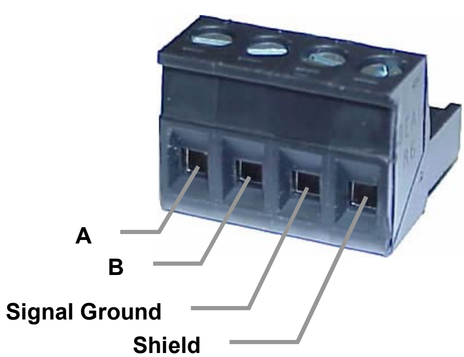

Figure 7: RS-485 Terminal Block Connections

6. 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

7. 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 (with Toshiba ASD connections, turn off all power supplies to connected drives and wait at least five minutes after each drive's "CHARGE" lamp has gone out.)

Inspection Points

- Check that the dust covers for all unused RJ45 ports are seated firmly in their connectors.
- 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 scarred by overheating.
- 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.

8. Storage and Warranty

8.1 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.

8.2 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.

9. 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.

9.1 Toshiba ASD Port Indicators

Each Toshiba ASD port RJ45 connector contains two integrated green LEDs. Figure 8 indicates the functions of these LEDs.

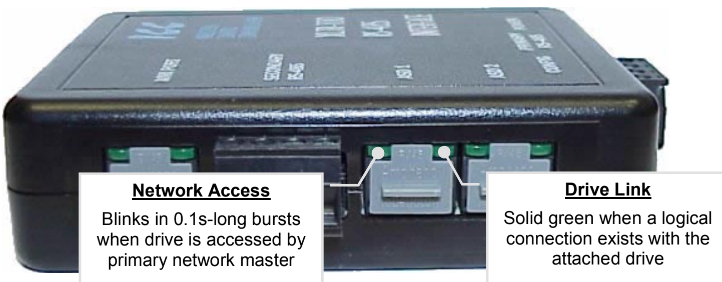

Figure 8: Drive Connector Indicators

The Network Access indicator is useful for confirming that a specific drive channel is being accessed correctly by the primary network, while the Drive Link indicator provides an easy method of determining that the XLTR-100 and drive are successfully exchanging data, independent of primary network activity (Note: Drive Link LED will only represent "last access" status if no child points are defined for that channel).

9.2 MMI Port Indicators

The MMI port RJ45 connector also contains two integrated green LEDs. Figure 9 indicates the functions of these LEDs.

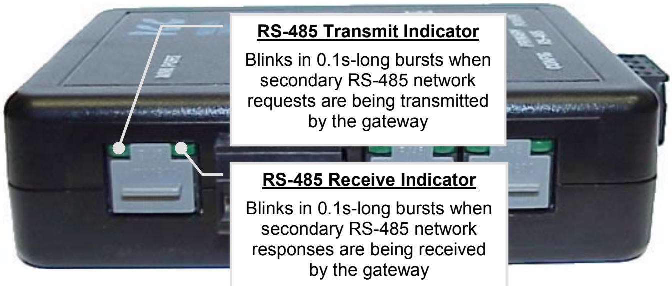

Figure 9: MMI Port Indicators

10. Configuration Switches

There are four configuration switches located on the bottom side of the gateway. Currently, switches #1 - #3 are reserved, and switch #4 is used during flash firmware reprogramming of the gateway (refer to section 15).

11. Internal Battery

The XLTR-100 gateway has an internal coin-cell type battery that is used to backup the file system when the gateway is unpowered. This battery is designed to last the lifetime of the product under normal use. However, if the gateway is left unpowered for several years, the battery may become exhausted. For this reason, always be certain to download any customized point files to a PC so that they will be available for uploading again if the battery fails and requires replacement.

If the battery becomes discharged, contact ICC for assistance in obtaining a replacement. Alternatively, it can be replaced by the user by removing all power sources from the gateway, opening the case, carefully popping out the discharged battery and replacing it with a Panasonic BR2330 or equivalent component.

12. Point Configuration

As mentioned in section 1, the Network Gateway Series concept revolves around a central "point database", containing various individual points. A "point" is simply an object that defines some sort of primary -to- secondary network mapping information.

There are two different types of points:

- Parent points
- Child points

The relationship between these two point types is as suggested by their names: parent points (from hereon referred to simply as "parents") define the upper-most level of mapping information, and child points (hereon referred to individually as "child" or collectively as "children") exist as sub-elements of parent points, inheriting the parent's attributes while simultaneously adding additional mapping information. Parents can have any number of children assigned to them, limited only by the maximum number of points available (100 total). In certain instances (such as with a Modbus RTU primary protocol), it is also possible to have parents that do not have any children assigned to them. Although the details may vary among different Network Gateway Series devices, the conceptual relationship for the XLTR-100 is detailed in Figure 10.

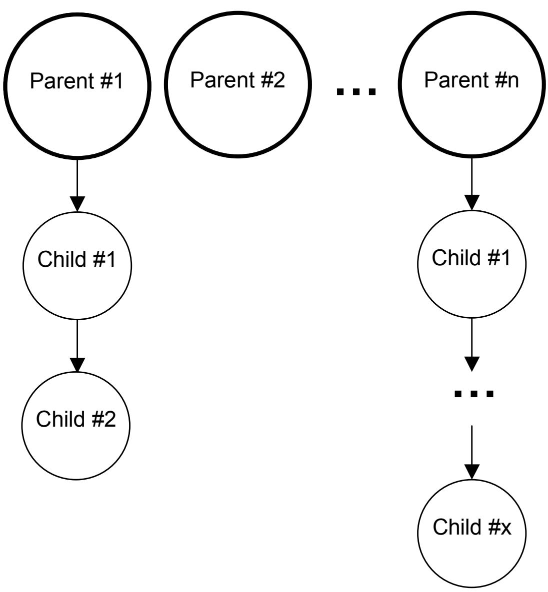

Figure 10: Parent / Child Relationship

12.1 Parents

Parents map a primary network address (device) to a secondary network address (device). This can perhaps best be demonstrated by use of an example. Say, for instance, that a Metasys N2 Network Control Unit (NCU) would like to gain access to four Modbus RTU devices. The Modbus devices have been pre-assigned the addresses 5, 7, 9 and 11. This system is represented in Figure 11.

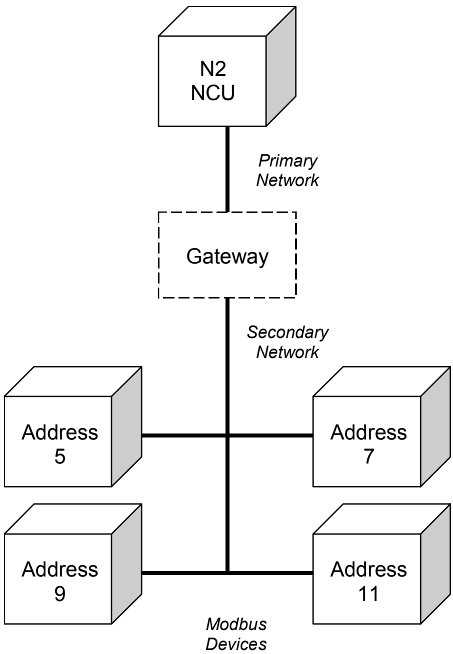

Figure 11: Example System

In order to allow the NCU to access the Modbus devices, we must create a parent point for each Modbus device (four total). The secondary addresses of the parent points must of course be the respective pre-assigned Modbus addresses (5, 7, 9 and 11), but the parents provide flexibility in assigning the primary network addresses to be any valid addresses supported by the network. Let's say that we would like the NCU to be able to access the four devices with Modbus network addresses 5, 7, 9 and 11 at Metasys network addresses 1, 2, 3, and 4, respectively.

Metasys Address	Maps To	Modbus Address
1	……………..	5
2	……………..	7
3	……………..	9
4	……………..	11

Therefore, we would need to create our parent points as indicated in Figure 12 (this manual will use the graphical convention of a large, bolded circle with a line down the middle to represent a parent. The number on the left of the line will indicate the primary network address, and the number on the right will indicate the corresponding secondary network address.)

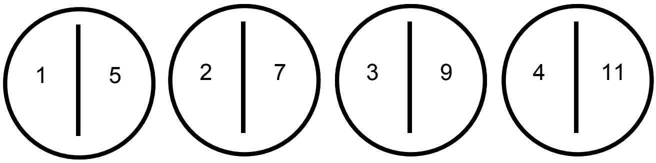

Figure 12: Parent Assignments for Example System

Note that with these parent assignments, the gateway will now respond to the NCU on behalf of the four Modbus devices, and it will do so at Metasys addresses 1, 2, 3 and 4. From this simple example, some observations can be made:

- The gateway will consume as much of the primary network address space as there are parents assigned within it. In this example, the gateway has 4 parents and therefore takes up 4 Metasys addresses. No other devices (gateways or otherwise) can be assigned primary network addresses that have already been assigned to the primary side of parents in a gateway.
- Primary and secondary network parent addresses must be unique. The gateway will not allow the same parent address to be used more than once (e.g. you cannot create a parent mapping address 1 to address 5, and then attempt to create another parent mapping address 1 to address 7).
- If the Toshiba common serial secondary network physical layer is selected, then “ASD 1” and “ASD 2” are the only options available for secondary network addresses. Any addressing entered via the drive’s panel (“inverter number” parameter, for example) has no relevance to how that drive is accessed by the gateway.
- Based on the two previous points, it can be seen that applications using the Toshiba common serial secondary network physical layer can have at most two existing parents (some address mapping to “ASD 1”, and some other address mapping to “ASD 2”).
- Secondary network device address assignment is relevant only from a logical or network organizational standpoint. Because the primary network master never “sees” the true secondary network address assigned to a device, the secondary network address assignment can be determined by any user-defined criteria (physical unit position on the floors of a building, for example), while allowing the primary network address assignment to be chosen using a different criteria (grouping according to device application or function, for example).

Now that we thoroughly understand the role of parents in the gateway configuration, let's move on to the (only slightly more diverse) topic of children.

12.2 Children

While parents provide an address-to-address mapping function, children provide a lower-level object-to-object mapping function. The definition of what constitutes an object can vary depending on the protocols and devices involved. For example, an object on the Metasys network can be a Binary Output (BO), Binary Input (BI), Analog Output (AO) or Analog Input (AI). On the other hand, an object on a Modbus network is simply a Modbus holding register, and on a Toshiba network is a drive parameter (configuration parameters, control parameters and status parameters are all handled the same by the gateway).

Therefore, a child could map an AO to a register when the primary network is Metasys N2 and the secondary network is Modbus, or it could map a register to a drive parameter when the primary network is Modbus and the secondary network is Toshiba protocol. The child is therefore responsible for migrating a specific piece of data from a device on one network to a device on another network. The specific object indices (register number, BI number etc.) are completely user-configurable within the child point configuration.

The specific configurable items associated with a child depend on primary network and the type of child. While a child on a Modbus-to-Toshiba network may require only two pieces of information (Modbus register and corresponding drive parameter), a child on a Metasys-to-Toshiba network will require more information (AI multiplier value, BO on/off write data etc.) These variations will be discussed later during the individual network issues section.

At this point, one may ask “how do I know where the individual objects reside on the different networks?” The answer to that question lies in each child’s parent. Children are always “owned” by a parent: the parents determine the address-to-address mapping, while the children determine the object-to-object mapping within the parents’ address-to-address mapping space. Parents can have as many children assigned to them as required to access all the necessary objects on the secondary network devices (up to the maximum number of points available, which is 100).

As a continuation of the Metasys-to-Modbus network described in the previous section, let’s assume that the data shown in Table 1 is to be accessed on each of the Modbus devices, and that the data’s characteristics are as indicated.

From this table we notice that in total 12 children must be created. Let’s begin by creating our first child, which will map to Modbus register 10 (“frequency command”) on Modbus address 5. Because Modbus address 5 is mapped via a parent to Metasys N2 address 1 (refer to Figure 12), this child will be created under this parent. From the Metasys NCU’s perspective, the frequency command is an analog output (AO) object, and it will have a multiplier of 0.01 (writing a Metasys value of 10.50Hz, for example, will therefore result in write data on the Modbus secondary network of 1050_{10} (0x041A)).

Table 1: Example Secondary-Network Data

Modbus Address	Modbus Register	Note
5	10	Frequency command (1=0.01Hz)
“	15	Operating frequency (1=0.01Hz)
“	120	Run/Stop command (run=0x0080)
“	125	Run/Stop status (running=0x0080)
7	2	Temperature sensor (1=0.1C)
“	4	Digital output (ON=0x0001)
9	8	Voltage monitor #1 (1=1v)
“	9	Voltage monitor #2 (1=1v)
“	10	Voltage monitor #3 (1=1v)
11	8	Voltage monitor #1 (1=1v)
“	9	Voltage monitor #2 (1=1v)
“	10	Voltage monitor #3 (1=1v)

Therefore, we would need to create this child as indicated in Figure 13. This manual will use the graphical convention of a smaller, unbolded circle with a line down the middle to represent a child. The numbers or letters on the left of the line will indicate the primary network characteristics (object type, index, multiplier etc.) and the number on the right will indicate the corresponding secondary network object index (Modbus register number, for example). The specifics of these elements will be discussed later in this manual.

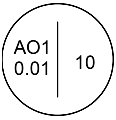

Figure 13: Child Point

In a similar manner, the remaining children can be created under each respective parent, resulting in the final network diagram as shown in Figure 14.

While the mapping function provided by children may be obvious, there is another less-apparent service provided by children. This service is termed “data mirroring”, whereby current copies of point values (secondary network object data) are maintained locally within the gateway itself. This greatly reduces the primary network’s request-to-response latency time, as requests (read or write) can be entirely serviced locally, thereby eliminating the time required to execute a secondary network transaction. As will be later discussed in the network-specific sections of this manual, primary networks with strict response-time requirements (such as Metasys N2) must use data mirroring (and therefore must have all accessible data objects explicitly declared as children) in order to ensure that response time specifications are met. Primary networks without such time requirements (such as Modbus RTU) may still use data mirroring to optimize network bandwidth, but are not required to do so.

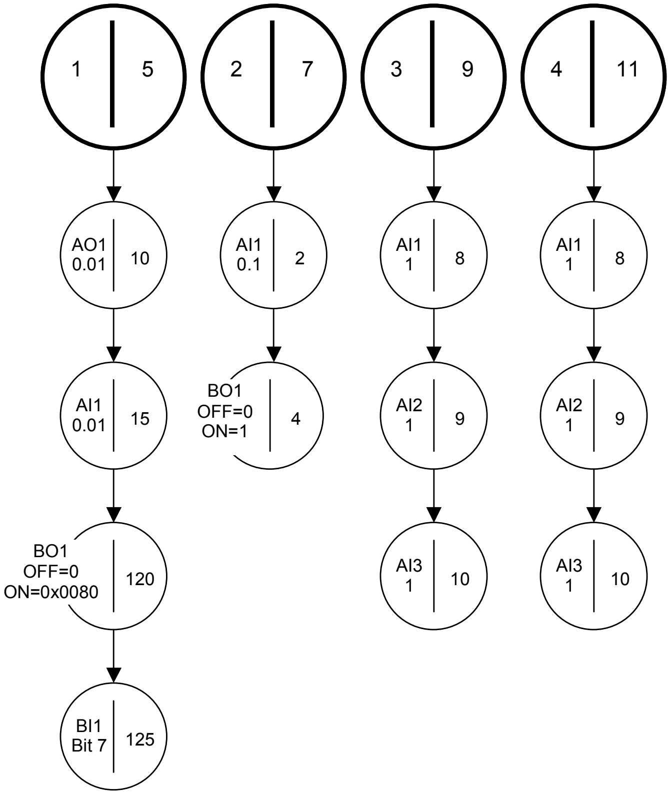

Figure 14: Completed Example Configuration

12.3 Network Timeout Settings

The gateway can be configured to perform a specific set of actions when primary network communications are lost. This allows each internally-defined child point to have its own unique "fail-safe" condition in the event of a primary network interruption. There are three separate elements that define the network timeout behavior:

- The network timeout time (refer to section 13.5.1.5)
- A child point's "Timeout Enable" setting (refer to section 13.5.1.1.3)
- A child point's "Timeout Value" setting (refer to section 13.5.1.1.3)

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

When the timeout time is nonzero and a communication interruption is detected, the ***timeout enable*** selections for all configured child points 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 corresponding secondary network objects. This mechanism provides for a flexible set of device failsafe conditions to be established on a point-by-point basis.

12.4 General Configuration Procedure

Now that we have had a brief tutorial on parents and children, 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. Enter the console (this stops all network communication tasks)
2. Define a new point setup by selecting the primary and secondary protocols
3. Modify network characteristics if necessary
4. Create parent points
5. Create child points under parents
6. Save the newly-created point database to the gateway's file system, and download a copy to your PC for backup purposes
7. Exit the console (resets the gateway)

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.

13. Console Access

As mentioned in section 1, the gateway's functionality is entirely controlled by a "point database" that is user-modifiable. The method of accessing this database is via a text-based console interface over an RS232 connection to a computer's serial (COM) port. This connection is performed by using the included DB9-RJ45 cable to connect the gateway's MMI port to the computer's serial port.

13.1 Requirements

All that is needed is a computer with a standard serial (COM) port, some sort of communications software (such as HyperTerminal, included with Microsoft Windows operating systems), and the included MMI cable (ICC part number #10425). Any communications software and PC will work, provided they support ASCII communications at 38.4kbaud.

13.2 Connection

The gateway ships from the factory with a dust cover installed in the MMI port. To minimize contamination of the port's electrical contacts, keep this dust cover in place whenever the MMI port is not in use.

Connect the RJ45 end of the MMI cable to the MMI port, and connect the other end to the computer's serial port.

13.3 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 15 shows the "Connect To" tab of the properties window for COM1. Figure 16 shows the window that appears when "Configure" is selected in the "Connect To" tab. Figure 17 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 16.

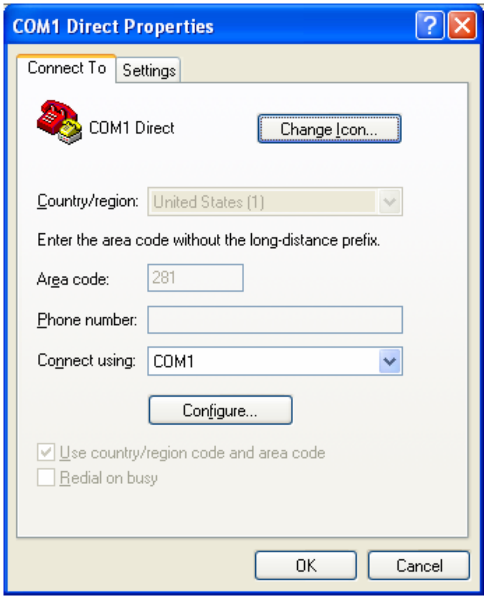

Figure 15: HyperTerminal Properties…Connect To

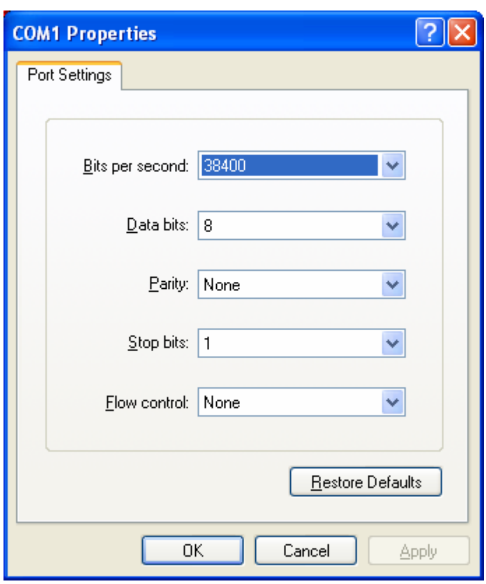

Figure 16: HyperTerminal Properties…Connect To…Configure

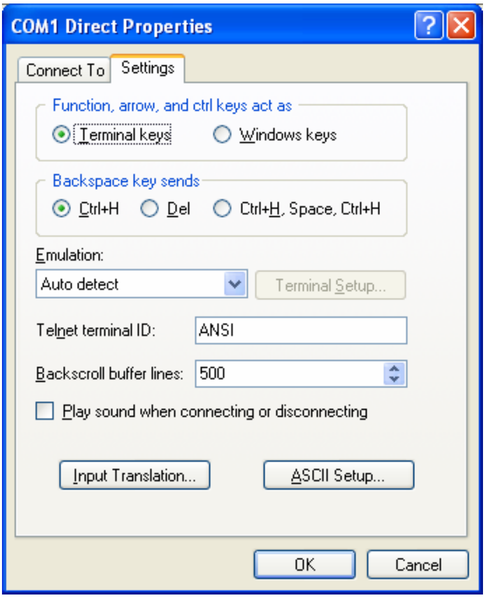

Figure 17: HyperTerminal Properties…Settings

13.4 Invocation

The console provides standard access and editing methods for the various configuration items (points and their associated attributes). It is important to note that unless otherwise indicated, any modifications made to the point database will become effective immediately. However, these changes will only be permanently retained when the current database is saved to a file location: if a change is made to the database and then the gateway is reset without saving those changes, then the active file will be restored upon initialization, overwriting the unsaved changes.

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 18). 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 currently-active database file.

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.

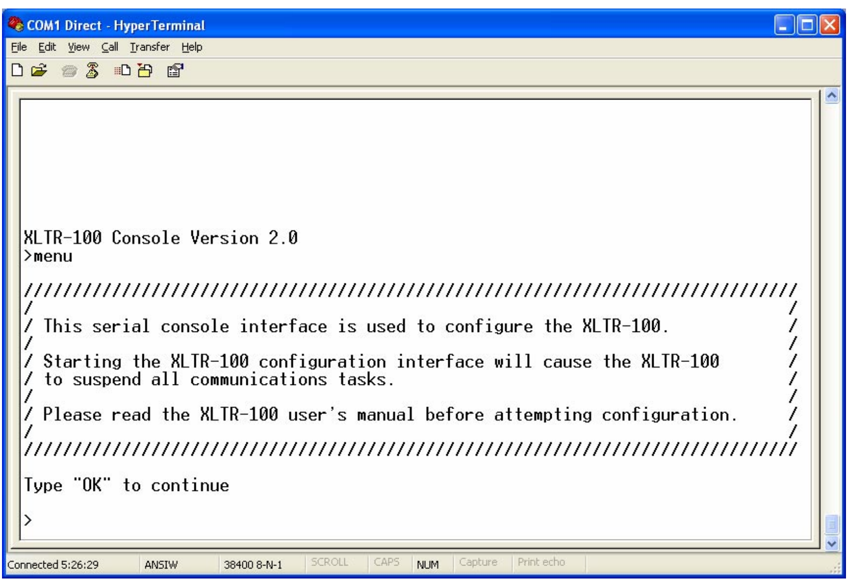

Figure 18: Starting the Console

13.5 Main Menu

The main menu is shown in Figure 19. All gateway configuration is performed by "drilling down" into progressively lower-level menus.

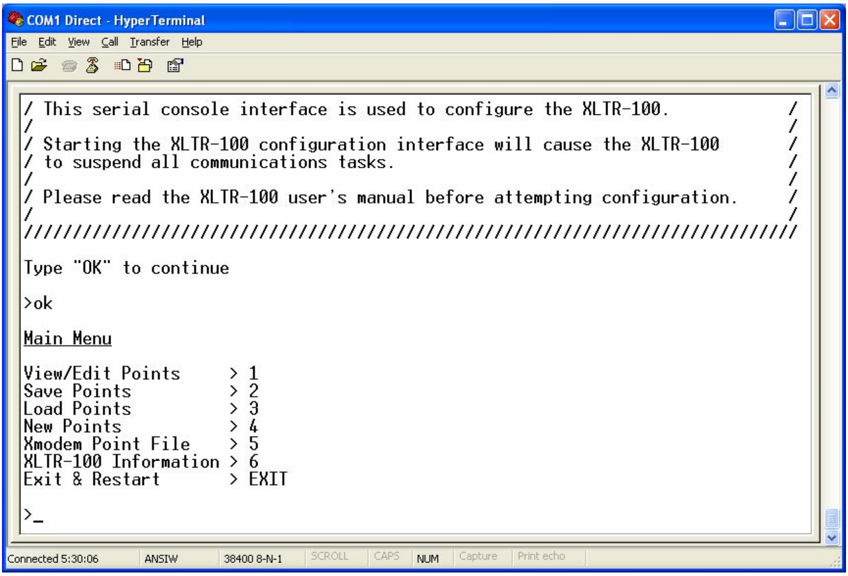

Figure 19: Console Main Menu

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 19, 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, they 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 filename as "My test file" would result in an error, but "My_test_file" would be perfectly acceptable.

13.5.1 View/Edit Points

Main menu selection number 1 displays a screen which shows a summary of the current point configuration (see Figure 20). This screen only displays the parent point (address mapping) information: in order to access any child point information, menu selection number 1 “Edit a Parent” must be entered with the additional argument of the targeted parent point’s primary network address.

The top half of the screen contains the parents table, which lists the primary and secondary network addresses of each parent. The bottom half of the screen contains the menu options for editing the parent points and network characteristics.

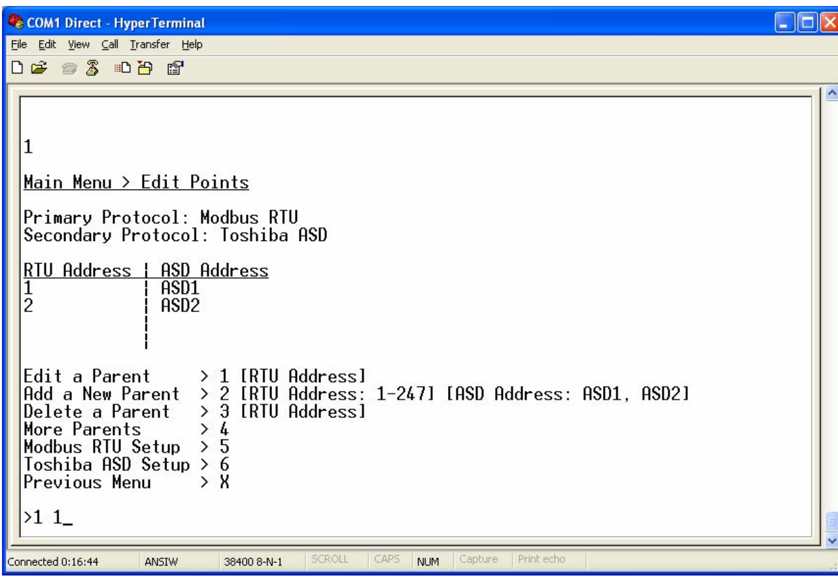

Figure 20: View/Edit Points

13.5.1.1 Edit a Parent

Entering “1” with a parent point’s primary network address (such as “1 1”, as shown at the bottom of Figure 20) at the View/Edit Points submenu will display and allow editing of the parent’s mapping and child point definition information. Refer to Figure 21 for an example. Although the number of menu selections in this submenu will remain consistent, the semantics of the menu titles and argument names will vary slightly depending on the currently-defined networks.

When editing a parent, the top half of the screen contains the children table, which lists the child types (relevant only for those networks, such as Metasys N2, which allow different types of children), the primary network object number and the secondary network object number. The bottom half of the screen contains the menu options for editing the child points.

Whenever a new parent point is added (refer to section 13.5.1.2), no children are assigned to that parent. One must therefore navigate to the Edit a Parent submenu in order to add to or modify that parent's child point configuration.

Throughout the console, note that the entry and display radices of the primary and secondary network data objects depend on the chosen networks. For example, entering an "ASD param" number of 10 when the Toshiba ASD secondary network is selected will map a child to ASD parameter 0x0010 (16_{10}). However, entering an "RTU reg num" of 10 when the Modbus network is selected will map a child to holding register 10_{10} (0x0A). These radices are chosen based on the "natural radix" defined for each protocol. For more information on the natural radices of the available networks, refer to section 14.

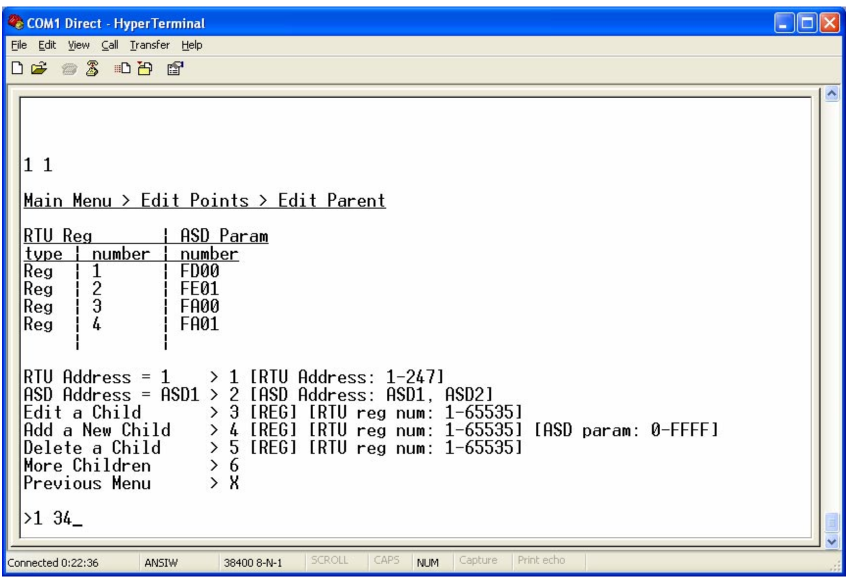

Figure 21: Edit a Parent

13.5.1.1.1 Edit Primary Network Address

Menu selection number 1 allows you to change the current parent's primary network address. For example, the bottom of Figure 21 shows an example of changing a parent's primary network address to 34.

13.5.1.1.2 Edit Secondary Network Address

Menu selection number 2 allows you to change the current parent's secondary network address. The entry method is similar to that for the primary network address described in section 13.5.1.1.1.

13.5.1.1.3 Edit a Child

Entering menu selection number 3 with the additional arguments of the child's type and primary network object number will display a submenu that allows editing of various child characteristics. For example, the top of Figure 22 shows an example of editing Metasys N2 binary output (BO) #1.

The child type varies depending on the primary network selected. For example, with a Modbus RTU primary network, the child type will always be "REG" (for "register"). If a Metasys N2 primary network is selected, however, then the child type could be AO, BO, AI or BI.

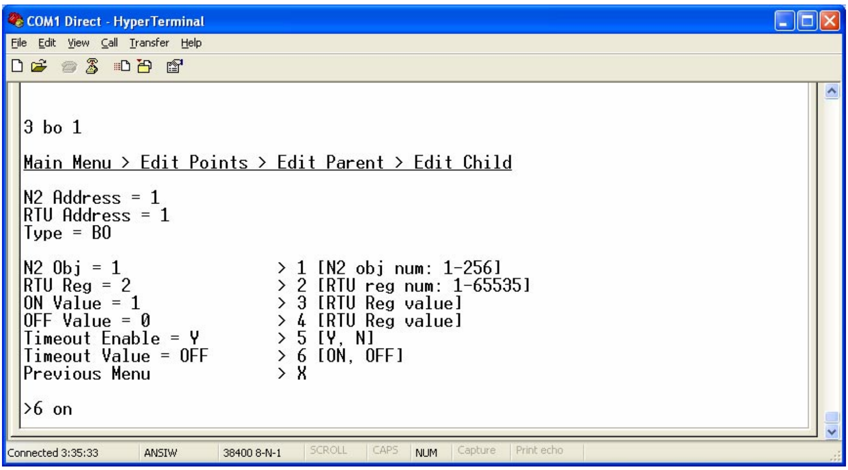

Figure 22: Edit a Child

<u>**Primary Network Object Number:**</u> Submenu selection number 1 allows modification of the primary network object number. An example of changing the point shown in Figure 22 from BO #1 to BO #8 would be "1 8".

<u>**Secondary Network Object Number:**</u> Submenu selection number 2 allows modification of the secondary network object number. An example of changing the point shown in Figure 22 from holding register #2 to holding register #123 would be "2 123".

<u>**Other Attributes:**</u> The first two selections in the "Edit a Child" menu will always be as indicated above. The remainder of the selections, however, will vary depending on the child's type. Metasys N2 binary output objects, for example, will allow configuration of the point's ON value, OFF value, Timeout Enable and Timeout Value. Refer to Figure 22 for an example of selecting BO #1's timeout value to "ON"

13.5.1.1.4 Add a New Child

To add a new child to the configuration, enter menu selection number 4 with the additional arguments of the child's type, the child's primary network object number, and the child's secondary network object number. For example, Figure 23 shows an example of adding a new child to map Modbus holding register 11 to Toshiba ASD parameter FE14. The semantics of the menu prompt and allowable object ranges vary depending on the currently-active networks.

The child type varies depending on the primary network selected. For example, with a Modbus RTU primary network, the child type will always be "REG" (for "register"). If a Metasys N2 primary network is selected, however, then the child type could be AO, BO, AI or BI.

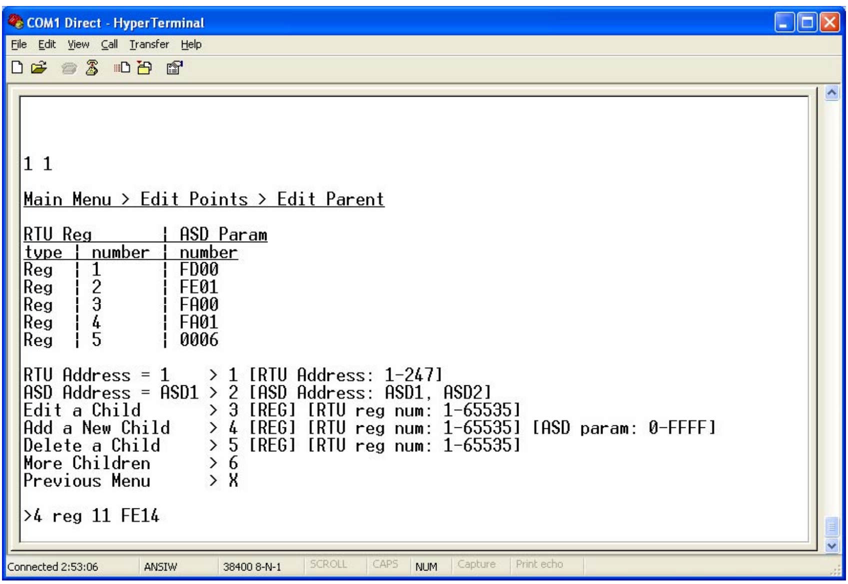

Figure 23: Add a New Child

13.5.1.1.5 Delete a Child

To delete a child from the configuration, enter menu selection number 5 with the additional arguments of the child's type and primary network object number. For example, Figure 24 shows an example of deleting a child that represents Metasys N2 AO #1. The semantics of the menu prompt and allowable object ranges vary depending on the currently-active networks.

The child type varies depending on the primary network selected. For example, with a Modbus RTU primary network, the child type will always be "REG" (for "register"). If a Metasys N2 primary network is selected, however, then the child type could be AO, BO, AI or BI.

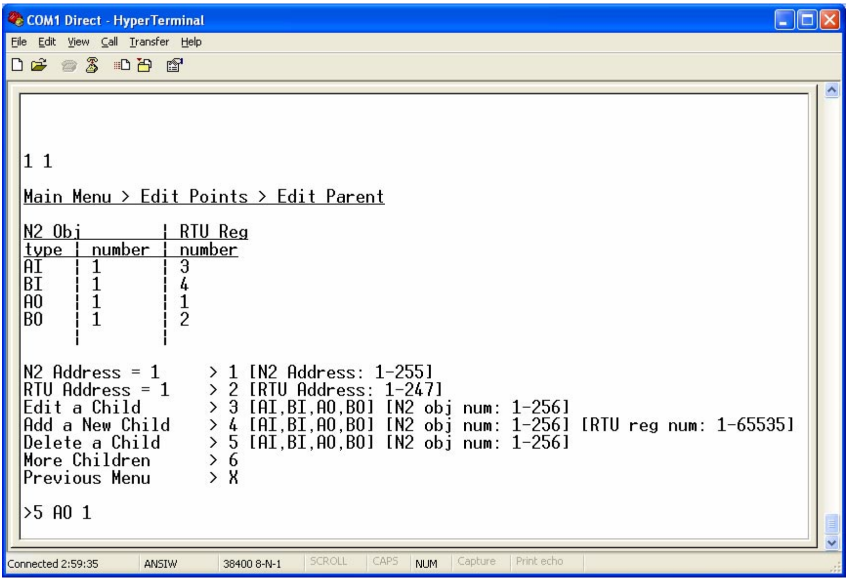

Figure 24: Delete a Child

13.5.1.1.6 More Children

The children table displays the mapping information for 5 children at a time. If more than 5 children are available in the current configuration, menu selection number 6 will display the next 5 children in the list. When all children have been displayed, entering menu selection number 6 will roll back around to the first 5 children again.

13.5.1.2 Add a New Parent

To add a new parent to the configuration, enter menu selection number 2 with the additional arguments of the parent's primary and secondary network addresses. For example, the bottom of Figure 25 shows an example of adding a new parent to map Metasys N2 address 4 to Modbus RTU address 9. The semantics of the menu prompt and allowable address ranges vary depending on the currently-active networks.

Once the new parent has been added to the parent list, its children (if any) must be added by using the Edit a Parent menu selection (refer to section 13.5.1.1). Note that parent addresses must be unique: if an attempt is made to enter a primary or secondary network address that has already been defined, the console will return an error.

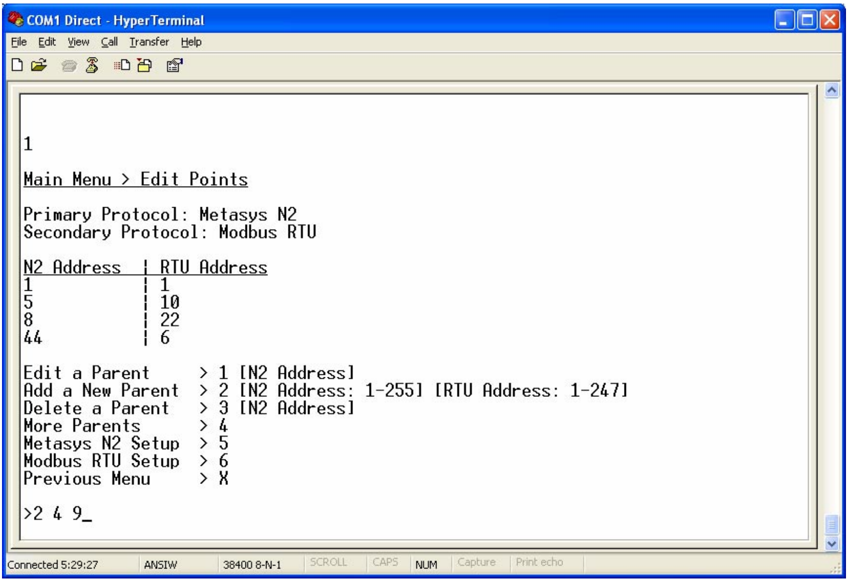

Figure 25: Add a New Parent

13.5.1.3 Delete a Parent

Entering menu selection number 3 with the additional argument of a parent's primary network address will delete that parent and all of its children.

13.5.1.4 More Parents

The parents table displays the mapping information for 4 parents at a time. If more than 4 parents are available in the current configuration, menu selection number 4 will display the next 4 parents in the list. When all parents have been displayed, entering menu selection number 4 will roll back around to the first 4 parents again.

13.5.1.5 Primary Network Setup

Menu selection number 5 displays a submenu that provides a means to configure the characteristics of the selected primary network, such as baud rate and parity. Refer to Figure 26 for an example. Note that not all primary networks are user-configurable. The specific menu label and subsequent available submenu options depend on the currently-active primary network.

Along with the network characteristics, this submenu allows for setting the network timeout time. For more information on the network timeout configuration, refer to section 12.3.

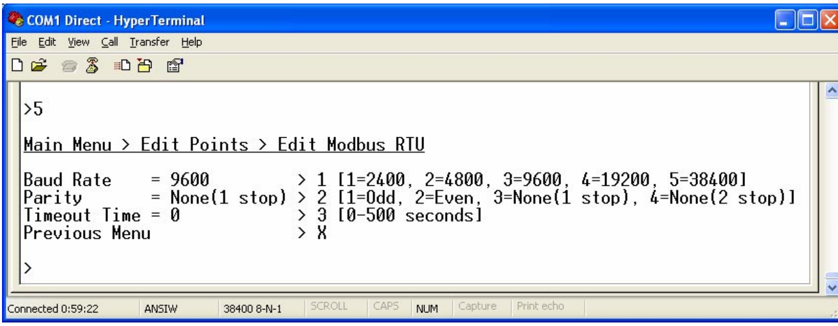

Figure 26: Example Primary Network Setup

13.5.1.6 Secondary Network Setup

Menu selection number 6 displays a submenu that provides a means to configure the characteristics of the selected secondary network, such as baud rate and parity. Note that not all secondary networks are user-configurable. The specific menu label and subsequent available submenu options depend on the currently-active secondary network.

13.5.2 Save Points

Main menu selection number 2 allows the current gateway configuration to be saved to one of the three available file locations in the gateway's file system. It is important to reiterate that whenever any configuration changes are performed, they are performed only on the gateway's working memory, and that those changes will be lost unless they are saved to the gateway's file system prior to exiting the console. The saved file also becomes the new active file, which means that it will automatically be loaded from the file system into the gateway's working memory every time the gateway boots up. The gateway provides space for three independent files to be stored.

Refer to Figure 27 for an example of saving the current configuration to file system location #1 with the name "Assy_Line_6". "Assy_Line_6" will then also become the active file, and will be the configuration loaded into the gateway's working memory at the beginning of the next boot cycle.

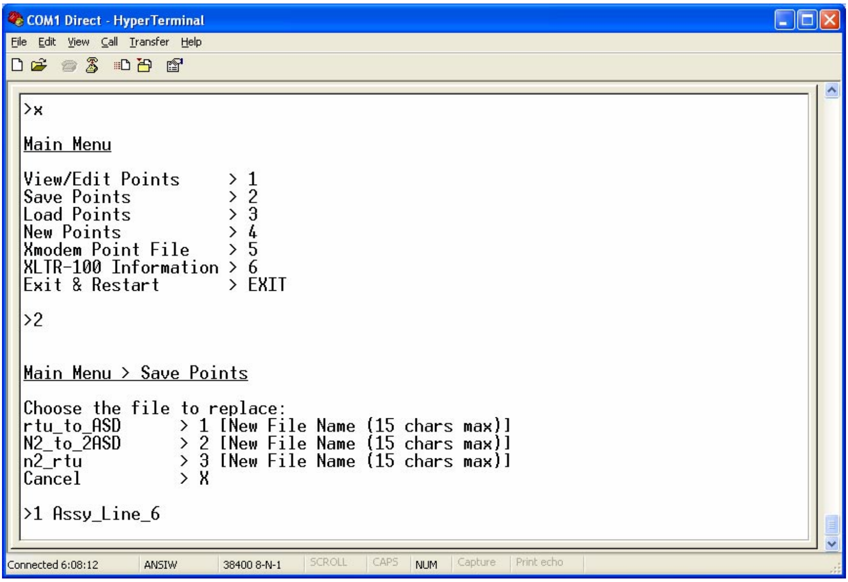

Figure 27: Saving a Point File

13.5.3 Load Points

Main menu selection number 3 allows the retrieval of a configuration file from the gateway's file system into its working memory. The configuration can then be modified while in the working memory and saved back to the file system if desired. Loading a file also causes it to become the active file, which means that it will automatically be loaded from the file system into the gateway's working memory every time the gateway subsequently boots up.

Refer to Figure 28 for an example of loading file "N2_to_2ASD". "N2_to_2ASD" will then also become the active file, and will be the configuration loaded into the gateway's working memory at the beginning of the next boot cycle.

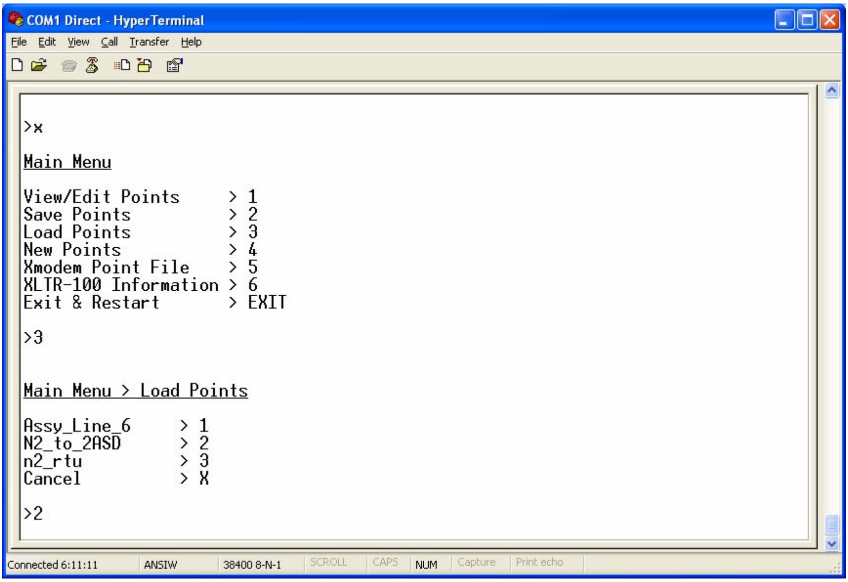

Figure 28: Loading a Point File

13.5.4 New Points

Main menu selection number 4 is used to begin a new configuration from scratch. When selected, a prompt will be displayed indicating that the current configuration in the gateway's working memory will be cleared (refer to Figure 29). The console will then prompt for the primary and secondary networks (as an example, Modbus RTU is being selected for the primary network protocol in Figure 29). This action will clear all parent and child points, necessitating the general configuration process outlined in section 12.4 to add parents and children, configure network characteristics, save the point file, etc.

Because the point database is constructed uniquely for a specific primary/secondary network combination, it is necessary to create a new point setup anytime the primary or secondary network protocol is changed (or alternatively, one could start with an existing point setup file with the desired primary and secondary network protocols already selected, and then modify the point definitions to fit the target application).

After configuration has been completed, always remember to save the new point setup to the gateway's file system prior to restarting. Otherwise, the currently-active file will be restored from the file system upon boot up, overwriting the newly-created setup.

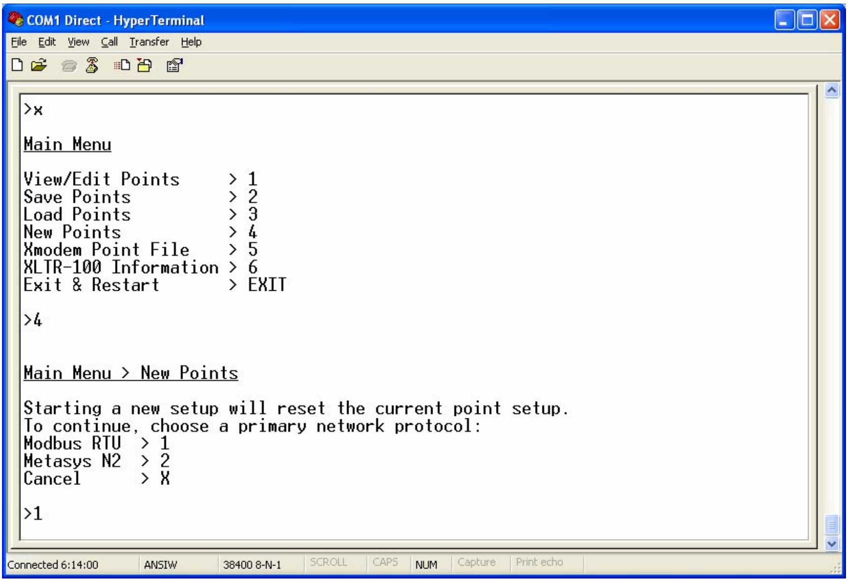

Figure 29: Beginning a New Setup

13.5.5 Xmodem Point File

Main menu selection 5 provides a method to upload and download point files to/from your PC via the Xmodem protocol. Xmodem is a data transfer protocol supported by virtually all terminal emulation programs (such as HyperTerminal).

Whenever a custom point setup is created, it is highly recommended that a backup copy of the file be downloaded to a PC in case it becomes necessary to restore it to the gateway's file system later (such as if the gateway's internal backup battery fails and requires replacement). Two different variations of the Xmodem protocol are supported (CRC and Checksum) for those terminal emulation programs that only support one or the other. This menu selection is also useful for copying point files from one gateway to another, or for uploading pre-configured point files that have been obtained from the ICC website.

Figure 30 shows an example of initiating the download of the file "Assy_Line_6" from the gateway's file system to the PC. Once the file to download has been chosen, the console will indicate that the gateway is now ready to transmit the file. At this point, you have 30 seconds in which to initiate the receive function of your terminal emulation program before the gateway will timeout the transaction and return to the main menu prompt.

In HyperTerminal, the "receive" function can be selected by the  icon in the toolbar. This will bring up a dialog box (Figure 31) that allows you to select the file destination and the transfer protocol (Xmodem). Lastly, you will be prompted for a filename which the point file will be saved under (Figure 32).

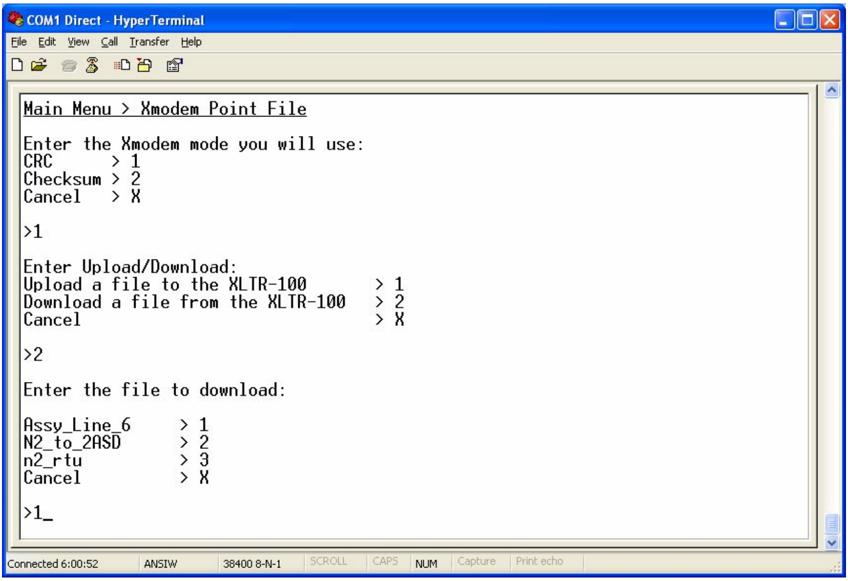

Figure 30: Downloading a Point File

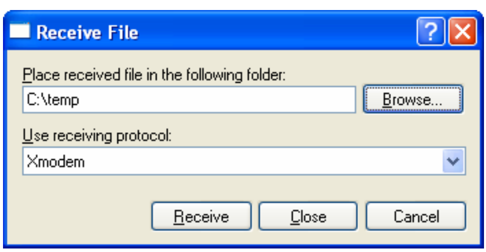

Figure 31: HyperTerminal "Receive File" Dialog Box

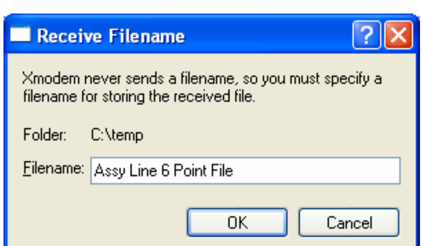

Figure 32: HyperTerminal "Receive Filename" Dialog Box

As soon as the filename is entered and “OK” selected, the download 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 main menu.

Uploading a file from the PC to the gateway is similar in many ways to downloading. Figure 33 shows an example of initiating a file upload. Once the console indicates that the gateway is ready to receive the file, you have 30 seconds in which to initiate the send function of your terminal emulation program before the gateway will timeout the transaction and return to the main menu prompt.

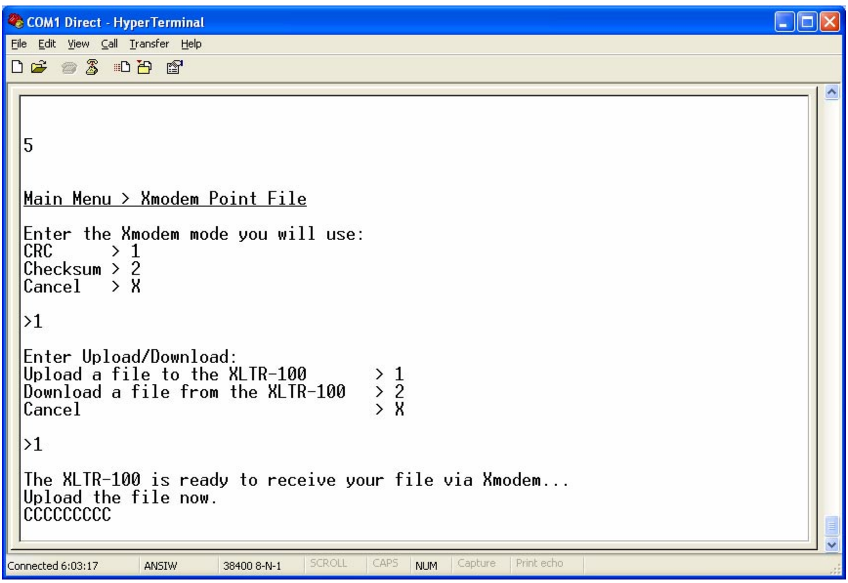

Figure 33: Uploading a Point File

In HyperTerminal, the “send” function can be selected by the icon in the toolbar. This will bring up a dialog box (Figure 34) that allows you to select the source file and the transfer protocol (Xmodem). Upon entering the information and selecting “Send”, the upload 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, if successful, will prompt for a file system location in which to store the received file. The console does not prompt for a filename, as the point file is internally watermarked with the name the file was given when it was originally created and stored in the file system.

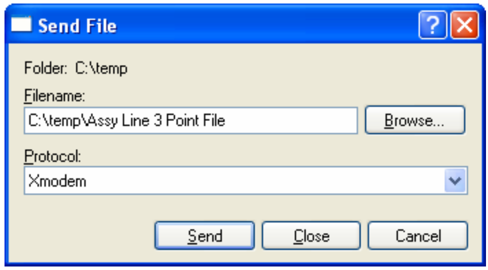

Figure 34: HyperTerminal "Send File" Dialog Box

13.5.6 XLTR-100 Information

Main menu selection number 6 displays the unit's application firmware version information.

13.5.7 Exit & Restart

Type "exit" at any menu prompt to reboot the gateway and startup the communication tasks. Note that whenever you modify the point database and are ready to restart the gateway, <u>you must save the database to the file system prior to restarting or your changes will be lost</u>. The console will automatically warn you that any unsaved changes will be lost and prompt you for confirmation every time you "exit", even if the database had not been modified. If the database was unchanged, then no saving is required.

14. Network-Specific Information

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

14.1 Primary Networks

14.1.1 Modbus RTU

- The gateway acts as a Modbus RTU slave. Supported Modbus functions are indicated in Table 2.

Table 2: 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

- Broadcast (for functions 5, 6, 15 and 16) is supported.
- Required Child Point Information:
    - Holding register (4X reference)
- Point diagram nomenclature: as indicated in Figure 35.

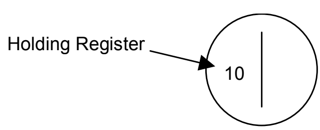

Figure 35: Modbus Slave Point Diagram Nomenclature

- Network characteristics selections
    - Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
    - Parity: odd / even / none (1 stop bit) / none (2 stop bits)
- Console holding register number entry radix is decimal (e.g. 10 = 10_{10})

- Children are optional: because the Modbus protocol does not specify any response time requirements, targeted registers do not need to be configured as children (which provide data mirroring). If a targeted holding register is found to not exist as a defined child point for a specific parent, then the request will be passed on to the secondary network for servicing. While providing the benefits of requiring very little configuration (only parent points need to be defined) and allowing access to the full object address range on secondary network devices, this technique does incur the penalty of increased latency, as affected requests must be passed on to the secondary network for processing and subsequent response.

- Configuration tip: Improved primary network utilization may be obtained by appropriately grouping disjoint secondary network objects into contiguous blocks of children (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 defined children. For example, if a write to a register or coil defined by a child point is performed, and the write data is out-of-range of the corresponding secondary network object, no Modbus exception will be immediately returned. However, the child point will always reflect the secondary network status and object value. In other words, if such an out-of-range write is performed, the unsuccessful secondary-side write can be observed by reading the current (unchanged) value of the child point during a subsequent Modbus transaction.

- The gateway can be configured to perform a specific set of actions for each point when Modbus communications are lost. Modbus communications are said to be “lost” when the gateway does not receive any Modbus packets for a specified period of time, causing a “network timeout”. Refer to section 12.3 for more information about configuring network timeout parameters.

Coil Mappings

The gateway provides read/write support for Modbus coils. 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:

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

Where the bracket symbols "$\lfloor\ \rfloor$" 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:

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

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

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 $\lfloor 3.0625 \rfloor = \lfloor 3\ r1 \rfloor = 3$. 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 = mod(3 r1) = 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 how (or even if) holding register #3 is defined. If holding register #3 is defined as a point in the point database, then this coil access will be entirely internal to the unit. If holding register #3 is <u>not</u> defined as a point in the point database, however, then an on-demand secondary-network transaction will take place, requesting data object number 3 and returning the value of bit #1 of that data object. Either way, coil #34 will <u>always</u> access holding register #3, bit #1.

14.1.2 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 child's secondary network data to produce the floating-point AI value sent to the NCU (AI value = [secondary-side data value] X multiplier). The AI point diagram nomenclature is as indicated in Figure 36.

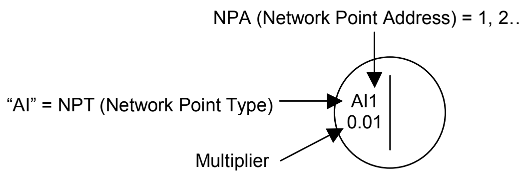

Figure 36: N2 AI Object Point Diagram Nomenclature

- **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 secondary network data result (secondary-side data value = [AO value] / multiplier). The AO point diagram nomenclature is as indicated in Figure 37.

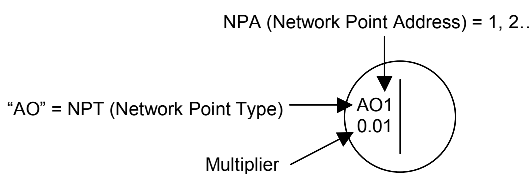

Figure 37: N2 AO Object Point Diagram Nomenclature

- **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 child’s secondary-network data at the bit location indicated in the bit mask. If the indicated bit is a “1”, then the BI’s current state is set to “1”. Else, it is set to “0”. The secondary-network data’s least-significant bit (LSB) is bit #0, and the most-significant bit (MSB) is bit #15. The BI point diagram nomenclature is as indicated in Figure 38. In the example indicated by this figure, BI1’s current state will be “1” whenever bit #7 of the secondary-network data is “1” (e.g. 0x0080), and will be “0” at all other times.

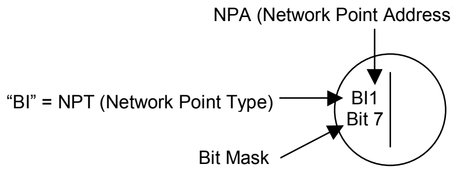

Figure 38: N2 BI Object Point Diagram Nomenclature

- **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. An “ON” value and an “OFF” value (both 16-bit numbers) are associated with the object. When the BO’s current state is set to “1” by the NCU, then the “ON” value is written to the child’s secondary-network data object, and when the BO’s current state is set to “0” by the NCU, then the “OFF” value is written to the child’s secondary-network data object. In this way, complex or multi-function secondary-network commands can be issued in response to a simple Metasys BO ON/OFF override command. The BO point diagram nomenclature is as indicated in Figure 45.

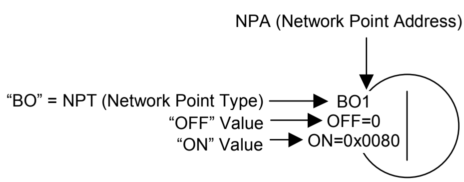

Figure 39: N2 BO Object Point Diagram Nomenclature

- The Metasys device type for the gateway is VND.

- Console object number entry radix is decimal (e.g. 10 = 10_{10})

- Because the Metasys N2 protocol specifies strict response timing requirements, all accessible data objects must be designated as child 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 secondary network status and data object value. In other words, if such an out-of-range write is performed, the unsuccessful secondary-side 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 12.3 for more information about configuring network timeout parameters.

14.2 Secondary Networks

14.2.1 Modbus RTU

- The gateway acts as a Modbus RTU master via the secondary RS-485 port. Supported Modbus functions are indicated in Table 3.

Table 3: Supported Modbus Master Functions

Function Code	Function
3	Read multiple registers
16	Write multiple registers

- The slave response timeout is fixed at 3s.

- Network characteristics selections
  - Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
  - Parity: odd / even / none (1 stop bit) / none (2 stop bits)

- Any defined children will be continuously read by the gateway for data mirroring. When allowed by the primary network protocol, primary network requests that target registers not declared as children will generate secondary network traffic only on-demand.

- Modbus RTU is not available as the secondary network if it has already been selected as the primary network.

- Console holding register number entry radix is decimal (e.g. 10 = 10_{10})

14.2.2 Toshiba Protocol

- The gateway acts as a Toshiba ASD master via the dedicated common serial port connections. All Toshiba ASDs that include a common serial port are supported.

- Network characteristics selections: no configuration is necessary, as the gateway automatically adapts to the ASD's configured characteristics.

- Any defined children will be continuously read by the gateway for data mirroring. When allowed by the primary network protocol, primary network requests that target ASD parameters not declared as children will generate secondary network traffic only on-demand.

- 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.

- Console parameter number entry radix is hexadecimal (e.g. 10 = 0x0010 or 16_{10})

14.2.3 Mitsubishi Protocol

- The gateway acts as a Mitsubishi protocol master via the secondary RS-485 port. Adjustable speed drives such as the FR-A500/E500/F500 series that support the Mitsubishi protocol can be accessed.

- 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 40.

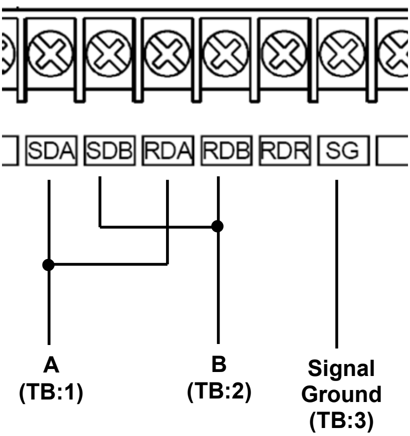

Figure 40: FR-A5NR Connections

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 41). 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 42.

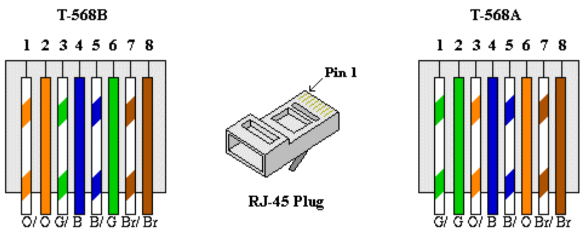

Figure 41: EIA/TIA Wiring Standards

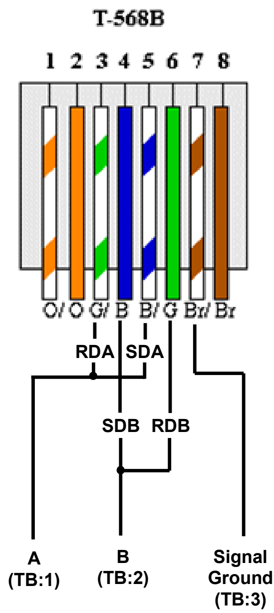

Figure 42: PU Port Connections

- The slave response timeout is fixed at 2s.
- Network characteristics selections
  - Baud rate: 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 bps
  - Parity: odd / even / none (1 stop bit) / none (2 stop bits)
- Console parameter number entry radix is decimal (e.g. 10 = 10_{10})
- 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 4 have been assigned. For further information on these parameters, please refer to the relevant Mitsubishi documentation.

Table 4: 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

- Any defined children will be continuously read by the gateway for data mirroring. When allowed by the primary network protocol, primary network requests that target parameters not declared as children will generate secondary network traffic only on-demand.

- ASD communication characteristics are dictated by parameters 117-124 (PU port) and 331-342 (FR-A5NR interface). 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)*

14.2.4 Sullair Supervisor Protocol

- The gateway acts as a Sullair Supervisor Protocol network monitor via the secondary RS-485 port. It can automatically adapt to the Supervisor network configuration (sequencing or non-sequencing/slave mode).

- Any numerically-addressed parameter defined by the Supervisor protocol is directly accessible (machine type = parameter #1, etc.). However, some Supervisor data objects are not natively numerically-addressed. For these data objects, the additional parameter numbers indicated in Table 5 have been assigned.

Table 5: Additional Supervisor Parameter Assignments

Parameter Number	Item	Note	Source
100	Capacity		Net / quick status
101	P2		
102	Run hours		
103	Run status	0 = E-stop 1 = remote stop 2 = manual stop 3 = standby 4 = starting 5 = load 6 = unload 7 = trim 8 = full load	
104	Mode	0 = auto 1 = continuous	
105	P1		Info status
106	P2		
107	P3		
108	P4		
109	T1		
110	T2		
111	T3		
112	T4		
113	T5		
114	ID		
115	Analog shutdown		
116	Relay outputs		
117	Digital shutdown		
118	Digital inputs		
119	Run time		
120	Load time		
126	Online	0 = offline (not sequencing) 1 = online (sequencing)	Net / quick status
127	Faulted	0 = not faulted 1 = faulted	

- Any defined children will be continuously read by the gateway for data mirroring. Additionally, info status messages will always be sent to defined parent addresses. Otherwise, when allowed by the primary network protocol, primary network requests that target Supervisor parameters not declared as children will generate secondary network traffic only on-demand.

- Network characteristics selections: no configuration is possible. The baud rate is fixed at 9600 baud.

- The gateway Supervisor interface is primarily a system monitor and configuration device. As such, the following native Supervisor network commands are not accessible:

  S – Stop
  L – Load (modulate)
  T – Trim (modulate)
  D – Display message
  C – Cont run mode
  U – Unload
  F – Full load
  E – Emergency stop
  A – Auto run mode

- Console parameter number entry radix is decimal (e.g. 10 = 10_{10})

15. 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.

15.1 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 15.3), and the MMI cable included with the gateway kit (ICC part number 10425).

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 point files: prior to starting an update procedure always back up your point files to a PC for later recovery if necessary.

15.2 Connection

The gateway ships from the factory with a dust cover installed in the MMI port. To minimize contamination of the port's electrical contacts, keep this dust cover in place whenever the MMI port is not in use.

⚠ **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 RJ45 end of the MMI cable to the MMI port, and connect the other end to the computer's serial port. Move "CONFIG" switch #4 to the "ON" (down) position: this will place the gateway into the "firmware download" mode. Whenever "CONFIG" switch #4 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.

15.3 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.

15.3.1 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.

15.3.2 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 43).

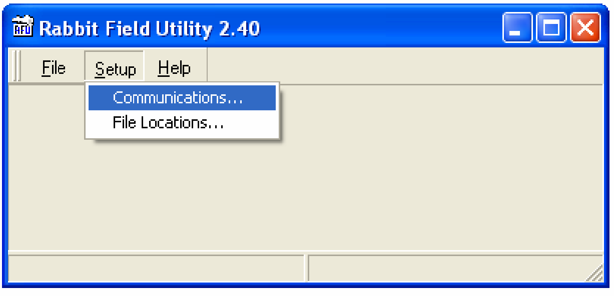

Figure 43: RFU Main Screen

The Communications Options window shown in Figure 44 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.

Note: It is possible that certain computers may have difficulty communicating at a sustained 115kbaud rate, which may result in communication errors during firmware downloading. If this occurs, try setting the "baud rate" parameter shown in Figure 44 to a lower value.

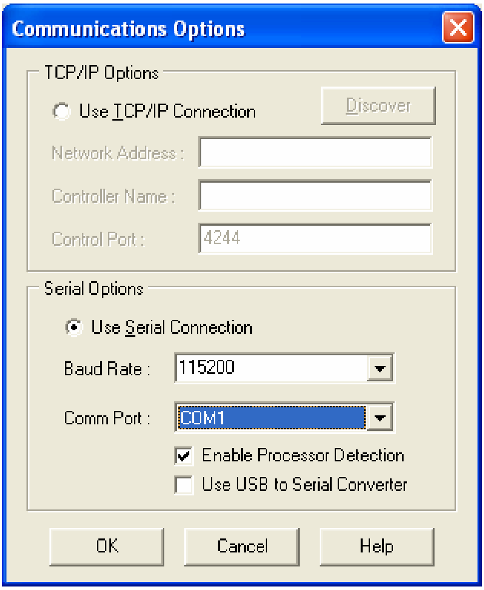

Figure 44: Communications Options Window

Next, select the "Setup…File Locations" menu item from the main screen. The "Choose File Locations" window shown in Figure 45 then appears. Confirm that the correct paths to the referenced files are entered. Enter the correct paths if necessary.

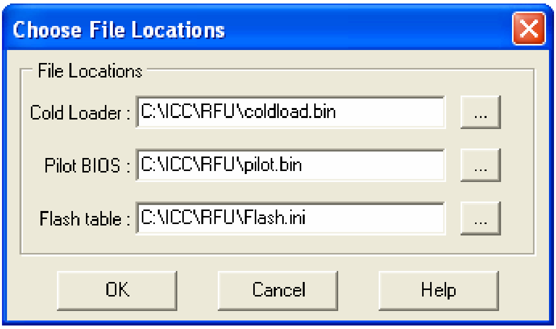

Figure 45: Choose File Locations Window

15.3.3 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 46).

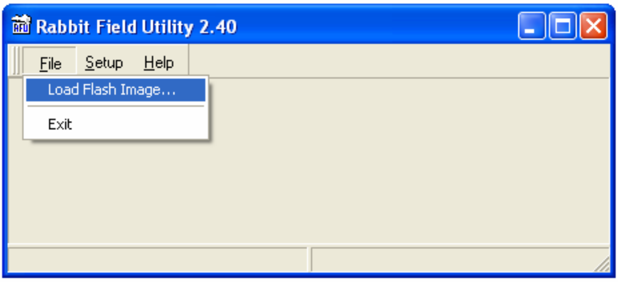

Figure 46: Load Flash Image Menu Selection

The flash image (.BIN file) selection window will then appear (refer to Figure 47). Browse to the location of the flash image file and select it. Clicking "OK" will then initiate the download process.

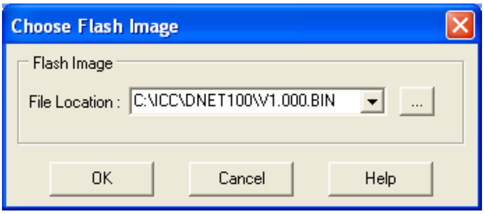

Figure 47: Flash File Selection Window

While downloading, the RFU utility will indicate the download status. Once complete, summary information will be displayed in the bottom status bar (see Figure 48).

Figure 48: Summary Information

15.4 Wrap-Up

Once downloading is complete, close the RFU utility, move "CONFIG" switch #4 back to the "OFF" (up) 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 point files might need to be reloaded, then do so at this point.

When completed with MMI port use, remove the MMI cable and replace the MMI port dust cover to minimize contamination of the port's electrical contacts.

16. Notes

INDUSTRIAL CONTROL COMMUNICATIONS, INC.

2204 Timberloch Place, Suite 250
The Woodlands, TX USA 77380-1049
Tel: [281] 292-0555 Fax: [281] 292-0564
World Wide Web http://www.iccdesigns.com

Printed in U.S.A