
ASD INTERFACE SERIES



INDUSTRIAL CONTROL COMMUNICATIONS, INC.



ETH-100

**ETHERNET COMMUNICATIONS INTERFACE
FOR TOSHIBA ADJUSTABLE SPEED DRIVES**

Introduction

Thank you for purchasing the ICC, Inc. ETH-100 Ethernet Communications Interface for the Toshiba 7-Series, 9-Series and VF-nC1 Series Adjustable Speed Drives. Before using the ETH-100 interface, please familiarize yourself with the product and be sure to thoroughly read the instructions and precautions contained in this manual. In addition, please make sure that this instruction manual is delivered to the end user of the drive units with which the ETH-100 interface is connected, and keep this instruction manual in a safe place for future reference or drive/interface inspection.

This instruction manual describes the device specifications, wiring methods, maintenance procedures, supported functions and usage methods for the ETH-100 Ethernet communications interface.

In conjunction with this manual, the following manuals are supplied by Toshiba, and are essential both for ensuring a safe, reliable system installation as well as for realizing the full potential of the ETH-100 interface:

- Toshiba *TOSVERT VF-S7 Series Instruction Manual*
- Toshiba *TOSVERT VF-S9 Series Instruction Manual*
- Toshiba *TOSVERT VF-A7 Series Instruction Manual*
- Toshiba *TOSVERT VF-nC1 Series Instruction Manual*
- Toshiba *G7 Series Operation Manual*
- Toshiba *VF-S7 Industrial Inverter Serial Communications Option Manual*

If you do not have copies available of the documents relevant to your installation, please contact Toshiba or your local Toshiba distributor to obtain them, or copies may be downloaded from <http://www.tic.toshiba.com> (subject to availability).

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

- ETH-100 interface in DIN rail mountable case
- 2 meter DB9-RJ45 MMI port cable (part number 10425)
- This manual



ETH-100 Ethernet Interface User's Manual

Part Number 10449-2.100-000

Printed in U.S.A.

©2001-2004 Industrial Control Communications, Inc.

All rights reserved

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 ETH-100 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 ETH-100 terminals to either the ASD's E/GND terminals, the motor, or to any other power ground.
- When making common serial connections between the ETH-100 and 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 drive 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.
- Because the ETH-100 derives its control power from the connected drives, removing power to all connected drives will also cause the ETH-100 to lose power.

TABLE OF CONTENTS

1.	The Point Database Concept.....	6
2.	Mechanical Diagrams	7
2.1	Enclosure	7
2.2	Mounting Clip	8
2.3	External Interface	9
3.	Feature Summary.....	10
4.	Installing the Interface.....	13
4.1	Installation for G7 ASDs.....	13
4.2	Installation for S7, S9, A7 and VF-nC1 ASDs	15
5.	Grounding	17
6.	Environmental Specifications	18
7.	Maintenance and Inspection	19
8.	Storage and Warranty	20
8.1	Storage	20
8.2	Warranty	20
9.	LED Indicators	21
9.1	Module and Ethernet Indicators	21
9.2	ASD Port Indicators	21
9.3	MMI Port Indicators	22
10.	Internal Battery.....	23
11.	Initial Configuration.....	24
11.1	ARP Method.....	24
11.2	Console Method	25
12.	Console Access	26
12.1	RS232	26
12.1.1	<i>Requirements</i>	<i>26</i>
12.1.2	<i>Connection</i>	<i>26</i>
12.1.3	<i>Application Configuration</i>	<i>26</i>
12.2	Telnet.....	29
12.2.1	<i>Requirements</i>	<i>29</i>
12.2.2	<i>Connection</i>	<i>29</i>

12.2.3	Application Configuration.....	29
12.3	Command Overview	30
13.	Modbus TCP/IP.....	34
13.1	Drive Channel Access	34
13.2	Timeout Processing.....	34
13.3	Supported Modbus Functions.....	35
13.4	Modbus/Drive Register Mappings	35
13.4.1	Point Mapping.....	35
13.4.2	Direct (Implicit) Mapping	36
13.4.3	Universal Access Registers	37
13.5	Coil Mappings.....	38
13.6	Exceptions and Troubleshooting	40
13.6.1	Common Error Causes	40
13.6.2	General ASD Access Notes.....	41
14.	Embedded Web Server.....	42
14.1	Authentication.....	43
14.2	Communication Status Indicators.....	44
14.3	Unit Status	44
14.4	Set Date and Time.....	44
14.5	Network Configuration	44
14.6	Master Timeout Configuration	45
14.7	Authentication Configuration	46
14.8	Parent Selection	46
14.9	Child Selection	46
14.10	Child Edit.....	47
14.11	Radix Selection	48
14.12	Error Code Reference	49
14.13	Allocated Sockets Report.....	49
15.	Firmware Updates.....	50
15.1	Requirements	50
15.2	Connection	50
15.3	Using the RFU Utility	51
15.3.1	Required Files.....	51
15.3.2	First-Time Configuration	51
15.3.3	Transmitting Firmware Files	53
15.4	Wrap-Up	54
16.	Notes	55

1. The Point Database Concept

The heart of the ETH-100's mapping capabilities 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 (Ethernet) network requests to be routed to the correct locations on the secondary network (the ASD ports), 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 (ASD registers) are maintained locally within the ETH-100 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 network, and the primary network master can engage in a seamless dialogue with one or more secondary network devices (ASDs).

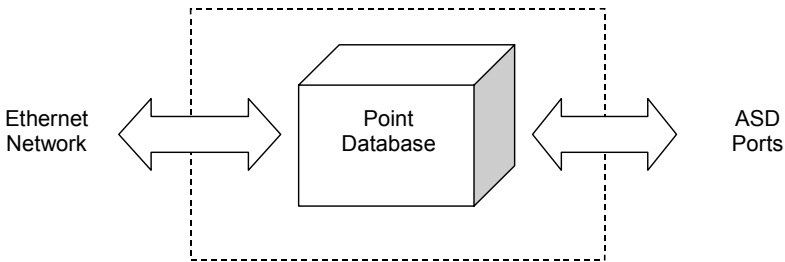


Figure 1: The Point Database Concept

2. Mechanical Diagrams

2.1 Enclosure

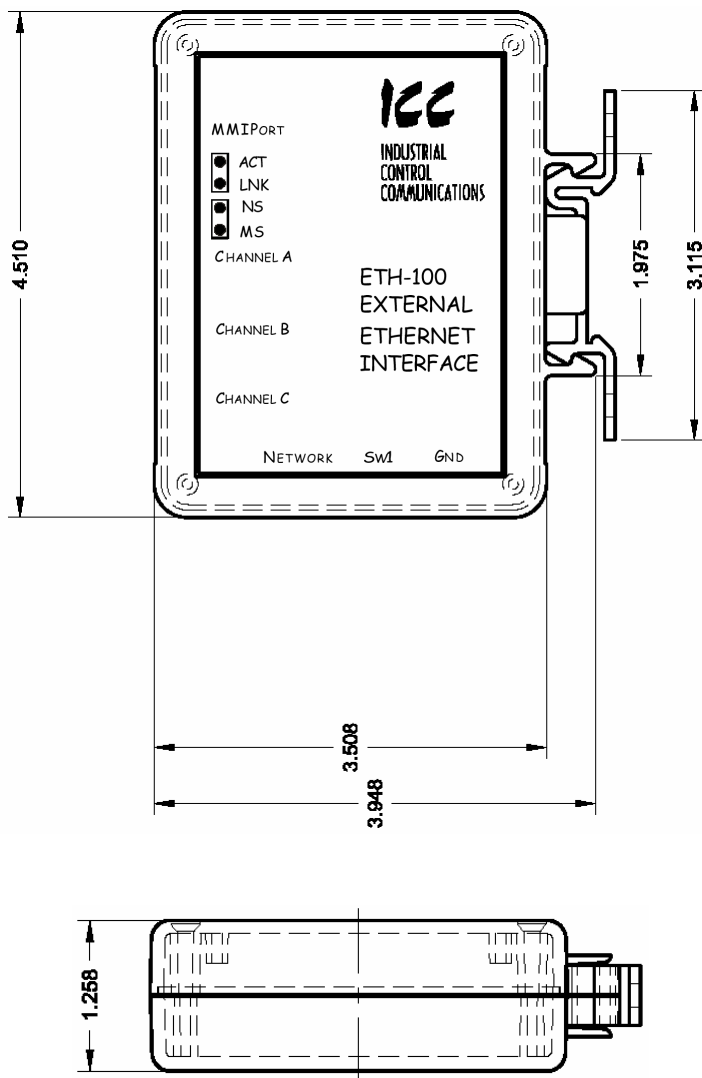


Figure 2: Enclosure Dimensions (units are inches)

2.2 Mounting Clip

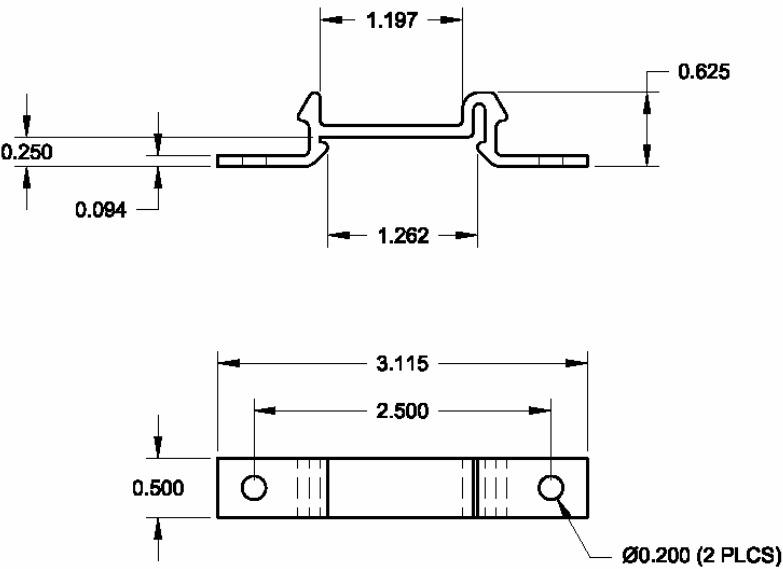


Figure 3: Mounting Clip Dimensions (units are inches)

2.3 External Interface

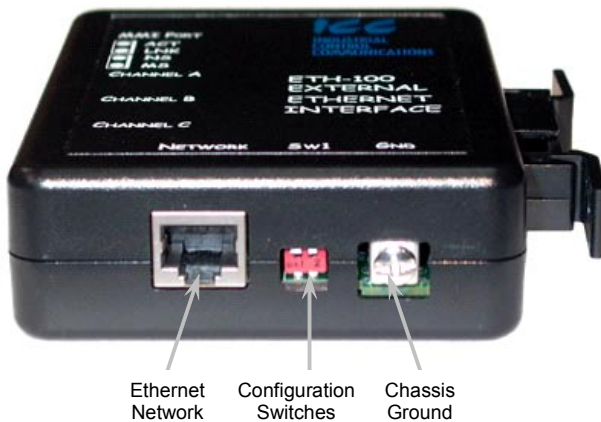


Figure 4: Bottom View

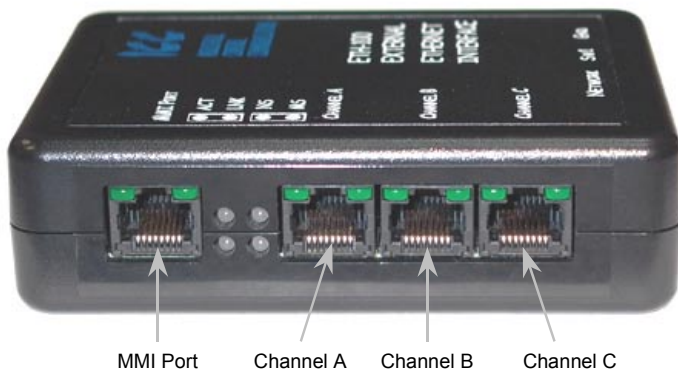


Figure 5: Front View

3. Feature Summary

Primary Network

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

Secondary Network

ASD common serial: The ETH-100 provides support for simultaneous connection of three Toshiba 7-series, 9-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 ETH-100 to the drives.

Power Supply

Self-contained. Powered directly from the connected drives. Drives can be connected to the ETH-100 on any channel (A, B or C) in any order or combination. When more than 1 drive is connected to the unit, the ETH-100 will draw its control power from the drive with the highest power supply voltage.

Supported Protocols

- Primary Network
 - Schneider Electric Modbus TCP/IP, release 1.0. Conformance Class 0 and partial Class 1 and Class 2 compliant. Allows up to 8 simultaneous Modbus TCP/IP client connections.
- Secondary Network
 - Toshiba ASD (common serial)

Text-Based Console Configuration

Basic unit configuration is performed via a text-based console interface, available locally over RS232 by using the included MMI cable and a standard PC terminal program such as Microsoft Windows HyperTerminal®, or over Ethernet via a Telnet session. The unit also provides initial configuration access via ICMP ("ping") configuration.

Macromedia® Flash-Enabled Embedded Web Server

Advanced unit configuration and drive monitoring/control are also provided via an embedded web server using the HTTP protocol. The ETH-100's web server feature provides direct data access and control via standard web browsers such as Microsoft Internet Explorer and Netscape Navigator. The latest version of Macromedia Flash Player browser plug-in is required.

Point File-Based Configuration

A point file (primary / secondary network mapping definition file) is 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 the ICC web site, uploaded to a unit, and custom-modified to suit a specific application.

Drive AutoScan Algorithm

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 ETH-100 to the drives. Just plug it in – it's that simple.

Modbus TCP/IP Universal Access Registers

Modbus TCP/IP holding registers 9998 and 9999 provide an easy method of directly accessing any drive register that may have already been “masked” by definition of an internal point. Refer to section 13.4.3 for more information.

Per-Point Failsafe Timeout Processing

A “master” IP address and timeout time can be assigned to the unit. Each point defined in the point database also has the capability to be assigned an optional failsafe timeout value. When an unexpected socket failure from the “master” device occurs, all points with timeout processing enabled will be written with their failsafe values. This provides an additional level of process security in the event of a network or master device disturbance.

Selectable Grounding

Switch SW1 #2 allows the ground plane to be split into 2 different sections: one for the main control circuitry and another for the Ethernet network connector shield and associated magnetics. The latter ground point is accessible for external termination via the GND screw terminal located on the bottom of the unit. Refer to section 5 for more information related to grounding.

Indicators

- 1 green “LNK” LED that is on whenever a valid Ethernet connection is detected.
- 1 red “ACT” LED that flashes whenever data is transferred across the Ethernet network.
- 1 bicolor red/green “MS” LED that indicates module status information.
- 1 bicolor red/green “NS” LED that indicates network status information.
- 2 green LEDs on each of the drive communication connectors 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 ETH-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 ETH-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, chassis ground terminal or network connector.

4. Installing the Interface




The ETH-100 connects to each drive via the drive's common serial (logic level) communication port, typically located on either the main drive control board (G7), 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 ETH-100 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 ETH-100, 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 any ETH-100 channel in any order or combination. When more than one drive is connected to the unit, the gateway will draw its control power from the source with the highest power supply voltage.

Installation of the ETH-100 should only be performed by a qualified technician familiar with the maintenance and operation of the connected drives. To install the ETH-100, complete the steps outlined in the following sections related to your specific drive.




4.1 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 interface enclosure in your desired manner (refer to page 12 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 interface 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 interface with the communication cable (communication cable is not included with the ETH-100 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 Ethernet network cable to the shielded RJ45 connector marked "Network" on the bottom of the unit. If a ground cable is going to be used, attach the ground cable to the screw terminal marked "GND" on the bottom side of the unit (refer to section 5). Ensure that the network cable is fully seated into the modular connector, 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.
11. Take a moment to verify that the interface and all primary and secondary network cables have sufficient clearance from drives, motors, or power-carrying electrical wiring.
12. 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 Installation for S7, S9, 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 interface enclosure in your desired manner (refer to page 12 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 interface is ever disconnected from the drive.
5. Connect the drive's common serial communication port to one of the ASD channels of the interface 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 Ethernet network cable to the shielded RJ45 connector marked "Network" on the bottom of the unit. If a ground cable is going to be used, attach the ground cable to the screw terminal marked "GND" on the bottom side of the unit (refer to section 5). Ensure that the network

cable is fully seated into the modular connector, 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. Take a moment to verify that the interface and all primary and secondary network cables have sufficient clearance from drives, motors, or power-carrying electrical wiring.
9. 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. Grounding

Grounding is of particular importance for reliable, stable operation. Communication system characteristics may vary from system to system, depending on the system environment and grounding method used. The ETH-100 interface is provided with a “GND” screw terminal on the bottom of the unit. This “GND” terminal constitutes an effective “chassis ground”, and is directly connected to the metallic housing of the shielded RJ45 Ethernet network connector and to the appropriate locations on its integrated isolation magnetics.

This chassis ground plane is physically separate from the ETH-100’s control logic ground plane, which is directly referenced to the CC (control common) terminal on the connected drives. Switch SW1 #2 on the ETH-100 unit, however, provides a method to selectively connect these 2 ground planes together.

When switch SW1 #2 is ON (switch in the “down” position when looking at the bottom of the ETH-100 unit end-on), the ETH-100’s control logic ground plane and chassis ground plane are connected together. In this configuration, no external GND wire should be connected to the unit’s GND terminal. In this case, the chassis ground plane is directly connected to the drives’ CC reference, and Toshiba typically recommends that the CC reference of the drives not be connected to earth ground. Refer to your drive’s instruction manual for specific information about the CC terminal and ground connections.

In some high-noise environments or under unusual wiring conditions, it may be possible to obtain improved Ethernet communication characteristics by referencing the ETH-100’s “chassis ground” to a localized earth ground. In these cases, place switch SW1 #2 in the OFF (up) position and connect the GND screw terminal to an appropriate ground connection.

Please be sure to consider the following general points for making proper ground connections:

Grounding method checkpoints

1. Make all ground connections such that no ground current flows through the case or heatsink of a connected drive.
2. Do not connect the ETH-100’s GND terminal to a power ground or any other potential noise-producing ground connection (such as a drive’s “E” terminal).
3. Do not make connections to unstable grounds (paint-coated screw heads, grounds that are subjected to inductive noise, etc.)

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	Selectable split ground planes
Cooling Method	Self-cooled

7. Maintenance and Inspection

Preventive maintenance and inspection is required to maintain the interface 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, always 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 ASD communication cables are fully seated in both the drive and interface RJ45 ports. 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 interface 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 interface, 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 interface 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 interface 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 interface 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 Module and Ethernet Indicators

The module and Ethernet indicators are located between the MMI port and the Channel A drive port. Figure 6 indicates the functions of these LEDs.

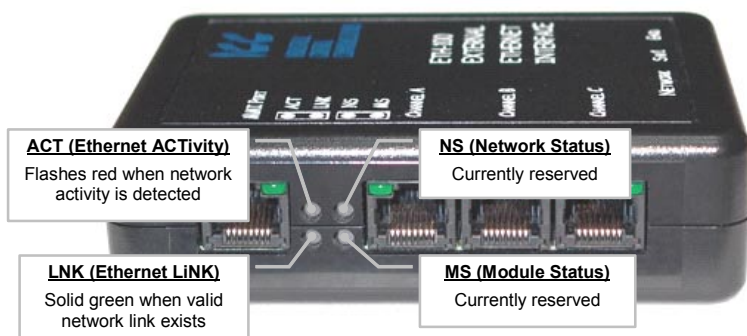


Figure 6: Module and Ethernet Indicators

9.2 ASD Port Indicators

Each ASD port RJ45 connector contains two integrated green LEDs. Figure 7 indicates the functions of these LEDs.

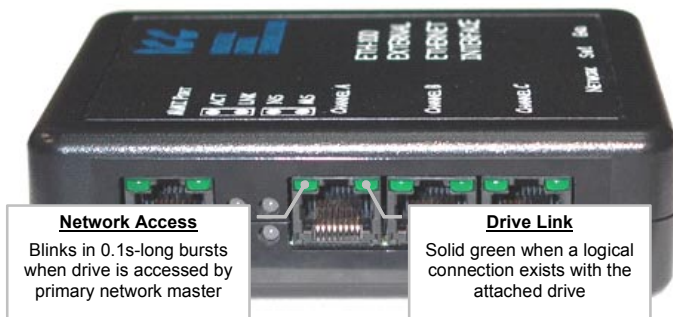


Figure 7: ASD Port Indicators

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 interface and drive are successfully exchanging data, independent of primary network activity.

9.3 MMI Port Indicators

The MMI port RJ45 connector also contains two integrated green LEDs. Figure 8 indicates the functions of these LEDs.

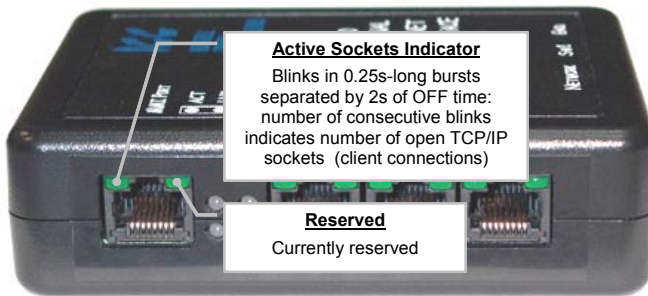


Figure 8: MMI Port Indicators

The *Active Sockets* indicator is helpful in determining how many TCP/IP sockets are currently allocated to Ethernet clients (masters). As indicated in Figure 8, the number of currently-allocated sockets can be determined by counting the number of concurrent short blinks. Each stream of short blinks is terminated by 2s of continuous off time, after which the next stream of short blinks begins.

10. Internal Battery

The ETH-100 interface has an internal battery that is used to backup the file system containing the unit configuration and point database information when the unit is unpowered. This battery is designed to last the lifetime of the product under normal use. However, if the interface is left unpowered for several years, the battery may become exhausted. For this reason, always be certain to download the configured point file to a PC via the Xmodem protocol so that it will be available for uploading again if the battery fails and requires replacement. Additionally, it is recommended to record the IP address, subnet mask and gateway settings in the notes section (section 16) of this manual for future reference.

The battery is a soldered-in type, and is not user-replaceable. If the battery becomes discharged, contact ICC for replacement assistance.

11. Initial Configuration

The ETH-100 typically requires configuration prior to communicating on an Ethernet network. This fundamental configuration is achieved via one of two possible methods: using ICMP (“ping”) configuration via the Address Resolution Protocol (ARP), or via a text-based console interface, accessible over an RS232 serial channel and a telnet interface. The following are the factory-set values of the most important Ethernet parameters:

IP Address..... 192.168.16.100
Subnet Mask 255.255.255.0
Default Gateway..... 192.168.16.2

If these parameters are not compatible with your network settings, they will need to be modified.

11.1 ARP Method

The IP address can be changed remotely by using the Address Resolution Protocol (ARP). This is performed by adding a static entry into a PC’s ARP cache table, which stores the associations between a device’s IP and physical (MAC) addresses. The unit is then “pinged” from a command prompt (MS DOS™ window) to assign the new IP address to it. Below is an example of the commands used to change the unit’s IP address:

```
arp -s <IP address> <MAC address>
ping <IP address>
arp -d <IP address>
```

The initial “arp -s” command adds a static association between the unit’s MAC address and the desired IP address to the PC’s ARP table. When the ping command is executed with the IP address as an argument, the PC sends this information to the unit indicated by the associated MAC address. The unit then detects that it was addressed with the correct MAC address and adopts the IP address indicated in the ICMP “ping” packet. The optional “arp -d” command then removes the static route from the PC’s ARP table.

The unit’s MAC address is printed on a label on the back of the case. An example of setting a unit’s IP address to 192.168.16.110 would look like:

```
arp -s 192.168.16.110 00-90-C2-C0-29-8B
ping 192.168.16.110
arp -d 192.168.16.110
```

Forcing the unit to adopt the new IP address completes only half of the ARP configuration process. In addition to the IP address being changed, the unit also automatically configures its subnet mask to 255.255.255.255. This setting essentially allows only the computer that issued the ping command to communicate with the unit. From this computer, then, the user must also access the unit’s web page via a web browser, or its console via a telnet

session, in order to assign a new subnet mask. Until the new subnet mask is assigned to the unit, the IP address change is only temporary. If the unit loses power or is otherwise reset prior to submitting a new subnet mask, the previous IP address and subnet mask settings will return.

Note that if the subnet mask is to be modified via the unit's web page, that network elements such as HTTP proxy servers may relay the web page request for the configuring computer. The unit, seeing the HTTP request from a computer other than that which performed the initial "ping", will ignore such a request. Therefore, be sure to bypass or disable any proxy servers at least temporarily when using this configuration method.

For security reasons, once the ARP method of configuration has been successfully completed (i.e. a new subnet mask has been entered), the ARP method of configuration will be disabled, and all future attempts at using this method will be ignored by the unit. It is possible, however, to re-enable the ARP method via a console command (refer to section 12.3).

11.2 Console Method

The console method of configuration is achieved via a text-based console interface, accessible over an RS232 serial channel and a telnet interface. The RS232 console is accessed by using the included DB9-RJ45 cable to connect the ETH-100's MMI port to a PC's serial (COM) port, and then running a terminal emulation program, such as Windows® HyperTerminal. If the ARP method of initial configuration is not used, then the RS232 console must be accessed. More information about the console interface and its commands can be found in section 12.

12. Console Access

12.1 RS232

The console is accessible via an RS232 interface for direct connection to a computer's serial (COM) port. This is performed by using the included DB9-RJ45 cable to connect the ETH-100's MMI port to the computer's serial port. This will typically be the initial configuration channel, as the telnet interface can only be accessed once the network parameters have already been established and the device is communicating on the Ethernet network.

12.1.1 Requirements

All that is needed is a computer with a standard serial (COM) port containing some sort of communications software (such as HyperTerminal, shipped 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.

12.1.2 Connection

The ETH-100 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. Make sure that switch SW1 #1 is in the "OFF" position.

12.1.3 Application Configuration

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

Figure 9 shows the "Connect To" tab of the properties window for COM1. Figure 10 shows the window that appears when "Configure" is selected in the "Connect To" tab. Figure 11 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 10.

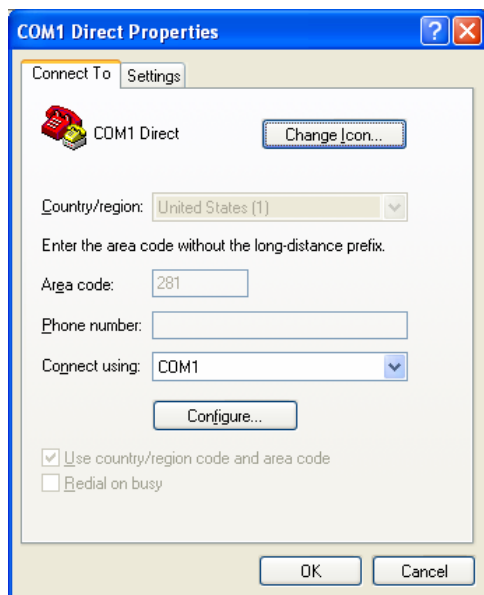


Figure 9: HyperTerminal Properties...Connect To

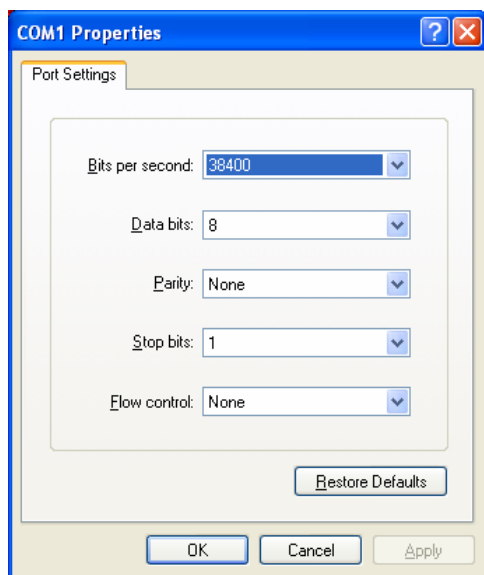


Figure 10: HyperTerminal Properties...Connect To...Configure

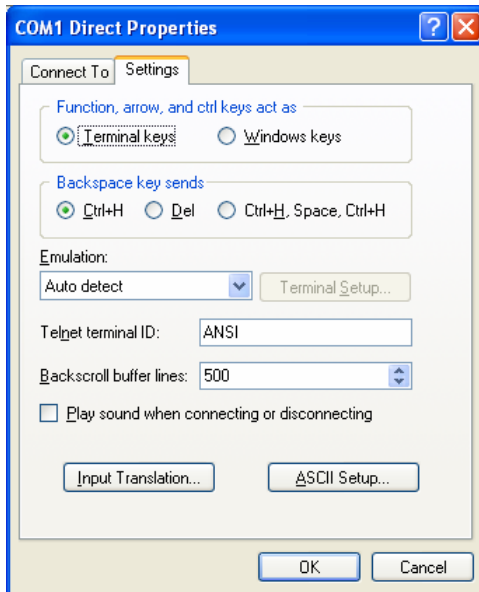


Figure 11: HyperTerminal Properties...Settings

12.2 Telnet

The console is also accessible via a Telnet interface for remote administration over Ethernet once the unit is communicating on the network. The Telnet console uses well-known port 23. Note that although only 1 telnet console session can be active at any given time, the telnet console and RS232 console operate independently and can be used simultaneously.

12.2.1 Requirements

All that is needed is a computer with telnet software that can access the ETH-100 over the Ethernet network. Telnet software is typically included as a standard component of Microsoft Windows and other PC operating systems.

12.2.2 Connection

No special connections are required, other than the PC running the Telnet application must be able to access the ETH-100 to be configured.

12.2.3 Application Configuration

Although any software vendor's Telnet client application can be used, the configuration example given here will use the Microsoft Windows Telnet application. To start the Telnet application, simply type "telnet" at either a DOS (command) prompt or in the "Start...Run" window. Once the telnet client screen opens, the target device can be accessed simply by typing "open" at the Telnet prompt with the ETH-100's IP address as an argument. Refer to Figure 12.

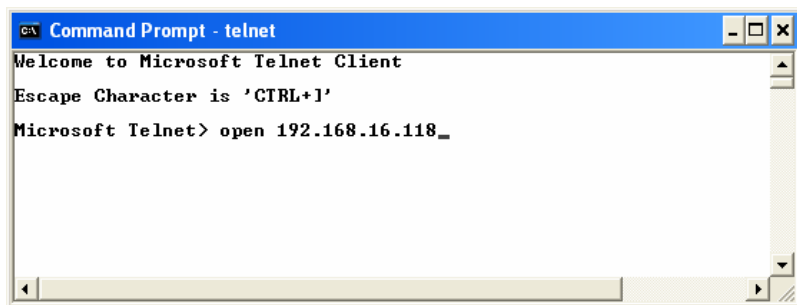


Figure 12: Telnet Menu

12.3 Command Overview

The console provides standard access and configuration methods for the various network parameters and configurations supported by the ETH-100. The number and type of supported console commands may vary with different console version and application version firmware. This section will present an overview of the supported console commands.

It is important to note that unless otherwise indicated, each of these commands will become effective immediately after it has been successfully entered. This may have several repercussions; for example, if you change the IP address of the device via the Telnet console, then you will lose the telnet connection to the device (as it was a connection to the old IP address) and therefore must re-connect to the console if you wish to continue changing parameters. Also note that the console commands are not case-sensitive.

Help: This command shows the console version and an overview of all available commands. As indicated in the returned help information, typing "Help <command>" with a specific command will return help information specific to that command. Refer to Figure 13 for the help command output via Telnet. All further display screens shown in this section will be from Telnet, although they will look identical when accessed via the serial channel (MMI port).

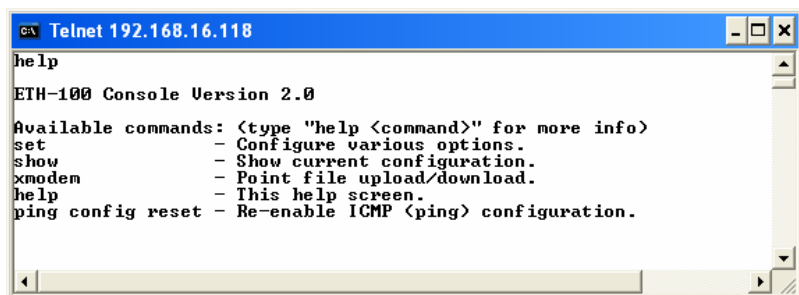
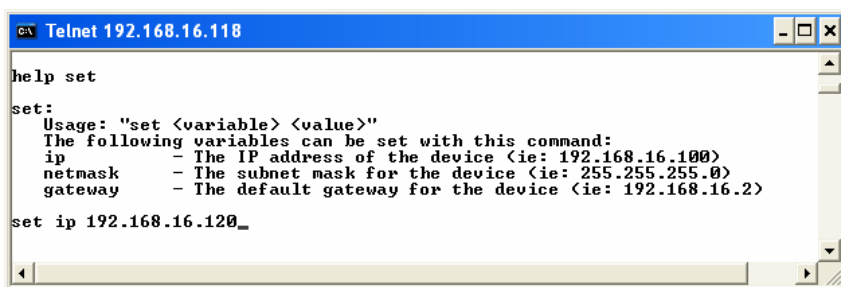


Figure 13: "Help" Command

Set: The "Set" command actually encompasses several subcommands, each of which allows setting a different configuration parameter. To set a parameter, two arguments are required: the parameter's name and the value to set it to. Figure 14 shows an example of changing the IP address of a device to 192.168.16.120. After this command is entered, the device will then reconfigure itself to allow network access via the IP address 192.168.16.120.



```

C:\> Telnet 192.168.16.118

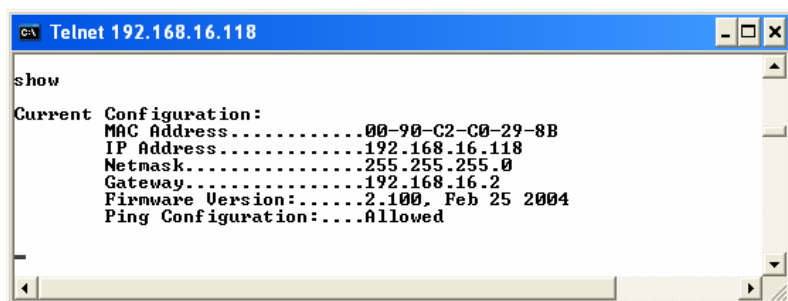
help set

set:
  Usage: "set <variable> <value>"
  The following variables can be set with this command:
  ip          - The IP address of the device (ie: 192.168.16.100)
  netmask     - The subnet mask for the device (ie: 255.255.255.0)
  gateway     - The default gateway for the device (ie: 192.168.16.2)

set ip 192.168.16.120_
  
```

Figure 14: "Set" Command Overview and Implementation

Show: Figure 15 shows an example of this command, which displays current configuration information. Some of this information (IP Address, Netmask and Gateway) is configurable via the "set" command. The "Firmware Version" field indicates the unit's current application firmware version. The "Ping Configuration" field indicates whether or not the ability to remotely configure the unit via the ARP method is currently allowed (refer to section 11.1).



```

C:\> Telnet 192.168.16.118

show

Current Configuration:
MAC Address.....00-90-C2-C0-29-8B
IP Address.....192.168.16.118
Netmask.....255.255.255.0
Gateway.....192.168.16.2
Firmware Version:....2.100, Feb 25 2004
Ping Configuration:....Allowed
  
```

Figure 15: "Show" Command Overview

Xmodem: The "xmodem" command allows point configuration files to be transferred between the unit and a PC. Refer to section 13.4.1 for more information about point mapping. As Xmodem is a serial protocol, the xmodem command only applies to the serial console (MMI port)

Whenever a point configuration is created, it is highly recommended that a backup copy of the point configuration file be downloaded from the unit to a PC. One reason for this is in case it becomes necessary to restore the file to the unit's file system later (such as if the unit's internal backup battery becomes exhausted and requires replacement). Another reason is that it may be desirable to load multiple units with the same configuration. A downloaded point file can be uploaded to any ETH-100, allowing the user to clone multiple units with the same configuration.

Two different variations of the Xmodem protocol are supported (CRC and Checksum) for those serial communication packages that only support one or the other. However, some programs can automatically adapt to the user's selection, making the specific Xmodem protocol selection arbitrary. The first argument of the xmodem command indicates the mode, and must be set to either "/crc" for Xmodem CRC mode, or "/cs" for Xmodem checksum mode.

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

Figure 16 shows an example of initiating an Xmodem download in CRC mode. Once the message "The ETH-100 is ready to send its point file via Xmodem...Download the file now" appears, the user has 30 seconds to start the Xmodem download. This can be performed in HyperTerminal by clicking the "receive" button on the tool bar. Figure 17 shows the dialog box that will appear after clicking the "receive" button. Specify the folder in which to place the received file, select Xmodem as the receiving protocol, and click "Receive". One last dialog box will prompt the user to name the received file, and then the transfer will begin.

```

COM1 Direct - HyperTerminal
File Edit View Call Transfer Help
help xmodem

xmodem:
Usage: "xmodem <mode> <action>"
Xmodem is used to upload or download a point file.

<mode> must be one of the following:
"/crc" - transfer the file via Xmodem CRC mode.
"/cs" - transfer the file via Xmodem Checksum mode.

<action> must be one of the following:
"/u" - upload a point file to the unit.
"/d" - download the current point file from the unit.

xmodem /crc /d
The ETH-100 is ready to send its point file via Xmodem...
Download the file now.

Connected 0:08:14 ANSI 38400 8-N-1 SCROLL CAPS NUM Capture Print echo
  
```

Figure 16: "Xmodem" Command Overview and Implementation

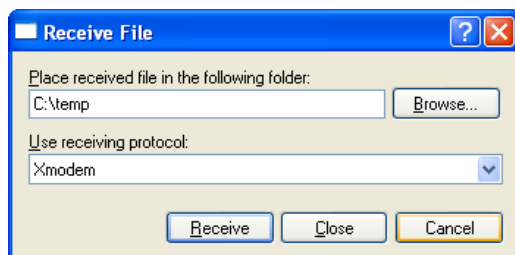


Figure 17: HyperTerminal receive file dialog box

When uploading a file, the procedure is similar to downloading. Enter “u” instead of “d” for the action parameter of the xmodem command. Once the xmodem upload command is entered, the user will have 30 seconds to click the “send” button on the tool bar in HyperTerminal and initiate the Xmodem upload transaction. Upon successful completion of the Xmodem upload, the unit will reset, and the uploaded point file will become the unit’s active point configuration. The previous point configuration cannot be recovered.

Ping config reset: This command re-enables the ability to configure the unit’s IP address via the ARP method (refer to section 11.1). For security reasons, whenever the ARP method of configuration is successfully completed, the unit disables this method, and subsequent attempts at ARP configuration will be ignored. By entering the “ping config reset” console command, however, the unit will once again allow the ARP method of configuration. Refer to Figure 18. Recall that the current ARP method configuration status can always be obtained via the “show” command.

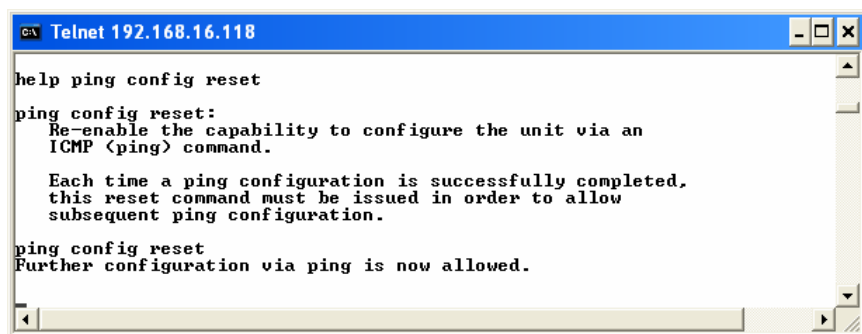


Figure 18: "Ping Config Reset" Overview and Implementation

13. Modbus TCP/IP

The ETH-100 interface supports Schneider Electric's Modbus TCP/IP protocol, release 1.0. The ETH-100 is conformance class 0 and partial class 1 and class 2 compliant, and allows up to 8 simultaneous Modbus TCP/IP client connections (sockets).

13.1 Drive Channel Access

Each specific drive channel (Channel A, Channel B and Channel C) is accessed via the "Unit Identifier" (UI) field of a Modbus TCP/IP packet. Drive channel A is accessed when the UI field is set to "1", channel B is accessed when the UI field is set to "2", and channel C is accessed when the UI field is set to "3". Any other UI setting is invalid and will result in a GATEWAY PATH UNAVAILABLE exception (Modbus TCP/IP exception code 0A).

13.2 Timeout Processing

The unit supports two different socket timeout processing capabilities. Standard socket timeouts are set to 30s, which means that if a particular open socket experiences no activity for more than 30s, then the interface assumes that the client or network has experienced some sort of unexpected problem, and the ETH-100 will close that socket.

Alternatively, a "master" IP address and timeout time can be assigned to the unit. Each point defined in the point database has the capability to be assigned an optional failsafe timeout value. When an unexpected socket failure from the "master" client occurs, all points with timeout processing enabled will be written with their failsafe values. This provides an additional level of process security in the event of a network or master device disturbance.

13.3 Supported Modbus Functions

The ETH-100 interface supports the Modbus TCP/IP function codes indicated in Table 1.

Table 1: Supported Modbus TCP/IP Functions

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

13.4 Modbus/Drive Register Mappings

The ETH-100 uses three methods to determine the manner in which Modbus registers are mapped to ASD registers. These are outlined below.

13.4.1 Point Mapping

The unit can contain a user-configurable **point database**. The point database is a list of register mappings that describe how Modbus holding registers map to Toshiba ASD parameters. Each point in the point database contains a Modbus holding register number, an ASD parameter number, a value, a name, a timeout value, and a timeout enable/disable selection.

A point's *Modbus holding register number* indicates the Modbus register number the point is accessed with. Similarly, a point's *ASD parameter number* indicates the ASD parameter that the point refers to. Each ASD channel (A, B, and C) has its own independent list of points. The point database can contain a maximum of 100 total points, distributed in any manner among the three ASD channels.

A point's *value* contains the value of the ASD register that it refers to. Via a service called **data mirroring**, point values are constantly being updated via communication with the connected drives and maintained locally within the interface itself. This greatly reduces the Ethernet network's request-to-response latency time, as requests (read or write) can be entirely serviced locally, thereby eliminating the time required to execute an on-demand ASD data transaction.

Besides data mirroring, another advantage afforded by the ability to map any ASD register to any Modbus register is the capability of **data reorganization**. Data reorganization allows the grouping of ASD registers into more logical or

efficient patterns to suit a given application. Because the Ethernet network client never “sees” the true ASD register numbers, the point mapping assignments can be determined by any user-defined criteria. For instance, several disjoint ASD status registers can be assigned to contiguous Modbus registers, thereby allowing the status items to be read with a single “read multiple register” transaction. Data reorganization can therefore enhance network efficiency by minimizing the total number of data transactions required.

A point’s *name* is simply a descriptive title assigned to the point to more easily identify the point’s function during device configuration and monitoring. This name is only accessible via the HTTP (web browser) interface.

A point’s *timeout value* and *timeout enable/disable selection* are used in conjunction with the master device timeout function. When a timeout from a “master” client is detected, the timeout enable/disable selections for all configured points are inspected. Those points that are found to have their timeout enable/disable selections set to “enabled” will then have their configured timeout values automatically written to their corresponding ASD registers. This mechanism provides for a flexible set of ASD failsafe conditions to be established on a point-by-point basis.

Refer to section 14 for specific information related to configuring points.

13.4.2 Direct (Implicit) Mapping

The ETH-100 also provides direct access to the attached ASDs by allowing circumvention of the point database. Modbus TCP/IP holding registers (04 registers) that are not defined as points are directly mapped to the numerically corresponding ASD registers (also referred to as “communication numbers” in Toshiba documentation) with a 1-to-1 relationship. This means that in order to access a Toshiba drive register, simply access the same-numbered Modbus TCP/IP holding register. Because this access method bypasses the point database’s explicit mapping definitions, it is referred to as “direct” or “implicit” mapping. Also, because direct mapping cannot take advantage of the point database’s data mirroring service, Ethernet network response latency times will be extended by the amount of time required to perform an on-demand ASD data transaction.

As an example of this relationship, let’s say that we would like to access parameter “Deceleration Time #1” on an ASD connected to the ETH-100. According to the relevant Toshiba *Serial Communications Manual*, we see that “Deceleration Time #1” resides at drive register number 0x0010 (note hexadecimal notation). We would therefore need to access Modbus holding register 16 (0x0010=16₁₀) to implicitly access this drive parameter.

As mentioned above, direct mapping only applies when attempting to access a Modbus register that is not already defined in the point database. If a specific Modbus register is defined in the point database, then the point database mapping overrides direct mapping, and the actual ASD register accessed will depend on the point’s configured ASD parameter number.

13.4.3 Universal Access Registers

Until now, our discussions regarding how to access ASD registers have primarily revolved around the method of mapping ASD registers to unique Modbus TCP/IP registers. For most control/monitoring applications, this is not a problem. However, Toshiba ASDs contain many more accessible parameters than just the control/status parameters typically accessed during day-to-day operations. Often, these “seldom used” parameters are configuration parameters that are typically set only during system commissioning, and then never accessed again.

In some applications, it may be desirable to take a “snapshot” of all configuration parameters on an ASD via the Modbus TCP/IP network, in order to create a backup file of the drive’s settings in case the drive needs to be replaced at some future time. Clearly, it would not be feasible or even desirable to create a point database that explicitly mapped all drive registers to unique Modbus TCP/IP registers. It may be possible to take advantage of the ETH-100’s direct mapping method to access all of the ASD registers, but some ASD register numbers may have already been defined as Modbus register numbers in the point database, thereby forcing explicit point mapping to override implicit (direct) mapping.

To solve this problem, the ETH-100 defines two “Universal Access Registers” per drive channel, which together allow asynchronous access to any ASD parameter, on any ASD channel, at any time.

The two Universal Access Registers are reserved by the ETH-100, so they cannot be programmed as a point’s Modbus holding register number in the point database. The Universal Access Register numbers and functions are indicated in Table 2.

Table 2: Universal Access Registers

Modbus TCP/IP Register	Function
9998	ASD register number
9999	Read / write data

To use this feature, first write the ASD register number that you wish to access to Modbus register 9998. Then, any subsequent read/write accesses to Modbus register 9999 will be redirected to the ASD register number defined in register 9998. In this manner, any ASD register can be accessed simply by changing the ASD register number held in Modbus register 9998, and then performing a read or write command on the read/write data register (9999).

For example, let’s say we would like to read a group of ASD configuration registers starting at register 100 from Modbus TCP/IP unit identifier 1 (UI1=ETH-100 channel A). Therefore, we would write a value of 100 to Modbus UI1 register 9998. By then reading from Modbus UI1 register 9999,

we will actually be retrieving the data from register 100 on the ASD connected to channel A. By alternating between incrementing the value contained in register 9998 (100...101...102 etc.) and then reading from register 9999, we can access all the desired configuration parameters from the ASD.

If the requested operation cannot be performed (typically due to such reasons as a non-existent ASD register being targeted or a written data value being out of range), a corresponding Modbus TCP/IP error code will be returned.

13.5 Coil Mappings

The ETH-100 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, which are described in section 13.4. What this means is that when a coil is accessed, that coil is resolved by the ETH-100 into a specific holding register, and a specific bit within that holding register. The pattern of coil-to-register/bit relationships can be described as follows:

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

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

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

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

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

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

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

For clarity, let's use Equation 1 and Equation 2 in a calculation example. Say, for instance, that we are going to read coil #34. Using Equation 1, we can determine that coil #34 resides in holding register #3, as $\lfloor 3.0625 \rfloor = \lfloor 3 \text{ r}1 \rfloor = 3$.

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

Note that this coil-to-register/bit relationship holds true regardless of 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 not defined as a point in the point database, however, then an on-demand ASD data transaction will take place, requesting ASD parameter 0x0003 and returning the value of bit #1 of that parameter. Either way, coil #34 will always access holding register #3, bit #1.

Although Equation 1 and Equation 2 can be used to numerically determine any arbitrary coil-to-register/bit relationship, this can be a tedious process if many coils are to be resolved. Fortunately, the embedded web server (described in section 14) calculates these values for you automatically for those holding registers that are defined as points in the point database. In these cases, therefore, the specific coil(s) that is (are) to be accessed can usually be determined just by viewing the “coils” column of the point database display.

13.6 Exceptions and Troubleshooting

13.6.1 Common Error Causes

Although by no means exhaustive, Table 3 provides possible causes behind some of the most common errors experienced when using the Modbus TCP/IP interface.

Table 3: Troubleshooting Reference

Problem	Possible Cause
Modbus TCP/IP client cannot establish communication with the ETH-100	<ul style="list-style-type: none"> • Ensure at least one of the connected drives is powered on • Check that the drive and Ethernet communication cables are fully seated into their respective communication ports • Check the Ethernet communication parameters (IP address, etc.)
Drive does not respond to network commands / frequency command	<ul style="list-style-type: none"> • Check drive's frequency mode and command mode selection parameters • Where applicable, confirm the values of bits #14 and #15 of the communication command word • Confirm that the communication frequency command value is between lower limit and upper limit frequencies
ILLEGAL FUNCTION exception (Modbus exception code 01)	The indicated Modbus function is not supported: refer to section 13.3 for a list of supported functions
ILLEGAL DATA ADDRESS exception (Modbus exception code 02)	The targeted drive register (or one in a group of targeted registers) does not exist: check the drive's supported register list
ILLEGAL DATA VALUE exception (Modbus exception code 03)	The value written was rejected by the drive as invalid: check the value and drive setting range
NEGATIVE ACKNOWLEDGE exception (Modbus exception code 07)	<ul style="list-style-type: none"> • An attempt was made to write to a drive register while the drive was running that does not accept writes while the drive is running • An attempt was made to write to a read-only register • Confirm that the drive communication cable is fully seated into the drive's and ETH-100's communication ports • Confirm that the drive communication cable is not routed near the drive's input power or motor wiring or any other electrical noise-producing cables or equipment
GATEWAY PATH UNAVAILABLE exception (Modbus exception code 0A)	Unit Identifier (UI) was invalid: UI must be 1 ~ 3
GATEWAY TARGET DEVICE FAILED TO RESPOND exception (Modbus exception code 0B)	<p>The targeted drive is not online or failed to respond:</p> <ul style="list-style-type: none"> • Confirm that the targeted drive is powered-on • Confirm that the drive communication cable is fully seated into the drive's and ETH-100's communication ports • Confirm that the drive communication cable is not routed near the drive's input power or motor wiring or any other electrical noise-producing cables or equipment

13.6.2 General ASD Access Notes

- Because write transactions targeting internally-defined points (refer to section 13.4.1) are handled locally within the ETH-100, data range checking is not available. For example, if a write to a point is performed, and the write data is out-of-range of the corresponding ASD parameter, no exception will be immediately returned. However, the point will always reflect the ASD parameter's value. In other words, if such an out-of-range write is performed, the unsuccessful ASD write can be observed by reading the current (unchanged) value of the register during a subsequent transaction.
- For those drive families (such as the S7 and S9) which do not have an explicit FREQUENCY MODE SELECTION or COMMAND MODE SELECTION parameter setting corresponding to the common serial channel, remember that bits #14 and #15 of the communication command register (drive register 0xFA00) must be set to enable network frequency and network commands, respectively.
- All register 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.

14. Embedded Web Server

The ETH-100 interface contains an embedded web server (also known as an HTTP server), which allows users to access the unit's internal data and ASD data in a graphical manner with web browsers such as Microsoft Internet Explorer or Netscape Navigator. In this way, the unit and connected drives can be monitored, configured and controlled from across the room or from across the globe.

The ETH-100's web pages are best viewed with either Internet Explorer version 5.x and later, or Netscape Navigator version 6.x and later. The free Macromedia Flash player plug-in is also required, and can be obtained at <http://www.macromedia.com/go/getflash>. Always ensure that you have the latest version of the Flash player installed: if some aspect of the web pages appears to be displayed unusually, installing the latest Flash player update usually resolves the problem.

To access the unit's embedded web server, just enter its configured IP address into the address (URL) field of your web browser. Accessing the ETH-100's web page is the same as surfing the Internet's world-wide web. Refer to Figure 19 for an example.

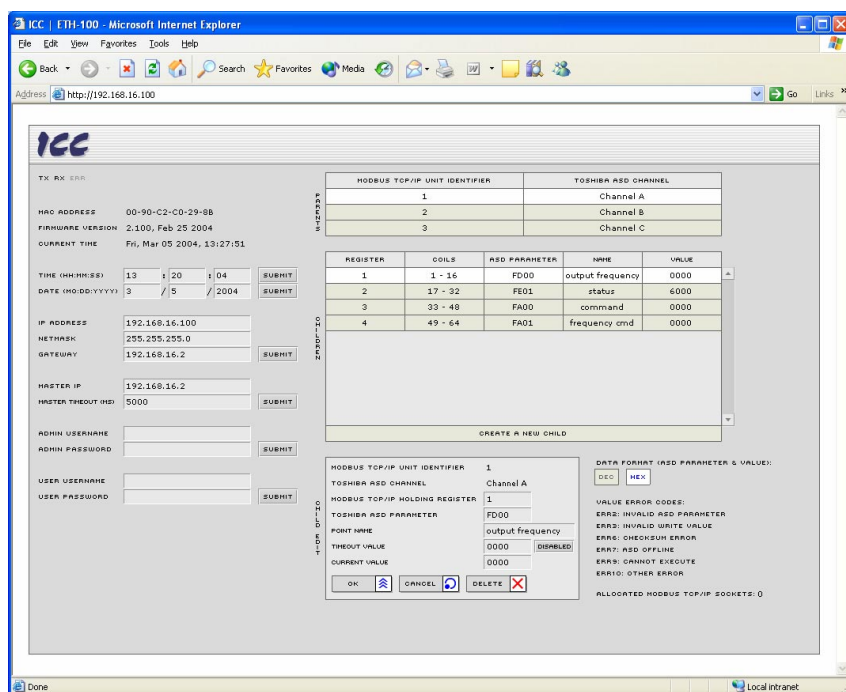


Figure 19: Embedded Web Server

14.1 Authentication

For security, the ETH-100 requires valid user authentication when the web page is accessed or the point information is modified. The authentication request will appear as a browser popup box that will request entry of a user name and password. The unit contains two different security realms: an administrator realm and a user realm. Each of these realms has a different username and password, and applies to different activities. This division of authentication realms allows a device administrator to retain control of critical items (such as changing a unit's IP address or modifying point values and point definitions) while allowing a device user with appropriate authorization to monitor point values (i.e. observe the status of the attached drives).

Refer to Figure 20 for a screen shot of the administrator realm authentication dialog box, and Table 4 for initial factory-set authentication values. Note that the username and password are case-sensitive, and that once authenticated, the authentication will remain in effect from that point until all browser windows are closed.

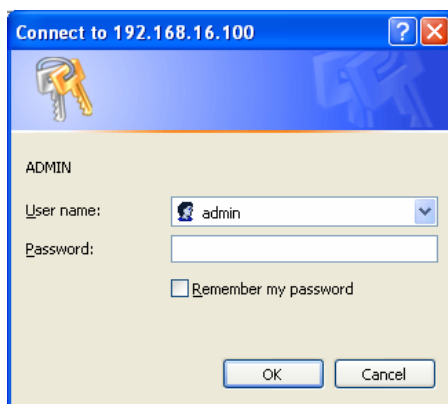


Figure 20: Administrator Authentication

Table 4: Initial factory-set authentication values

Realm	Username	Password	Realm Applies To
USER	user	Blank (i.e. do not enter a password)	Monitoring capabilities
ADMIN	admin	Blank (i.e. do not enter a password)	All change actions

14.2 Communication Status Indicators

Figure 21 shows the communication status indicators. These will blink periodically to show the status of data communication between the web browser and the unit.



Figure 21: Communication Status Indicators

14.3 Unit Status

Figure 22 shows the non-modifiable unit status information. This includes the 48-bit hardware MAC address, the application firmware version information, and the current date and time.

MAC ADDRESS	00-90-C2-C0-29-8B
FIRMWARE VERSION	2.100, Feb 25 2004
CURRENT TIME	Fri, Mar 05 2004, 13:27:51

Figure 22: Unit Status

14.4 Set Date and Time

Figure 23 shows the submission boxes in which new date and time information can be entered. Note that the hours are entered in military time format (0-23 = 12AM – 11PM).

TIME (HH:MM:SS)	<input type="text" value="13"/>	:	<input type="text" value="20"/>	:	<input type="text" value="04"/>	<input type="button" value="SUBMIT"/>
DATE (MO:DD:YYYY)	<input type="text" value="3"/>	/	<input type="text" value="5"/>	/	<input type="text" value="2004"/>	<input type="button" value="SUBMIT"/>

Figure 23: Set Date and Time

14.5 Network Configuration

Figure 24 shows the submission boxes in which network configuration information can be entered. Note that changing the subnet mask or default gateway will immediately result in a momentary loss of communications: just

wait for a moment, or use the “refresh” button on your browser to re-establish communications. Changing the unit’s IP address, however, will result in a complete loss of communications, as the unit’s IP address will immediately be changed from that of the page you are viewing to the new value. To reconnect, therefore, requires transitioning to the new IP address via the browser’s “Address” (URL) field.

IP ADDRESS	192.168.16.100
NETMASK	255.255.255.0
GATEWAY	192.168.16.2
<input type="button" value="SUBMIT"/>	

Figure 24: Network Configuration

14.6 Master Timeout Configuration

Figure 25 shows the submission boxes used to define the parameters associated with the “master” client timeout determination. The “Master IP” field entry defines the IP address of the client computer that is designated as the “master”. The “Master Timeout” field entry defines the number of milliseconds of inactivity that must transpire on a Modbus TCP/IP socket connection with the “master” device before the ETH-100 will terminate the socket and perform its per-point timeout processing. Valid master timeout times are 500ms-30000ms (0.5s-30.0s).

MASTER IP	192.168.16.2
MASTER TIMEOUT (MS)	5000
<input type="button" value="SUBMIT"/>	

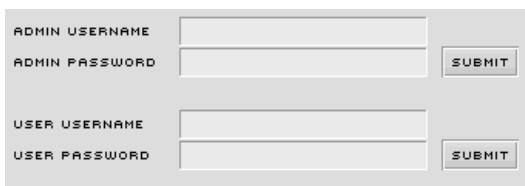
Figure 25: Master Timeout Configuration

Because the socket timeout determination is performed on a per-socket duration basis, note that a certain degree of caution must be exercised when using the network timeout feature to avoid “nuisance” timeouts from occurring. Specifically, do not perform inadvisable behavior such as sending a request from the master device to an ETH-100, and then closing the socket prior to successfully receiving the unit’s response. The reason for this is because the ETH-100 will then experience an error when attempting to respond via the now-closed socket, which will immediately trigger the timeout action. Always be sure to manage socket life cycles “gracefully”, and do not abandon outstanding requests.

Modbus TCP/IP sockets initiated from devices other than the “master” device use a fixed 30s timeout time, and do not perform timeout processing. This allows devices other than the designated “master” to access the unit for monitoring or other non-critical access purposes.

14.7 Authentication Configuration

Figure 26 shows the submission boxes used to change the user-level and administrator-level usernames and passwords.



The form is divided into two sections. The top section is for administrator-level credentials, with labels 'ADMIN USERNAME' and 'ADMIN PASSWORD' next to input fields, and a 'SUBMIT' button to the right. The bottom section is for user-level credentials, with labels 'USER USERNAME' and 'USER PASSWORD' next to input fields, and a 'SUBMIT' button to the right.

Figure 26: Authentication Configuration

To change, enter your desired username and password (max 11 characters each), then click “Submit”. Contact ICC if you have forgotten your username or password for instructions on how to reset them.

14.8 Parent Selection

Each of the 3 ASD channels is automatically defined as a point in the internal point database. These special points are called “parent points” and their sole responsibility is simply to define the primary-to-secondary network address mapping. In the case of the ETH-100, each of the ASD channels is accessed by appropriate selection of the Modbus TCP/IP unit identifier (UI) field.

P A R E N T S	MODBUS TCP/IP UNIT IDENTIFIER	TOSHIBA ASD CHANNEL
	1	Channel A
	2	Channel B
	3	Channel C

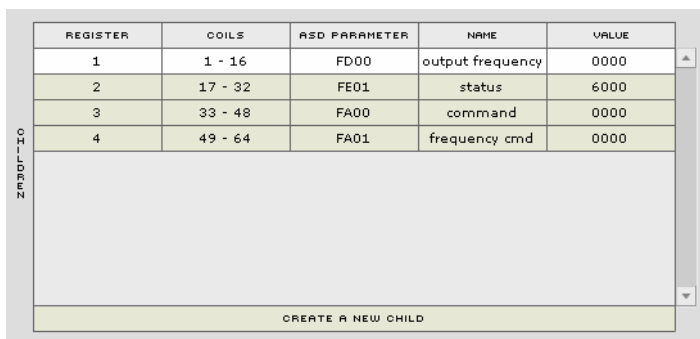
Figure 27: Parent Selection

As mentioned in section 13.4.1, the pool of available points in the point database can be allocated as desired among the three ASD channels. To view and edit the point assignments for each ASD channel, click on the row in the “Parents” window for the channel you wish to access. The currently-selected channel will appear with a white background, and the points associated with that channel (that parent’s “children”) will be displayed in the “Children” window (refer to section 14.9).

14.9 Child Selection

When a parent (ASD channel) is selected in the “Parents” windows (refer to section 14.8), that parent’s children (assigned points) will be displayed in the

“Children” window. Refer to Figure 28 for an example. Each row of this window displays the attribute information for a single point. These attributes include the Modbus holding register number, the associated coil numbers (refer to section 13.5), the ASD parameter number, the user-assigned name, and the point’s current value. The “value” column will display each point’s current value updated every second. To edit an existing point, click on the row belonging to the point you wish to edit. The currently-selected point will appear with a white background, and the attributes of the point will be displayed in the “Child Edit” window (refer to section 14.10).



REGISTER	COILS	ASD PARAMETER	NAME	VALUE
1	1 - 16	FD00	output frequency	0000
2	17 - 32	FE01	status	6000
3	33 - 48	FA00	command	0000
4	49 - 64	FA01	frequency cmd	0000

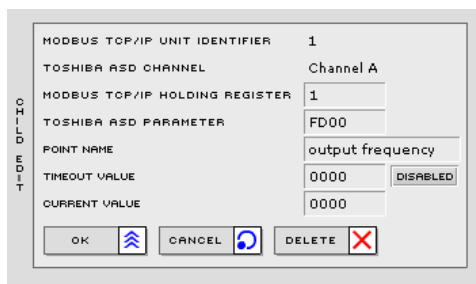
CREATE A NEW CHILD

Figure 28: Child Selection

To add a new child point to the currently-selected parent (channel), click the “Create a New Child” button located at the bottom of the “Children” window. This will bring up an empty point definition in the “Child Edit” window, where the new point’s information can be entered.

14.10 Child Edit

When a child (point) is selected in the “Children” windows (refer to section 14.9), that child’s attributes (details) will be displayed in the “Child Edit” window. Refer to Figure 29 for an example.



MODEBUS TCP/IP UNIT IDENTIFIER 1

TOSHIBA ASD CHANNEL Channel A

MODEBUS TCP/IP HOLDING REGISTER 1

TOSHIBA ASD PARAMETER FD00

POINT NAME output frequency

TIMEOUT VALUE 0000

CURRENT VALUE 0000

OK CANCEL DELETE

Figure 29: Child Edit

The “Modbus TCP/IP Unit Identifier” and “Toshiba ASD Channel” fields are for reference only, and indicate the same selection that was previously made in the “Parents” window (refer to section 14.8). The remainder of the displayed attributes, however, are editable.

The “Holding Register” and “ASD Parameter” entry boxes allow assignment of their respective information. The “Point Name” entry box accepts a user-defined name for the point (max 16 characters). The “Timeout Value” entry box and associated “Enabled/Disabled” button allow for definition of a network timeout value and whether or not this point will participate in network timeout processing (refer to section 13.2). Lastly, the “Current Value” entry box indicates (when editing an existing point) the point’s value at the time the point was selected for editing, and accepts new values to be written to the point (to control an attached drive, for example).

Note that the Radix Selection buttons (refer to section 14.11) allow dynamic modification of the display and entry format of the “ASD Parameter”, “Timeout Value” and “Current Value” fields.

After changing or entering new attribute information, the changes can be written to the unit by selecting the “OK” button. Prior to selecting the “OK” button, changes may be aborted at any time by selecting the “Cancel” button. To delete a point, select the “Delete” button.

When configuring the point database, there are several rules that must be followed:

- Only one child per parent may have a specific holding register number.
- Modbus holding register numbers must be 1-65535.
- ASD parameter numbers must be 0-65535 (0x0000-0xFFFF).
- Modbus holding registers 9998 and 9999 are reserved for Universal Access registers and therefore cannot be programmed as a point’s holding register number. Refer to section 13.4.3 for more information.

14.11 Radix Selection

Figure 30 shows the radix selection buttons. These selection buttons allow changing the data display and entry radix between decimal and hexadecimal formats. This change applies to the “ASD Parameter” and “Value” fields both in the Child Selection (section 14.9) and Child Edit (section 14.10) windows.



Figure 30: Radix Selection

14.12 Error Code Reference

Figure 31 shows the error code reference table. These error codes may appear in certain situations in the “Value” fields in the Child Selection (section 14.9) and Child Edit (section 14.10) windows. If an error code is indicated, confirm the validity of the ASD register being accessed, check the ASD communication cabling, and review the troubleshooting information contained in section 13.6.

```
VALUE ERROR CODES:
ERR2: INVALID ASD PARAMETER
ERR3: INVALID WRITE VALUE
ERR6: CHECKSUM ERROR
ERR7: ASD OFFLINE
ERR9: CANNOT EXECUTE
ERR10: OTHER ERROR
```

Figure 31: Error Code Reference

14.13 Allocated Sockets Report

Figure 32 shows the allocated sockets report. This section indicates the number of Modbus TCP/IP sockets that are currently allocated by network clients (0-8).

```
ALLOCATED MODBUS TCP/IP SOCKETS: 1
```

Figure 32: Allocated Sockets Report

15. Firmware Updates

The ETH-100'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 later) and a serial port, the RFU PC application (refer to section 15.3), and the MMI cable included with the interface 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 ETH-100 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 ETH-100 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 switch SW1 #1 to the "ON" (down) position: this will place the ETH-100 into the "firmware download" mode. Whenever switch SW1 #1 is "ON", the ETH-100 can only download firmware to

its flash: 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 interface 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 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. 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 characteristics and bootstrap loaders path. First, select the "Setup...Communications" menu item (refer to Figure 33).

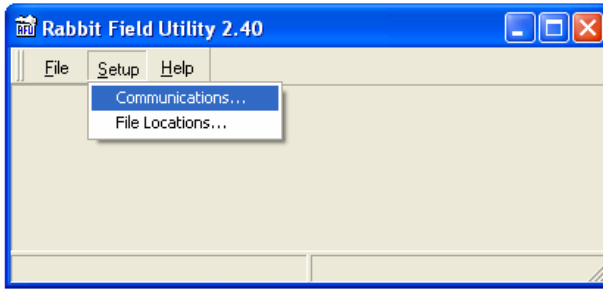


Figure 33: RFU Main Screen

The Communications Options window shown in Figure 34 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 34 to a lower value.

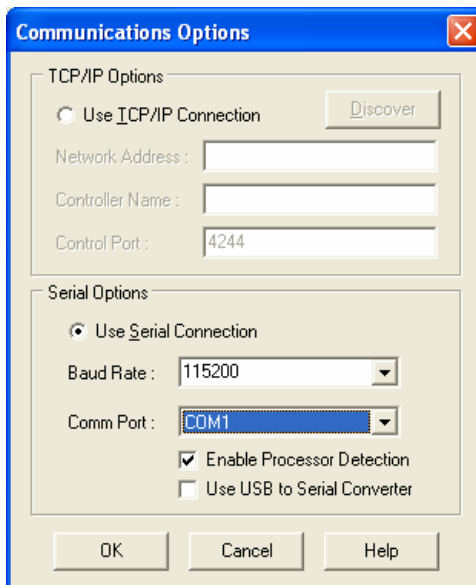


Figure 34: Communications Options Window

Next, select the “Setup...File Locations” menu item from the main screen. The “Choose File Locations” window shown in Figure 35 then appears. Confirm

that the correct paths to the referenced files are entered. Enter the correct paths if necessary.

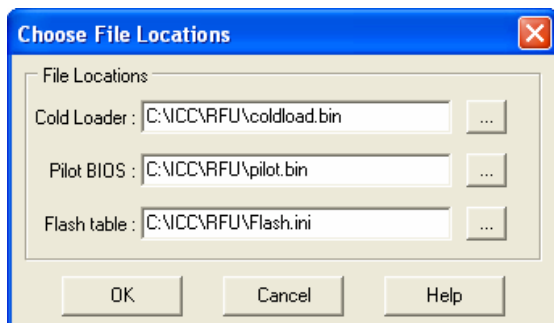


Figure 35: Choose File Locations Window

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 interface 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 36).

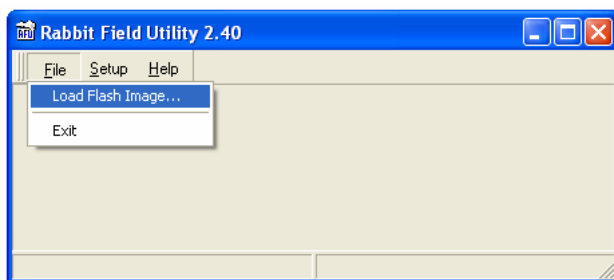


Figure 36: Load Flash Image Menu Selection

The flash image (.BIN file) selection window will then appear (refer to Figure 37). Browse to the location of the flash image file and select it. Clicking “OK” will then initiate the download process.

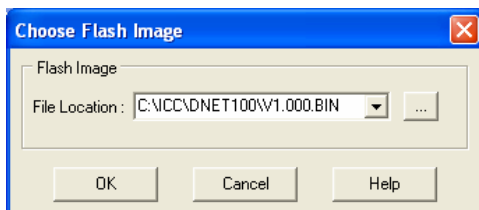


Figure 37: Flash File Selection Window

While downloading, the RFU utility will indicate the download status. Once complete, summary information will be displayed in the bottom status bar (see Figure 38).

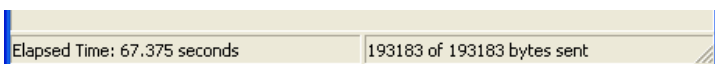


Figure 38: Summary Information

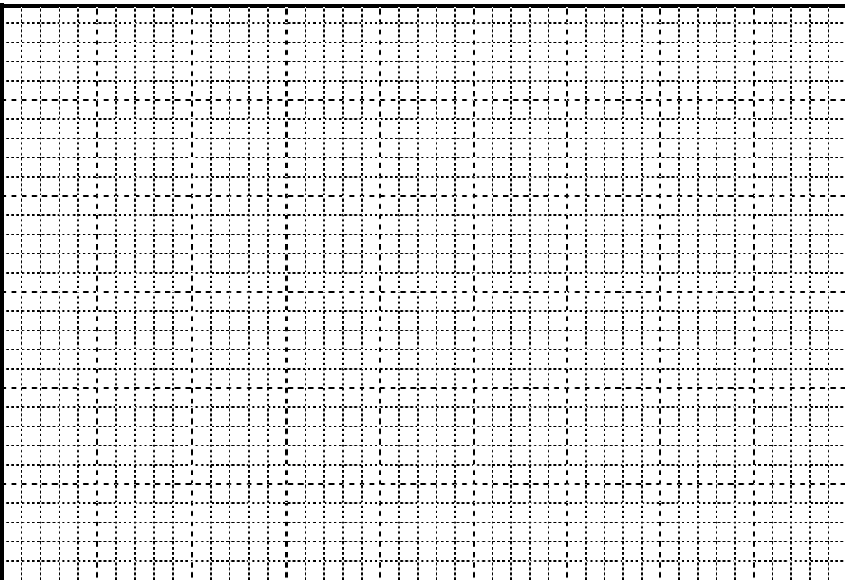
15.4 Wrap-Up

Once downloading is complete, close the RFU utility, move switch SW1 #1 on the ETH-100 unit back to the “OFF” (up) position to leave “firmware download” mode, and cycle power momentarily to the unit by either 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 indicate 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
<http://www.iccdesigns.com>