




ProLinX[®]
MNET

ProLinX Gateway

Modbus TCP/IP Interface Module

September 1, 2010

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MNET Driver Manual
September 1, 2010

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Important Installation Instructions

Power, Input, and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

- A** WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2;
- B** WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES
- C** WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- D** THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

All ProLinx® Products

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT – RISQUE D'EXPLOSION – AVANT DE DÉCONNECTER L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

Markings

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183151

CL I Div 2 GPs A, B, C, D

II 3 G

Ex nA nL IIC X

0°C ≤ Ta ≤ 60°C

II – Equipment intended for above ground use (not for use in mines).

3 – Category 3 equipment, investigated for normal operation only.

G – Equipment protected against explosive gasses.

ProLinx Gateways with Ethernet Ports

Series C ProLinx™ Gateways with Ethernet ports do **NOT** include the HTML Web Server. The HTML Web Server must be ordered as an option. This option requires a factory-installed hardware addition. The HTML Web Server now supports:

- 8 MB file storage for HTML files and associated graphics files (previously limited to 384K)
- 32K maximum HTML page size (previously limited to 16K)

To upgrade a previously purchased Series C model:

Contact your ProSoft Technology distributor to order the upgrade and obtain a Returned Merchandise Authorization (RMA) to return the unit to ProSoft Technology.

To order a ProLinx Plus gateway with the -WEB option

Add **-WEB** to the standard ProLinx part number. For example, **5201-MNET-MCM-WEB**.

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1 Functional Overview

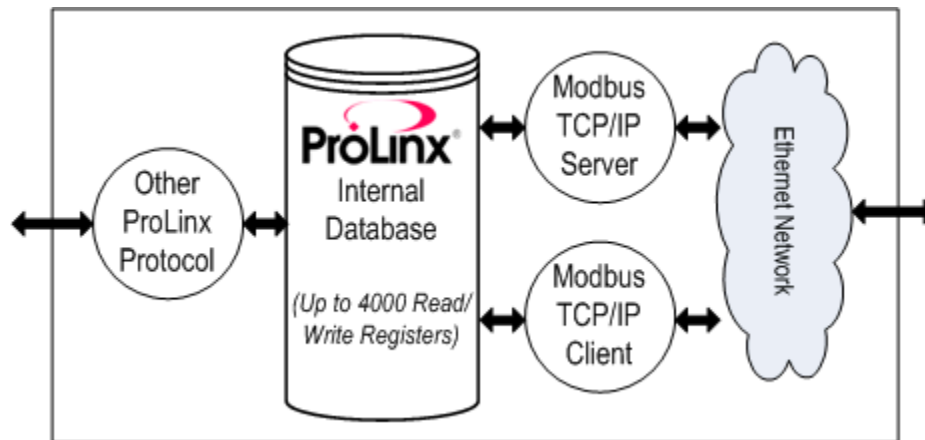
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The ProLinx Modbus TCP/IP (MNET) driver can be used to interface many different protocols into the Schneider Electric Quantum family of processors as well other devices supporting the protocol. The MNET driver supports Client connections as well as Server connections, and, with the addition of the WEB hardware option, the gateway also provides HTTP, FTP and Email capability.

The Ethernet driver interfaces with a common internal database in the gateway. This permits the sharing of data across many different protocols and networks.

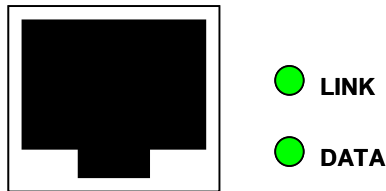
The following illustration shows the functionality of the MNET driver.



1.1 Modbus TCP/IP (MNET) Port

The gateway supports a client connection on the TCP/IP network to interface with processors (and other server based devices) using a user constructed command list of up to 100 entries. The gateway's internal database is used as the source for write commands to the remote processors. Data collected from the processors using read commands is placed in the gateway's database.

Data in the gateway's internal database is accessible for read and write operations by any node on the network supporting the MBAP (Service Port 502) or MNET (Service Ports 2000/2001) TCP/IP protocols. The MBAP protocol (Port 502) is a standard implementation defined by Schneider Automation and used on their Quantum Processor. This open protocol is a modified version of the serial Modbus protocol. The MNET protocol is an embedded Modbus protocol message in a TCP/IP packet. The gateway supports up to five active server connections on Service Ports 502, five additional active server connections on Service Port 2000, and one active client connection.



1.2 General Specifications

- 10 MB Ethernet Application port
- Supports Enron version of Modbus protocol for floating-point data transactions
- Configurable parameters for the client including a minimum response delay of 0 to 65535 ms and floating-point support
- Supports five independent server connections for Service Port 502
- Supports five independent server connections for Service Port 2000
- All data mapping begins at Modbus register 400001, protocol base 0.
- Error codes, network error counters, and port status data available in user data memory

1.3 Modbus TCP/IP

ProSoft's Modbus TCP/IP implementation uses the module's shared internal memory for data transfer. Sharing the memory with another protocol driver allows the module to transfer data between Modbus TCP/IP devices and other devices on other networks.

Configurable floating-point data movement is supported, including support for Enron or Daniel[®] floating-point applications.

Modbus TCP/IP Server (Slave)

The server driver accepts incoming connections on Service Port 502 for clients using Modbus TCP/IP MBAP messages and from clients on Service Port 2000 (or other Service Ports) for clients using Encapsulated Modbus messages..

- Supports five independent server connections for Service Port 502 (MBAP)
- Supports five independent server connections for Service Port 2000 (Encapsulated)
- Supports a total Modbus TCP/IP data transfer capacity of up to 4000 registers or up to 64,000 bits in any combination of data types throughout the memory database
- Modbus data types overlap in the gateway's memory database, so the same data can be conveniently read or written as bit-level or register-level data.

Modbus TCP/IP Client (Master)

- Actively reads data from and writes data to Modbus TCP/IP devices, using MBAP or Encapsulated Modbus message formats
- Offers one client connection with up to 100 commands to talk to multiple servers

Status Data

Error codes, counters, and port status available

1.4 Internal Database

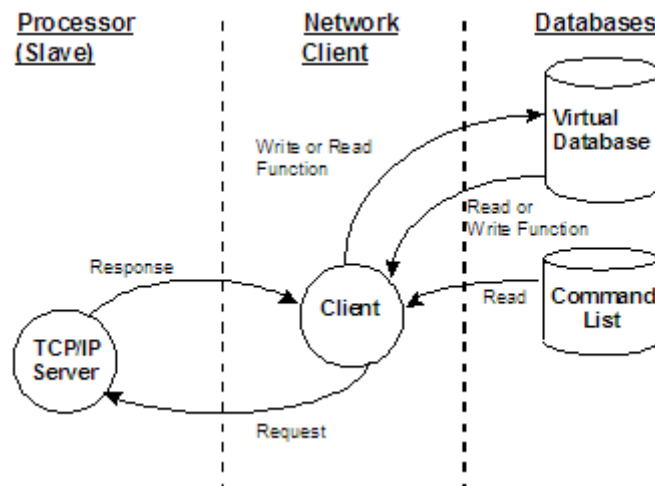
Central to the functionality of the gateway is the internal database. This database is shared between all the ports on the gateway and is used as a conduit to pass information from one device on one network to one or more devices on another network. This permits data from devices on one communication port to be viewed and controlled by devices on another port.

In addition to data from the Server and Client ports, status and error information generated by the gateway can also be mapped into the internal database.

1.4.1 Modbus TCP/IP Client Access to Database

The client functionality exchanges data between MNET module's internal database and data tables established in one or more Quantum processors or other server based devices. The command list, defined in the user configuration, defines what data is to be transferred between the module and each of the servers on the network. No ladder logic is required in the processor (server) for client functionality, except to assure that sufficient data memory exists.

The following illustration describes the flow of data between the Ethernet clients and the internal database.



1.4.2 Modbus TCP/IP Server Access to Database

The MNET gateway provides server functionality using reserved Service Port 502 for Modbus TCP/IP MBAP messages, as well as Service Ports 2000 and 2001 to support the TCP/IP Encapsulated Modbus version of the protocol used by several HMI manufacturers. Server support in the gateway permits client applications (that is, HMI software, Quantum processors, and so on) to read from and write to the gateway's database. This document discusses the requirements for attaching to the gateway using client applications.

The Server driver is able to support multiple concurrent connections from several Clients. Up to five (5) Clients can simultaneously connect on Service Port 502 and five (5) more can also simultaneously connect on Service Port 2000. Service Port 2001 is used by the MNET driver to pass Encapsulated Modbus commands through from the Ethernet port to the gateway's serial port (Modbus pass-through support is available on 5201-MNET-MCM and 5202-MNET-MCM4 models only). When configured as a Server, the internal database of the MNET gateway is used as the source for read requests and the destination for write requests from remote clients. Access to the database is controlled by the command type received in the incoming message from the Client. The following table defines the relationship of the gateway's internal database to the addresses required in the incoming Modbus TCP/IP requests:

Database Address	Modbus Address
0	40001
1000	41001
2000	42001
3000	43001
3999	44000

The following virtual addresses are not part of the normal gateway user database and are not valid addresses for standard data. However, these addresses may be used for incoming commands that are requesting floating-point data. To use addresses in this upper range requires you to set the Float Flag to Yes, the Float Start to a database address in the range below, and the Float Offset to a database address in the gateway user memory area shown above. Remember that, once you do this, all data above the Float Start address must be floating-point data.

Database Address	Modbus Address
4000	44001
5000	45001
6000	46001
7000	47001
8000	48001
9000	49001
9999	50000

The MNET gateway must be correctly configured and connected to the network before you attempt to use it. Use a network verification program, such as the command prompt PING instruction, to verify that the gateway can be seen on the network. Use ProSoft Configuration Builder to confirm proper configuration of the gateway and to transfer the configuration files to and from the gateway.

1.4.3 Modbus Message Routing: Port 2001

When Modbus messages are sent to the module over the TCP/IP connection to port 2001, the messages are sent (routed in the module) directly out the serial communication port (Port 0, if it is configured as a Modbus Master. The commands (whether a read or a write command) are immediately routed to the slave devices on the serial port. Response messages from the slave devices are routed to the TCP/IP network to be received by the originating host.

2 Modbus TCP/IP Protocol Configuration

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2.1 Installing ProSoft Configuration Builder Software

You must install the *ProSoft Configuration Builder (PCB)* software to configure the gateway. You can always get the newest version of *ProSoft Configuration Builder* from the ProSoft Technology website.

Installing ProSoft Configuration Builder from the ProSoft website

- 1 Open your web browser and navigate to *http://www.prosoft-technology.com/pcb*
- 2 Click the **DOWNLOAD HERE** link to download the latest version of *ProSoft Configuration Builder*.
- 3 Choose **SAVE** or **SAVE FILE** when prompted.
- 4 Save the file to your *Windows Desktop*, so that you can find it easily when you have finished downloading.
- 5 When the download is complete, locate and open the file, and then follow the instructions on your screen to install the program.

If you do not have access to the Internet, you can install *ProSoft Configuration Builder* from the *ProSoft Solutions Product CD-ROM*, included in the package with your gateway.

Installing ProSoft Configuration Builder from the Product CD-ROM

- 1 Insert the *ProSoft Solutions Product CD-ROM* into the CD-ROM drive of your PC. Wait for the startup screen to appear.
- 2 On the startup screen, click **PRODUCT DOCUMENTATION**. This action opens a *Windows Explorer* file tree window.
- 3 Click to open the **UTILITIES** folder. This folder contains all of the applications and files you will need to set up and configure your gateway.
- 4 Double-click the **SETUP CONFIGURATION TOOL** folder, double-click the **PCB_*.EXE** file and follow the instructions on your screen to install the software on your PC. The information represented by the "*" character in the file name is the *PCB* version number and, therefore, subject to change as new versions of *PCB* are released.

Note: Many of the configuration and maintenance procedures use files and other utilities on the CD-ROM. You may wish to copy the files from the Utilities folder on the CD-ROM to a convenient location on your hard drive.



2.1.1 Using the Online Help

Most of the information needed to help you use ProSoft Configuration Builder is provided in a Help System that is always available whenever you are running ProSoft Configuration Builder. The Help System does not require an Internet connection.

To view the help pages, start ProSoft Configuration Builder, open the **HELP** menu, and then choose **CONTENTS**.

2.2 Configure the Gateway

2.2.1 Configuring Module Parameters

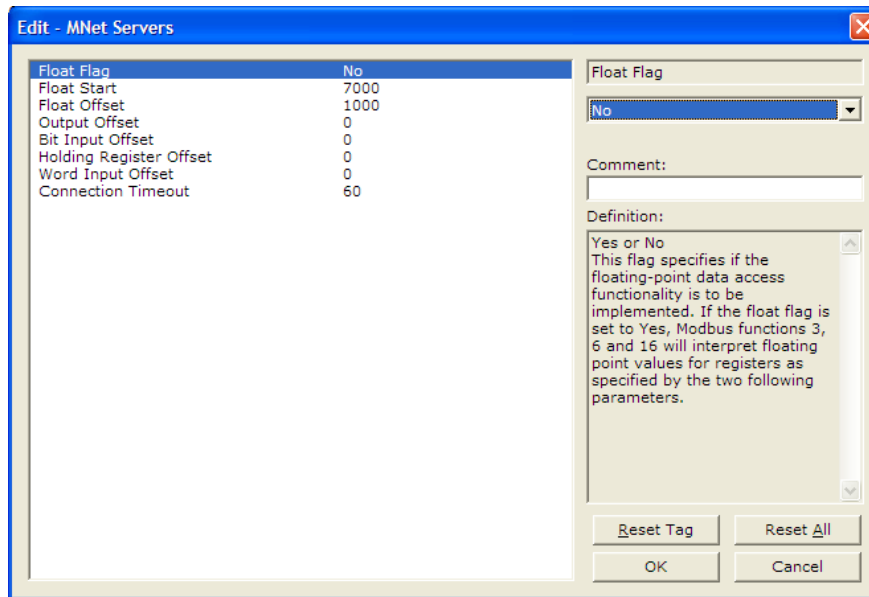
- 1 Click on the **[+]** sign next to the gateway icon to expand gateway information.
- 2 Click on the **[+]** sign next to any  icon to view gateway information and configuration options.
- 3 Double-click any  icon to open an *Edit* dialog box.
- 4 To edit a parameter, select the parameter in the left pane and make your changes in the right pane.
- 5 Click **OK** to save your changes.

2.2.2 Printing a Configuration File

- 1 Select the gateway icon, and then click the right mouse button to open a shortcut menu.
- 2 On the shortcut menu, choose **VIEW CONFIGURATION**. This action opens the *View Configuration* window.
- 3 On the *View Configuration* window, open the **FILE** menu, and choose **PRINT**. This action opens the *Print* dialog box.
- 4 On the *Print* dialog box, choose the printer to use from the drop-down list, select printing options, and then click **OK**.

2.3 [MNET Servers]

This section contains database offset information used by the servers when accessed by external clients. These offsets can be utilized to segment the database by data type.



2.3.1 Float Flag

Yes or No

This flag specifies if the floating-point data access functionality is to be implemented. If the float flag is set to Yes, Modbus functions 3, 6, and 16 will interpret floating-point values for registers as specified by the two following parameters.

2.3.2 Float Start

0 to 32767

This parameter defines the first register of floating-point data. All requests with register values greater-than or equal to this value will be considered floating-point data requests. This parameter is only used if the Float Flag is enabled. For example, if a value of 7000 is entered, all requests for registers 7000 and above will be considered as floating-point data.

2.3.3 Float Offset

0 to 4999

This parameter defines the start register for floating-point data in the internal database. This parameter is used only if the Float Flag is enabled. For example, if the Float Offset value is set to 3000 and the float start parameter is set to 7000, data requests for register 7000 will use the internal Modbus register 3000.

2.3.4 Output Offset

0 to 3999

When the port is configured as a slave, this parameter specifies the internal database address to use as the zero address or starting point for binary output Coil data. Coil data is read by Modbus Function Code 1 commands (Read Coils) and written by Function Codes 5 (Force Single Coil) or Function Code 15 (Force Multiple Coils). For example, if this parameter is set to 50 and a Function Code 1 command is received requesting Coil address 0 (virtual Modbus Coil address 00001 or 000001), the data returned in the response will be the value at register 50, bit 0 in the gateway's database.

2.3.5 Bit Input Offset

0 to 3999

This parameter specifies the offset address in the internal Modbus database for network requests for Modbus function 2 commands. For example, if the value is set to 150, an address request of 0 will return the value at register 150 in the database.

2.3.6 Holding Register Offset

0 to 4999

This parameter specifies the offset address in the internal Modbus database to with network requests for Modbus functions 3, 6, or 16 commands. For example, if the value is set to 50, an address request of 0 will return the value at register 50 in the database.

2.3.7 Word Input Offset

0 to 3999

This parameter specifies the offset address in the internal Modbus database for network requests for Modbus function 4 commands. For example, if the value is set to 150, an address request of 0 will return the value at register 150 in the database.

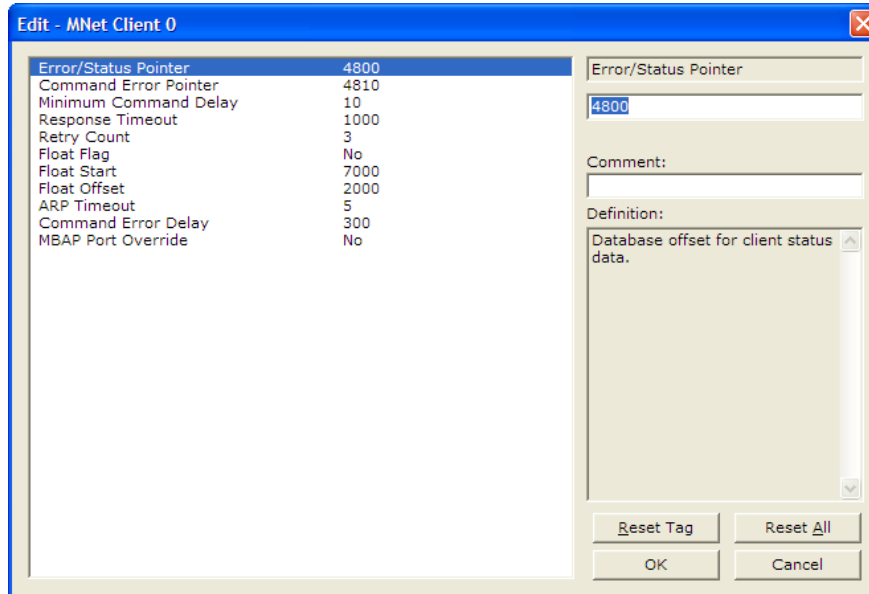
2.3.8 Connection Timeout

0 to 1200 seconds.

This is the number of seconds the Server will wait to receive new data. If the Server does not receive any new data during this time, it will close the connection.

2.4 [MNET CLIENT 0]

The [MNET CLIENT 0] section of the **CFG** file specifies the parameters for the client to be emulated on the gateway. The command list for the client is entered in a separate section.



2.4.1 Minimum Command Delay

0 to 32767

This parameter specifies the number of milliseconds to wait between the initial issuance of a command. This parameter can be used to delay all commands sent to slaves to avoid "flooding" commands on the network. This parameter does not affect retries of a command as they will be issued when failure is recognized.

2.4.2 Response Timeout

0 to 65535 milliseconds

This is the time in milliseconds that a Client will wait before re-transmitting a command if no response is received from the addressed server. The value to use depends upon the type of communication network used, and the expected response time of the slowest device on the network.

2.4.3 Retry Count

0 to 10

This parameter specifies the number of times a command will be retried if it fails.

2.4.4 Float Flag

Yes or No

This flag specifies if the floating-point data access functionality is to be implemented. If the float flag is set to Yes, Modbus functions 3, 6, and 16 will interpret floating-point values for registers as specified by the two following parameters.

2.4.5 Float Start

0 to 32767

This parameter defines the first register of floating-point data. All requests with register values greater-than or equal to this value will be considered floating-point data requests. This parameter is only used if the Float Flag is enabled. For example, if a value of 7000 is entered, all requests for registers 7000 and above will be considered as floating-point data.

2.4.6 Float Offset

0 to 3998

This parameter defines the starting register for floating-point data in the internal gateway database. This parameter is used only if the *Float Flag* is set to **YES**. For example, if the *Float Offset* value is set to 3000 and the *Float Start* parameter is set to 7000, the data returned as floating-point data for register 47001 (or 407001) will actually come from internal gateway registers 3000 and 3001. If the requested address was 47002 (407002), the data will be returned from internal registers 3002 and 3003. If the requested address was 47101 (407101), the data will be returned from internal registers 3200 and 3201; and so on.

2.4.7 ARP Timeout

1 to 60

This parameter specifies the number of seconds to wait for an ARP reply after a request is issued.

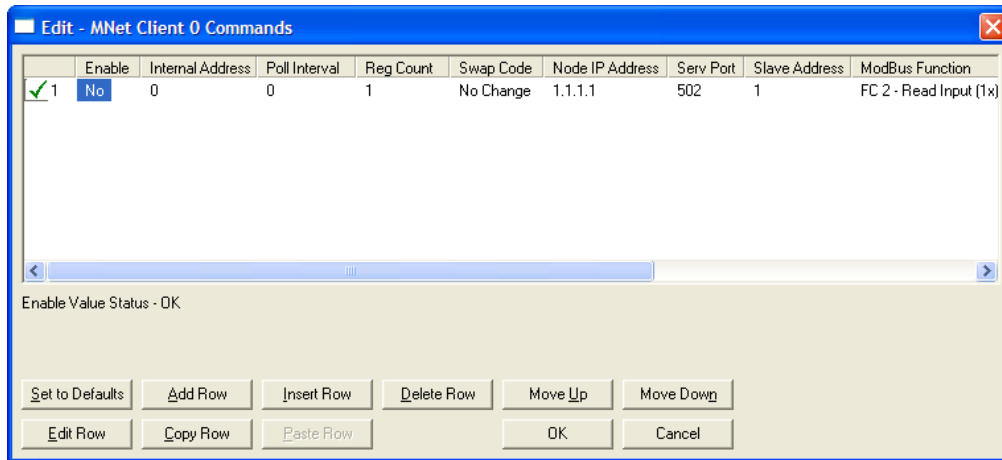
2.4.8 Command Error Delay

0 to 300

This parameter specifies the number of 100 millisecond intervals to turn off a command in the error list after an error is recognized for the command. If this parameter is set to **0**, there will be no delay.

2.5 [MNET CLIENT 0 COMMANDS]

The [MNET CLIENT 0 COMMANDS] section defines the Modbus TCP/IP commands to be issued from the gateway to server devices on the network. These commands can be used for data collection and/or control of devices on the TCP/IP network.



The command list is formatted differently than the other sections of the configuration file. Commands are present in a block between the labels **START** and **END**. These labels inform the program where the list resides. The gateway's program will parse all commands after the **START** label until it reaches the **END** label or until the command count entered for the port is reached.

2.5.1 Command List Overview

In order to interface the ProLinx module with Modbus TCP/IP Server devices, you must construct a command list. The commands in the list specify the Server device to be addressed, the function to be performed (read or write), the data area in the device to interface with and the registers in the internal database to be associated with the device data. The Client command list supports up to 16 commands.

The command list is processed from top (command #0) to bottom. A poll interval parameter is associated with each command to specify a minimum delay time in tenths of a second between the issuance of a command. If the user specifies a value of 10 for the parameter, the command will be executed no more frequently than every 1 second.

Write commands have a special feature, as they can be set to execute only if the data in the write command changes. If the register data values in the command have not changed since the command was last issued, the command will not be executed. If the data in the command has changed since the command was last issued, the command will be executed. Use of this feature can lighten the load on the network. In order to implement this feature, set the enable code for the command to a value of 2.

2.5.2 Commands Supported by the Module

The format of each command in the list depends on the Modbus Function Code being executed.

The following table lists the functions supported by the module.

Function Code	Definition	Supported in Client	Supported in Server
1	Read Coil Status	X	X
2	Read Input Status	X	X
3	Read Holding Registers	X	X
4	Read Input Registers	X	X
5	Set Single Coil	X	X
6	Single Register Write	X	X
7	Read Exception Status		X
8	Diagnostics		X
15	Multiple Coil Write	X	X
16	Multiple Register Write	X	X
22	Mask Write 4X		X
23	Read/Write		X

Each command list record has the same general format. The first part of the record contains the information relating to the communication module and the second part contains information required to interface to the Modbus TCP/IP Server device.

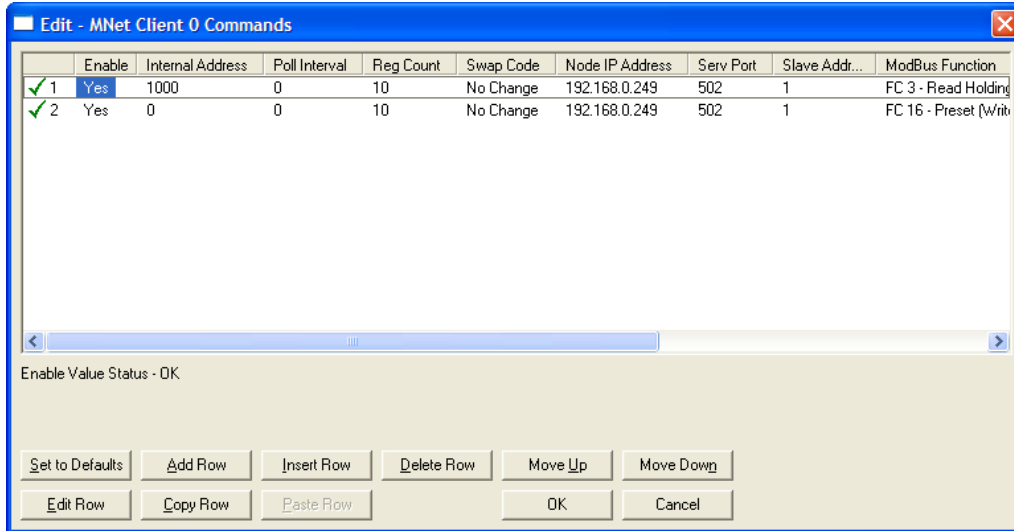
2.5.3 Command Entry Formats

The following table shows the structure of the configuration data necessary for each of the supported commands.

1	2	3	4	5	6	7	8	9	10
Enable Code	Internal Address	Poll Interval Time	Count	Swap Code	IP Address	Serv Port	Slave Node	Function Code	Device Modbus Address
Code	Register (bit)	1/10th Seconds	Bit Count	0	IP Address	Port #	Address	Read Coil (0x)	Register
Code	Register (bit)	1/10th Seconds	Bit Count	0	IP Address	Port #	Address	Read Input (1x)	Register
Code	Register	1/10th Seconds	Word Count	Code	IP Address	Port #	Address	Read Holding Registers (4x)	Register
Code	Register	1/10th Seconds	Word Count	0	IP Address	Port #	Address	Read Input Registers (3x)	Register
Code	1 bit	1/10th Seconds	Bit Count	0	IP Address	Port #	Address	Force (Write) Single Coil (0x)	Register
Code	1 bit	1/10th Seconds	Word Count	0	IP Address	Port #	Address	Preset (Write) Single Register (4x)	Register
Code	Register (bit)	1/10th Seconds	Bit Count	0	IP Address	Port #	Address	Force (Write) Multiple Coil (0x)	Register
Code	Register	1/10th Seconds	Word Count	0	IP Address	Port #	Address	Preset (Write) Multiple Register (4x)	Register

The first part of the record is the gateway Information, which relates to the ProLinx gateway and the second part contains information required to interface to the Server device.

Command list example:



2.5.4 Enable

YES, NO, or CONDITIONAL

This field defines whether the command is to be executed and under what conditions.

Value	Description
0	The command is disabled and will not be executed in the normal polling sequence.
1	The command is executed each scan of the command list if the Poll Interval Time is set to zero. If the Poll Interval time is set, the command will be executed, when the interval timer expires.
2	The command will execute only if the internal data associated with the command changes. This value is valid only for write commands.

2.5.5 Internal Address

0 to 4999 (for word-level addressing)

or

0 to 65535 (for bit-level addressing)

This field specifies the database address in the gateway's internal database to use as the destination for data brought in by a read command or as the source for data to be sent out by a write command. The database address is interpreted as a bit address or a 16-bit word (register) address, depending on the Modbus Function Code used in the command.

- For Modbus functions 1, 2, 5, and 15, this parameter is interpreted as a bit-level address.
- For Modbus functions 3, 4, 6, and 16, this parameter is interpreted as a word- or register-level address.

2.5.6 Reg Count

Regs: **1 to 125**

Coils: **1 to 800**

This parameter specifies the number of 16-bit registers or binary bits to be transferred by the command.

- Functions 5 and 6 ignore this field as they apply only to a single data point.
- For functions 1, 2, and 15, this parameter sets the number of bits (inputs or coils) to be transferred by the command.
- For functions 3, 4, and 16, this parameter sets the number of registers to be transferred by the command.

2.5.7 Swap Code

NONE

SWAP WORDS

SWAP WORDS & BYTES

SWAP BYTES

This parameter defines if and how the order of bytes in data received or sent is to be rearranged. This option exists to allow for the fact that different manufacturers store and transmit multi-byte data in different combinations that do other manufacturers. This parameter is helpful when dealing with floating-point or other multi-byte values, as there is no one standard method of storing these data types. This parameter can be set to rearrange the byte order of data received or sent into order more useful or convenient for other applications. The following table defines the valid *Swap Code* values and the effect they have on the byte-order of the data.

Swap Code	Description
None	No Change is made in the byte ordering (1234 = 1234)
Swap Words	The words are swapped (1234=3412)
Swap Words & Bytes	The words are swapped then the bytes in each word are swapped (1234=4321)
Swap Bytes	The bytes in each word are swapped (1234=2143)

These swap operations affect 4-byte (or 2-word) groups of data. Therefore, data swapping using these Swap Codes should be done only when using an even number of words, such as when 32-bit integer or floating-point data is involved.

2.5.8 Node IP Address

xxx.xxx.xxx.xxx

The IP address of the device being addressed by the command.

2.5.9 Service Port

502 or other supported ports on server

Use a value of 502 when addressing Modbus TCP/IP servers that are compatible with the Schneider Electric MBAP specifications (this will be most devices). If a server implementation supports another service port, enter the value here.

2.5.10 Slave Address

0 - Broadcast to all nodes

1 to 255

Use this parameter to specify the slave address of a remote Modbus Serial device through a Modbus Ethernet to Serial converter.

Note: Use the Node IP Address parameter (page 28) to address commands to a remote Modbus TCP/IP device.

Note: Most Modbus devices accept an address in the range of only 1 to 247, so check with slave device manufacturer to see if a particular slave can use addresses 248 to 255.

If the value is set to zero, the command will be a broadcast message on the network. The Modbus protocol permits broadcast commands for **write** operations. **Do not** use node address 0 for **read** operations.

2.5.11 Modbus Function

1, 2, 3, 4, 5, 6, 15, or 16

This parameter specifies the Modbus Function Code to be executed by the command. These function codes are defined in the Modbus protocol. The following table lists the purpose of each function supported by the module. More information on the protocol is available from www.modbus.org.

Modbus Function Code	Description
1	Read Coil Status
2	Read Input Status
3	Read Holding Registers
4	Read Input Registers
5	Force (Write) Single Coil
6	Preset (Write) Single Register
15	Force Multiple Coils
16	Preset Multiple Registers

2.5.12 MB Address in Device

This parameter specifies the starting Modbus register or bit address in the slave to be used by the command. Refer to the documentation of each Modbus slave device for the register and bit address assignments valid for that device.

The Modbus Function Code determines whether the address will be a register- or bit- level OFFSET address into a given data type range. The offset will be the target data address in the slave minus the base address for that data type. Base addresses for the different data types are:

- 00001 or 000001 (0x0001) for bit-level Coil data (Function Codes 1, 5, and 15).
- 10001 or 100001 (1x0001) for bit-level Input Status data (Function Code 2)
- 30001 or 300001 (3x0001) for Input Register data (Function Code 4)
- 40001 or 400001 (4x0001) for Holding Register data (Function Codes 3, 6, and 16).

Address calculation examples:

- For bit-level Coil commands (FC 1, 5, or 15) to read or write a Coil 0X address 00001, specify a value of 0 (00001 - 00001 = 0).
- For Coil address 00115, specify 114
(00115 - 00001 = 114)
- For register read or write commands (FC 3, 6, or 16) 4X range, for 40001, specify a value of 0
(40001 - 40001 = 0).
- For 01101, 11101, 31101 or 41101, specify a value of 1100.
(01101 - 00001 = 1100)
(11101 - 10001 = 1100)
(31101 - 30001 = 1100)
(41101 - 40001 = 1100)

Note: If the documentation for a particular Modbus slave device lists data addresses in hexadecimal (base16) notation, you will need to convert the hexadecimal value to a decimal value to enter in this parameter. In such cases, it is not usually necessary to subtract 1 from the converted decimal number, as this addressing scheme typically uses the exact offset address expressed as a hexadecimal number.

2.6 Using the CommonNet Data Map

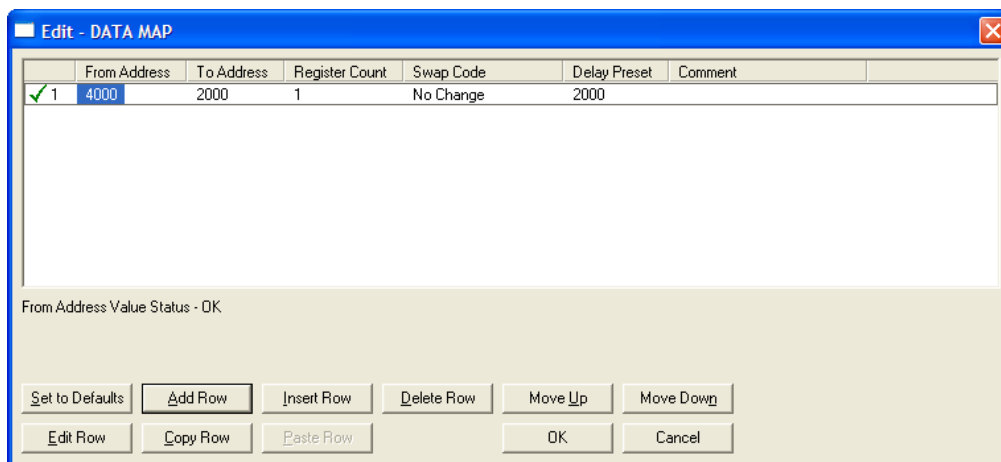
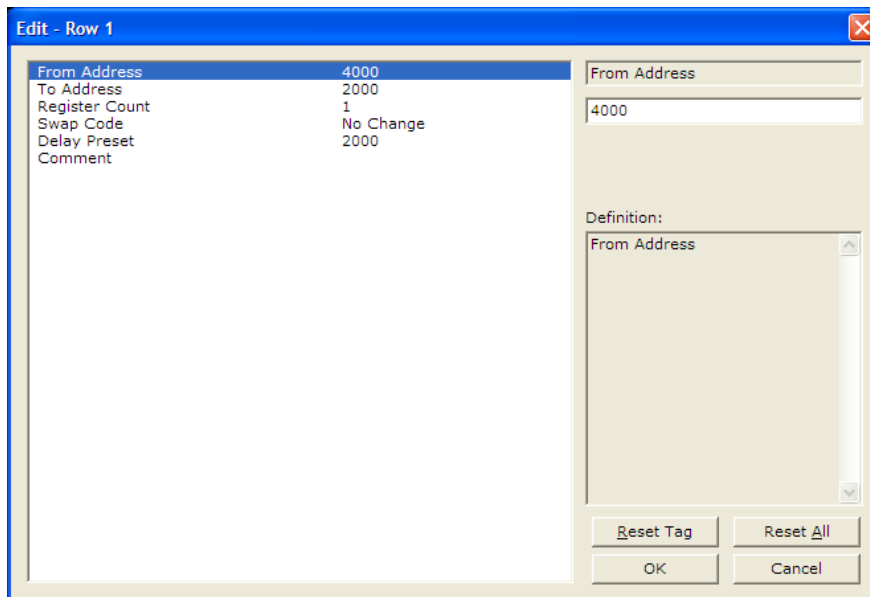
The *Data Map* section allows you to copy data between areas in the gateway's internal database.

You can copy a maximum of 100 registers per *Data Map* command, and you can configure a maximum of 200 separate copy commands.

You can copy data from the error or status tables in upper memory to internal database registers in the *User Data memory* area.

You can rearrange the byte and/or word order during the copy process. For example, by rearranging byte or word order, you can convert floating-point values to the correct format for a different protocol.

You can also use the *Data Map* to condense widely dispersed data into one contiguous data block, making it easier to access.



2.6.1 From Address

0 to highest *Status Data* address

This field specifies the beginning internal database register address for the copy operation. This address can be any valid address in the *User Data Area* or the *Status Data Area* of the gateway.

2.6.2 To Address

0 to 3999

This parameter specifies the beginning destination register address for the copy operation. This address must always be within the *User Data registers* area. Take care to specify a destination address that will not overwrite data that has been stored in memory by one of the communication protocols running on the gateway.

2.6.3 Register Count

1 to 100

This parameter specifies the number of registers to copy.

2.6.4 Swap Code

NO CHANGE, WORD SWAP, WORD AND BYTE SWAP, BYTE SWAP

You may need to swap the order of the bytes in the registers during the copy process in order to change the alignment of bytes between dissimilar protocols. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard method of storage of these data types in slave devices.

The following table defines the values and their associated operations:

Swap Code	Description
No Swap	No change is made in the byte ordering (1234 = 1234)
Word Swap	The words are swapped (1234=3412)
Word and Byte Swap	The words are swapped, then the bytes in each word are swapped (1234=4321)
Bytes	The bytes in each word are swapped (1234=2143)

2.6.5 Delay Preset

This parameter sets an interval for each *Data Map* copy operation. The value you put for the *Delay Preset* is not a fixed amount of time. It is the number of firmware scans that must transpire between copy operations.

The firmware scan cycle can take a variable amount of time, depending on the level of activity of the protocol drivers running on the ProLinx gateway and the level of activity on the gateway's communication ports. Each firmware scan can take from 1 to several milliseconds to complete. Therefore, *Data Map* copy operations cannot be expected to happen at regular intervals.

If multiple copy operations (several rows in the *Data map* section) happen too frequently or all happen in the same update interval, they could delay the process scan of the gateway protocols, which could result in slow data updates or missed data on communication ports. To avoid these potential problems, you should set the *Delay Preset* to different values for each row in the *Data Map* section and set them to higher, rather than lower, numbers.

For example, *Delay Preset* values below 1000 could begin to cause a noticeable delay in data updates through the communication ports. And you should not set all *Delay Presets* to the same value. Instead, use different values for each row in the *Data Map* such as 1000, 1001, and 1002 or any other different *Delay Preset* values you like. This will prevent the copies from happening concurrently and prevent possible process scan delays.

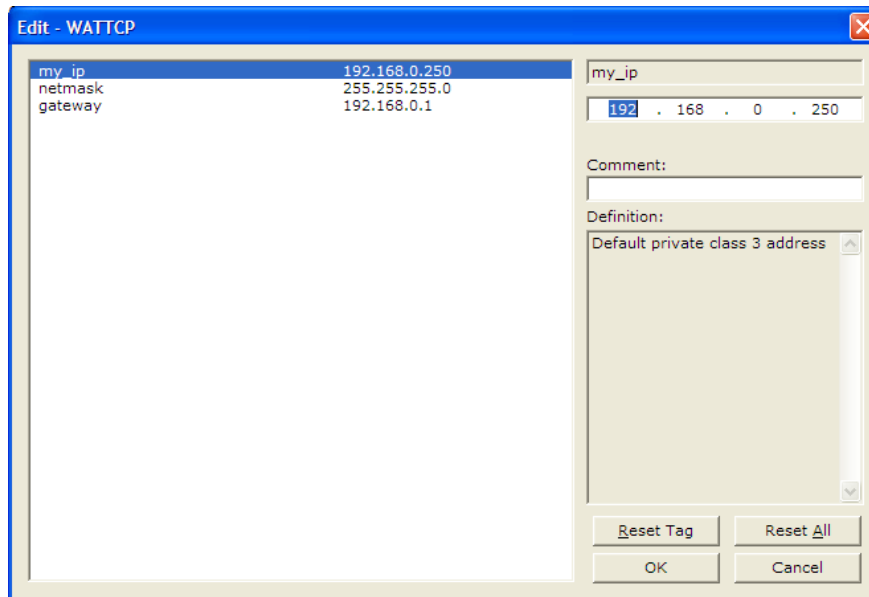
2.7 Ethernet Configuration

Use this procedure to configure the Ethernet settings for your module. You must assign an IP address, subnet mask and gateway address. After you complete this step, you can connect to the module with an Ethernet cable.

- 1 Determine the network settings for your module, with the help of your network administrator if necessary. You will need the following information:
 - IP address (fixed IP required) _____ . _____ . _____ . _____
 - Subnet mask _____ . _____ . _____ . _____
 - Gateway address _____ . _____ . _____ . _____

Note: The gateway address is optional, and is not required for networks that do not use a default gateway.

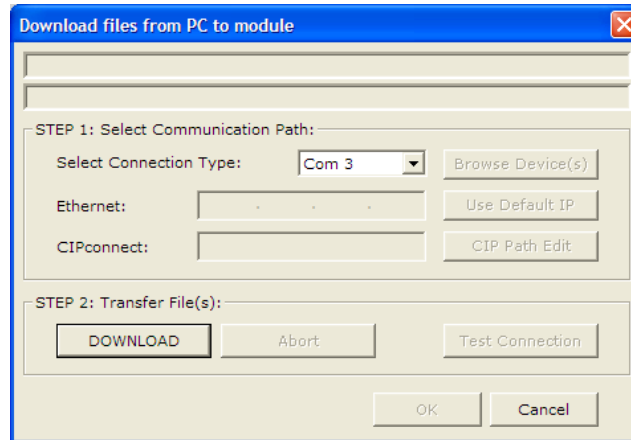
- 2 Double-click the **ETHERNET CONFIGURATION** icon. This action opens the *Edit* dialog box.



- 3 Edit the values for *my_ip*, *netmask* (subnet mask) and *gateway* (default gateway).
- 4 When you are finished editing, click **OK** to save your changes and return to the *ProSoft Configuration Builder* window.

2.8 Downloading a File from PC to the Module

- 1 Verify that your PC is connected to the gateway with a null-modem serial cable connected to the serial port on your PC and the serial port on the gateway
- 2 Open the **PROJECT** menu, and then choose **MODULE**.
- 3 On the **MODULE** menu, choose **DOWNLOAD**. Wait while ProSoft Configuration scans for communication ports on your PC. When the scan is complete, the *Download* dialog box opens.



- 4 Select the **PORT** to use for the download.
- 5 Click the **DOWNLOAD** button.

Note: If you change the IP Address, you must cycle power to the gateway for the change to take effect.

3 Diagnostics and Troubleshooting

In This Chapter

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❖ LED Indicators.....	49
❖ MNET Error and Status Data.....	50

There are two ways to troubleshoot ProLinx Gateways:

- Using the LEDs located on the front of the gateway
- Using the Debug port that provides a view into the gateway's internal database.

3.1 Debug Port Requirements

In order to use the Debug capabilities of any ProLinx Module you will need the following:

- A PC running ProSoft Configuration Builder or HyperTerminal software
- A Null Modem cable
- A Mini-DIN to DB-9M connector
- Configuration and executable files described earlier

3.1.1 Using ProSoft Configuration Builder (PCB) for Diagnostics

The *Configuration and Debug* menu for this gateway is arranged as a tree structure, with the *Main* menu at the top of the tree, and one or more submenus for each menu command. The first menu you see when you connect to the gateway is the *Main* menu.

Because this is a text-based menu system, you enter commands by typing the [command letter] from your computer keyboard in the *Diagnostic* window in *ProSoft Configuration Builder (PCB)*. The gateway does not respond to mouse movements or clicks. The command executes as soon as you press the [COMMAND LETTER] — you do not need to press [ENTER]. When you type a [COMMAND LETTER], a new screen will be displayed in your terminal application.

Required Hardware

You can connect directly from your computer's serial port to the serial port on the gateway to view configuration information, perform maintenance, and send or receive configuration files.

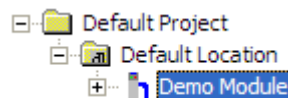
ProSoft Technology recommends the following minimum hardware to connect your computer to the gateway:

- 80486 based processor (Pentium preferred)
- 1 megabyte of memory
- At least one UART hardware-based serial communications port available. USB-based virtual UART systems (USB to serial port adapters) often do not function reliably, especially during binary file transfers, such as when uploading/downloading configuration files or gateway firmware upgrades.

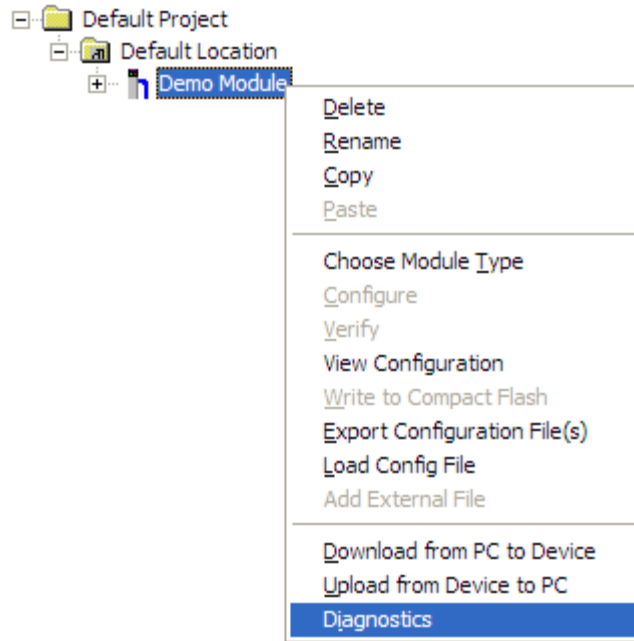
Using the Diagnostic Window in ProSoft Configuration Builder

To connect to the gateway's Configuration/Debug serial port

- 1 Start *PCB*, and then select the gateway to test. Click the right mouse button to open a shortcut menu.

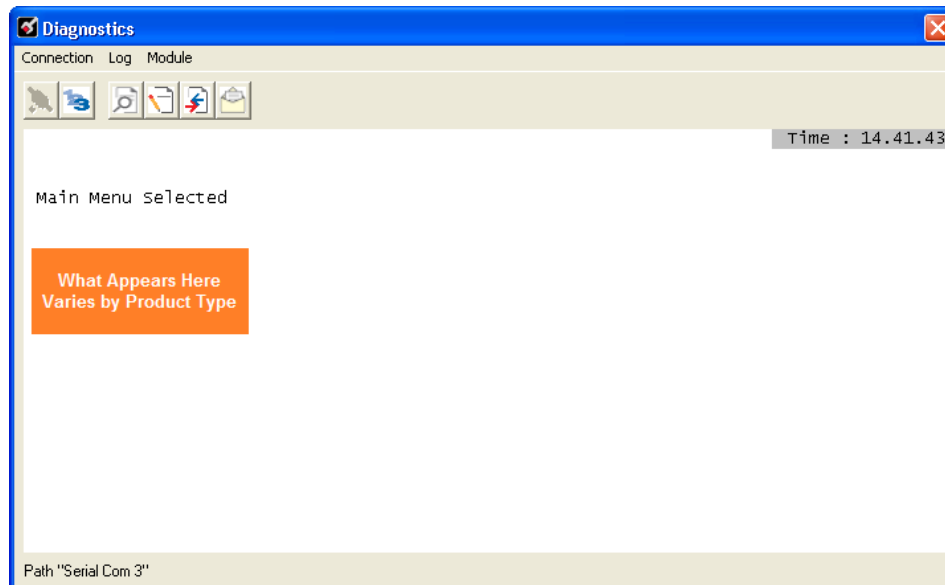


- 2 On the shortcut menu, choose **DIAGNOSTICS**.



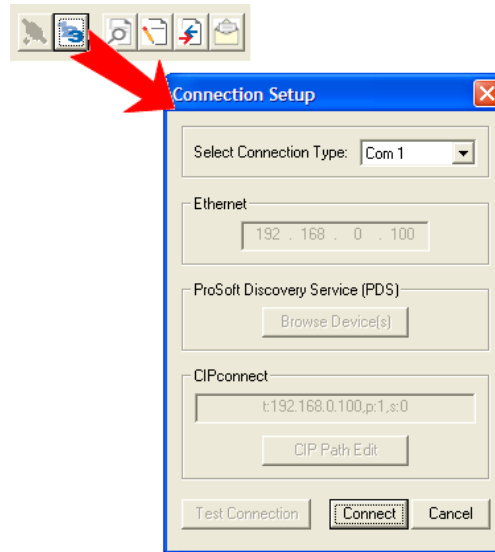
This action opens the *Diagnostics* dialog box.

- 3 Press [?] to open the *Main* menu.



If there is no response from the gateway, follow these steps:

- 1 Click to configure the connection. On the *Connection Setup* dialog box, select a valid com port or other connection type supported by the gateway.

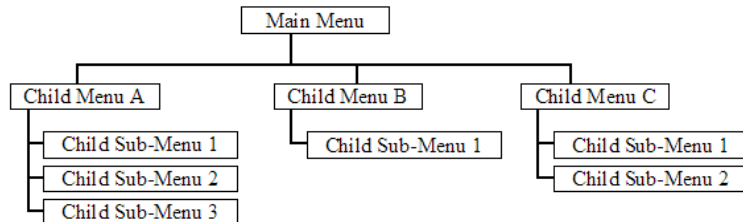


- 2 Verify that the null modem cable is connected properly between your computer's serial port and the gateway. A regular serial cable will not work.
 - 3 On computers with more than one serial port, verify that your communication program is connected to the same port that is connected to the gateway.
- If you are still not able to establish a connection, contact ProSoft Technology for assistance.

Navigation

All of the submenus for this gateway contain commands to redisplay the menu or return to the previous menu. You can always return from a submenu to the next higher menu by pressing **[M]** on your keyboard.

The organization of the menu structure is represented in simplified form in the following illustration:



The remainder of this section shows the menus available for this gateway, and briefly discusses the commands available to you.

Keystrokes

The keyboard commands on these menus are usually not case sensitive. You can enter most commands in lowercase or uppercase letters.

The menus use a few special characters (**?**, **-**, **+**, **@**) that must be entered exactly as shown. Some of these characters will require you to use the **SHIFT**, **CTRL**, or **ALT** keys to enter them correctly. For example, on US English keyboards, enter the **?** command as **SHIFT** and **/**.

Also, take care to distinguish the different uses for uppercase letter "eye" (**I**), lowercase letter "el" (**L**), and the number one (**1**). Likewise, uppercase letter "oh" (**O**) and the number zero (**0**) are not interchangeable. Although these characters look alike on the screen, they perform different actions on the gateway and may not be used interchangeably.

3.1.2 Main Menu

When you first connect to the module from your computer, your terminal screen will be blank. To activate the main menu, press the **[?]** key on your computer's keyboard. If the module is connected properly, the main menu will appear on your terminal screen.

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the gateway to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

Opening the Database View Menu

Press **[D]** to open the *Database View* menu.

Use this menu command to view the current contents of the gateway's database. For more information about this submenu, see *Database View Menu* (page 43).

Viewing Module Configuration

Press **[C]** to view the *Module Configuration* screen.

Use this command to display the current configuration and statistics for the gateway.

Viewing Version Information

Press **[V]** to view version information for the gateway.

Use this command to view the current version of the software for the gateway, as well as other important values. You may be asked to provide this information when calling for technical support on the product.

Values at the bottom of the display are important in determining gateway operation. The *Program Scan Counter* value is incremented each time a gateway's program cycle is complete.

Tip: Repeat this command at one-second intervals to determine the frequency of program execution.

Viewing Client Configuration

Press **[B]** to view configuration information for the client.

Opening the Network Menu

Press **[@]** to open the *Network* menu.

The *Network* menu allows you to send, receive and view the WATTCP.CFG file that contains the IP, gateway and other network specification information. For more information about this submenu, see *Network Menu* (page 47).

Warm Booting the Module

Press **[W]** from the *Main* menu to warm boot (restart) the gateway.

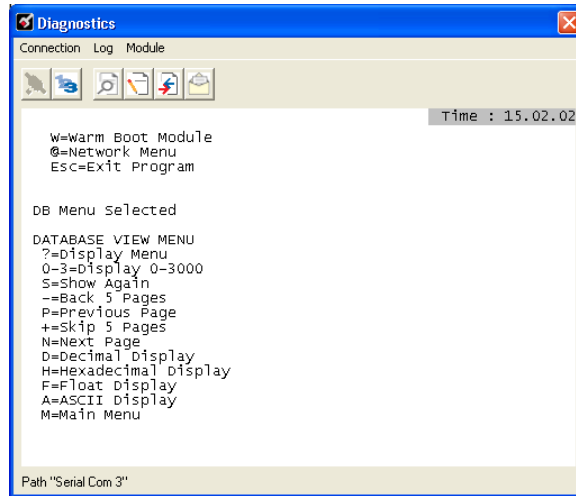
This command will cause the program to exit and reload, refreshing configuration parameters that must be set on program initialization. Only use this command if you must force the gateway to reboot.

Exiting the Program

Press **[ESC]** to restart the gateway and force all drivers to be loaded. The gateway will use the configuration stored in the gateway's Flash memory to configure the gateway.

3.1.3 Database View Menu

Press **[D]** from the *Main* menu to open the *Database View* menu. Use this menu command to view the current contents of the gateway database. Press **[?]** to view a list of commands available on this menu.



Viewing Register Pages

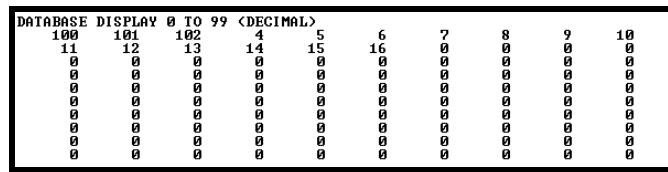
To view sets of register pages, use the keys described below:

Command	Description
[0]	Display registers 0 to 99
[1]	Display registers 1000 to 1099
[2]	Display registers 2000 to 2099

And so on. The total number of register pages available to view depends on your gateway's configuration.

Displaying the Current Page of Registers Again

Press **[S]** from the *Database View* menu to show the current page of registers again.



This screen displays the current page of 100 registers in the database.

Moving Back Through 5 Pages of Registers

Press **[-]** from the *Database View* menu to skip five pages back in the database to see the 100 registers of data starting 500 registers before the currently displayed page.

Moving Forward Through 5 Pages of Registers

Press **[+]** from the *Database View* menu to skip five pages ahead in the database to see the 100 registers of data starting 500 registers after the currently displayed page.

Viewing the Previous 100 Registers of Data

Press **[P]** from the *Database View* menu to display the previous 100 registers of data.

Viewing the Next 100 Registers of Data

Press **[N]** from the *Database View* menu to display the next 100 registers of data.

Viewing Data in Decimal Format

Press **[D]** from the *Database View* menu to display the data on the current page in decimal format.

Viewing Data in Hexadecimal Format

Press **[H]** from the *Database View* menu to display the data on the current page in hexadecimal format.

Viewing Data in Floating-Point Format

Press **[F]** from the *Database View* menu to display the data on the current page in floating-point format. The program assumes that the values are aligned on even register boundaries. If floating-point values are not aligned as such, they are not displayed properly.

Viewing Data in ASCII (Text) Format

Press **[A]** from the *Database View* menu to display the data on the current page in ASCII format. This is useful for regions of the database that contain ASCII data.

Returning to the Main Menu

Press **[M]** to return to the *Main* menu.

3.1.4 Master Command Error List Menu

Use this menu to view the command error list for the module. Press **[?]** to view a list of commands available on this menu.

Redisplaying the Current Page

Press **[S]** to display the current page of data.

Viewing the Previous 20 Commands

Press **[-]** to display data for the previous 20 commands.

Viewing the Previous Page of Commands

Press **[P]** to display the previous page of commands.

Viewing the Next 20 Commands

Press **[+]** to display data for the next 20 commands.

Viewing the Next Page of Commands

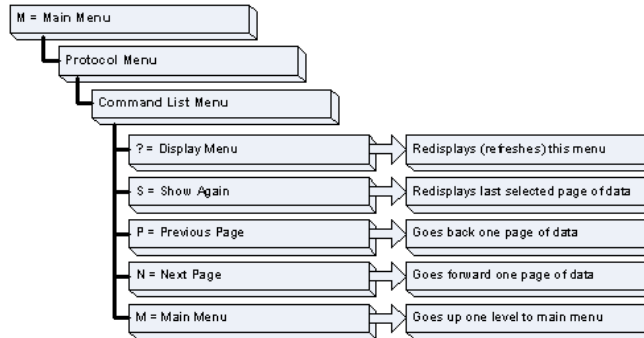
Press **[N]** to display the next page of commands.

Returning to the Main Menu

Press **[M]** to return to the *Main* menu.

3.1.5 Master Command List Menu

Use this menu to view the command list for the module. Press **[?]** to view a list of commands available on this menu.



Redisplaying the Current Page

Press **[S]** to display the current page of data.

Viewing the Previous 50 Commands

Press **[-]** to view the previous 50 commands.

Viewing the Previous Page of Commands

Press **[P]** to display the previous page of commands.

Viewing the Next 50 Commands

Press **[+]** to view the next 50 commands from the master command list.

Viewing the Next Page of Commands

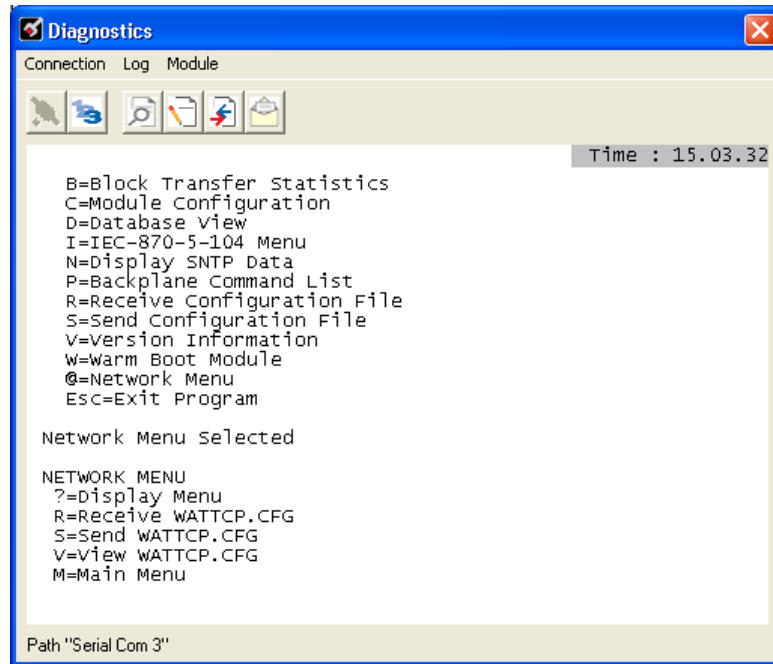
Press **[N]** to display the next page of commands.

Returning to the Main Menu

Press **[M]** to return to the *Main* menu.

3.1.6 Network Menu

From the *IEC-870-5-104 Server* menu press [**@**] to display the *IEC-870-5-104 Network* menu screen. The *Network* menu allows you to send, receive, and view the WATTCP.CFG file that contains the IP and gateway addresses, and other network information.



Transferring WATTCP.CFG to the module

Use this command if you are using HyperTerminal to communicate with the module, instead of using ProSoft Configuration Builder (the preferred method).

Press [**R**] to transfer a new WATTCP.CFG file from the PC to the module. Use this command to change the network configuration for the module (for example, the module's IP address).

Press [**Y**] to confirm the file transfer, and then open the Transfer menu in HyperTerminal. On the Transfer menu, choose Send File, and then choose Ymodem as the file transfer protocol.

Transferring WATTCP.CFG to the PC

Use this command if you are using HyperTerminal to communicate with the module, instead of using ProSoft Configuration Builder (the preferred method).

Press [**S**] to transfer the WATTCP.CFG file from the module to your PC.

Press [**Y**] to confirm the file transfer, and then open the Transfer menu in HyperTerminal. On the Transfer menu, choose Receive File, and then choose Ymodem as the file transfer protocol.

After the file has been successfully transferred, you can open and edit the file to change the module's network configuration.

Viewing the WATTCP.CFG File on the gateway

Press **[V]** to view the gateway's WATTCP.CFG file. Use this command to confirm the gateway's current network settings.

```
WATTCP.CFG FILE:
# ProLinx Communication Gateways, Inc.
# Default private class 3 address
my_ip=192.168.0.75
# Default class 3 network mask
netmask=255.255.255.0
# name server 1 up to 9 may be included
# nameserver=xxx.xxx.xxx.xxx
# name server 2
# nameserver=xxx.xxx.xxx.xxx
# The gateway I wish to use
gateway=192.168.0.1
# some networks (class 2) require all three parameters
# gateway,network,subnetmask
# gateway 192.168.0.1,192.168.0.0,255.255.255.0
# The name of my network
# domainlist="mynetwork.name"
```

Returning to the Main Menu

Press **[M]** to return to the *Main* menu.

3.2 LED Indicators

LEDs provide visual indications of potential problems. The following LEDs are found on all ProLinX gateways.

3.2.1 Base Module LEDs

LED	State	Description
Power	Off	Power is not connected to the power terminals or source is insufficient to properly power the gateway (minimum required is 800mA at 24 Vdc)
	Green Solid	Power is connected to the power terminals.
Fault	Off	Normal operation.
	Red Solid	A critical error has occurred. Program executable has failed or has been user-terminated and is no longer running. Press Reset p/b or cycle power to clear error. If not, use the Debug procedures described later in this manual.
Cfg	Off	Normal operation.
	Amber Solid	The unit is in configuration mode. The configuration file is currently being downloaded or, after power-up, is being read, the unit is implementing the configuration values, and initializing the hardware. This will occur during power cycle, or after pressing the reset button. It also occurs after a cold/warm boot command is received.
Err	Off	Normal operation.
	Flashing	An error condition has been detected and is occurring on one of the application ports. Check configuration and troubleshoot for communication errors.
	Solid Red	This error flag is cleared at the start of each command attempt (Master/Client) or on each receipt of data (slave/adaptor/server); so, if this condition exists, it indicates a large number of errors are occurring in the application (due to bad configuration) or on one or more ports (network communication failures).

3.2.2 Ethernet LED Indicators

LED	State	Description
Data	OFF	No activity on the Ethernet port.
	GREEN Flash	The Ethernet port is actively transmitting or receiving data.
Link	OFF	No physical network connection is detected. No Ethernet communication is possible. Check wiring and cables.
	GREEN Solid	Physical network connection detected. This LED must be ON solid for Ethernet communication to be possible.

3.3 MNET Error and Status Data

The following topics list the register addresses that contain error and status data. Use the Database View option from the ProLinx Main Menu to view the contents of each register. The *ProLinx Reference Guide* provides the information on using this option.

3.3.1 MNET Client Error/Status Data

The Client connection Error and Status Data areas are discussed in this section. The error/status data table is located at the virtual addresses 6000 through 6009. This data will be available through the Configuration/Debug Port or through the Server driver, if requested by a remote Client.

The data area is initialized with zeros whenever the gateway is initialized. This occurs during a cold-start (power-on), reset (reset push-button pressed) or a warm-boot operation (commanded from the Diagnostics menu or immediately after a new configuration has been downloaded).

Internal Database Address	Description
6000	Command Request Count (total Client commands sent)
6001	Command Response Count (total command responses received)
6002	Command Error Count
6003	Number of Request Packets
6004	Number of Response Packets
6005	Errors Sent
6006	Errors Received
6007	Configuration Error Word
6008	Current Error
6009	Last Error

Registers 6000 through 6006 are counters and are shown as 16-bit signed integer values in the range of -32768 to +32767. When a count exceeds +32767, it will automatically rollover to -32768 and become less negative (increment) with each additional count.

Register 6007, the MNET Configuration Error Word, is a bit-mapped value. Not all bits are used; some are reserved for future use. The bit-map indicates the following errors if specific bits are set to 1. Note that, since this is a bit map, if multiple errors are present, the value displayed will be the sum of the values shown in the chart for all of the bits set to 1.

Bit	Decimal Value	Description
0	0001	Reserved
1	0002	Reserved
2	0004	Reserved
3	0008	Reserved
4	0016	Invalid Retry Count (0 to 10)
5	0032	Invalid Float Flag (Y or N)

6	0064	Invalid Float Start value (<0)
7	0128	Invalid Float Offset value
8	0256	Reserved
9	0512	Reserved
10	1024	Reserved
11	2048	Reserved
12	4096	Reserved
13	8192	Reserved
14	16383	Reserved
15	-32768	Reserved (Signed Integer value shown)

Registers 6008 and 6009 contain information about the most recent communication errors. The Current Error (6008) will have a non-zero value if the currently executing Client command experiences an error. The Last Error (6009) will store the most recent non-zero value error code that was reported by the Client the last time it experienced an error. Note that this value is retentive. This register will hold the last error value until the memory is cleared by a restart, reset, cold-boot, or warm-boot operation. Therefore, any value you see here may indicate an error that could have occurred at any time since the module was last restarted and may not indicate a current or recent error. For details on error codes, see MNET Client Command List Error Data.

3.3.2 MNET Server Port 2000 Status Error Locations

The following table lists the status error locations for MNET Server Port 2000 errors.

Internal Database Address	Description
6200	Number of Command Requests
6201	Number of Command Responses
6202	Number of Command Errors
6203	Number of Requests
6204	Number of Responses
6205	Number of Errors Sent
6206	Number of Errors Received
6207	Configuration Error Word
6208	Current Error Code
6209	Last Error Code

Refer to the Error Codes section in this manual to interpret the status/error codes present in the data area.

3.3.3 MNET Server Port 502 Status Error Locations

The following table lists the status error locations for MNET Server Port 502 errors.

Internal Database Address	Description
6210	Number of Command Requests
6211	Number of Command Responses
6212	Number of Command Errors
6213	Number of Requests
6214	Number of Responses
6215	Number of Errors Sent
6216	Number of Errors Received
6217	Configuration Error Word
6218	Current Error Code
6219	Last Error Code

Refer to the Error Codes section in this manual to interpret the status/error codes present in the data area.

3.3.4 MNET Server Port 2001 Error Locations

The following table lists the status error locations for MNET Server Port 2001 errors.

Internal Database Address	Description
6220	Number of Command Requests
6221	Number of Command Responses
6222	Number of Command Errors
6223	Number of Requests
6224	Number of Responses
6225	Number of Errors Sent
6226	Number of Errors Received
6227	Configuration Error Word
6228	Current Error Code
6229	Last Error Code
6230 to 6299	No Valid Data

Refer to the Error Codes section in this manual to interpret the status/error codes present in the data area.

3.3.5 MNET Client Command List Error Data

Each command in the command list for the MNET Client has a reserved word value for a status/error code. This error data list can be read using the Debug/Config Port and can be placed in the gateway's internal database.

The first word in the register location defined contains the status/error code for the first command in the Client Command List. Each successive word in the Command Error List is associated with the next command in the Client Command List. Therefore, the number of valid error values is dependent upon the number of commands defined. The structure of the data area is displayed below:

Internal Database Address	Description
6010	Command #0 Error Status
6011	Command #1 Error Status
6012	Command #2 Error Status
6013	Command #3 Error Status
6014	Command #4 Error Status
	.
	.
	.
6107	Command #97 Error Status
6108	Command #98 Error Status
6109	Command #99 Error Status

Note that the values in the Command List Error Status tables are initialized to zero (0) at power-up, cold boot and during warm boot. Refer to the next section containing Error Codes to interpret the status/error codes present in the data area.

Standard Modbus Protocol Errors

Code	Description
1	Illegal Function
2	Illegal Data Address
3	Illegal Data Value
4	Failure in Associated Device
5	Acknowledge
6	Busy, Message Was Rejected

MNET Client Specific Errors

Code	Description
-33	Failed to connect to server specified in command
-36	MNET command response timeout
-37	TCP/IP connection ended before session finished

Command List Entry Errors

Code	Description
-40	Too few parameters
-41	Invalid enable code
-42	Internal address > maximum address
-43	Invalid node address (<0 or >255)
-44	Count parameter set to 0
-45	Invalid function code
-46	Invalid swap code
-47	ARP could not resolve MAC from IP (bad IP address, not part of a network, invalid parameter to ARP routine).
-48	Error during ARP operation: the response to the ARP request did not arrive to the module after a user-adjustable ARP Timeout.

Note: When the client gets error -47 or -48, it uses the adjustable ARP Timeout parameter in the configuration file to set an amount of time to wait before trying again to connect to this non-existent server. This feature allows the client to continue sending commands and polling other existing servers, while waiting for the non-existent server to appear on the network.

Module Communication Error Codes

Code	Description
-2	Timeout while transmitting message
-11	Timeout waiting for response after request
253	Incorrect slave address in response
254	Incorrect function code in response
255	Invalid CRC/LRC value in response

4 Modbus Protocol Specification

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4.1 Read Coil Status (Function Code 01)

Query

This function allows the user to obtain the ON/OFF status of logic coils used to control discrete outputs from the addressed Server only. Broadcast mode is not supported with this function code. In addition to the Server address and function fields, the message requires that the information field contain the initial coil address to be read (Starting Address) and the number of locations that will be interrogated to obtain status data.

The addressing allows up to 2000 coils to be obtained at each request; however, the specific Server device may have restrictions that lower the maximum quantity. The coils are numbered from zero; (coil number 1 = zero, coil number 2 = one, coil number 3 = two, and so on).

The following table is a sample read output status request to read coils 0020 to 0056 from Server device number 11.

Adr	Func	Data Start Pt Hi	Data Start Pt Lo	Data # Of Pts Ho	Data # Of Pts Lo	Error Check Field
11	01	00	13	00	25	CRC

Response

An example response to Read Coil Status is as shown in Figure C2. The data is packed one bit for each coil. The response includes the Server address, function code, quantity of data characters, the data characters, and error checking. Data will be packed with one bit for each coil (1 = ON, 0 = OFF). The low order bit of the first character contains the addressed coil, and the remainder follow. For coil quantities that are not even multiples of eight, the last characters will be filled in with zeros at high order end. The quantity of data characters is always specified as quantity of RTU characters, that is, the number is the same whether RTU or ASCII is used.

Because the Server interface device is serviced at the end of a controller's scan, data will reflect coil status at the end of the scan. Some Servers will limit the quantity of coils provided each scan; thus, for large coil quantities, multiple PC transactions must be made using coil status from sequential scans.

Adr	Func	Byte Count	Data Coil Status 20 to 27	Data Coil Status 28 to 35	Data Coil Status 36 to 43	Data Coil Status 44 to 51	Data Coil Status 52 to 56	Error Check Field
11	01	05	CD	6B	B2	OE	1B	CRC

The status of coils 20 to 27 is shown as CD(HEX) = 1100 1101 (Binary). Reading left to right, this shows that coils 27, 26, 23, 22, and 20 are all on. The other coil data bytes are decoded similarly. Due to the quantity of coil statuses requested, the last data field, which is shown 1B (HEX) = 0001 1011 (Binary), contains the status of only 5 coils (52 to 56) instead of 8 coils. The 3 left most bits are provided as zeros to fill the 8-bit format.

4.2 Read Input Status (Function Code 02)

Query

This function allows the user to obtain the ON/OFF status of discrete inputs in the addressed Server PC Broadcast mode is not supported with this function code. In addition to the Server address and function fields, the message requires that the information field contain the initial input address to be read (Starting Address) and the number of locations that will be interrogated to obtain status data.

The addressing allows up to 2000 inputs to be obtained at each request; however, the specific Server device may have restrictions that lower the maximum quantity. The inputs are numbered from zero; (input 10001 = zero, input 10002 = one, input 10003 = two, and so on, for a 584).

The following table is a sample read input status request to read inputs 10197 to 10218 from Server number 11.

Adr	Func	Data Start Pt Hi	Data Start Pt Lo	Data #of Pts Hi	Data #of Pts Lo	Error Check Field
11	02	00	C4	00	16	CRC

Response

An example response to Read Input Status is as shown in Figure C4. The data is packed one bit for each input. The response includes the Server address, function code, quantity of data characters, the data characters, and error checking. Data will be packed with one bit for each input (1=ON, 0=OFF). The lower order bit of the first character contains the addressed input, and the remainder follow. For input quantities that are not even multiples of eight, the last characters will be filled in with zeros at high order end. The quantity of data characters is always specified as a quantity of RTU characters, that is, the number is the same whether RTU or ASCII is used.

Because the Server interface device is serviced at the end of a controller's scan, data will reflect input status at the end of the scan. Some Servers will limit the quantity of inputs provided each scan; thus, for large coil quantities, multiple PC transactions must be made using coil status for sequential scans.

Adr	Func	Byte Count	Data Discrete Input 10197 to 10204	Data Discrete Input 10205 to 10212	Data Discrete Input 10213 to 10218	Error Check Field
11	02	03	AC	DB	35	CRC

The status of inputs 10197 to 10204 is shown as AC (HEX) = 10101 1100 (binary). Reading left to right, this show that inputs 10204, 10202, and 10199 are all on. The other input data bytes are decoded similar.

Due to the quantity of input statuses requested, the last data field which is shown as 35 HEX = 0011 0101 (binary) contains the status of only 6 inputs (10213 to 10218) instead of 8 inputs. The two left-most bits are provided as zeros to fill the 8-bit format.

4.3 Read Holding Registers (Function Code 03)

Query

Read Holding Registers (03) allows the user to obtain the binary contents of holding registers 4xxxx in the addressed Server. The registers can store the numerical values of associated timers and counters which can be driven to external devices. The addressing allows up to 125 registers to be obtained at each request; however, the specific Server device may have a restriction that is lower than this maximum quantity. The registers are numbered from zero (40001 = zero, 40002 = one, and so on). The broadcast mode is not allowed.

The example below reads registers 40108 through 40110 from Server 584 number 11.

Adr	Func	Data Start Reg Hi	Data Start Reg Lo	Data #of Regs Hi	Data #of Regs Lo	Error Check Field
11	03	00	6B	00	03	CRC

Response

The addressed Server responds with its address and the function code, followed by the information field. The information field contains 1 byte describing the quantity of data bytes to be returned. The contents of the registers requested (DATA) are two bytes each, with the binary content right justified within each pair of characters. The first byte includes the high order bits and the second, the low order bits.

Because the Server interface device is normally serviced at the end of the controller's scan, the data will reflect the register content at the end of the scan. Some Servers will limit the quantity of register content provided each scan; thus for large register quantities, multiple transmissions will be made using register content from sequential scans.

In the example below, the registers 40108 to 40110 have the decimal contents 555, 0, and 100 respectively.

Adr	Func	ByteCnt	Hi Data	Lo Data	Hi Data	Lo Data	Hi Data	Lo Data	Error Check Field
11	03	06	02	2B	00	00	00	64	CRC

4.4 Read Input Registers (Function Code 04)

Query

Function code 04 obtains the contents of the controller's input registers at addresses 3xxxx. These locations receive their values from devices connected to the I/O structure and can only be referenced, not altered from within the controller. The addressing allows up to 125 registers to be obtained at each request; however, the specific Server device may have restrictions that lower this maximum quantity. The registers are numbered for zero (30001 = zero, 30002 = one, and so on). Broadcast mode is not allowed.

The example below requests the contents of register 3009 in Server number 11.

Adr	Func	Data Start Reg Hi	Data Start Reg Lo	Data #of Regs Hi	Data #of Regs Lo	Error Check Field
11	04	00	08	00	01	CRC

Response

The addressed Server responds with its address and the function code followed by the information field. The information field contains 1 byte describing the quantity of data bytes to be returned. The contents of the registers requested (DATA) are 2 bytes each, with the binary content right justified within each pair of characters. The first byte includes the high order bits and the second, the low order bits.

Because the Server interface is normally serviced at the end of the controller's scan, the data will reflect the register content at the end of the scan. Each PC will limit the quantity of register contents provided each scan; thus for large register quantities, multiple PC scans will be required, and the data provided will be from sequential scans.

In the example below the register 3009 contains the decimal value 0.

Adr	Func	Byte Count	Data Input Reg Hi	Data Input Reg Lo	Error Check Field
11	04	02	00	00	E9

4.5 Force Single Coil (Function Code 05)

Query

This message forces a single coil either ON or OFF. Any coil that exists within the controller can be forced to either state (ON or OFF). However, because the controller is actively scanning, unless the coil is disabled, the controller can also alter the state of the coil. Coils are numbered from zero (coil 0001 = zero, coil 0002 = one, and so on). The data value 65,280 (FF00 HEX) will set the coil ON and the value zero will turn it OFF; all other values are illegal and will not affect that coil.

The use of Server address 00 (Broadcast Mode) will force all attached Servers to modify the desired coil.

Note: Functions 5, 6, 15, and 16 are the only messages that will be recognized as valid for broadcast.

The example below is a request to Server number 11 to turn ON coil 0173.

Adr	Func	Data Coil # Hi	Data Coil # Lo	Data On/off Ind	Data	Error Check Field
11	05	00	AC	FF	00	CRC

Response

The normal response to the Command Request is to re-transmit the message as received after the coil state has been altered.

Adr	Func	Data Coil # Hi	Data Coil # Lo	Data On/ Off	Data	Error Check Field
11	05	00	AC	FF	00	CRC

The forcing of a coil via MODBUS function 5 will be accomplished regardless of whether the addressed coil is disabled or not (*In ProSoft products, the coil is only affected if the necessary ladder logic is implemented*).

Note: The Modbus protocol does not include standard functions for testing or changing the DISABLE state of discrete inputs or outputs. Where applicable, this may be accomplished via device specific Program commands (*In ProSoft products, this is only accomplished through ladder logic programming*).

Coils that are reprogrammed in the controller logic program are not automatically cleared upon power up. Thus, if such a coil is set ON by function Code 5 and (even months later), an output is connected to that coil, the output will be "hot".

4.6 Preset Single Register (Function Code 06)

Query

Function (06) allows the user to modify the contents of a holding register. Any holding register that exists within the controller can have its contents changed by this message. However, because the controller is actively scanning, it also can alter the content of any holding register at any time. The values are provided in binary up to the maximum capacity of the controller unused high order bits must be set to zero. When used with Server address zero (Broadcast mode) all Server controllers will load the specified register with the contents specified.

Note Functions 5, 6, 15, and 16 are the only messages that will be recognized as valid for broadcast.

Adr	Func	Data Start Reg Hi	Data Start Reg Lo	Data #of Regs Hi	Data #of Regs Lo	Error Check Field
11	06	00	01	00	03	CRC

Response

The response to a preset single register request is to re-transmit the query message after the register has been altered.

Adr	Func	Data Reg Hi	Data Reg Lo	Data Input Reg Hi	Data Input Reg Lo	Error Check Field
11	06	00	01	00	03	CRC

4.7 Diagnostics (Function Code 08)

MODBUS function code 08 provides a series of tests for checking the communication system between a Client device and a server, or for checking various internal error conditions within a server.

The function uses a two-byte sub-function code field in the query to define the type of test to be performed. The server echoes both the function code and sub-function code in a normal response. Some of the diagnostics cause data to be returned from the remote device in the data field of a normal response.

In general, issuing a diagnostic function to a remote device does not affect the running of the user program in the remote device. Device memory bit and register data addresses are not accessed by the diagnostics. However, certain functions can optionally reset error counters in some remote devices.

A server device can, however, be forced into 'Listen Only Mode' in which it will monitor the messages on the communications system but not respond to them. This can affect the outcome of your application program if it depends upon any further exchange of data with the remote device. Generally, the mode is forced to remove a malfunctioning remote device from the communications system.

4.7.1 Sub-function codes supported

Only Sub-function 00 is supported by the MNET gateway.

00 Return Query Data

The data passed in the request data field is to be returned (looped back) in the response. The entire response message should be identical to the request.

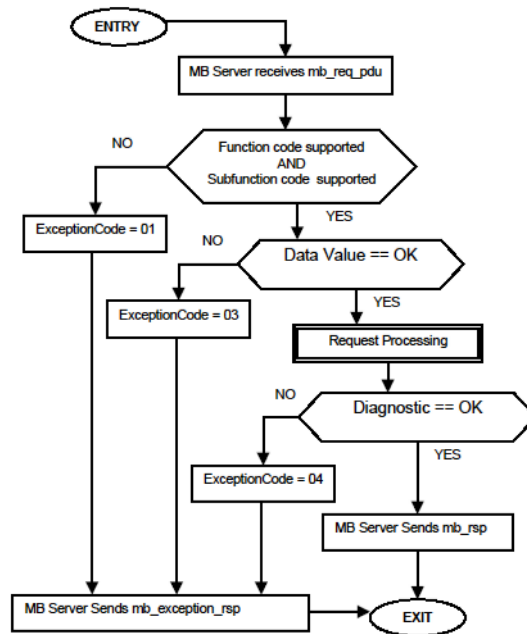
Sub-function	Data Field (Request)	Data Field (Response)
00 00	Any	Echo Request Data

Example and state diagram

Here is an example of a request to remote device to Return Query Data. This uses a sub-function code of zero (00 00 hex in the two-byte field). The data to be returned is sent in the two-byte data field (A5 37 hex).

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	08	Function	08
Sub-function Hi	00	Sub-function Hi	00
Sub-function Lo	00	Sub-function Lo	00
Data Hi	A5	Data Hi	A5
Data Lo	37	Data Lo	27

The data fields in responses to other kinds of queries could contain error counts or other data requested by the sub-function code.



4.7.2 Modbus Exception Responses

When a Modbus Client sends a request to a Server device, it expects a normal response. One of four possible events can occur from the Client's query:

- If the server device receives the request without a communication error, and can handle the query normally, it returns a normal response.
- If the server does not receive the request due to a communication error, no response is returned. The Client program will eventually process a timeout condition for the request.
- If the server receives the request, but detects a communication error (parity, LRC, CRC, ...), no response is returned. The Client program will eventually process a timeout condition for the request.
- If the server receives the request without a communication error, but cannot handle it (for example, if the request is to read a non-existent output or register), the server will return an exception response informing the Client of the nature of the error.

The exception response message has two fields that differentiate it from a normal response:

Function Code Field: In a normal response, the server echoes the function code of the original request in the function code field of the response. All function codes have a most-significant bit (MSB) of 0 (their values are all below 80 hexadecimal). In an exception response, the server sets the MSB of the function code to 1. This makes the function code value in an exception response exactly 80 hexadecimal higher than the value would be for a normal response.

With the function code's MSB set, the Client's application program can recognize the exception response and can examine the data field for the exception code.

Data Field: In a normal response, the server may return data or statistics in the data field (any information that was requested in the request). In an exception response, the server returns an exception code in the data field. This defines the server condition that caused the exception.

The following table shows an example of a Client request and server exception response.

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	01	Function	81
Starting Address Hi	04	Exception Code	02
Starting Address Lo	A1		
Quantity of Outputs Hi	00		
Quantity of Outputs Lo	01		

In this example, the Client addresses a request to server device. The function code (01) is for a Read Output Status operation. It requests the status of the output at address 1245 (04A1 hex). Note that only that one output is to be read, as specified by the number of outputs field (0001).

If the output address is non-existent in the server device, the server will return the exception response with the exception code shown (02). This specifies an illegal data address for the Server.

Modbus Exception Codes

Code	Name	Meaning
01	Illegal Function	The function code received in the query is not an allowable action for the Server. This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the Server is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
02	Illegal Data Address	The data address received in the query is not an allowable address for the Server. More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed; a request with offset 96 and length 5 will generate exception 02.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for Server. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does not mean that a data item submitted for storage in a register has a value outside the expectation of the application program, because the Modbus protocol is unaware of the significance of any particular value of any particular register.
04	Slave Device Failure	An unrecoverable error occurred while the Server was attempting to perform the requested action.
05	Acknowledge	Specialized use in conjunction with programming commands. The Server has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the Client. The Client can next issue a poll program complete message to determine if processing is completed.
06	Slave Device Busy	Specialized use in conjunction with programming commands. The Server is engaged in processing a long-duration program command. The Client should retransmit the message later when the Server is free.
08	Memory Parity Error	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. The Server attempted to read record file, but detected a parity error in the memory. The Client can retry the request, but service may be required on the Server device.
0a	Gateway Path Unavailable	Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request. Usually means that the gateway is misconfigured or overloaded.
0b	Gateway Target Device Failed To Respond	Specialized use in conjunction with gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

4.8 Force Multiple Coils (Function Code 15)

Query

This message forces each coil in a consecutive block of coils to a desired ON or OFF state. Any coil that exists within the controller can be forced to either state (ON or OFF). However, because the controller is actively scanning, unless the coils are disabled, the controller can also alter the state of the coil. Coils are numbered from zero (coil 00001 = zero, coil 00002 = one, and so on). The desired status of each coil is packed in the data field, one bit for each coil (1= ON, 0= OFF). The use of Server address 0 (Broadcast Mode) will force all attached Servers to modify the desired coils.

Note: Functions 5, 6, 15, and 16 are the only messages (other than Loopback Diagnostic Test) that will be recognized as valid for broadcast.

The following example forces 10 coils starting at address 20 (13 HEX). The two data fields, CD =1100 and 00 = 0000 000, indicate that coils 27, 26, 23, 22, and 20 are to be forced on.

Adr	Func	Hi Add	Lo Add	Quantity	Byte Cnt	Data Coil Status 20 to 27	Data Coil Status 28 to 29	Error Check Field
11	0F	00	13	00	0A	02	CD	00 CRC

Response

The normal response will be an echo of the Server address, function code, starting address, and quantity of coils forced.

Adr	Func	Hi Addr	Lo Addr	Quantity	Error Check Field
11	0F	00	13	00	0A CRC

The writing of coils via Modbus function 15 will be accomplished regardless of whether the addressed coils are disabled or not.

Coils that are unprogrammed in the controller logic program are not automatically cleared upon power up. Thus, if such a coil is set ON by function code 15 and (even months later) an output is connected to that coil, the output will be hot.

4.9 Preset Multiple Registers (Function Code 16)

Query

Holding registers existing within the controller can have their contents changed by this message (a maximum of 60 registers). However, because the controller is actively scanning, it also can alter the content of any holding register at any time. The values are provided in binary up to the maximum capacity of the controller (16-bit for the 184/384 and 584); unused high order bits must be set to zero.

Note: Function codes 5, 6, 15, and 16 are the only messages that will be recognized as valid for broadcast.

Adr	Func	Hi Add	Lo Add	Quantity	Byte Cnt	Hi Data	Lo Data	Hi Data	Lo Data	Error Check Field	
11	10	00	87	00	02	04	00	0A	01	02	CRC

Response

The normal response to a function 16 query is to echo the address, function code, starting address and number of registers to be loaded.

Adr	Func	Hi Addr	Lo Addr	Quantity	Error Check Field	
11	10	00	87	00	02	56

5 Support, Service & Warranty

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How to Contact Us: Technical Support

ProSoft Technology, Inc. (ProSoft) is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

- 1 Product Version Number
- 2 System architecture
- 3 Network details

If the issue is hardware related, we will also need information regarding:

- 1 Module configuration and associated ladder files, if any
- 2 Module operation and any unusual behavior
- 3 Configuration/Debug status information
- 4 LED patterns
- 5 Details about the serial, Ethernet or fieldbus devices interfaced to the module, if any.

Note: For technical support calls within the United States, an after-hours answering system allows 24-hour/7-days-a-week pager access to one of our qualified Technical and/or Application Support Engineers.

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5.1 Return Material Authorization (RMA) Policies and Conditions

The following RMA Policies and Conditions (collectively, "RMA Policies") apply to any returned Product. These RMA Policies are subject to change by ProSoft without notice. For warranty information, see Limited Warranty (page 73). In the event of any inconsistency between the RMA Policies and the Warranty, the Warranty shall govern.

5.1.1 All Product Returns:

- a) In order to return a Product for repair, exchange or otherwise, the Customer must obtain a Return Material Authorization (RMA) number from ProSoft and comply with ProSoft shipping instructions.
- b) In the event that the Customer experiences a problem with the Product for any reason, Customer should contact ProSoft Technical Support at one of the telephone numbers listed above (page 69). A Technical Support Engineer will request that you perform several tests in an attempt to isolate the problem. If after completing these tests, the Product is found to be the source of the problem, we will issue an RMA.
- c) All returned Products must be shipped freight prepaid, in the original shipping container or equivalent, to the location specified by ProSoft, and be accompanied by proof of purchase and receipt date. The RMA number is to be prominently marked on the outside of the shipping box. Customer agrees to insure the Product or assume the risk of loss or damage in transit. Products shipped to ProSoft using a shipment method other than that specified by ProSoft, or shipped without an RMA number will be returned to the Customer, freight collect. Contact ProSoft Technical Support for further information.
- d) A 10% restocking fee applies to all warranty credit returns, whereby a Customer has an application change, ordered too many, does not need, etc. Returns for credit require that all accessory parts included in the original box (i.e.; antennas, cables) be returned. Failure to return these items will result in a deduction from the total credit due for each missing item.

5.1.2 Procedures for Return of Units Under Warranty:

A Technical Support Engineer must approve the return of Product under ProSoft's Warranty:

- a) A replacement module will be shipped and invoiced. A purchase order will be required.
- b) Credit for a product under warranty will be issued upon receipt of authorized product by ProSoft at designated location referenced on the Return Material Authorization
 - i. If a defect is found and is determined to be customer generated, or if the defect is otherwise not covered by ProSoft's warranty, there will be no credit given. Customer will be contacted and can request module be returned at their expense;
 - ii. If defect is customer generated and is repairable, customer can authorize ProSoft repair the unit by providing a purchase order for 30% of the current list price plus freight charges, duties and taxes as applicable.

5.1.3 Procedures for Return of Units Out of Warranty:

- a) Customer sends unit in for evaluation to location specified by ProSoft, freight prepaid.
- b) If no defect is found, Customer will be charged the equivalent of \$100 USD, plus freight charges, duties and taxes as applicable. A new purchase order will be required.
- c) If unit is repaired, charge to Customer will be 30% of current list price (USD) plus freight charges, duties and taxes as applicable. A new purchase order will be required or authorization to use the purchase order submitted for evaluation fee.

The following is a list of non-repairable units:

- o 3150 - All
- o 3750
- o 3600 - All
- o 3700
- o 3170 - All
- o 3250
- o 1560 - Can be repaired, only if defect is the power supply
- o 1550 - Can be repaired, only if defect is the power supply
- o 3350
- o 3300
- o 1500 - All

5.2 LIMITED WARRANTY

This Limited Warranty ("Warranty") governs all sales of hardware, software and other products (collectively, "Product") manufactured and/or offered for sale by ProSoft, and all related services provided by ProSoft, including maintenance, repair, warranty exchange, and service programs (collectively, "Services"). By purchasing or using the Product or Services, the individual or entity purchasing or using the Product or Services ("Customer") agrees to all of the terms and provisions (collectively, the "Terms") of this Limited Warranty. All sales of software or other intellectual property are, in addition, subject to any license agreement accompanying such software or other intellectual property.

5.2.1 What Is Covered By This Warranty

- a) *Warranty On New Products:* ProSoft warrants, to the original purchaser, that the Product that is the subject of the sale will (1) conform to and perform in accordance with published specifications prepared, approved and issued by ProSoft, and (2) will be free from defects in material or workmanship; provided these warranties only cover Product that is sold as new. This Warranty expires three (3) years from the date of shipment for Product purchased **on or after** January 1st, 2008, or one (1) year from the date of shipment for Product purchased **before** January 1st, 2008 (the "Warranty Period"). If the Customer discovers within the Warranty Period a failure of the Product to conform to specifications, or a defect in material or workmanship of the Product, the Customer must promptly notify ProSoft by fax, email or telephone. In no event may that notification be received by ProSoft later than 39 months from date of original shipment. Within a reasonable time after notification, ProSoft will correct any failure of the Product to conform to specifications or any defect in material or workmanship of the Product, with either new or remanufactured replacement parts. ProSoft reserves the right, and at its sole discretion, may replace unrepairable units with new or remanufactured equipment. All replacement units will be covered under warranty for the 3 year period commencing from the date of original equipment purchase, not the date of shipment of the replacement unit. Such repair, including both parts and labor, will be performed at ProSoft's expense. All warranty service will be performed at service centers designated by ProSoft.
- b) *Warranty On Services:* Materials and labor performed by ProSoft to repair a verified malfunction or defect are warranted in the terms specified above for new Product, provided said warranty will be for the period remaining on the original new equipment warranty or, if the original warranty is no longer in effect, for a period of 90 days from the date of repair.

5.2.2 What Is Not Covered By This Warranty

- a) ProSoft makes no representation or warranty, expressed or implied, that the operation of software purchased from ProSoft will be uninterrupted or error free or that the functions contained in the software will meet or satisfy the purchaser's intended use or requirements; the Customer assumes complete responsibility for decisions made or actions taken based on information obtained using ProSoft software.
- b) This Warranty does not cover the failure of the Product to perform specified functions, or any other non-conformance, defects, losses or damages caused by or attributable to any of the following: (i) shipping; (ii) improper installation or other failure of Customer to adhere to ProSoft's specifications or instructions; (iii) unauthorized repair or maintenance; (iv) attachments, equipment, options, parts, software, or user-created programming (including, but not limited to, programs developed with any IEC 61131-3, "C" or any variant of "C" programming languages) not furnished by ProSoft; (v) use of the Product for purposes other than those for which it was designed; (vi) any other abuse, misapplication, neglect or misuse by the Customer; (vii) accident, improper testing or causes external to the Product such as, but not limited to, exposure to extremes of temperature or humidity, power failure or power surges; or (viii) disasters such as fire, flood, earthquake, wind and lightning.
- c) The information in this Agreement is subject to change without notice. ProSoft shall not be liable for technical or editorial errors or omissions made herein; nor for incidental or consequential damages resulting from the furnishing, performance or use of this material. The user guide included with your original product purchase from ProSoft contains information protected by copyright. No part of the guide may be duplicated or reproduced in any form without prior written consent from ProSoft.

5.2.3 Disclaimer Regarding High Risk Activities

Product manufactured or supplied by ProSoft is not fault tolerant and is not designed, manufactured or intended for use in hazardous environments requiring fail-safe performance including and without limitation: the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines or weapons systems in which the failure of the product could lead directly or indirectly to death, personal injury or severe physical or environmental damage (collectively, "high risk activities"). ProSoft specifically disclaims any express or implied warranty of fitness for high risk activities.

5.2.4 Intellectual Property Indemnity

Buyer shall indemnify and hold harmless ProSoft and its employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not ProSoft is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless ProSoft and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party. ProSoft makes no warranty that the product is or will be delivered free of any person's claiming of patent, trademark, or similar infringement. The Buyer assumes all risks (including the risk of suit) that the product or any use of the product will infringe existing or subsequently issued patents, trademarks, or copyrights.

- a) Any documentation included with Product purchased from ProSoft is protected by copyright and may not be duplicated or reproduced in any form without prior written consent from ProSoft.
- b) ProSoft's technical specifications and documentation that are included with the Product are subject to editing and modification without notice.
- c) Transfer of title shall not operate to convey to Customer any right to make, or have made, any Product supplied by ProSoft.
- d) Customer is granted no right or license to use any software or other intellectual property in any manner or for any purpose not expressly permitted by any license agreement accompanying such software or other intellectual property.
- e) Customer agrees that it shall not, and shall not authorize others to, copy software provided by ProSoft (except as expressly permitted in any license agreement accompanying such software); transfer software to a third party separately from the Product; modify, alter, translate, decode, decompile, disassemble, reverse-engineer or otherwise attempt to derive the source code of the software or create derivative works based on the software; export the software or underlying technology in contravention of applicable US and international export laws and regulations; or use the software other than as authorized in connection with use of Product.
- f) **Additional Restrictions Relating To Software And Other Intellectual Property**

In addition to compliance with the Terms of this Warranty, Customers purchasing software or other intellectual property shall comply with any license agreement accompanying such software or other intellectual property. Failure to do so may void this Warranty with respect to such software and/or other intellectual property.

5.2.5 Disclaimer of all Other Warranties

The Warranty set forth in What Is Covered By This Warranty (page 73) are in lieu of all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

5.2.6 Limitation of Remedies **

In no event will ProSoft or its Dealer be liable for any special, incidental or consequential damages based on breach of warranty, breach of contract, negligence, strict tort or any other legal theory. Damages that ProSoft or its Dealer will not be responsible for include, but are not limited to: Loss of profits; loss of savings or revenue; loss of use of the product or any associated equipment; loss of data; cost of capital; cost of any substitute equipment, facilities, or services; downtime; the claims of third parties including, customers of the Purchaser; and, injury to property.

** Some areas do not allow time limitations on an implied warranty, or allow the exclusion or limitation of incidental or consequential damages. In such areas, the above limitations may not apply. This Warranty gives you specific legal rights, and you may also have other rights which vary from place to place.

5.2.7 Time Limit for Bringing Suit

Any action for breach of warranty must be commenced within 39 months following shipment of the Product.

5.2.8 No Other Warranties

Unless modified in writing and signed by both parties, this Warranty is understood to be the complete and exclusive agreement between the parties, suspending all oral or written prior agreements and all other communications between the parties relating to the subject matter of this Warranty, including statements made by salesperson. No employee of ProSoft or any other party is authorized to make any warranty in addition to those made in this Warranty. The Customer is warned, therefore, to check this Warranty carefully to see that it correctly reflects those terms that are important to the Customer.

5.2.9 Allocation of Risks

This Warranty allocates the risk of product failure between ProSoft and the Customer. This allocation is recognized by both parties and is reflected in the price of the goods. The Customer acknowledges that it has read this Warranty, understands it, and is bound by its Terms.

5.2.10 Controlling Law and Severability

This Warranty shall be governed by and construed in accordance with the laws of the United States and the domestic laws of the State of California, without reference to its conflicts of law provisions. If for any reason a court of competent jurisdiction finds any provisions of this Warranty, or a portion thereof, to be unenforceable, that provision shall be enforced to the maximum extent permissible and the remainder of this Warranty shall remain in full force and effect. Any cause of action with respect to the Product or Services must be instituted in a court of competent jurisdiction in the State of California.

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