



Where Automation Connects.



inRAX[®]
MVI56-103M

ControlLogix Platform
IEC 60870-5-103 Master
Communication Module

February 22, 2013

USER MANUAL

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MVI56-103M User Manual

February 22, 2013

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In an effort to conserve paper, ProSoft Technology no longer includes printed manuals with our product shipments. User Manuals, Datasheets, Sample Ladder Files, and Configuration Files are provided on the enclosed CD-ROM, and are available at no charge from our web site: www.prosoft-technology.com

Printed documentation is available for purchase. Contact ProSoft Technology for pricing and availability.

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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.

MVI (Multi Vendor Interface) Modules

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'ÉQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

Warnings

North America Warnings

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, Division 2.
- B** Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or rewiring modules.
- C** 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'équipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux.

- D** Suitable for use in Class I, Division 2 Groups A, B, C and D Hazardous Locations or Non-Hazardous Locations.

ATEX Warnings and Conditions of Safe Usage

Power, Input, and Output (I/O) wiring must be in accordance with the authority having jurisdiction.

- A** Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or wiring modules.
- B** Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- C** These products are intended to be mounted in an IP54 enclosure. The devices shall provide external means to prevent the rated voltage being exceeded by transient disturbances of more than 40%. This device must be used only with ATEX certified backplanes.
- D** DO NOT OPEN WHEN ENERGIZED.

Battery Life Advisory

The MVI46, MVI56, MVI56E, MVI69, and MVI71 modules use a rechargeable Lithium Vanadium Pentoxide battery to backup the real-time clock and CMOS. The battery should last for the life of the module. The module must be powered for approximately twenty hours before the battery becomes fully charged. After it is fully charged, the battery provides backup power for the CMOS setup and the real-time clock for approximately 21 days. When the battery is fully discharged, the module will revert to the default BIOS and clock settings.

Note: The battery is not user replaceable.

Markings

Electrical Ratings

- Backplane Current Load: 800 mA @ 5.1 Vdc; 3 mA @ 24 Vdc
- Operating Temperature: 0°C to 60°C (32°F to 140°F)
- Storage Temperature: -40°C to 85°C (-40°F to 185°F)
- Shock: 30 g, operational; 50 g, non-operational; Vibration: 5 g from 10 Hz to 150 Hz
- Relative Humidity: 5% to 95% with no condensation
- All phase conductor sizes must be at least 1.3 mm(squared) and all earth ground conductors must be at least 4mm(squared).

Label Markings

ATEX

II 3 G

EEx nA IIC T6

0°C ≤ Ta ≤ 60°C

cULus

E183151

Class I Div 2 Groups A,B,C,D

T6

-30°C ≤ Ta ≤ 60°C

Agency Approvals and Certifications

Agency	Applicable Standard
RoHS	
CE	EMC-EN61326-1:2006; EN61000-6-4:2007
ATEX	EN60079-15:2003
cULus	UL508; UL1604; CSA 22.2 No. 142 & 213
CB Safety	CA/10533/CSA IEC 61010-1 Ed.2; CB 243333-2056722 (2090408)
GOST-R	EN 61010
CSA	EN 61010

RoHS



243333



ME06



E183151

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Guide to the MVI56-103M User Manual

Function		Section to Read	Details
Introduction (Must Do)	→	Start Here (page 11)	This section introduces the customer to the module. Included are: package contents, system requirements, hardware installation, and basic configuration.
Diagnostic and Troubleshooting	→	Diagnostics and Troubleshooting (page 67)	This section describes Diagnostic and Troubleshooting procedures.
Reference Product Specifications Functional Overview	→	Reference (page 89) Product Specifications (page 90) Functional Overview	These sections contain general references associated with this product, Specifications, and the Functional Overview.
Support, Service, and Warranty Index	→	Support, Service and Warranty (page 141) Index	This section contains Support, Service and Warranty information. Index of chapters.

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To get the most benefit from this User Manual, you should have the following skills:

- **Rockwell Automation® RSLogix™ software:** launch the program, configure ladder logic, and transfer the ladder logic to the processor
- **Microsoft Windows:** install and launch programs, execute menu commands, navigate dialog boxes, and enter data
- **Hardware installation and wiring:** install the module, and safely connect 103 and ControlLogix devices to a power source and to the MVI56-103M module's application port(s)

1.1 System Requirements

The MVI56-103M module requires the following minimum hardware and software components:

- Rockwell Automation ControlLogix™ processor, with compatible power supply and one free slot in the rack, for the MVI56-103M module. The module requires 800 mA of available power.
- Rockwell Automation RSLogix 5000 programming software version 2.51 or higher
- Rockwell Automation RSLinx communication software
- Pentium® II 450 MHz minimum. Pentium III 733 MHz (or better) recommended
- Supported operating systems:
 - Microsoft Windows XP Professional with Service Pack 1 or 2
 - Microsoft Windows 2000 Professional with Service Pack 1, 2, or 3
 - Microsoft Windows Server 2003
- 128 Mbytes of RAM minimum, 256 Mbytes of RAM recommended
- 100 Mbytes of free hard disk space (or more based on application requirements)
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 × 768 recommended)
- CD-ROM drive
- ProSoft Configuration Builder, HyperTerminal or other terminal emulator program.

Note: You can install the module in a local or remote rack. For remote rack installation, the module requires EtherNet/IP or ControlNet communication with the processor.

1.2 Package Contents

The following components are included with your MVI56-103M module, and are all required for installation and configuration.

Important: Before beginning the installation, please verify that all of the following items are present.

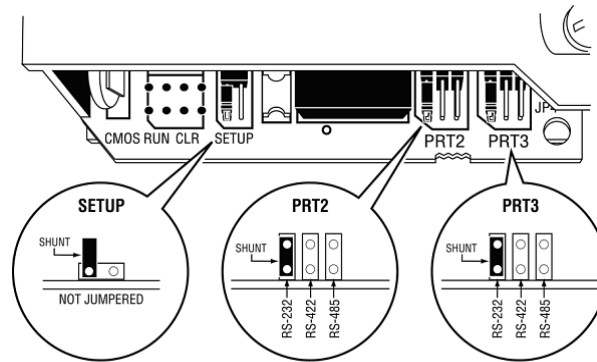
Qty.	Part Name	Part Number	Part Description
1	MVI56-103M Module	MVI56-103M	IEC 60870-5-103 Master Communication Module
1	Cable	Cable #15, RS232 Null Modem	For RS232 Connection to the CFG Port
3	Cable	Cable #14, RJ45 to DB9 Male Adapter cable	For DB9 Connection to Module's Port
2	Adapter	1454-9F	Two Adapters, DB9 Female to Screw Terminal. For RS422 or RS485 Connections to Port 1 and 2 of the Module
1	ProSoft Solutions CD		Contains sample programs, utilities and documentation for the MVI56-103M module.

If any of these components are missing, please contact ProSoft Technology Support for replacement parts.

1.3 Setting Jumpers

If you use an interface other than RS-232 (default), you must change the jumper configuration to match the interface. There are three jumpers located at the bottom of the module.

The following illustration shows the MVI56-103M jumper configuration:



- 1 Set the PRT 2 (for application port 1) and PRT 3 (for application port 2) jumpers for RS232, RS422, or RS485 to match the wiring needed for your application. The default jumper setting for both application ports is RS-232.
- 2 The Setup Jumper acts as "write protection" for the module's flash memory. In "write protected" mode, the Setup pins are not connected, and the module's firmware cannot be overwritten. Do not jumper the Setup pins together unless you are directed to do so by ProSoft Technical Support.

1.4 Installing the Module in the Rack

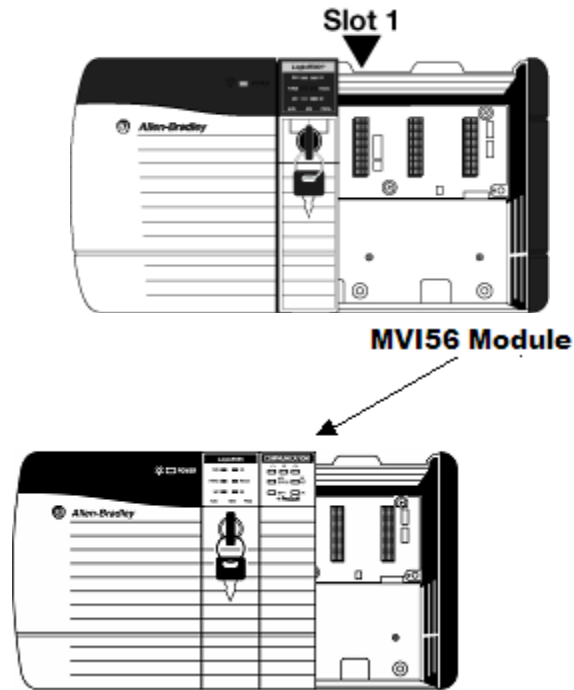
If you have not already installed and configured your ControlLogix processor and power supply, please do so before installing the MVI56-103M module. Refer to your Rockwell Automation product documentation for installation instructions.

Warning: You must follow all safety instructions when installing this or any other electronic devices. Failure to follow safety procedures could result in damage to hardware or data, or even serious injury or death to personnel. Refer to the documentation for each device you plan to connect to verify that suitable safety procedures are in place before installing or servicing the device.

After you have checked the placement of the jumpers, insert MVI56-103M into the ControlLogix chassis. Use the same technique recommended by Rockwell Automation to remove and install ControlLogix modules.

Warning: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Verify that power is removed or the area is non-hazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

- 1 Turn power OFF.
- 2 Align the module with the top and bottom guides, and slide it into the rack until the module is firmly against the backplane connector.



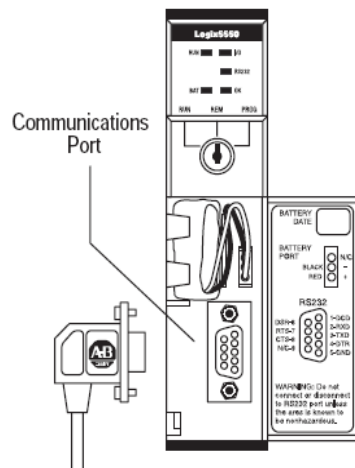
- 3 With a firm but steady push, snap the module into place.
- 4 Check that the holding clips on the top and bottom of the module are securely in the locking holes of the rack.
- 5 Make a note of the slot location. You must identify the slot in which the module is installed in order for the sample program to work correctly. Slot numbers are identified on the green circuit board (backplane) of the ControlLogix rack.
- 6 Turn power ON.

Note: If you insert the module improperly, the system may stop working, or may behave unpredictably.

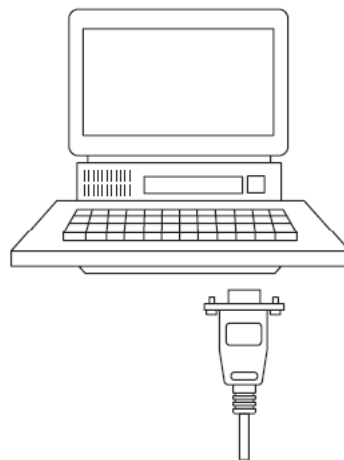
1.5 Connecting Your PC to the ControlLogix Processor

There are several ways to establish communication between your PC and the ControlLogix processor. The following steps show how to establish communication through the serial interface. It is not mandatory that you use the processor's serial interface. You may access the processor through whatever network interface is available on your system. Refer to your Rockwell Automation documentation for information on other connection methods.

- 1 Connect the right-angle connector end of the cable to your controller at the communications port.



- 2 Connect the straight connector end of the cable to the serial port on your computer.



1.6 Opening the Sample Ladder Logic

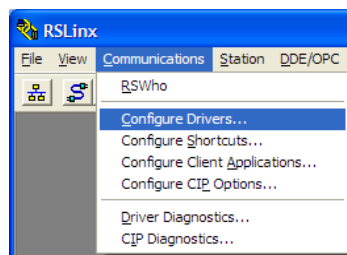
The sample program for your MVI56-103M module includes custom tags, data types and ladder logic for data I/O and status monitoring. For most applications, you can run the sample ladder program without modification, or, for advanced applications, you can incorporate the sample program into your existing application.

The *inRax Solutions CD* provides one or more versions of the sample ladder logic. The version number appended to the file name corresponds with the firmware version number of your ControlLogix processor. The firmware version and sample program version must match.

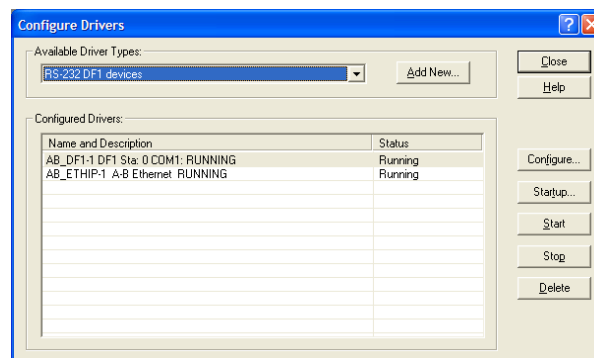
1.6.1 Configuring the RSLinx Driver for the PC COM Port

If RSLogix is unable to establish communication with the processor, follow these steps.

- 1 Open *RSLinx*.
- 2 Open the **COMMUNICATIONS** menu, and choose **CONFIGURE DRIVERS**.

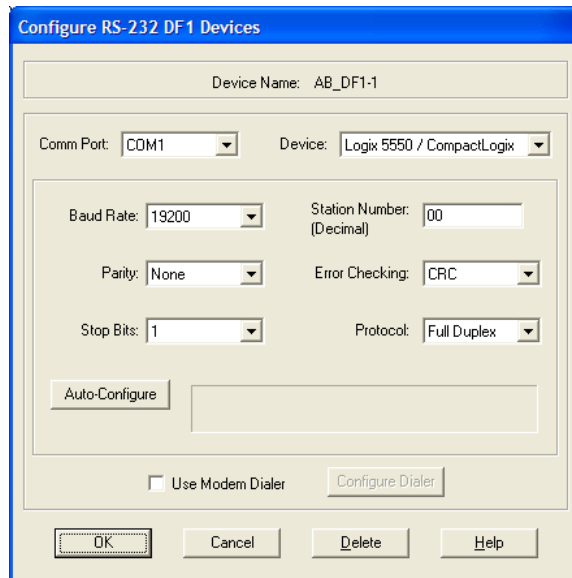


This action opens the *Configure Drivers* dialog box.



Note: If the list of configured drivers is blank, you must first choose and configure a driver from the Available Driver Types list. The recommended driver type to choose for serial communication with the processor is *RS-232 DF1 Devices*.

- 3 Click to select the driver, and then click **CONFIGURE**. This action opens the *Configure RS-232 DF1 Devices* dialog box.



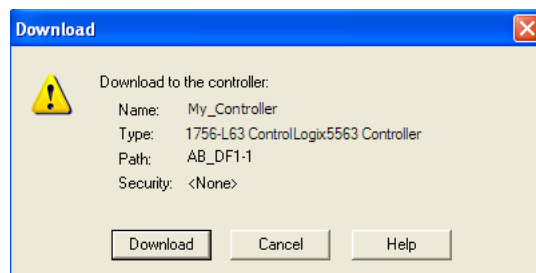
- 4 Click the **AUTO-CONFIGURE** button. RSLinx will attempt to configure your serial port to work with the selected driver.
- 5 When you see the message *Auto Configuration Successful*, click the **OK** button to dismiss the dialog box.

Note: If the auto-configuration procedure fails, verify that the cables are connected correctly between the processor and the serial port on your computer, and then try again. If you are still unable to auto-configure the port, refer to your RSLinx documentation for further troubleshooting steps.

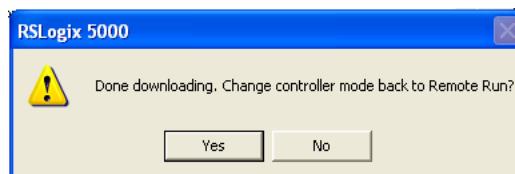
1.7 Downloading the Sample Program to the Processor

Note: The key switch on the front of the ControlLogix processor must be in the REM or PROG position.

- 1 If you are not already online with the processor, open the *Communications* menu, and then choose **DOWNLOAD**. RSLogix 5000 will establish communication with the processor. You do not have to download through the processor's serial port, as shown here. You may download through any available network connection.
- 2 When communication is established, RSLogix 5000 will open a confirmation dialog box. Click the **DOWNLOAD** button to transfer the sample program to the processor.



- 3 RSLogix 5000 will compile the program and transfer it to the processor. This process may take a few minutes.
- 4 When the download is complete, RSLogix 5000 will open another confirmation dialog box. If the key switch is in the REM position, click **OK** to switch the processor from PROGRAM mode to RUN mode.

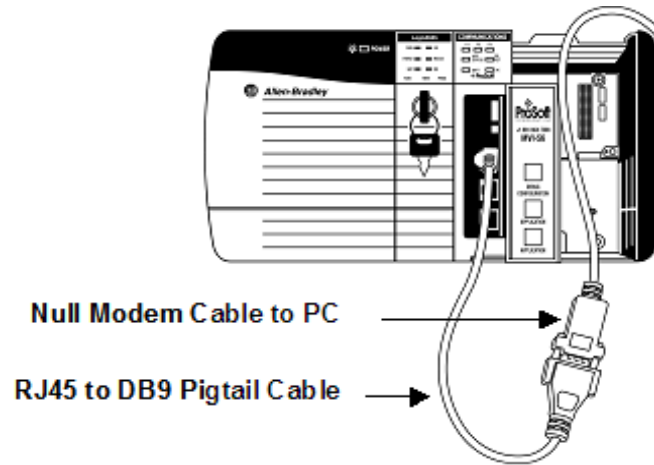


Note: If you receive an error message during these steps, refer to your RSLogix documentation to interpret and correct the error.

1.8 Connecting Your PC to the Module

With the module securely mounted, connect your PC to the **Configuration/Debug** port using an RJ45-DB-9 Serial Adapter Cable and a Null Modem Cable.

- 1 Attach both cables as shown.
- 2 Insert the RJ45 cable connector into the Configuration/Debug port of the module.
- 3 Attach the other end to the serial port on your PC.



2 Configuring the MVI56-103M Module

In This Chapter

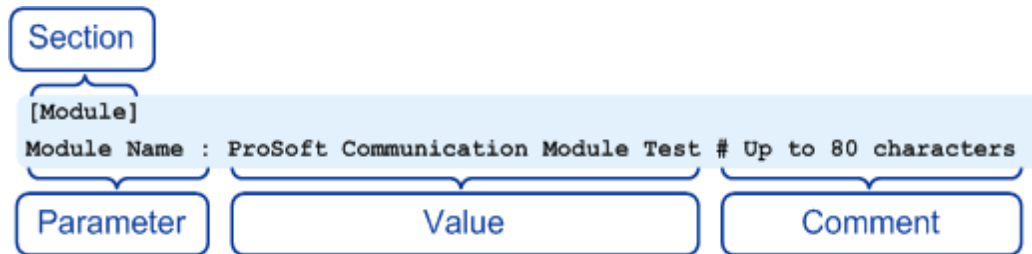
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2.1 Configuration File

The MVI56-103M module stores its configuration in a text file called IEC103M.CFG, located in the module's flash memory. When the module starts up, it reads the configuration file and uses the information to control how the 103 protocol interacts with the module's application port(s).

The configuration file is arranged in *Sections*, with a heading in [] characters at the beginning of each section. Each *Section* contains a list of *Parameters* and *Values*, followed by an optional *Comment* that explains the parameter.

The following illustration shows an example of a *Section*, a *Parameter*, a *Value*, and a *Comment*.



The *Parameter* must be followed by a [:] (colon) character. The text following the [:] is a *Value*.

The module ignores "comment" text following the [#] character. Use comments to document your configuration settings.

You can get a sample configuration file for the module in the following places:

- Copy the IEC103M.CFG from the module's flash memory to your PC
- Copy the IEC103M.CFG from the ProSoft Solutions CD-ROM supplied with the module
- Download the IEC103M.CFG from the ProSoft Technology web site at www.prosoft-technology.com

2.1.1 Editing the Configuration File

The DNPSNET_Q.CFG file consists of the following sections:

- [Module]
- [Backplane Configuration]
- [DNP ENET Slave]
- [DNP ENET IP Addresses]
- [DNP Slave Binary Inputs]
- [DNP Slave Analog Inputs]
- [DNP Slave Float Inputs]
- Important notes to consider when editing the sample configuration file:
- Comments within the file are preceded by the pound (#) sign. Any text on a line that occurs after the # character will be ignored.
- Do not use tabs or other non-printing characters instead of spaces to separate parameters (spacebar).
- Parameter names must begin in the first column of a line, and may not be preceded with a space (spacebar) or other non-printing character.

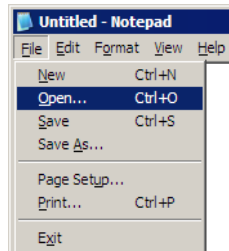
The IEC103M.CFG file is a plain ASCII text file. Use a text editor such as Notepad.exe (included with Microsoft Windows) to open and edit the file.

To open the configuration file in Notepad

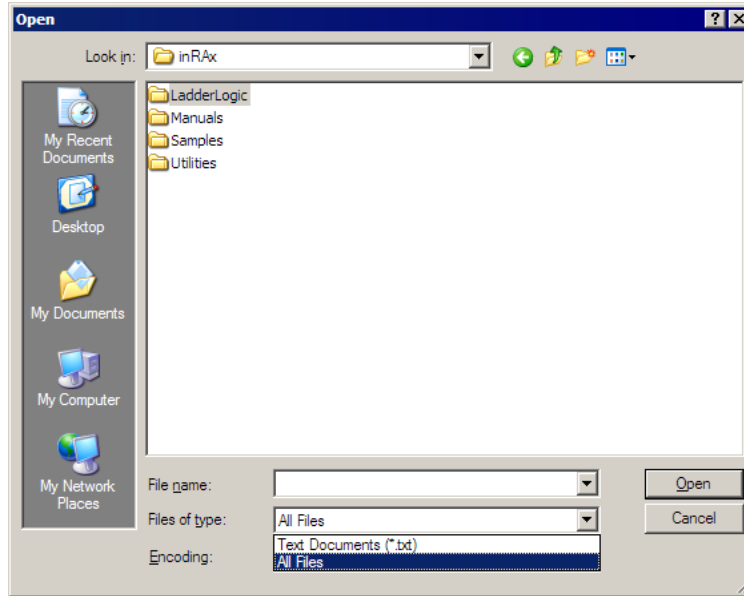
- 1 Click the **START** button, and then choose **PROGRAMS**
- 2 Expand the *Programs* menu, and then choose **ACCESSORIES**.
- 3 On the *Accessories* menu, choose **NOTEPAD**.



- 4 In *Notepad*, open the **FILE** menu, and then choose **OPEN**



- 5 In the *Open* dialog box, select **ALL FILES** in the *Files of Type:* dropdown list.



Tip: Sample configuration files are stored under the LadderLogic folder on the ProSoft Solutions CD-ROM.

- 6 Navigate to the folder containing the configuration file, and then select the file to edit.
- 7 Click **OPEN** to open the file.
- 8 When you have finished editing, **SAVE** the file and close Notepad.

Important: Changes to the configuration file will not take effect until you download the file to the module, and then reboot the module.

2.2 Quick Start

This section provides the steps required to configure the module. After you download the sample configuration file, please perform the following steps:

Step 1: Configure the Number of Slaves (Sessions)

The IEC 60870-5-103 protocol is a Master-slave protocol where the slaves are typically protection equipments for substations. The MVI56-103M module supports up to 32 slaves (total) connected to its application serial ports. Each slave has to be configured as a *session*. Refer to the configuration file to enter the number of slaves that will be connected to the MVI56-103M module:

```
[IEC-870-5-103 Master]
Session Count: 5 #1 to 32 - maximum number of slaves on all channels
```

In the example above, the module will only poll sessions 0 to 4. The module would not poll sessions 5 to 31.

In Step 3, you will configure each session as an actual slave in the network.

Step 2: Configure the Port Communication Parameters

The user should configure the port communication parameters in order to enable data transfer between the Master and the slave(s). The port communication parameters include baud rate, parity, RTS ON, RTS OFF and Minimum Delay. The IEC 60870-5-103 protocol uses two baud rates: 19200 or 9600 kb/s and even parity.

Refer to the [IEC-870-5-103 Master Port 0] section in the configuration file in order to configure the communication parameters for the 103M port:

```
[IEC-870-5-103 Master Port 0]
# Communication Parameters
Baud Rate : 19200 #Baud rate for port 9600-19200
Parity : E #N=None, O=Odd, E=Even, M=Mark, S=Space
RTS On : 0 #0-65536 mSec before message
RTS Off : 1 #0-65536 mSec after message
Minimum Delay : 10 #Minimum # of mSec before response sent
Receive Timeout: 2000 #Maximum mSec from first char to last to wait
# These parameters are protocol specific
Single char ACK F0,1 or 3: Y #Single E5 resp to ACK func 0, 1 & 3 req (Y/N)
```

The user should also configure the jumpers located at the bottom of the module to select the correct electrical interface mode: RS-232, RS-422 or RS-485.

Step 3: Configure the Session (Slave) Poll Parameters

According to the IEC 60870-5-103 protocol, the Master cyclically polls data from the slaves. The data is classified into two classes; Class 1 and Class 2. Events belong to Class 1 and analog data to Class 2. The module can request data through Class 1 or Class 2 requests. Responses to control command and general interrogation commands are also sent as Class 1 data.

Refer to the [IEC-103 Master Session x] section in the configuration file in order to configure how each slave will be polled.

Initially, the user should enter the MVI56-103M port number that will be connected to the session (slave) using the "Communication Port" parameter. Valid values are 0 or 1.

These parameters include the *Data Link Address*, which is the slave address that identifies all protection equipment on the network. There should be a unique number for each slave on the network. There are also certain parameters that pertain to how the Class 1 and Class 2 polls will be used for data transfer.

You must enter the number of sectors for each session using the Sector Count parameter. The module accepts up to 5 sectors per session.

```
[IEC-103 Master Session 0]
Communication Port      :      0 #Index of COM port for session (0 or 1)
Sector Count           :      5 #5 is max for this version of app
Data Link Address      :      0 #Range is 0 to 65535 DL address of slave

Failure Delay          :      3 #Min Sec to delay before poll of offline slave
                        :      # (0 to 2000 seconds)
Confirm Timeout        :    20000 #0 to 4,294,967,295 msec to wait for DL confirm
Retry Count            :      5 #0 to 255 retries for if no confirm
Response Timeout       :    5000 #Timeout for confirm of req (0 to 4,294,967,295
msec)
C1/C2 Poll Count Pend:      6 #Class 1 or 2 polls before next slave tried (0-
65535)
Class 1 Polls          :      10 #Max Class 1 polls to this session
Class 1 Pend delay     :    1000 #Min mSec delay between call (0 to 4,294,967,295
msec)
Class 2 Pend delay     :    1000 #Min mSec delay between call (0 to 4,294,967,295
msec)
Class 1 Poll delay     :    1000 #Min mSec delay between call (0 to 4,294,967,295
msec)
Class 2 Poll delay     :    1000 #Min mSec delay between call (0 to 4,294,967,295
msec)
```

This step should be repeated for each session to be used. For example, if the user selected 8 sessions during **Step 1**, he or she should configure sessions 0 to 7:

```
[IEC-103 Master Session 0]
[IEC-103 Master Session 1]
[IEC-103 Master Session 2]
[IEC-103 Master Session 3]
[IEC-103 Master Session 4]
[IEC-103 Master Session 5]
[IEC-103 Master Session 6]
[IEC-103 Master Session 7]
```

Step 4: Sector (Data Set) Configuration

For each session (slave), you must configure one or more sectors (maximum of 5). A sector is a data set defined by the vendor. Each sector is identified by the Common ASDU Address parameter in the [IEC-103 Master Session x Sector 0] area in the configuration file. This area also contains some parameters that will affect the module initialization procedure.

```
[IEC-103 Master Session 0 Sector 0]
Common ASDU Address    :      0 #Range 0 to 255 Sector address
```

```
#Req init requests when session first online (not req if slave sends# EOI
sequence)
Online Time sync      :      Y #Send time sync message when first online
Online General Int   :      Y #Send general interrogation

#Req init requests when EOI (end of initialization) received from slave
EOI Time sync        :      Y #Send time sync message when first online
EOI General Int      :      Y #Send general interrogation

# Database definition for this session/sector
# Types are as follows:
#
# Monitored ASDU Types
# 1 = Time-tagged message (bit addressed with 2 bits/point)
# 2 = Time-tagged message with relative time (bit addressed with 2
bits/point)
# 3 = Measurands I (4 word values using word address using double-word
address)
# 4 = Time-tagged measurands with relative time (1 float value)
# 5 = Identification (12 characters using a byte address)
# 9 = Measurands II (9 word values using word address)
# 205 = SIEMENS Meter Data (Private Range)
#
# Point Index is the information object number in the slave unit.
# ASDU Index Description
# 1 Bit address with each point occupying 2 bits
# 2 Bit address with each point occupying 2 bits
# 3 Word address with each point occupying 4 words
# 4 Double-word address for the single float value
# 5 Byte address with each point occupying 12 bytes
# 9 Word address with each point occupying 9 words
# 205 Double-word address for each meter point
#
# Function Code Values
# Code Definition
# 128 Distance protection
# 160 Overcurrent protection
# 133 Energy
# 176 Transformer differential protection
# 192 Line Differential protection
# 255 Global function type
#
# Database Index = Database address in module
#
# ASDU Database Function Point
# Type Index Code Index
START
1 0 128 16
1 16 128 18
1 32 128 19
1 48 128 20
1 64 128 21
1 80 128 22
1 96 128 23
1 112 128 24
```

```

1      128      128      25
1      144      128      26
205    100      133      51
205    100      133      52
END

```

This step should be repeated for each sector used by the application. The module will only use the sectors configured in the previous step.

Step 5: Monitor Point Configuration (Monitor Direction)

After the slave receives a Class 1 or Class 2 request from the Master, it responds with a message containing data. Each piece of equipment is normally configured to respond with specific points when it is being polled with a Class 2 request. During a Class 2 response, the slave may set a control bit (ACD) to inform the Master that there are new events to be transmitted. Then, the Master will send a Class 1 poll to read the events from the slave.

The IEC 60870-5-103 protocol states that the data is transferred between the Master and slave using an ASDU (Application Service Data Unit) format. Each format is given by:

- Type Identification
- Variable Structure Qualifier
- Cause Of Transmission
- Common Address of ASDU
- Function Type
- Information Number
- Data...

Refer to the protection equipment specification for the following information about each point:

- Type: Type of the message
- Function Type: Type of protection function
- Information Number: Point Identification

This information will identify each point in the MVI56-103M configuration file. The user has to configure the points that will be updated in the MVI56-103M database when a Class 2 or Class 1 response containing data is sent from the slave. Refer to [IEC-103 Master Session x Sector y] section in the configuration file in order to configure each point:

```

# ASDU   Database  Function  Point
# Type   Index      Code      Index
START
1        0         128      16
1        16        128      17
1        32        160      18
1        48        176      19
1        64        192      20
1        80        128      21
END

```

Where the user should enter:

ASDU Type: ASDU type for the point

Function Type: Function type for the point

Point Index: Information number for the point

Database Index: The MVI56-103M database location where the value will be copied. Special attention should be considered since the type of addressing will depend on the ASDU type:

ASDU Type	DB Addressing
1	Bit address with each point occupying 2 bits
2	Bit address with each point occupying 2 bits
3	Word address with each point occupying 4 words
4	Double-word address for the single float value
5	Byte address with each point occupying 12 bytes
9	Word address with each point occupying 9 words
205	SIEMENS Meter Data (Private Range) Double-word address for each meter point

For example, in order to configure the following points:

- Time-tagged message point with information number 17 (teleprotection active) and distance protection function (128). The value will be copied to bits 0 and 1 in word 1 (second word) in the module's database.
- Measurands I point with information number 144 (measurands I) and overcurrent protection function (160). The value will be copied to word 50 in the module's database.

The following configuration information should be entered:

```
# ASDU      Database  Function  Point
# Type      Index      Code      Index
START
    1         16       128       17
    1         50       160       144
END
```

Every time the module responds with a Class 1 or Class 2 poll with these points, the module will update its value to the database.

All the points configured in this section are sent from the slave to the Master. The protocol specification refers to this data flow as the *Monitor Direction*.

This step should be repeated for each sector.

Step 6: Command Configuration (Control Direction)

The user might also configure the Master to send commands to slaves. The IEC 60870-5-103 protocol specification refers to this data flow as *Control Direction*.

The commands include general commands, interrogation requests, and time synchronization requests. In order to configure a command, refer to the [IEC-103 Master Commands] section:

```
[IEC-103 Master Commands]
#
# Enable code field is as follows:
#     0 = Disabled
#     1 = Enabled with Poll Interval (seconds) utilized
#     2 = Conditional (executed when point in database changes)
#
# Database Index is the location in the module's database to use as the source
```

```

#           for the data in the command. The data type field determines
#           the meaning of the index as follows:
#   Type   Description                               DB Index type
#   ----   -
#       6   Clock synchronization                   NA
#       7   General interrogataion                   NA
#      20   General Command                           Bit address
#
# Poll Interval field is utilized when the Enable Code is set to 1. This field
#           determines the minimum number of seconds to wait between each
#           execution of the command.
#
# Session Index represents the session index in the module to associate with
the
#           command. This index is set when the session is read in from
#           this file. The range of values for this field is 0 to 31.
#
# Sector Index represents the sector index for the specific session. The range
#           of values for this field is 0 to 4.
#
# Data type file represents the ASDU type as follows:
#       0 = Special command
#       6 = Time synchronization
#       7 = General Interrogation
#      20 = General Command
#
# Function code
#   Code   Definition
#   128   Distance protection
#   160   Overcurrent protection
#   176   Transformer differential protection
#   192   Line Differential protection
#   205   Meter Data for SIEMENS Devices
#   255   Global function type
#
# Point Index field is used to specify the address in the remote slave device
#           of the point to interact with.
#
# Override Flag field is used for general commands to determine the value
#           to be written. If the override flag is clear (0), the value
#           in the database will be utilized. If the override flag is set
(1),
#           the value specified in the override value field will be used.
#
# Override Value field is utilized if the override flag is set. This can be
#           used to always force a control parameter to a fixed value. The
#           Enable code 2 and the database value for the command can be used
#           to determine when the value should be written.
#
# Enable Database   Poll   Session   Sector   Data   Func   Point   Ovr'd   Ovr'd
# Code   Index   Interval   Index   Index   Type   Code   Index   Flag   Val
START
  1       0       0       0       0       6   255   0       0       0
  1      10       0       0       0       7   255   0       0       0
END

```


When sending a General Command, the user might associate the source data with a register in the MVI56-103M database to be sent to the remote slave. The following example will send 8 commands to the slave configured as Session 0/Sector 0. When using a General Command, the bit addressing should be used:

#	Enable	DB	Poll	Session	Sector	Data	Func	Point	Ovrd	Ovrd
#	Code	Index	Interval	Index	Index	Type	Code	Index	Flag	Val
START										
	1	16000	0	0	0	20	128	16	0	0
	1	16016	0	0	0	20	128	17	0	0
	1	16032	0	0	0	20	128	18	0	0
	1	16048	0	0	0	20	128	19	0	0
	1	16064	0	0	0	20	128	23	0	0
	1	16080	0	0	0	20	128	24	0	0
	1	16096	0	0	0	20	128	25	0	0
	1	16112	0	0	0	20	128	26	0	0
END										

Refer to the device specification for the Point Index (Information Number) listing available for control direction.

The module can also send a periodic General Interrogation command in order to initialize and refresh the event-updated points in its database. The slave keeps a list of all data subject to General Interrogation.

Step 7: Transfer the Configuration (page 68) from the Computer to the module.

2.3 [Backplane Configuration]

This section provides the module with a unique name, identifies the method of failure for the communications for the module if the processor is not in RUN mode, and describes how to initialize the module upon startup.

2.3.1 Module Name

0 to 80 characters

This parameter assigns a name to the module that can be viewed using the configuration/debug port. Use this parameter to identify the module and the configuration file.

2.3.2 Read Register Start

0 to 4999

The *Read Register Start* parameter specifies the start of the Read Data area in module memory. Data in this area will be transferred from the module to the processor.

Note: Total user database memory space is limited to the first 5000 registers of module memory, addresses 0 through 4999. Therefore, the practical limit for this parameter is 4999 minus the value entered for *Read Register Count*, so that the Read Data Area does not try to extend above address 4999. Read Data and Write Data Areas must be configured to occupy separate address ranges in module memory and should not be allowed to overlap.

2.3.3 Read Register Count

0 to 5000

The *Read Register Count* parameter specifies the size of the Read Data area of module memory and the number of registers to transfer from this area to the processor, up to a maximum of 5000 words.

Note: Total *Read Register Count* and *Write Register Count* cannot exceed 5000 total registers. Read Data and Write Data Areas must be configured to occupy separate address ranges in module memory and should not be allowed to overlap.

2.3.4 Write Register Start

0 to 4999

The *Write Register Start* parameter specifies the start of the Write Data area in module memory. Data in this area will be transferred in from the processor.

Note: Total user database memory space is limited to the first 5000 registers of module memory, addresses 0 through 4999. Therefore, the practical limit for this parameter is 4999 minus the value entered for *Write Register Count*, so that the Write Data Area does not try to extend above address 4999. Read Data and Write Data Areas must be configured to occupy separate address ranges in module memory and should not be allowed to overlap.

2.3.5 Write Register Count

0 to 5000

The *Write Register Count* parameter specifies the size of the Write Data area of module memory and the number of registers to transfer from the processor to this memory area, up to a maximum value of 5000 words.

Note: Total *Read Register Count* and *Write Register Count* cannot exceed 5000 total registers. Read Data and Write Data Areas must be configured to occupy separate address ranges in module memory and should not be allowed to overlap.

2.3.6 Failure Flag Count

0 through 65535

This parameter specifies the number of successive transfer errors that must occur before halting communication on the application port(s). If the parameter is set to **0**, the application port(s) will continue to operate under all conditions. If the value is set larger than **0** (**1 to 65535**), communications will cease if the specified number of failures occur.

2.3.7 Pass-Through Events

Y or N (N = Default)

This parameter specifies if event messages received on the Master ports will be passed to the processor. If the parameter is set to N, event messages will not be passed to the processor. If the parameter is set to Y, the module will pass all events received to the processor using block identifier 9903.

2.4 [IEC-870-5-103 Master]

This section establishes the total number of slaves to communicate with through both application serial ports.

[IEC-870-5-103 Master]

Session Count : 1 #1 to 32 - maximum number of slaves on all channels

2.4.1 *Session Count*

1 to 32

This parameter specifies the maximum number of sessions to establish on the module. This corresponds to the number of slaves to be interfaced with the module. This value represents the total number of slaves on all ports.

2.5 [IEC-870-5-103 Master Port x]

This section configures the communication parameters for each application serial port on the module. The following illustration shows typical settings for a Master port.

```
[IEC-870-5-103 Master Port 0]
Baud Rate           : 19200
Parity              : Even
RTS On              : 0
RTS Off             : 1
Minimum Delay       : 10
Receive Timeout     : 2000
Single char ACK F0,1 or 3 : Yes
```

2.5.1 Baud Rate

This is the baud rate to be used on the port. Enter the baud rate as a value. For example, to select **19K** baud, enter **19200**.

Baud Rate	Parameter Value Options
110	110
150	150
300	300
600	600
1200	12 or 1200
2400	24 or 2400
4800	48 or 4800
9600	96 or 9600
19,200	19, 192 or 19200
38,400	38, 384 or 38400
57,600	57 or 576
115,200	115 or 1152

2.5.2 Parity

N, O, E, M, or S

This parameter sets the parity to be used on the port. The values correspond to the following settings: N=None, O=Odd, E=Even, M=Mark and S=Space.

Note: The 103M specification supports only Even Parity.

2.5.3 RTS On

0 to **65535** milliseconds

This parameter sets the number of milliseconds to delay after *Ready To Send* (RTS) is asserted before data will be transmitted.

2.5.4 *RTS Off*

0 to 65535 milliseconds

This parameter sets the number of milliseconds to delay after the last byte of data is sent before the RTS modem signal will be set low.

2.5.5 *Minimum Delay*

1 to 60000 milliseconds

This parameter specifies the minimum number of milliseconds to delay before sending the message (setting RTS high). This can be used when the serial network requires time for units to turn off their transmitters.

2.5.6 *Receive Timeout*

1 to 65535 milliseconds

This value represents the number of milliseconds to wait on a port from the time the first character is received until the last character in the longest message is received. This parameter will be dependent on the baud rate. A value of 2000 should work with most applications.

2.5.7 *Single char ACK F0, 1, or 3*

Yes or No

This parameter specifies if the signal *E5* character will be used for *ACK* messages.

2.6 [IEC-103 Master Commands]

This section can contain up to 1000 user defined commands to be executed by the module and sent to the controlled devices. There is no need to place Class 1 or Class 2 polls in this list for the controlled devices as the Master driver for each port will execute these automatically when the port is idle. In order for the port to be idle, make sure that there is idle time available, and that the commands do not constantly utilize the ports. The command list section starts with a reserved label **START** and ends with the label **END**. Each row in the file corresponds to an individual command with the first character position in each row left blank (white space).

As an alternative to using a command list, blocks with an identification code of 9901 can be used to issue commands from the ladder logic.

2.6.1 Enable Code

0 = Disabled

1 = Enabled, will execute using Poll Interval parameter (page 40) (seconds)

2 = Conditional (executed when point in database changes)

This field defines whether the command is to be executed, and under what conditions. To disable the command, set this parameter to 0 (Disabled). You can still execute commands through the processor, using a *Special Function* block.

To enable the command, set this parameter to 1.

- Set the Poll Interval Time to 0 to execute the command during each scan of the command list.
- Set the Poll Interval Time to a value in seconds, to execute the command at the specified interval (page 40).

To execute the command only if the internal data associated with the command changes, set this parameter to 2. This value is valid only for write commands.

2.6.2 Database Index

Database Index is the location in the module's database to use as the source for the data in the command. Refer to Data Type for specific information on addressing (page 41).

2.6.3 Poll Interval

This parameter specifies the minimum frequency at which the module should execute the command when the Enable Code is set to one **1**. The value is entered in units of seconds. For example, to execute a command every 10 seconds, enter a value of **10** in the field. A value of **0** for the parameter implies that the command should be executed every scan of the list, as quickly as possible.

2.6.4 Session Index

0 to 31

Session Index represents the session index in the module to associate with the command. This index is set when the session is read in from this file. The range of values for this field is 0 to 31.

2.6.5 Sector Index

0 to 4

Sector Index represents the sector index for the specific session. There are a maximum of five (5) sectors per session.

2.6.6 Data Type

When interfacing data in the processor to that of the IEC 60870-5-103 protocol, it is important that the user understand the mapping of the data types to their corresponding representation in the modules database. The following table lists the data types supported by the module and their associated storage representation:

Type ID	Description	Data Representation
1	Time-tagged messages with each data point represented by two bits.	Dual-bit status (7.2.6.5 with 00b (0 decimal) = not used, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = not used
2	Time-tagged messages with relative time with each point represented by two bits.	Dual-bit status (7.2.6.5 with 00b (0 decimal) = not used, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = not used
3	Measurands with quality descriptor. The lower 3 bits of the values represented in this data type contain status information. The upper 13 bits of the value contained a signed, 12-bit number. This data type will return from 1 to 4 values. The number of words received is dependant on the information object number and the slave device.	Measurand with quality descriptor (7.2.6.8) Bit 0: 0 = No overflow, 1 = Overflow Bit 1: 0 = Valid, 1 = Invalid Bit 2: Reserved Bits 3 to 25: Value from $-1..+1 \cdot 2^{12}$
4	Time-tagged measurands with relative time with the value in the packet represented by a single floating point number.*	Short floating-point number stored in IEEE STD 754 format (Fraction, Exponent, Sign) (7.2.6.20)
5	Identification data composed of 12 characters of data. Each point in defined of this data type should reserve 12 bytes (6-word addresses) in the database for the data received.	Byte data as defined in 7.2.6.2. First 8 bytes are characters 1 to 8 and last 4 bytes are manufacture bytes either decimal (0 to 255) or as ASCII characters.
9	Measurands with quality descriptor. The lower 3 bits of the values represented in this data type contain status information. The upper 13 bits of the value contained a signed, 12-bit number. This data type will return from 1 to 9 values (some slaves may return up to 16 values). The number of words received is dependant on the information object number and the slave device.	Measurand with quality descriptor (7.2.6.8) Bit 0: 0 = No overflow, 1 = Overflow Bit 1: 0 = Valid, 1 = Invalid Bit 2: Reserved Bits 3 to 25: Value from $-1..+1 \cdot 2^{12}$
20	General command to control a dual-point object. Each command issued by the module uses the values of two adjacent bits in the database or an override value specified by the user command.	Dual-bit status (7.2.6.4 with 00b (0 decimal) = not used, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = not used

* The words should be swapped in the ladder logic.

As shown in the previous table, all bit types are addressed as bits in the modules database.

For additional details, refer to Addressing the Data Types.

2.6.7 Function Code

Code	Definition
128	Distance protection
160	Overcurrent protection
176	Transformer differential protection
192	Line Differential protection
255	Global function type
133	Meter Data for SIEMENS Devices
1	Reset Process
2	Class 2 Polls
x	User-defined

Note: The last item in the *Function Code* dropdown list is user-defined. If you select **USER DEFINED** from the dropdown list, a text box will appear below the list. You may enter any function code in this text box that will be accepted by the destination slave.

2.6.8 Point Index

The Point Index specifies the point address to be accessed in the remote slave device.

Index Value	Description
1	Bit address with each point occupying 2 bits
2	Bit address with each point occupying 2 bits
3	Word address with each point occupying 4 words
4	Double-word address for the single float value
5	Byte address with each point occupying 12 bytes
9	Word address with each point occupying 9 words

2.6.9 Override Flag

0 or 1

Override Flag field is used for general commands to determine the value to be written. If the override flag is clear (0), the value in the database will be utilized. If the override flag is set (1), the value specified in the override value field will be used.

2.6.10 Override Value

If the Override Flag is set to "Yes", you can use this setting to always force a control parameter to a fixed value. Use Enable code **CONDITIONAL** and the database value for the command to determine when the value should be written.

2.7 [IEC-103 Master Session x]

This section defines Session *y*, which runs on Port *x*. The *Session Count* parameter in the [IEC-870-5-103 Master] section of the configuration (page 36) determines the number of sessions (controlled devices) for this port.

The sessions are referenced by a zero-based index value. For example, if the module is configured for four sessions, the configuration file should contain sections for Sessions 0 to 3 (that is, [IEC-103 Master Session 0] to [IEC-103 Master Session 3]).

The parameters in [IEC-103 Master Session *y*] define the characteristics of the specific controlled device to interface.

2.7.1 Communication Port

0 or 1

This parameter sets the port to which the controlled device is connected. On this module, values of 0 and 1 are permitted.

2.7.2 Sector Count

1 to 5

This parameter sets the number of sectors contained in this controlled device. The range of values is from 1 to 5. A sector section is required for each sector in a session to define its database and settings.

2.7.3 Data Link Address

0 to 65535

This parameter defines the Data Link Address for the device emulated on the module. This address identifies the module on the network along with the common address of ASDU.

2.7.4 Failure Delay

0 to 2000 seconds

This parameter sets the minimum number of seconds to delay before polling this session when it is not online. This parameter is only used in unbalanced mode.

2.7.5 Confirm Timeout

0 to 4,294,967,295 (two raised to the power of 32, minus one) milliseconds

This parameter sets the number of milliseconds to wait for a confirm response from the controlled device.

2.7.6 Retry Count

0 to 255

In balanced mode, this parameter specifies the number of retries (0 to 255) if a response is not received. In unbalanced mode, this parameter is ignored.

2.7.7 C1/C2 Poll Count Pend

0 to 65535

This parameter sets the maximum number of Class 1 and Class 2 polls performed on this session before trying the next session. This parameter prevents a session from monopolizing the communication port.

2.7.8 Class 1 Polls

0 to 100

This parameter sets the maximum number of Class 1 polls performed on this session before switching to another session. This parameter prevents a session from monopolizing the communication port.

2.7.9 Class 1 Pend Delay

0 to 4,294,967,295 (two raised to the power of 32, minus one) milliseconds

This parameter sets the minimum number of milliseconds to delay between Class 1 polls for pending data.

2.7.10 Class 2 Pend Delay

0 to 4,294,967,295 (two raised to the power of 32, minus one) milliseconds

This parameter sets the minimum number of milliseconds to delay between Class 2 polls for pending data.

2.7.11 Class 1 Poll Delay

0 to 4,294,967,295 (two raised to the power of 32, minus one) milliseconds

This parameter sets the minimum number of milliseconds to delay between each Class 1 poll.

2.7.12 Class 2 Poll Delay

0 to 4,294,967,295 (two raised to the power of 32, minus one) milliseconds

This parameter sets the minimum number of milliseconds to delay between each Class 2 poll.

2.8 [IEC-103 Master Session x Sector y]

This section defines Sector *z*, which belongs to Session *y*. The *Sector Count* parameter (page 43) in the [IEC-870-5-103 Master Session *y*] section specifies the number of sectors for the session.

Each sector has a corresponding [IEC-103 Master Session *y* Sector *z*] section, where *y* represents the session index and *z* represents the sector index.

The sectors are referenced by a zero-based index value. For example, if Session 0 is configured for four sectors, the configuration file should contain sections for Sectors 0 to 3 (that is, [IEC-103 Master Session 0 Sector 0] to [IEC-103 Master Session 0 Sector 3]).

2.8.1 Common ASDU Address

0 to 255

This parameter sets the common *ASDU* address to association with this sector of the specified session. This parameter is usually set the same as the *Data Link Address* when only one sector is used.

2.8.2 Online Time Sync

Yes or No

This parameter specifies if the sector in the controlled device will be sent a time synchronization command when the unit is first recognized as being online. This should only be used for devices that do not send an *EOI* message after initializing.

2.8.3 Online General Int

Yes or No

This parameter specifies if the sector in the controlled device will be sent a general interrogation command when the unit is first recognized as being online. This should only be used for devices that do not send an *EOI* message after initializing.

2.8.4 EOI Time Sync

Yes or No

This parameter specifies if the sector in the controlled device will be sent a time synchronization command after this module received an *EOI* message from the controlled unit.

2.8.5 EOI General Int

Yes or No

This parameter specifies if the sector in the controlled device will be sent a general interrogation command after this module received an *EOI* message from the controlled unit.

2.8.6 ASDU Type

This field contains the *ASDU* type code for the data contained in the message.

- 1 = Time-tagged message (bit addressed with 2 bits/point)
- 2 = Time-tagged message with relative time (bit addressed with 2 bits/point)
- 3 = Measurands I (4 word values using word address using double-word address)
- 4 = Time-tagged measurands with relative time (1 float value)
- 5 = Identification (12 characters using a byte address)
- 9 = Measurands II (9 word values using word address)
- 205 = Siemens meter data

2.8.7 Database Index

Database Index is the location in the module's database to use as the source for the data in the command. Refer to *Data Type* for specific information on addressing (page 41).

The data type field determines the meaning of the database index as follows:

Type	Description	DB Index type
6	Clock synchronization	NA
7	General interrogation	NA
20	General Command	Bit address

2.8.8 Function Code

Code	Definition
128	Distance protection
160	Overcurrent protection
176	Transformer differential protection
192	Line Differential protection
133	For SIEMENS ASDU type 205
255	Global function type
x	User-defined

Note: The last item in the *Function Code* dropdown list is user-defined. If you select **USER DEFINED** from the dropdown list, a text box will appear below the list. You may enter any function code in this text box that will be accepted by the destination slave.

2.8.9 Point Index

Point Index specifies the address in the remote slave device of the point to interact with.

Index Value	Description
1	Bit address with each point occupying 2 bits
2	Bit address with each point occupying 2 bits
3	Word address with each point occupying 4 words
4	Double-word address for the single float value
5	Byte address with each point occupying 12 bytes
9	Word address with each point occupying 9 words

2.9 Uploading and Downloading the Configuration File

ProSoft modules are shipped with a pre-loaded configuration file. In order to edit this file, you may transfer the file from the module to your PC or locate and load the file from the distribution CD-ROM supplied with the module. After editing, you must transfer the file back to the module for your changes to take effect.

This section describes these procedures.

Important: The illustrations of configuration/debug menus in this section are intended as a general guide and may not exactly match the configuration/debug menus in your own module. For specific information about the configuration/debug menus in your module, refer to The Configuration/Debug Menu (page 68).

2.9.1 Required Hardware

You can connect directly from your computer's serial port to the serial port on the module 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 module:

- 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 module firmware upgrades.

2.9.2 Required Software

In order to send and receive data over the serial port (COM port) on your computer to the module, you must use a communication program (terminal emulator).

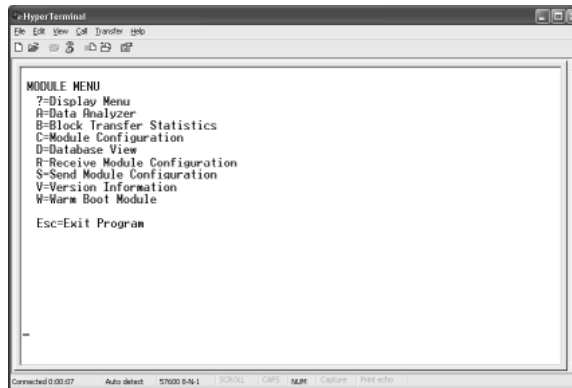
A simple communication program called HyperTerminal is pre-installed with recent versions of Microsoft Windows operating systems. If you are connecting from a machine running DOS, you must obtain and install a compatible communication program. The following table lists communication programs that have been tested by ProSoft Technology.

DOS	ProComm, as well as several other terminal emulation programs
Windows 3.1	Terminal
Windows 95/98	HyperTerminal
Windows NT/2000/XP	HyperTerminal

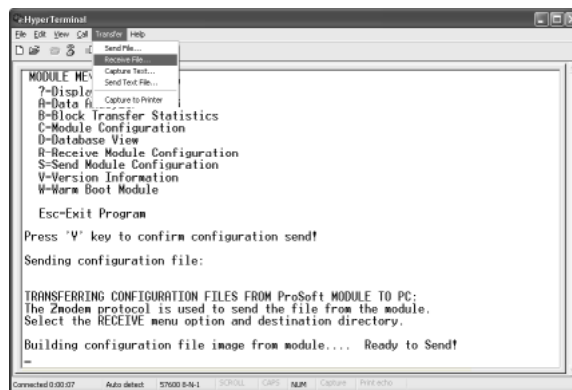
The module uses the Ymodem file transfer protocol to send and receive configuration files from your module. If you use a communication program that is not on the list above, please be sure that it supports Ymodem file transfers.

2.9.3 Transferring the Configuration File to Your PC

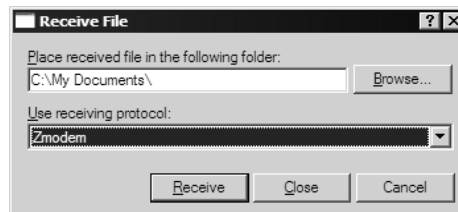
- 1 Connect your PC to the Configuration/Debug port of the module using a terminal program such as HyperTerminal. Press [?] to display the main menu.



- 2 From the **Transfer** menu in HyperTerminal, select **Receive File**.

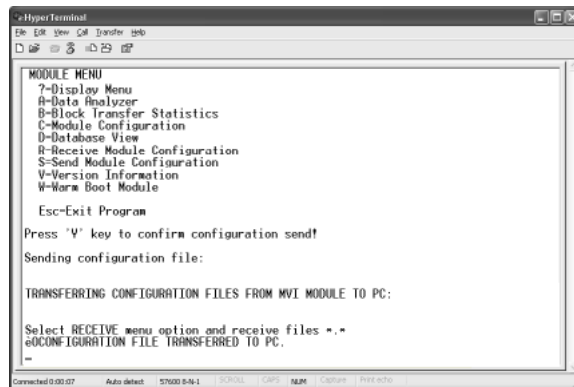


- 3 In the Receive File dialog box, browse to the location on your PC where the configuration file should be stored, and select Ymodem as the receiving protocol.

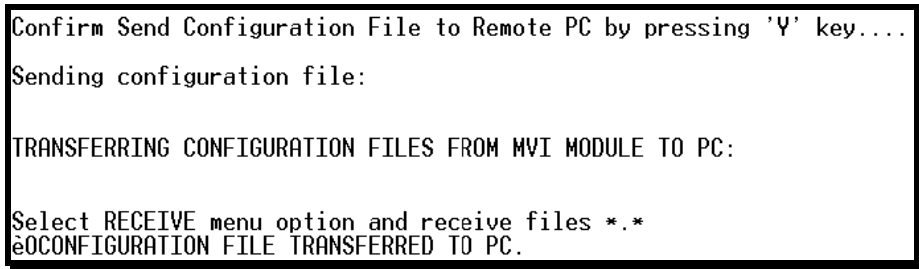


When you have completed your selections, click Close.

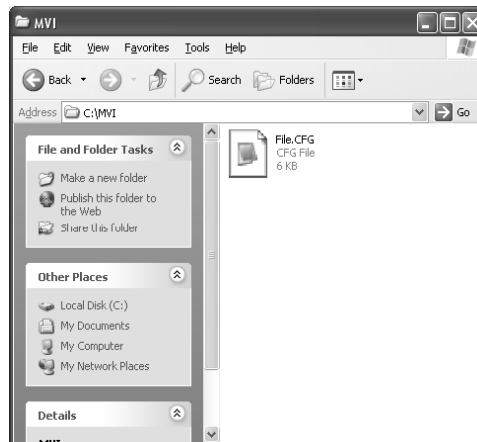
- 4 Press **[S]** (Send Module Configuration), and then press **[Y]** to confirm the transfer.



The file transfer will then begin automatically, using the protocol and location you specified in Step 3. When the configuration file has been transferred to your PC, the dialog box will indicate that the transfer is complete.



The configuration file is now on your PC at the location you specified.

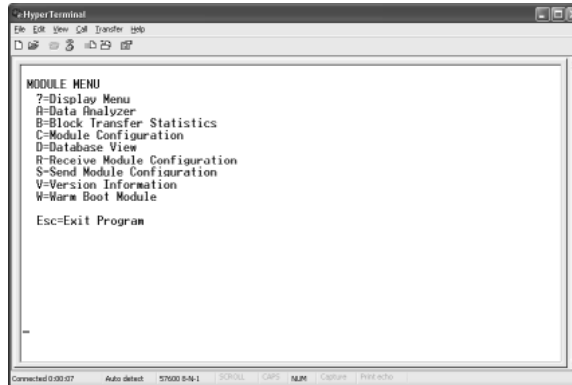


- 5 You can now open and edit the file in a text editor such as Windows Notepad. (page 25) When you have finished editing the file, save it and close Notepad.

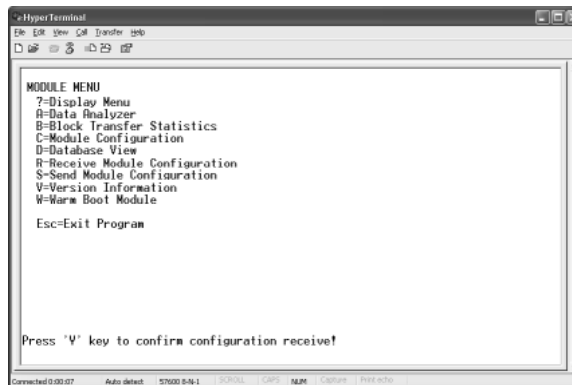
2.9.4 Transferring the Configuration File to the Module

Perform the following steps to transfer a configuration file from your PC to the module.

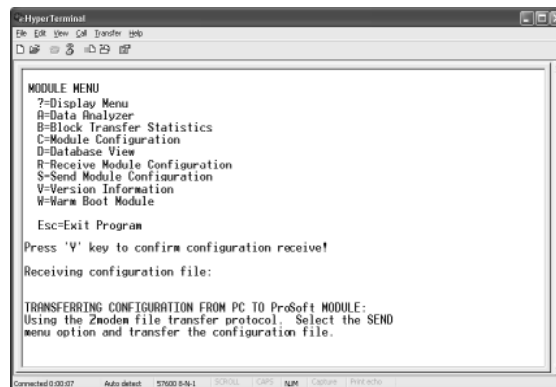
- 1 Connect your PC to the Configuration/Debug port of the module using a terminal program such as HyperTerminal. Press [?] to display the main menu.



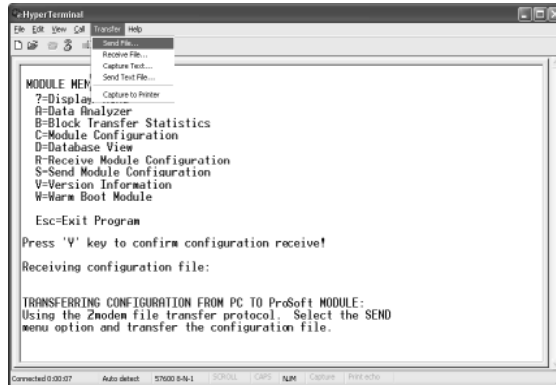
- 2 Press [R] (Receive Module Configuration). The message "Press Y key to confirm configuration receive!" is displayed at the bottom of the screen.



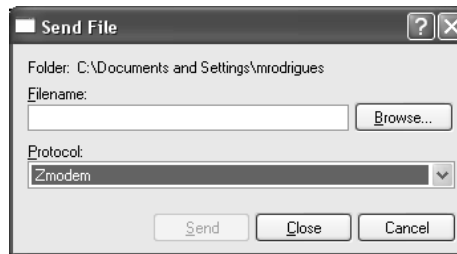
- 3 Press [Y]. The screen now indicates that the PC is ready to send.



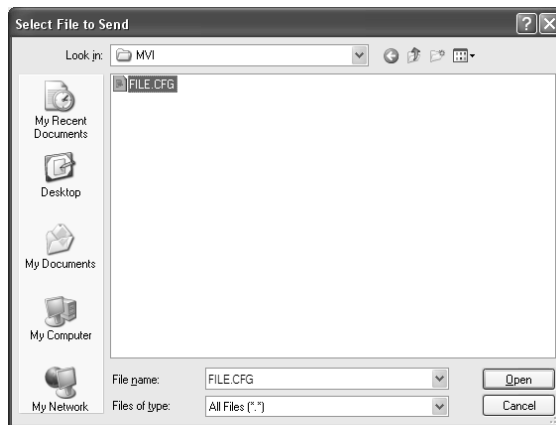
- 4 From the **Transfer** menu in HyperTerminal, select **Send File**.



The Send File dialog appears.



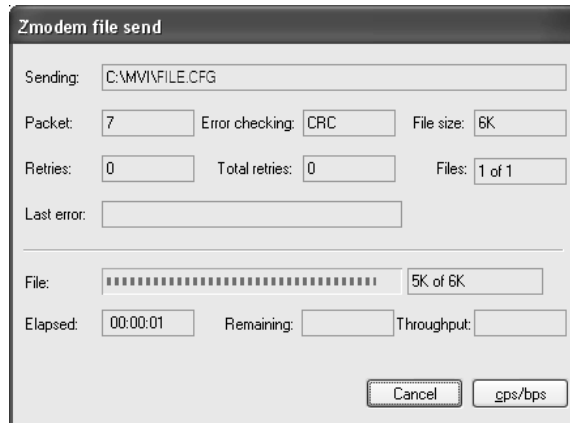
- 5 Use the Browse button to locate the configuration file your computer.



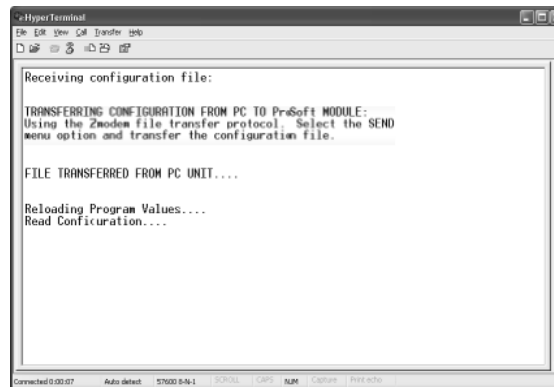
Note: This procedure assumes that you are transferring a newly edited configuration file from your PC to the module. However, the factory default configuration file is also available on the ProSoft CD, as well as from the ProSoft Technology web site.

- 6 Select Zmodem as the protocol.

- 7 Click the Send button. This action opens the Zmodem File Send dialog box.



When the transfer is complete, the screen indicates that the module has reloaded program values and displays information about the module.



- 8 Your module now contains the new configuration. To ensure your configuration changes take effect, please reboot the module by using the Warm Boot options on the Diagnostics Main Menu or by using the WarmBoot or ColdBoot options from ladder logic.

3 Ladder Logic

In This Chapter

❖ Module Data	56
❖ Command Control Data Object	60
❖ Event Message Data Object.....	62
❖ Adding the Module to an Existing Project.....	63

Ladder logic is required for application of the MVI56-103M module. Tasks that must be handled by the ladder logic are module data transfer, special block handling, and status data receipt. Additionally, a power-up handler may be needed to handle the initialization of the module's data and to clear any processor fault conditions.

The sample ladder logic, on the *ProSoft Solutions CD-ROM*, is extensively commented, to provide information on the purpose and function of each rung. For most applications, the sample ladder will work without modification.

3.1 Module Data

This section describes the controller tags that are defined in the example logic to interface with the module. The user can extend these tags to meet the specifications required for their application.

3.1.1 Module Status Data and Variables (*I103MModuleDef*)

All status and variable data related to the MVI56-103M is stored in a user-defined data type. An instance of the data type is required before the module can be used. This is done by declaring a variable of the data type in the Controller Tags Edit Tags dialog box. The following table describes the structure of the object.

Name	Data Type	Description
GenStat	I103MStat	
BP	I103MBackplane	

This object contains objects that define variables for the module and status data related to the module. Each of these object types is discussed in the following topics of the document.

Status Object (I103MStat)

This object stores the status data of the module. The I103MStat object shown below is updated each time a read block is received by the processor. Use this data to monitor the state of the module at a "real-time rate".

Name	Data Type	Description
Scan_Cnt	INT	
Product_Name	SINT[4]	
Rev_Level	SINT[4]	
Op_Sys	SINT[4]	
Run_Number	SINT[4]	
Blk_Rd_Count	INT	
Blk_Wr_Count	INT	
Blk_Parse_Cnt	INT	
Blk_Err	INT	
Evnt_Cnt	INT	
Evnt_Overflow	INT	
SesCnt	INT	
CurCmd	INT	
CmdBusy	INT	
CmdMax	INT	
CmdDelay	INT	
CmdQueue	INT	
CmdQCnt	INT	
Online	DINT	
ChStat	I103MCHStat[2]	

Within the I103MStat objects are objects containing the status information for each application port (I103MCHStat). Refer to Channel Status Object (page 58) for a complete listing of the data stored in this object.

Channel Status Object (I103MCHStat)

The I103MCHStat object holds the status data related to a single IEC 60870-5-103 Master port. The following table describes the structure of the object.

Data Type	Description
State	State machine value
CmdReq	Number of command requests
CmdResp	Number of command responses
CmdErr	Number of command errors
Req	Number of request messages
Resp	Number of responses
ErrSent	Number of errors sent
ErrRec	Number of errors received
CfgErr	Configuration Error Word for channel
CurErr	Current error code for channel
LastErr	Last error for channel

This information is passed to the controller from the module with each normal read block image.

Configuration/Error Status Flags (CfgErr)

The CfgErr word member of the I103MCHStat reports configuration errors for the respective server. If the module is not functioning as expected, inspect the value presented in this object. If a configuration error exists, the associated bit will be set. A value of zero for the bit indicates the configuration value is valid. This does not guarantee that the module is configured correctly for your application. The bits used by this member are shown in the following table.

Bit	Code	Description
0	0x0001	Invalid baud rate selected
1	0x0002	Invalid parity selected
2	0x0004	Received timeout set to 0
3	0x0008	Invalid Port selected for a session
4	0x0010	Invalid sector count for session
5	0x0020	Could not allocate memory for sector of a session.
6	0x0040	
7	0x0080	Invalid failure delay or confirm timeout for session.
8	0x0100	
9	0x0200	
10	0x0400	
11	0x0800	
12	0x1000	
13	0x2000	
14	0x4000	
15	0x8000	

Backplane Object (I103MBackplane)

The I103MBackplane object stores all the variables required for the data transfer operation between the module and the controller. The LastRead data member is used as the handshaking word to indicate the arrival of new data from the module. The following table describes the structure of the object.

Name	Data Type	Description
LastRead	INT	
LastWrite	INT	
BlockIndex	INT	

The other members of the object are utilized in the ladder logic to assist in the data transfer operation.

3.1.2 Data Object

Data for the module is stored in two controller tags for the example ladder logic. The Read Data (data transferred from the module to the processor) is stored in the controller tag array, I103ReadData[]. The Write Data (data transferred from the processor to the module) is stored in the controller tag array, I103WriteData[]. Separate tags can be constructed for each data type utilized by the controlled devices and for each device.

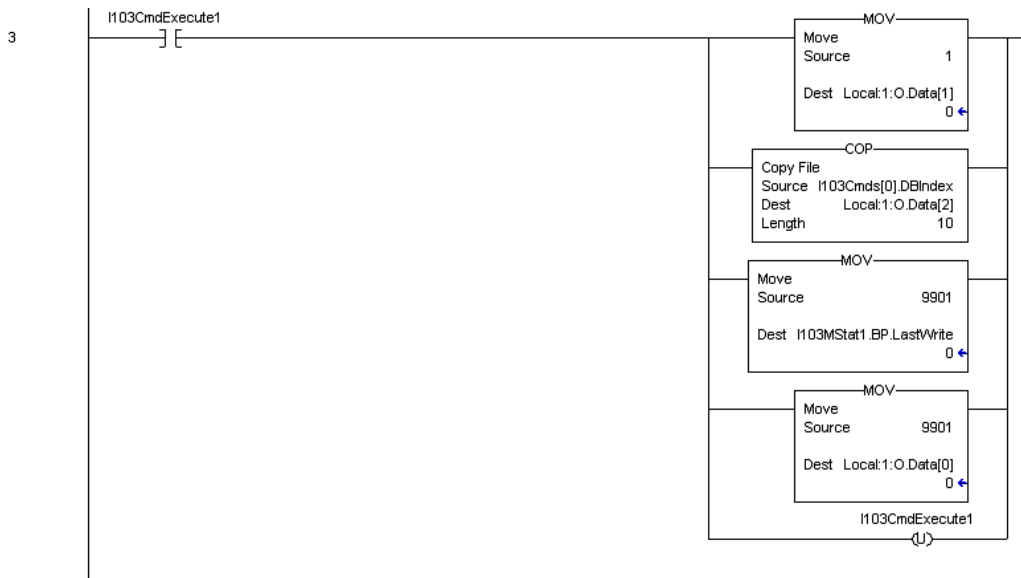
3.2 Command Control Data Object

In order to support the command control option of the module, a controller tag array, I103Cmds[] and two Boolean tags, I103CmdExecute1 and I103CmdExecute2. The bits in the I103CmdExecute tags trigger ladder logic that moves the command parameters contained in the I103Cmds[] array out to the module for execution on the networks. The I103Cmds[] are created using the User-defined Data Type, I103Cmd, that contains the data necessary to build a user command. The following table describes the structure of this object.

Name	Data Type	Description
DBIndex	INT	
Session	INT	
Sector	INT	
DataType	INT	
Func	INT	
Pnt	INT	
OvrFlg	INT	
OvrVal	INT	
Res1	INT	
Res2	INT	

Refer to the Command List section of this document for the definition of each of the parameters. This option permits execution of user-generated commands from the ladder logic directly to controlled devices. This feature is especially important in generating general commands, ASDU 20 object requests.

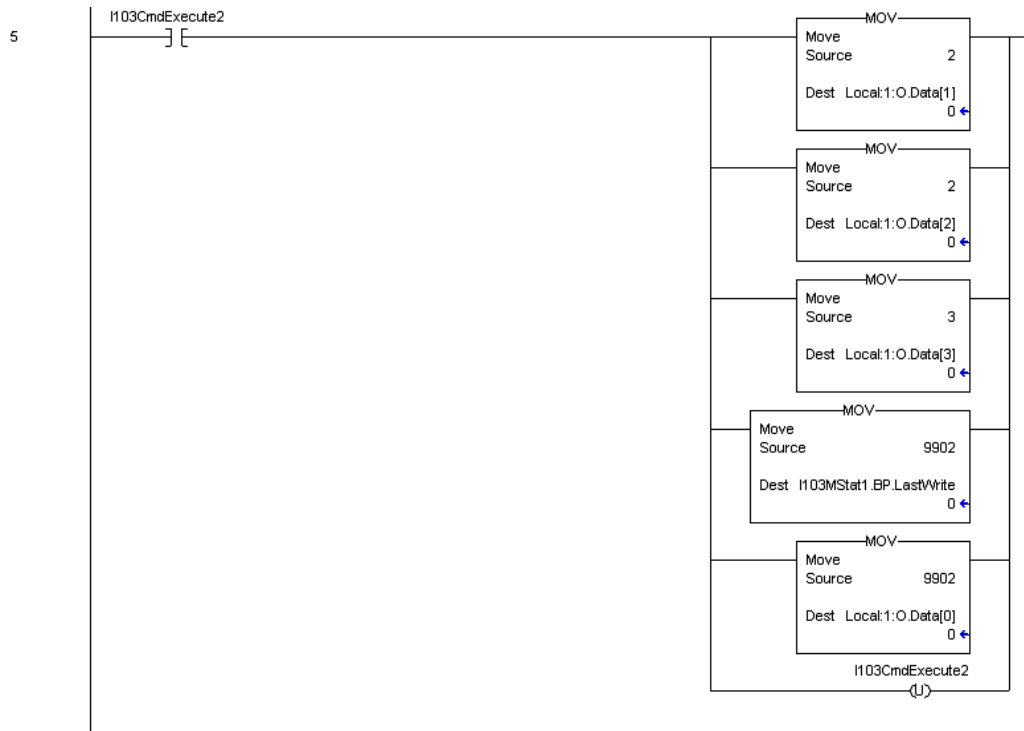
Example ladder logic to use this feature is shown in the following rung:



When the trigger bit (I103CmdExecute1) is set, the module will build a block 9901 with the command contained in the first command of the I103Cmds[]. The module receives this block and builds and sends the command to the specified control device. The data for the command element in the I103Cmds array is shown in the following illustration.

I103Cmds[0]	{...}	I103Cmd
I103Cmds[0].DBIndex	0 Decimal	INT
I103Cmds[0].Session	0 Decimal	INT
I103Cmds[0].Sector	0 Decimal	INT
I103Cmds[0].DataType	20 Decimal	INT
I103Cmds[0].Func	128 Decimal	INT
I103Cmds[0].Pnt	18 Decimal	INT
I103Cmds[0].DvrFlg	1 Decimal	INT
I103Cmds[0].DvrVal	2 Decimal	INT
I103Cmds[0].Res1	0 Decimal	INT
I103Cmds[0].Res2	0 Decimal	INT

The following rung displays ladder logic to build a 9902 block to place commands 2 and 3 of the user command list configured in the module's command queue:



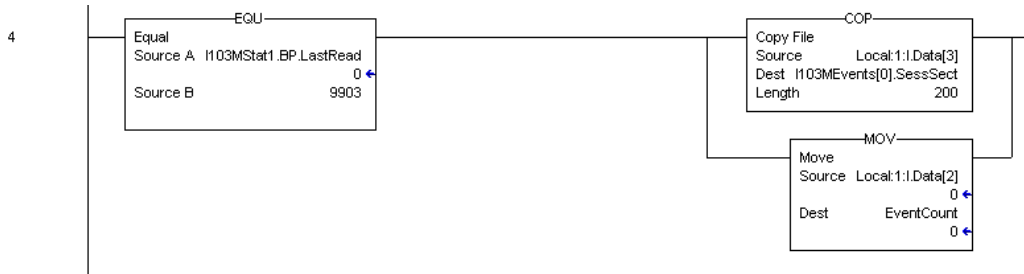
When the trigger bit (I103CmdExecute2) is set, the module will build the block 9902 in the output image. The module will receive the new block and place the commands into the command queue for execution.

3.3 Event Message Data Object

The module can be configured to pass event messages received from the controlled devices to the processor. The module sends this information to the processor in read blocks with identification codes of 9903. The example ladder logic has a data structure that conforms to the data structure sent for each element by the module. The following table describes the structure of this object.

Name	Data Type	Description
SessSect	INT	
ASDU	INT	
FuncPnt	INT	
FaultNum	INT	
mSec	INT	
HrMin	INT	
VDst	INT	
RelTime	INT	
val	DINT	

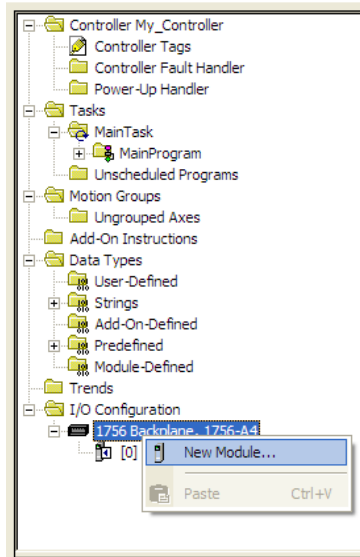
The example ladder logic defines a 20-element array of the I103Mevent objects to hold the data received in a single 9903 block. Ladder logic to handle a 9903 block is shown in the following figure:



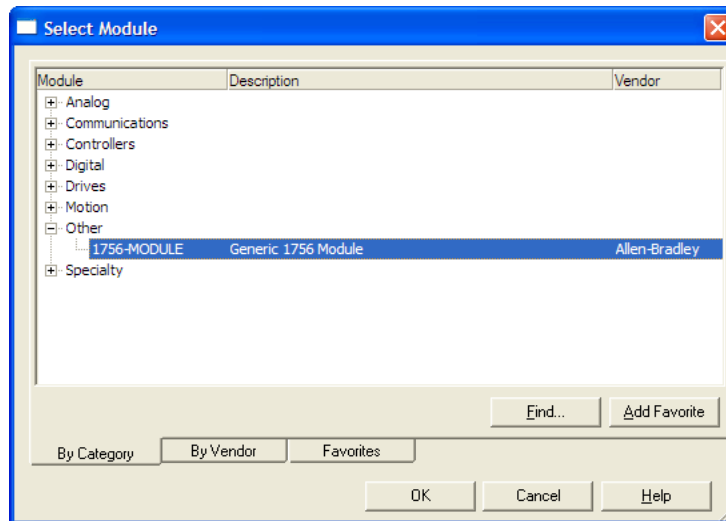
This simple logic does not use the message count parameter in the block and will not work for most applications. It is only provided as an example to display how to move the 9903 data to a user controller tag. If the message pass-through feature is utilized, more logic is required to store the messages received. This feature is most commonly utilized to pass events from the controlled device to an event logger connected to the processor.

3.4 Adding the Module to an Existing Project

- 1 Select the *I/O Configuration* folder in the *Controller Organization* window of RSLogix 5000, and then click the right mouse button to open a shortcut menu. On the shortcut menu, choose **NEW MODULE**.



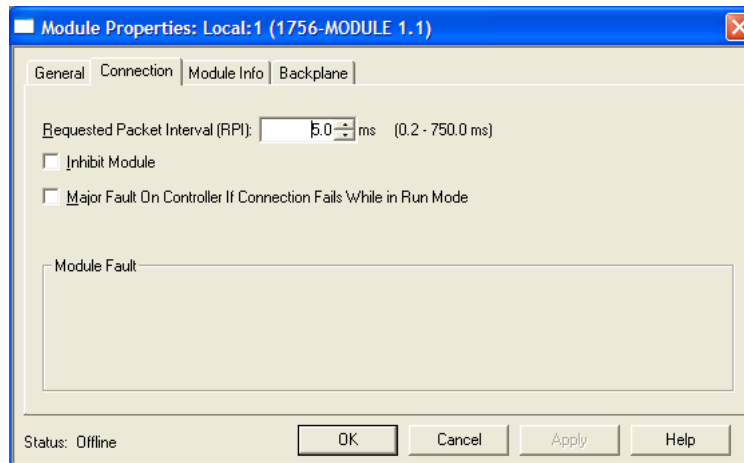
This action opens the *Select Module* dialog box:



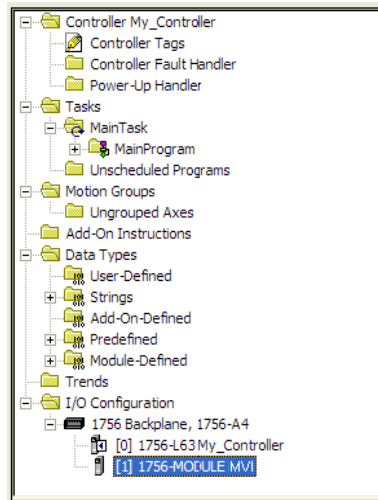
- 2 Select the **1756-MODULE (GENERIC 1756 MODULE)** from the list and click **OK**. This action opens the *New Module* dialog box.
- 3 Enter the *Name*, *Description* and *Slot* options for your application. You must select the *Comm Format* as **DATA - INT** in the dialog box, otherwise the module will not communicate. Click **OK** to continue.

Parameter	Value
Name	Enter a module identification string. Example: 103M_2
Description	Enter a description for the module. Example: IEC 60870-5-103 MASTER COMMUNICATION MODULE
Comm Format	Select DATA-INT .
Slot	Enter the slot number in the rack where the MVI56-103M module is located.
Input Assembly Instance	1
Input Size	250
Output Assembly Instance	2
Output Size	248
Configuration Assembly Instance	4
Configuration Size	0

- 4 Select the *Requested Packet Interval* value for scanning the I/O on the module. This value represents the minimum frequency that the module will handle scheduled events. This value should not be set to less than 1 millisecond. The default value is 5 milliseconds. Values between 1 and 10 milliseconds should work with most applications.



- 5 Save the module. Click **OK** to dismiss the dialog box. The *Controller Organization* window now displays the module's presence.



- 6 Copy the *User-Defined Data Types* from the sample program into your existing RSLogix 5000 project.
- 7 Copy the *Controller Tags* from the sample program into your project.
- 8 Copy the *Ladder Rungs* from the sample program into your project.

4 Diagnostics and Troubleshooting

In This Chapter

❖ Reading Status Data from the Module	68
❖ LED Status Indicators.....	84
❖ Clearing a Fault Condition	85
❖ Troubleshooting.....	86
❖ Frequently Asked Questions	87

The module provides information on diagnostics and troubleshooting in the following forms:

- LED status indicators on the front of the module provide general information on the module's status.
- Status data contained in the module can be viewed through the Configuration/Debug port, using the troubleshooting and diagnostic capabilities of *ProSoft Configuration Builder (PCB)*.
- Status data values can be transferred from the module to processor memory and can be monitored there manually or by customer-created logic.

4.1 Reading Status Data from the Module

The MVI56-103M module returns a status data set to the ControlLogix processor in each read block. This data is transferred to the ControlLogix processor continuously with each read block.

The Configuration/Debug port provides the following functionality:

- Full view of the module's configuration data
- View of the module's status data
- Version Information
- Control over the module (warm boot and cold boot)
- Facility to upload and download the module's configuration file

4.1.1 The Configuration/Debug Menu

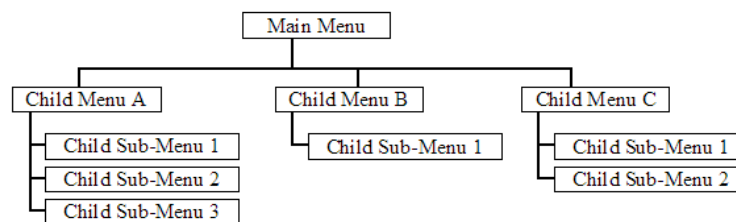
The Configuration and Debug menu for this module is arranged as a tree structure, with the Main Menu at the top of the tree, and one or more sub-menus for each menu command. The first menu you see when you connect to the module is the Main menu.

Because this is a text-based menu system, you enter commands by typing the command letter from your computer keyboard in *Prosoft Configuration Builder (PCB)*. The module 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.

Navigation

All of the submenus for this module 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 module, 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 module and may not be used interchangeably.

4.1.2 Required Software

In order to send and receive data over the serial port (COM port) on your computer to the module, you must use a communication program (terminal emulator).

A simple communication program called HyperTerminal is pre-installed with recent versions of Microsoft Windows operating systems. If you are connecting from a machine running DOS, you must obtain and install a compatible communication program. The following table lists communication programs that have been tested by ProSoft Technology.

DOS	ProComm, as well as several other terminal emulation programs
Windows 3.1	Terminal
Windows 95/98	HyperTerminal
Windows NT/2000/XP	HyperTerminal

The module uses the Ymodem file transfer protocol to send and receive configuration files from your module. If you use a communication program that is not on the list above, please be sure that it supports Ymodem file transfers.

4.1.3 Using the Configuration/Debug Port

To connect to the module's Configuration/Debug port:

- 1 Connect your computer to the module's port using a null modem cable.
- 2 Start the communication program on your computer and configure the communication parameters with the following settings:

Baud Rate	57,600
Parity	None
Data Bits	8
Stop Bits	1
Software Handshaking	None

- 3 Open the connection. When you are connected, press the **[?]** key on your keyboard. If the system is set up properly, you will see a menu with the module name followed by a list of letters and the commands associated with them.

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

- 1 Verify that the null modem cable is connected properly between your computer's serial port and the module. A regular serial cable will not work.
- 2 Verify that RSLinx is not controlling the COM port. Refer to Disabling the RSLinx Driver for the Com Port on the PC.
- 3 Verify that your communication software is using the correct settings for baud rate, parity and handshaking.
- 4 On computers with more than one serial port, verify that your communication program is connected to the same port that is connected to the module.

If you are still not able to establish a connection, you can contact ProSoft Technology Technical Support for further assistance.

4.1.4 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 following menu will appear.

```
IEC-870-5-103 MASTER COMMUNICATION MODULE
?=Display Menu
B=Block Transfer Statistics
C=Module Configuration
D=Database View
I=IEC-103 Master Menu
P=Backplane Command List
R=Receive Configuration File
S=Send Configuration File
V=Version Information
Esc=Exit Program
```

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module 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.

Viewing Block Transfer Statistics

Press **[B]** from the *Main* menu to view the *Block Transfer Statistics* screen.

Use this command to display the configuration and statistics of the backplane data transfer operations between the module and the processor. The information on this screen can help determine if there are communication problems between the processor and the module.

Tip: To determine the number of blocks transferred each second, mark the numbers displayed at a specific time. Then some seconds later activate the command again. Subtract the previous numbers from the current numbers and divide by the quantity of seconds passed between the two readings.

Viewing Module Configuration

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

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

Opening the Database View Menu

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

Use this menu command to view the current contents of the module's database. For more information about this submenu, see Database View Menu (page 73).

Opening the IEC-103 Master Menu

Press **[I]** from the Main Menu to open the IEC-870-5-103 Master Driver Menu. Use this menu command to view detailed configuration information for the module.

```
IEC-103 MASTER Menu Selected
IEC-870-5-103 MASTER DRIVER MENU
?=Display Menu
A=Data Analyzer
C=General Configuration
I=Command List Menu
P=Port Configuration Menu
Q=Port Status Menu
S=Session Menu
V=Version
Z=Previous Menu
```

For more information about the commands on this menu, refer to IEC-103 Master Driver Menu (page 74).

Viewing the Backplane Command List

Press **[P]** from the Main Menu to view the Backplane Data Exchange List. Use this command to display the configuration and statistics of the backplane data transfer operations.

```
BACKPLANE DATA EXCHANGE LIST -- COMMANDS 0 TO 9
TYPE  DBREG  DBTYPE  ADDRESS  COUNT  LASTERR
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
0      0       0        0         0      0X0000
```

Tip: Repeat this command at one-second intervals to determine the number of blocks transferred each second.

Receiving the Configuration File

Press **[R]** to download (receive) the current configuration file from the module.

Sending the Configuration File

Press **[S]** to upload (send) a configuration file from the module to your PC.

Viewing Version Information

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

Use this command to view the current version of the software for the module, 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 module operation. The *Program Scan Counter* value is incremented each time a module's program cycle is complete.

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

Exiting the Program

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

Warm Booting the Module

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

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 module to reboot.

4.1.5 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 module database. Press **[?]** to view a list of commands available on this menu.

```
DB Menu Selected

DATABASE VIEW MENU
?=Display Menu
0-9=Display 0-9000
S=Show Again
-=Back 5 Pages
P=Previous Page
+=Skip 5 Pages
N=Next Page
D=Decimal Display
H=Hexadecimal Display
F=Float Display
A=ASCII Display
M=Main Menu
```

Jumping to the first page of Memory Addresses 0, 1000, 2000, or 3000

The database is divided into pages that correspond with a specific number of registers. The total number of database pages and registers depends on the memory capacity and configuration of the module.

Use the keyboard commands **[0]**, **[1]**, **[2]**, or **[3]** to display database contents starting from address 0 (zero), 1000, 2000 and 3000 respectively.

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.

Viewing the Previous Page of Registers

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

Moving Forward Through 5 Pages of Registers

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

Viewing the Next Page of Registers

Press **[N]** from the *Database View* menu to display the next page 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.

4.1.6 IEC-103 Master Driver Menu

Press **[I]** from the Main Menu to open the IEC-870-5-103 Master Driver Menu. Use this menu command to view detailed configuration information for the module.

Opening the Data Analyzer Menu

Press **[A]** to open the Data Analyzer Menu. Use this command to view all bytes of data transferred on each port. Both the transmitted and received data bytes are displayed. Refer to Data Analyzer (page 79) for more information about this menu.

Important: When in analyzer mode, program execution will slow down. Only use this tool during a troubleshooting session. Before disconnecting from the Config/Debug port, please press **[S]** to stop the data analyzer, and then press **[M]** to return to the main menu. This action will allow the module to resume its normal high speed operating mode.

Viewing General Configuration

Press **[C]** from the IEC-103 Master Driver Menu to display the general configuration for the protocol. The following illustration shows an example of the Module Configuration screen:

```
MODULE CONFIGURATION
Max Sessions      = 0 (of maximum 32)
Online States    = 0x00000000 (bit mapped in hex format)
Command Count    = 0 (of maximum 1000)
Current Command  = 0 (IDLE)
MEMORY COUNTERS:
applRec          = 0
applTrans        = 0
anything         = 0
```

The Busy/Idle message indicates the current activity state of the module. "Idle" means it is waiting to execute a command. "Busy" means it is executing a command and is waiting for the response to the request. This does not include the normal Class 1 and 2 polls as these are automatically generated.

The counter data displays the number of memory areas allocated for the application layer. When no packets are pending, the counts should all be 0. If messages are waiting to be sent, the applRec count will indicate the number waiting to be sent. If many messages are received at the same time, the applRec count will indicate the number of packets that must be processed. The "anything" count indicates any other buffer area that is allocated and must be processed by the application.

Opening the IEC-870-Master Command List Menu

Press **[I]** from the IEC-103 Master Driver Menu to open the ICE-870 Master Command List menu. Use this command to view the configured command list for the module.

```
IEC-870-5-103 MASTER COMMAND LIST, COMMANDS 0 TO 9
ENB DBIDX POLLI SES SEC ASDU FUNC POINT LAST_POLL LERROR OUR VALUE
1 0 10 0 0 20 128 16 7 0 1 2
0 0 11 0 0 20 128 16 14932 0 1 1
0 1600 41 0 0 20 128 17 14932 0 0 0
0 1602 41 0 0 20 128 18 14932 0 0 0
1 0 5 0 0 7 255 0 4 0 0 0
**** END OF COMMAND LIST REACHED ****
```

For more information about the commands on this menu, refer to IEC-870-Master Command List Menu (page 77).

Opening the Port Configuration Menu

Press **[P]** from the IEC-103 Master Driver Menu to open the Port Configuration menu. Use this command to view the port configuration information for each of the application ports.

```
Port Configuration Menu Selected
IEC-870-5-103 MASTER CHANNEL 0 CONFIGURATION
Baudrate           = 19200
Parity             = EVEN
RTS On             = 1
RTS Off            = 0
Minimum Delay      = 30
Receive Timeout    = 2000
Single ACK         = YES
Data Link Length   = 1
Use Balanced Mode  = NO
```

The *Port Configuration Menu* section has more information about the commands on this menu.

Opening the Port Status Menu

Press **[Q]** from the IEC-103 Master Driver Menu to open the Port Status menu. Use this command to verify the status of the Master commands sent through the port. If the display indicates a communication error, you should compare the generated error code with the command error codes listed in the Appendices of this manual.

```
Port Status Menu Selected
IEC-870-5-103 MASTER PORT 0 STATUS
Commands Executed  = 0
Command Responses  = 0
Command Err Count  = 0
Request Count      = 0
Response Count     = 0
Error Sent Count   = 0
Error Rec Count    = 0
Cfg Error Word     = 0x0000
Current Error Code = 0
Last Error Code    = 0
```

The *Port Status Menu* section has more information about the commands on this menu.

Opening the Session Configuration Menu

Press **[S]** to open the Session Configuration menu. Use this command to view the session configuration data.

Refer to *Session Configuration Menu* (page 82) for more information about the commands on this menu.

Opening the Sector Menu

Press **[1]** from the IEC-103 Master Driver Menu to open the Sector Configuration menu. Use this command to view the Sector Configuration data.

```
SECTOR CONFIGURATION MENU
?=Display Menu
D=Sector Database Menu
S=Show Again
P=Previous Page
N=Next Page
M=Return to Session Menu
```

The *Sector Configuration Menu* section has more information about the commands on this menu.

Viewing Master Driver Version Information

Press **[V]** from the IEC-103 Master Driver Menu to view the Master driver version information.

```
DRIVER VERSION INFORMATION:
(c) 1999-2003, ProLinx Communication Gateways, Inc.
PRODUCT NAME CODE       : IEC-870-5-103 Master Driver
SOFTWARE REVISION LEVEL : 2.14
SOFTWARE REVISION DATE  : 04/17/2003
FAR CORE LEFT           : 322368
```

Returning to the Main Menu

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

4.1.7 IEC-870-Master Command List Menu

Press **[I]** from the IEC-103 Master Driver Menu to open the ICE-870 Master Command List menu. Use this command to view the configured command list for the module.

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Redisplaying the Current Page

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

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.

Viewing the Previous Page of Registers

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

Moving Forward Through 5 Pages of Registers

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

Viewing the Next Page of Registers

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

Returning to the Main Menu

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

4.1.8 Port Configuration Menu

Press **[P]** from the IEC-103 Master Driver Menu to open the Port Configuration menu. Use this command to view the port configuration information for each of the application ports.

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Redisplaying the Current Page

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

Displaying the Next Page

Press **[N]** to display the next 100 registers. Use this command to step forward through the data a page at a time.

Displaying the Previous Page

Press **[P]** to display the previous 100 registers. Use this command to step backward through the data a page at a time.

Returning to the Main Menu

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

4.1.9 Port Status Menu

Press **[Q]** from the IEC-103 Master Driver Menu to open the Port Status menu. Use this command to view the communication status information for each application port.

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Redisplaying the Current Page

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

Displaying the Previous Page

Press **[P]** to display the previous 100 registers. Use this command to step backward through the data a page at a time.

Displaying the Next Page

Press **[N]** to display the next 100 registers. Use this command to step forward through the data a page at a time.

Returning to the Main Menu

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

4.1.10 Data Analyzer

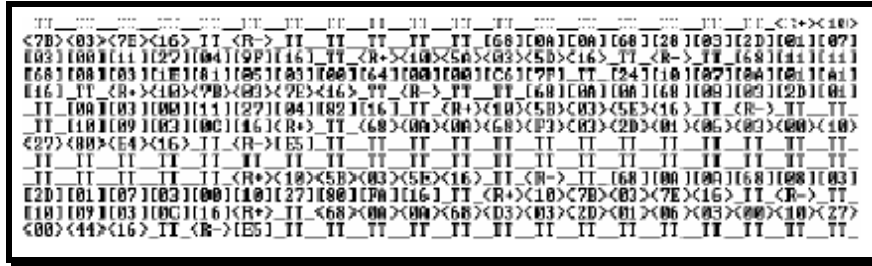
The data analyzer mode allows you to view all bytes of data transferred on each port. Both the transmitted and received data bytes are displayed. Use of this feature is limited without a thorough understanding of the protocol.

Note: The Port selection commands on the Data Analyzer menu differs very slightly in different modules, but the functionality is basically the same. Use the illustration above as a general guide only. Refer to the actual data analyzer menu on your module for the specific port commands to use.

Important: When in analyzer mode, program execution will slow down. Only use this tool during a troubleshooting session. Before disconnecting from the Config/Debug port, please press **[S]** to stop the data analyzer, and then press **[M]** to return to the main menu. This action will allow the module to resume its normal high speed operating mode.

Analyzing Data for the first application port

Press **[1]** to display I/O data for the first application port in the Data Analyzer. The following illustration shows an example of the Data Analyzer output.



Analyzing Data for the second application port

Press **[2]** to display I/O data for the second application port in the Data Analyzer.

Displaying Timing Marks in the Data Analyzer

You can display timing marks for a variety of intervals in the data analyzer screen. These timing marks can help you determine communication-timing characteristics.

Key	Interval
[5]	1 milliseconds ticks
[6]	5 milliseconds ticks
[7]	10 milliseconds ticks
[8]	50 milliseconds ticks
[9]	100 milliseconds ticks
[0]	Turn off timing marks

Removing Timing Marks in the Data Analyzer

Press **[0]** to turn off timing marks in the Data Analyzer screen.

Viewing Data in Hexadecimal Format

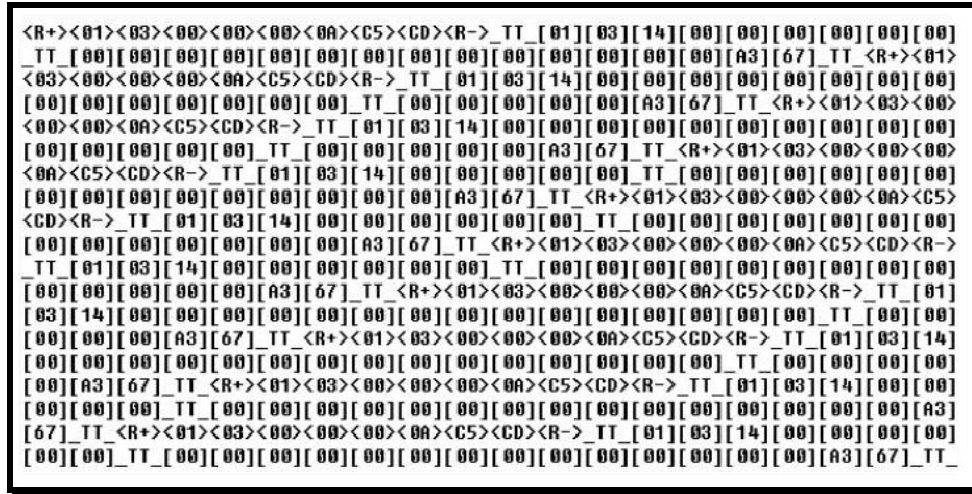
Press **[H]** from the *Database View* menu to display the data on the current page in hexadecimal format.

Viewing Data in 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.

Starting the Data Analyzer

Press **[B]** to start the data analyzer. After the key is pressed, all data transmitted and received on the currently selected port will be displayed. The following illustration shows an example.



The Data Analyzer displays the following special characters:

Character	Definition
[]	Data enclosed in these characters represent data received on the port.
< >	Data enclosed in these characters represent data transmitted on the port.
<R+>	These characters are inserted when the RTS line is driven high on the port.
<R->	These characters are inserted when the RTS line is dropped low on the port.
<CS>	These characters are displayed when the CTS line is recognized high.
TT	These characters are displayed when the timing mark interval has been reached. This parameter is user defined.

Stopping the Data Analyzer

Press **[S]** to stop the data analyzer. Use this option to freeze the display so the data can be analyzed. To restart the analyzer, press **[B]**.

Important: When in analyzer mode, program execution will slow down. Only use this tool during a troubleshooting session. Before disconnecting from the Config/Debug port, please press **[S]** to stop the data analyzer, and then press **[M]** to return to the main menu. This action will allow the module to resume its normal high speed operating mode.

Returning to the Main Menu

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

4.1.11 Session Configuration Menu

Press **[S]** from the IEC-103 Master Driver Menu to open the Session Configuration menu. Use this command to view the session configuration for each controlled device.

Online State

The *Online State* indicator displays 0 if the module is not online, 1 if the module is online.

Session State

The Session State indicator displays 1 if there is a configuration error, or 2 if the module is ready for communication. If the session is not in use, the Session State indicator displays 0.

4.1.12 Sector Configuration Menu

Press **[1]** from the IEC-103 Master Driver Menu to open the *Sector Configuration* menu. Use this command to view the contents of the *Sector Configuration Databases* for each session (controlled device). The module supports up to three sectors (databases) per session.

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Opening the Sector Database Menu

Press **[D]** from the Sector Configuration menu to open the Sector Database menu. Use this command to look at the configuration and current value for each point.

The *IEC-870-Master Command List Menu* section has more information about the commands on this menu.

Redisplaying the Current Page

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

Displaying the Next Page

Press **[N]** to display the next 100 registers. Use this command to step forward through the data a page at a time.

Displaying the Previous Page

Press **[P]** to display the previous 100 registers. Use this command to step backward through the data a page at a time.

Returning to the Main Menu

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

4.1.13 Sector Database Menu

Press **[D]** from the *Sector Configuration* menu to open the *Sector Database* menu. Use this command to display the sector database values. Each session (controlled device) contains one or more data sets (sectors) that are defined by the vendor of the device.

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Redisplaying the Current Page

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

Viewing ASDU n Data

Press keys **[0]** (zero) through **[4]** to display *ASDU (Application Data Service Unit)* data for each of the supported data types. Refer to *[IEC-103 Master Session x Sector x]* (page 45) for a list of *ASDU* types.

Listing ASDU point counts

Press **[5]** to display the *ASDU* point counts for each *ASDU* type.

SESSION 0	SECTOR 0	DATABASE SIZES:
ASDU	COUNT	
1&2	10	
3	0	
4	0	
5	0	
9	0	

Returning to the Main Menu

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

4.2 LED Status Indicators

The LEDs indicate the module's operating status as follows:

LED	Color	Status	Indication
CFG	Green	On	Data is being transferred between the module and a remote terminal using the Configuration/Debug port.
		Off	No data is being transferred on the Configuration/Debug port.
P1	Green	On	Data being transferred on the first application port
		Off	No data being transferred on port
P2	Green	On	Data being transferred on the second application port
		Off	No data being transferred on port
APP Status	Amber	Off	The MVI56-103M is working normally.
		On	The MVI56-103M module program has recognized a communication error.
BP ACT	Amber	On	The LED is on when the module is performing a write operation on the backplane.
		Off	The LED is off when the module is performing a read operation on the backplane. Under normal operation, the LED should blink rapidly on and off.
OK	Red/ Green	Off	The card is not receiving any power and is not securely plugged into the rack.
		Green	The module is operating normally.
		Red	The program has detected an error or is being configured. If the LED remains red for over 10 seconds, the program has probably halted. Remove the card from the rack and re-insert the card to restart the module's program.
BAT	Red	Off	The battery voltage is OK and functioning.
		On	The battery voltage is low or battery is not present. Allow battery to charge by keeping module plugged into rack for 24 hours. If BAT LED still does not go off, contact ProSoft Technology, as this is not a user serviceable item.

4.3 Clearing a Fault Condition

Typically, if the OK LED on the front of the module turns RED for more than ten seconds, a hardware problem has been detected in the module or the program has exited.

To clear the condition, follow these steps:

- 1 Turn off power to the rack.
- 2 Remove the card from the rack.
- 3 Verify that all jumpers are set correctly.
- 4 If the module requires a Compact Flash card, verify that the card is installed correctly.
- 5 Re-insert the card in the rack and turn the power back on.
- 6 Verify correct configuration data is being transferred to the module from the ControlLogix controller.

If the module's OK LED does not turn GREEN, verify that the module is inserted completely into the rack. If this does not cure the problem, contact ProSoft Technology Technical Support.

4.4 Troubleshooting

Use the following troubleshooting steps if you encounter problems when the module is powered up. If these steps do not resolve your problem, please contact ProSoft Technology Technical Support.

Processor Errors

Problem description	Steps to take
Processor fault	Verify that the module is plugged into the slot that has been configured for the module in the I/O Configuration of RSLogix. Verify that the slot location in the rack has been configured correctly in the ladder logic.
Processor I/O LED flashes	This indicates a problem with backplane communications. A problem could exist between the processor and any installed I/O module, not just the MVI56-103M. Verify that all modules in the rack are correctly configured in the ladder logic.

Module Errors

Problem description	Steps to take
BP ACT LED (not present on MVI56E modules) remains OFF or blinks slowly MVI56E modules with scrolling LED display: <Backplane Status> condition reads ERR	This indicates that backplane transfer operations are failing. Connect to the module's Configuration/Debug port to check this. To establish backplane communications, verify the following items: <ul style="list-style-type: none"> ▪ The processor is in RUN or REM RUN mode. ▪ The backplane driver is loaded in the module. ▪ The module is configured for read and write data block transfer. ▪ The ladder logic handles all read and write block situations. ▪ The module is properly configured in the processor I/O configuration and ladder logic.
OK LED remains RED	The program has halted or a critical error has occurred. Connect to the Configuration/Debug port to see if the module is running. If the program has halted, turn off power to the rack, remove the card from the rack and re-insert it, and then restore power to the rack.

4.5 Frequently Asked Questions

This section provides answers frequently asked questions about the ProLinx 103M module.

4.5.1 Why is the module not communicating with the slave?

First, ensure that the slave Data Link Address is configured as a slave (session) in the configuration file. The module will only try to initialize slaves identified by Data Link Addresses that are currently configured as sessions. Refer to technical specification for your protection equipment for its Data Link Address. You should also check to see if the common ASDU address is configured as a sector in the module. Make sure all port communication parameters match the slave parameters (baud rate, parity, and so on). Finally, look at the cables and ensure that the correct communication mode is set (RS-232 or RS-495).

4.5.2 The slave is responding but I cannot see the monitor data in the Module database.

Ensure that the monitor points are correctly configured. Refer to your protection equipment's documentation for the correct ASDU type, Function Code, and Information Number. These values must match the parameters that are entered for every monitor point in the [IEC-103 Master Session 0] section of the configuration file.

The addressing type in the module database depends on the point ASDU type. The Database Index parameter can be interpreted as bit, byte, word, or double-word address. For more details, refer to Data Types and Mapping (page 99).

4.5.3 How can I confirm if the configuration was received by the module?

You can verify this using the Debug menu. Refer to Diagnostics and Troubleshooting in this manual for information on using the Debug menu (page 67).

5 Reference

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5.1 Product Specifications

The MVI56 IEC 60870-5-103 Master Communication Module allows ControlLogix backplane I/O compatible processors to interface easily with IEC 60870-5-103 compatible devices. Devices commonly supporting the protocol include relays, breakers, sub-station Communication Modules and other serial communication devices used in power monitoring.

The MVI56-103M supports up to 32 total field devices between the module's two IEC 60870-5-103 Master ports. The module's communication ports can each be independently configured, allowing two separate field networks to be implemented. The field device data is exchanged between the MVI56 module and the ControlLogix processor over the backplane.

5.1.1 General Specifications

- Single Slot - 1756 backplane compatible
- The module is recognized as an Input/Output module and has access to processor memory for data transfer between processor and module.
- Ladder Logic is used for data transfer between module and processor. Sample ladder file included.
- Configuration data obtained from configuration text file downloaded to module. Sample configuration file included
- Local or remote rack

5.1.2 Functional Specifications - MVI56-103M

The MVI56-103M module supports the IEC 60870-5-103 protocol to the following specifications:

- The IEC 60870-5-103 communication driver is built in accordance to the approved IEC specification
- The module has two independent Master ports, each configurable via a simple configuration file
- Supports up to 32 sessions (controlled devices) between the two ports
- Supports up to five sectors (separate databases) for each session, with individual database definition for each sector
- Total of 1000 user-configurable commands to control data transfer to/from devices (controlled devices)
- Supports clock synchronization from/to the processor
- Event data received from the Control Devices updates the module database (Date and Time stamping is not stored or used by module)
- Class 1 and Class 2 delay parameters are configurable for each session
- An IEC Interoperability Document for the module is available from the web site, which fully documents data types supported by the module

Functional Overview

The standards used to build the module are listed in the following table.

PUBLICATION	TITLE
IEC 60870-5-103	Companion Standard for the informative interface of protection equipment.
IEC 60870-5-103 Annex A	Generic functions: Examples of constructing a directory
IEC 60870-5-1	Transmission Frame Formats
IEC 60870-5-2	Link Transmission Procedures
IEC 60870-5-3	General Structure of Application Data
IEC 60870-5-4	Definition and Coding of Application Information Elements
IEC 60870-5-5	Basic Application Functions

Detailed questions about the protocol can be answered by reading these documents. These documents should be obtained, reviewed, and understood in order to fully appreciate the protocol implementation. Most of the complexity of the protocol is hidden from the user and simplified in the application of the module.

5.1.3 Hardware Specifications

Specification	Description
Backplane Current Load	800 mA @ 5 Vdc 3 mA @ 24 Vdc
Operating Temperature	0°C to 60°C (32°F to 140°F)
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Shock	30 g operational 50 g non-operational Vibration: 5 g from 10 Hz to 150 Hz
Relative Humidity	5% to 95% (without condensation)
LED Indicators	Module Status Backplane Transfer Status Application Status Serial Activity
Debug/Configuration port (CFG)	
CFG Port (CFG)	RJ45 (DB-9M with supplied cable) RS-232 only
Application ports (PRT1 & PRT2)	
Full hardware handshaking control, providing radio, modem and multi-drop support	
Software configurable communication parameters	Baud rate: 110 to 115,200 baud, depending on protocol RS-232, 485 and 422 Parity: none, odd or even Data bits: 5, 6, 7, or 8 Stop bits: 1 or 2 RTS on/off delay: 0 to 65535 milliseconds
App Ports (P1, P2) (Serial modules)	RJ45 (DB-9M with supplied cable) RS-232 handshaking configurable 500V Optical isolation from backplane
Shipped with Unit	RJ45 to DB-9M cables for each port 6-foot RS-232 configuration cable

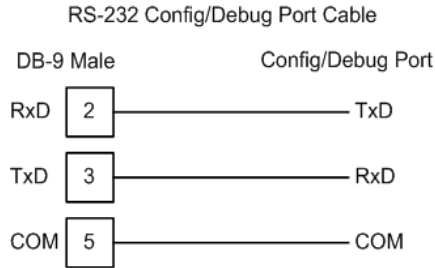
Cable Connections

The application ports on the MVI56-103M module support RS-232, RS-422, and RS-485 interfaces. Please inspect the module to ensure that the jumpers are set correctly to correspond with the type of interface you are using.

Note: When using RS-232 with radio modem applications, some radios or modems require hardware handshaking (control and monitoring of modem signal lines). Enable this in the configuration of the module by setting the UseCTS parameter to 1.

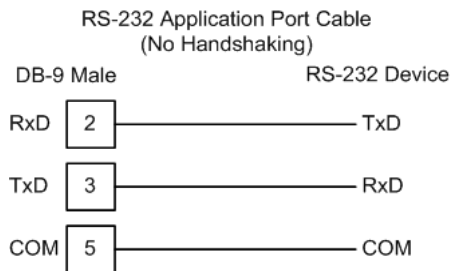
RS-232 Configuration/Debug Port

This port is physically an RJ45 connection. An RJ45 to DB-9 adapter cable is included with the module. This port permits a PC based terminal emulation program to view configuration and status data in the module and to control the module. The cable for communications on this port is shown in the following diagram:



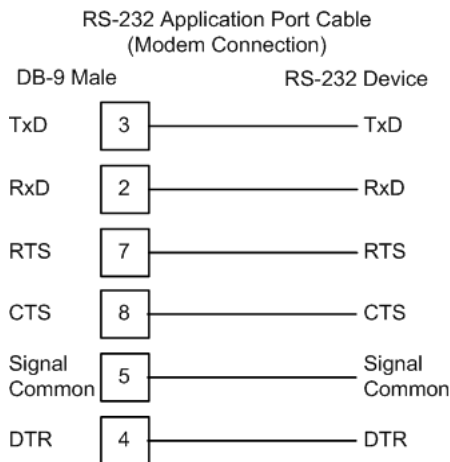
RS-232 Application Port(s)

When the RS-232 interface is selected, the use of hardware handshaking (control and monitoring of modem signal lines) is user definable. If no hardware handshaking will be used, here are the cable pinouts to connect to the port.



RS-232: Modem Connection (Hardware Handshaking Required)

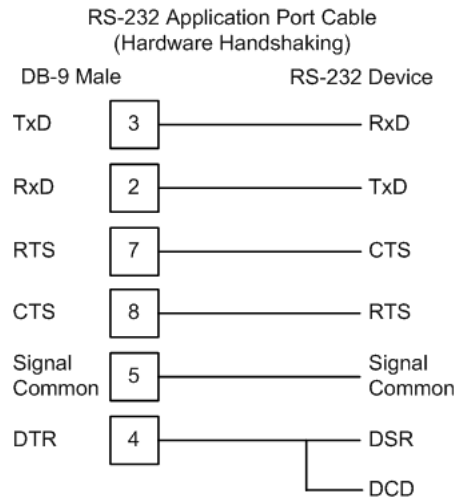
This type of connection is required between the module and a modem or other communication device.



The "Use CTS Line" parameter for the port configuration should be set to 'Y' for most modem applications.

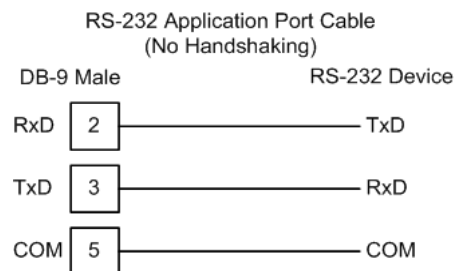
RS-232: Null Modem Connection (Hardware Handshaking)

This type of connection is used when the device connected to the module requires hardware handshaking (control and monitoring of modem signal lines).

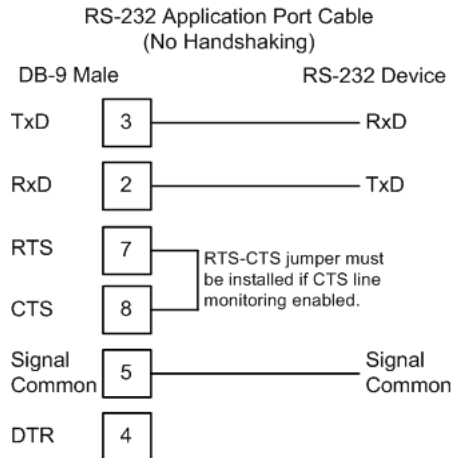


RS-232: Null Modem Connection (No Hardware Handshaking)

This type of connection can be used to connect the module to a computer or field device communication port.

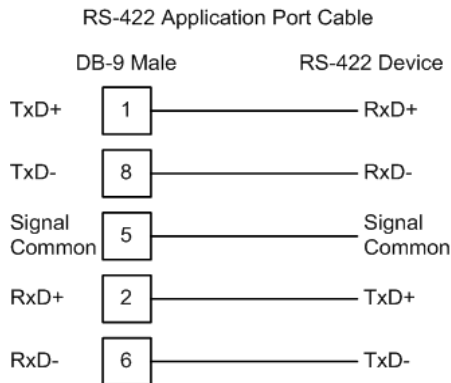


Note: For most null modem connections where hardware handshaking is not required, the *Use CTS Line* parameter should be set to **N** and no jumper will be required between Pins 7 (RTS) and 8 (CTS) on the connector. If the port is configured with the *Use CTS Line* set to **Y**, then a jumper is required between the RTS and the CTS lines on the port connection.



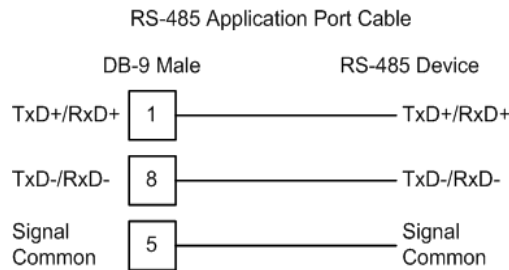
RS-422

The RS-422 interface requires a single four or five wire cable. The Common connection is optional, depending on the RS-422 network devices used. The cable required for this interface is shown below:



RS-485 Application Port(s)

The RS-485 interface requires a single two or three wire cable. The Common connection is optional, depending on the RS-485 network devices used. The cable required for this interface is shown below:

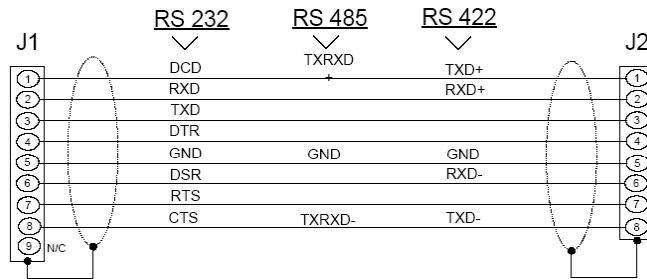
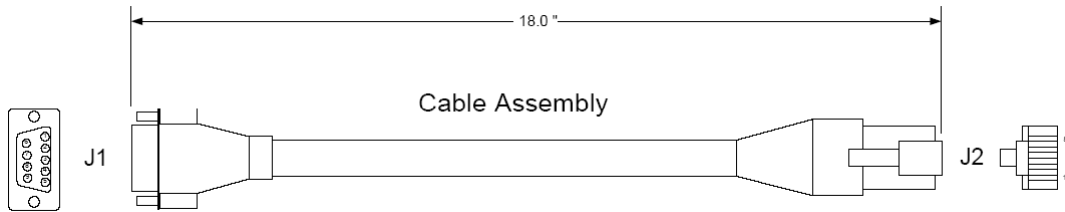


Note: Terminating resistors are generally not required on the RS-485 network, unless you are experiencing communication problems that can be attributed to signal echoes or reflections. In these cases, installing a 120-ohm terminating resistor between pins 1 and 8 on the module connector end of the RS-485 line may improve communication quality.

RS-485 and RS-422 Tip

If communication in the RS-422 or RS-485 mode does not work at first, despite all attempts, try switching termination polarities. Some manufacturers interpret + and -, or A and B, polarities differently.

DB9 to RJ45 Adaptor (Cable 14)



Wiring Diagram

5.2 General Concepts

The following discussion explains several concepts that are important for understanding module operation.

5.2.1 Module Power Up

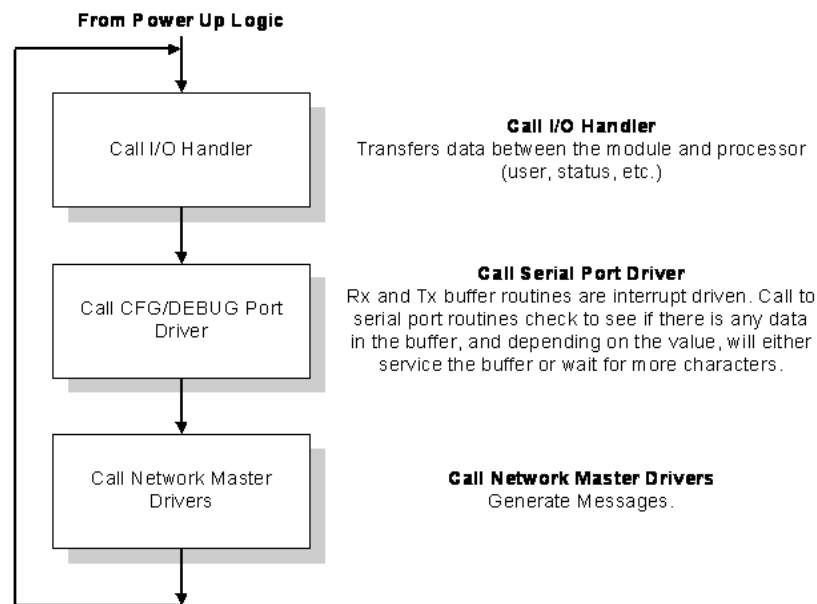
On power up the module begins performing the following logical functions:

- 1 Initialize hardware components
 - Initialize ControlLogix backplane driver
 - Test and clear all RAM
 - Initialize the serial communication ports
- 2 Read configuration for module from IEC103M.CFG file on Compact Flash Disk
- 3 Initialize the databases and ports
- 4 Set up the serial communication interface for the debug/configuration port

After the module has received the configuration, the module will begin receiving and transmitting messages with devices on the serial networks.

5.2.2 Main Logic Loop

Upon completing the power up configuration process, the module enters an infinite loop that performs the following functions:



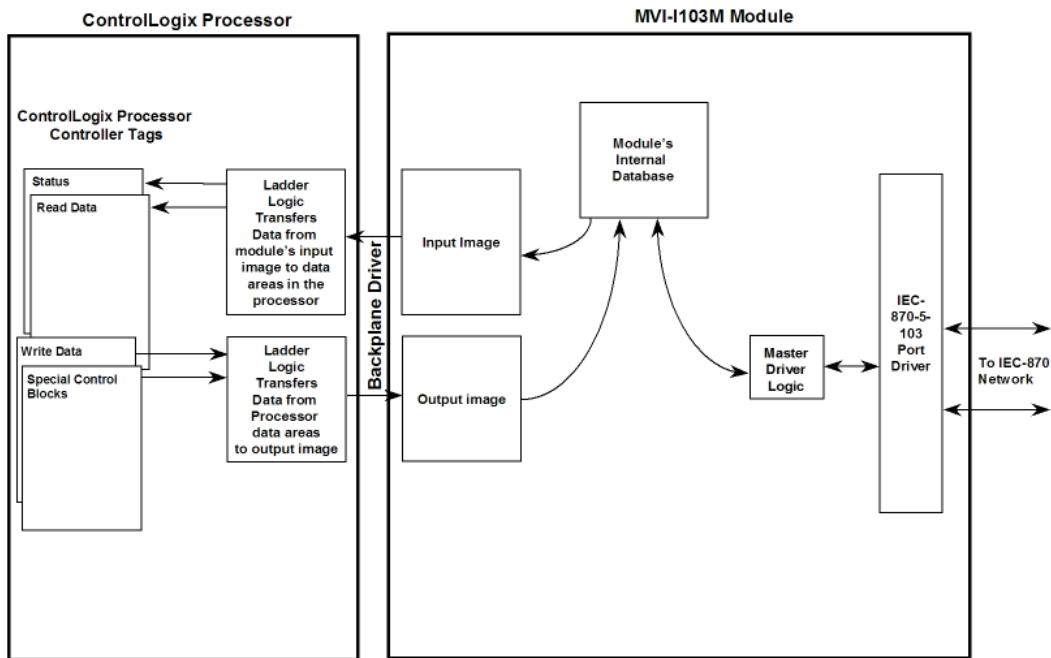
5.2.3 Backplane Data Transfer

The MVI56-103M module communicates directly over the ControlLogix backplane. Data travels between the module and the ControlLogix processor across the backplane using the module's input and output images. The update frequency of the data is determined by the scan rate defined by the user for the module and the communication load on the module. Typical updates are in the range of 1 to 10 milliseconds.

Data received by the Master drivers is placed in the module's input image. This data is processed by the ladder logic in the ControlLogix processor. The input image for the module is set to 500 bytes. This large data area permits fast throughput of data between the module and the processor.

The processor inserts data in the module's output image to transfer to the module. The module's program extracts the data and transmits the data out to the Master driver to the serial network. Additionally, the ControlLogix processor can send special control blocks to the module to instruct it to perform a special task. The output image for the module is set to 496 bytes. This large data area permits fast throughput of data from the processor to the module.

The following illustration shows the data transfer method used to move data between the ControlLogix processor, the MVI56-103M module, and the serial network.



All data transferred between the module and the processor over the backplane is through the input and output images. Ladder logic must be written in the ControlLogix processor to interface the input and output image data defined in the controller tags. The user is responsible for handling and interpreting all data received on the application ports and transferred to the input image.

5.2.4 Data Types and Mapping

When interfacing data in the processor to that of the IEC 60870-5-103 protocol, it is important that the user understand the mapping of the data types to their corresponding representation in the modules database. The following table lists the data types supported by the module and their associated storage representation:

Type ID	Description	Data Representation
1	Time-tagged messages with each data point represented by two bits.	Dual-bit status (7.2.6.5 with 00b (0 decimal) = not used, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = not used
2	Time-tagged messages with relative time with each point represented by two bits.	Dual-bit status (7.2.6.5 with 00b (0 decimal) = not used, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = not used
3	Measurands with quality descriptor. The lower 3 bits of the values represented in this data type contain status information. The upper 13 bits of the value contained a signed, 12-bit number. This data type will return from 1 to 4 values. The number of words received is dependant on the information object number and the slave device.	Measurand with quality descriptor (7.2.6.8) Bit 0: 0 = No overflow, 1 = Overflow Bit 1: 0 = Valid, 1 = Invalid Bit 2: Reserved Bits 3 to 25: Value from $-1..+1-2^{12}$
4	Time-tagged measurands with relative time with the value in the packet represented by a single floating point number.*	Short floating-point number stored in IEEE STD 754 format (Fraction, Exponent, Sign) (7.2.6.20)
5	Identification data composed of 12 characters of data. Each point in defined of this data type should reserve 12 bytes (6-word addresses) in the database for the data received.	Byte data as defined in 7.2.6.2. First 8 bytes are characters 1 to 8 and last 4 bytes are manufacture bytes either decimal (0 to 255) or as ASCII characters.
9	Measurands with quality descriptor. The lower 3 bits of the values represented in this data type contain status information. The upper 13 bits of the value contained a signed, 12-bit number. This data type will return from 1 to 9 values (some slaves may return up to 16 values). The number of words received is dependant on the information object number and the slave device.	Measurand with quality descriptor (7.2.6.8) Bit 0: 0 = No overflow, 1 = Overflow Bit 1: 0 = Valid, 1 = Invalid Bit 2: Reserved Bits 3 to 25: Value from $-1..+1-2^{12}$
20	General command to control a dual-point object. Each command issued by the module uses the values of two adjacent bits in the database or an override value specified by the user command.	Dual-bit status (7.2.6.4 with 00b (0 decimal) = not used, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = not used

* The words should be swapped in the ladder logic.

As shown in the previous table, all bit types are addressed as bits in the modules database.

Addressing the Data Types

The following table shows an example of how to address the data types in the MVI56-103M:

Data Type	Address Type	Length	Example
1	Bit	2 bits	Address 160 refers to first and second bits from word 10.
2	Bit	2 bits	Address 160 refers to first and second bits from word 10.
3	Word	4 words	Address 50 refers to word 50, 51, 52, and 53.
4	Double-word	2 words	Address 40 refers to two consecutive words starting at word 80.
5	Bit	12 bits	Address 180 refers to 12 consecutive bits starting at the LSB of word 90.
9	Word	5 words	Address 100 refers to 9 consecutive words starting at word 100.
20	Bit	2 bits	Address 160 refers to the first and second bits from word 10.

Therefore, address 16000 represents bit zero in word 1000 of the module's database. Short floating-point, 32-bit strings and integrated total values each occupy a double-word space in the database. Therefore, short float database address of 100 represents the two words, 200 and 201, in the modules database. Identification objects are stored as byte values in the modules database. Identification object address 1000 is stored in the module's database in word addresses 500 to 505.

When setting the monitored data and commands, each point is defined by its ASDU type, function code, and information number. Valid function codes are listed in the following table.

Function Code	Symbol	Number
Distance Protection	T(z)	128
Over-current Protection	I>>	160
Transformer Differential Protection	rlt	176
Line Differential Protection	rll	192
Global Function Type	GLB	255

Refer to Protocol Interoperability Documentation (page 133) for a full listing of the protocol support offered by the module.

As blocks are transferred between the module and the processor, each block contains block identification codes that define the content or function of the block of data transferred. The block identification codes used by the module are displayed in the following table.

Block Range	Descriptions
-1	Null block
0	Null block
1 to 20	Read or write data
9901	User Constructed Command
9902	Command Control Block (Add command to Command List Queue)
9903	Event Messages from Master port
9950	Command List Error data
9970	Set PLC time using module's time
9971	Set module's time using ControlLogix time
9998	Warm Boot Request from ControlLogix (Block contains no data)
9999	Cold Boot Request from ControlLogix (Block contains no data)

Blocks -1 and 0 transfer status data from the module to the processor and they contain no data when transferred from the processor to the module. Blocks 1 to 20 are utilized to transfer data stored or to be stored in the module's database. These data blocks send data from module to the processor (monitored data received from the devices on the serial network) and to send data from the processor to the module (control data to send to the end devices). Block identification codes 9901 to 9999 are used for special control blocks to control the module.

5.3 Normal Data Transfer

Normal data transfer includes the transferring of data received by or to be transmitted to the Master drivers and the status data. These data are transferred through read (input image) and write (output image) blocks.

Refer to Module Configuration for a description of the data objects used with the blocks and the ladder logic required. The following topics discuss the structure and function of each block.

5.3.1 Read Block

These blocks of data transfer information from the module to the ControlLogix processor. The following table describes the structure of the input image.

Offset	Description	Length
0	Reserved	1
1	Write Block ID	1
2 to 201	Read Data	200
202 to 247	Error/Status Data	46
248	Spare	1
249	Read Block ID	1

The Block Identification Code (word 249) is used to signal to the ControlLogix processor that a new block is ready for processing and informs the processor of the contents of the block. If the value of the code is set to 1, the block contains the first 200 words of data contained in the database of the module.

Additionally, the status data contained in the block should be copied to the status data area in the module. This information can be used to determine the "health" and activity of the module. For a detailed listing of the Status area and its contents, refer to Status Data Area (page 114).

The block also contains the Write Block Identification (ID) code the module expects to receive from the processor (word 1 in the block) in the next output image. Under normal data transfer conditions, the ladder logic should use this code to build the output image, unless a special output block has been triggered to be sent instead.

5.3.2 Block Request from Processor to the Module

These blocks of data transfer information from the <Processor Model> to the module. The following table describes the structure of the output image.

Offset	Description	Length
0	Write Block ID	1
1 to 200	Write Data	200
201 to 247	Spare	47

The Write Block ID code defines the content of the data area contained in the block. If the code is set to -1 or 0, the data area contains no valid data. If the word contains a value from 1 to 20, the data contained in the block will come from the appropriate position of the module's database. Under normal conditions, the value used for the Write Block ID should be that received in the Read Block from the module.

5.4 Command Control Blocks

Block identification codes greater than 9900 are utilized to perform special functions in the module. Each control block recognized and used by the module is defined in the following topics.

5.4.1 User Constructed Command Block (9901)

Block identification code 9901 issues one or more user constructed commands. When the module receives a block 9901 identification code, it will place the included commands into the command queue.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the block identification code of 9901 for the block.
1	Command Count	This field defines the number of user commands contained in the block. The valid range for the field is 1 to 10.
2 to 11	Command #1	Data required to build the user defined command in the command queue.
12 to 21	Command #2	Data required to build the user defined command in the command queue.
22 to 31	Command #3	Data required to build the user defined command in the command queue.
32 to 41	Command #4	Data required to build the user defined command in the command queue.
42 to 51	Command #5	Data required to build the user defined command in the command queue.
52 to 61	Command #6	Data required to build the user defined command in the command queue.
61 to 71	Command #7	Data required to build the user defined command in the command queue.
72 to 81	Command #8	Data required to build the user defined command in the command queue.
82 to 91	Command #9	Data required to build the user defined command in the command queue.
92 to 101	Command #10	Data required to build the user defined command in the command queue.
102 to 247	Spare	Not Used

The following fields are used for each 10-word record in the command list:

Word Offset	Definitions	Description
0	Database Index	Address in module to associate with the command.
1	Session Index	Session index defined in the module to associate with the command.
2	Sector Index	Sector index for session as defined in the module.
3	Data Type	ASDU data type associated with the command.
4	Function Code	Function Code for the command.
5	Point Index * * Information Number	Information object address for the point on which the command operates.
6	Override Flag	Override flag for general command.
7	Override Value	Override value for general command.
8	Reserved	Reserved for future use.
9	Reserved	Reserved for future use.

The fields shown here are the same as those used in constructing the commands in the Command List. For a detailed definition of the fields contained in this block, refer to the Command List (page 39).

There is no response block built by the module to send back to the processor after the 9901 block is processed. The commands are placed in the command queue and issued at a high priority.

This block and block 9902 should be used when controlling double-point data points in remote units using general commands. This provides complete control of the slave devices under ladder logic control. Alternatively, the slaves can be controlled by changing data in the database and having the data be transferred using pre-constructed commands in the user's command list. Some points only accept value of on for control (that is, LED reset or activate characteristic). For these points, block 9901 and 9902 should only be utilized.

5.4.2 Command Control Block (9902)

The Block 9902 identification code is used by the processor to send a list of commands to be placed in the command queue from the user-configured command list. Commands placed in the queue with this method need not have their enable bit set in the command list.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9902 identifying the enable command to the module.
1	Command count	This field contains the number of commands to enable in the command list. Valid values for this field are 1 to 60.
2 to 61	Command Numbers to enable	These 60 words of data contain the command numbers in the command list to enable. The commands in the list will be placed in the command queue for immediate processing by the module. The first command in the list has an index of 0.
62 to 247	Spare	Not Used

There is no response to this block by the module. The module will place the selected commands into the command queue. If the command references a unit that is not defined, the command will not be placed in the command queue. Normal processing of the command list will continue after the commands specified in this block are processed.

For digital output control, the use of Block 9901 and 9902 is preferred to the use of the command list. The exact state of the output can be specified in the command list and then the command can be enabled through the use of block 9902. When the user wishes to execute this command (knowing the state of the command), he or she can enable the command with the Block 9902 request.

5.4.3 Event Message Block (9903)

Block identification code 9903 sends event messages received on the Master port to the processor.

Note: Events are recognized when using a COT = Spontaneous.

Word Offset in Block	Data Field(s)	Description
0	Reserved	
1	Block ID	This is the next block requested by the module.
2	Event Count	This field contains the number of events present in the block. Values of 1 to 20 are valid.
3 to 12	Event 1	Event message
13 to 22	Event 2	Event message
23 to 32	Event 3	Event message
33 to 42	Event 4	Event message
43 to 52	Event 5	Event message
53 to 62	Event 6	Event message
63 to 72	Event 7	Event message
73 to 82	Event 8	Event message
83 to 92	Event 9	Event message
93 to 102	Event 10	Event message
103 to 112	Event 11	Event message
113 to 122	Event 12	Event message
123 to 132	Event 13	Event message
133 to 142	Event 14	Event message
143 to 152	Event 15	Event message
153 to 162	Event 16	Event message
163 to 172	Event 17	Event message
173 to 182	Event 18	Event message
183 to 192	Event 19	Event message
193 to 202	Event 20	Event message
203 to 248	Spare	Not Used
249	Block ID	This field contains the block identification code of 9903 for the block.

The format of each 10-word data region in the block is as follows:

Word Offset	Definitions	Description
0	Session Index/Sector Index	This field contains the session and sector indices used to define the controlled unit in the module from which the event was generated. The MSB contains the session index and the LSB contains the sector index.
1	ASDU Type	This field contains the ASDU type code for the data contained in the message.
2	Function Code/Point Index*	This field contains the function code and the point index associated with the event message. The MSB contains the function code and the LSB contains the point index.
3	Fault Number	This is the fault number for the event if applicable. Only valid for ASDU types 2 and 4.
4	Sec/milliseconds	This word contains the seconds and millisecond values with a range of 0 to 59999 time at which the message was generated by the slave device.
5	Hr/Min.	This word contains the hour and minutes the message was generated by the slave. The MSB contains the hour and the LSB contains the minute value.
6	Invalid/DST	This word contains two bits that relate to the time value recorded in the slave device for the message. Bit 0 corresponds to the validity of the time (0=valid, 1=invalid) and Bit 1 defines if daylight savings time is used in the time (0=no, 1=yes).
7	Relative Time	This field contains the relative time value if applicable to the object. Only valid for ASDU types 2 and 4.
8 to 9	Value	This double-word value contains the value for the point index/function code in the event message. For ASDU types 1 and 2, this value is only 2 bits wide. For ASDU type 4, this double-word value contains the floating-point number (short circuit location).

In order for this feature to be activated, the event pass-through parameter must be set. When a Master driver receives an event message from a controlled station, it will build an event message corresponding to the event in the event buffer of the module. This buffer is then sent to the processor when any messages are present. Therefore, these blocks are sent to the processor on a high priority. After the block is sent, the event message is removed from the module's event buffer.

If too many events are present in the buffer (>200), the module will set the event message overflow flag in the error/status data area of the normal read data block. There is no response block to be received by the module from the processor.

5.4.4 Read Command Error List Block (9950)

Block 9950 identification code requests the Command List Error Table from the module for the 1000 user-configurable commands. The format for the block is shown below:

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9950 identifying the block type to the module.
1	Number of Commands to report	This field contains the number of commands to report in the response message. The value has a range of 1 to 200.
2	Start Index of First Command	This parameter sets the index in the command list where to start. The first command in the list has a value of 0. The last index in the list has a value of MaxCommands -1.
3 to 247	Spare	Not Used

The module will respond to a valid request with a block containing the requested error information. The following table describes the format of this block.

Word Offset in Block	Data Field(s)	Description
0	Reserved	Reserved (0)
1	Block ID	This is the next block requested by the module.
2	Number of Commands reported	This field contains the number of commands contained in the block that must be processed by the PLC. This field will have a value of 1 to 200.
3	Start Index of First Command	This field contains the index in the command list for the first value in the file. This field will have a value of 0 to MaxCommands-1.
4 to 203	Command List Errors	Each word of this area contains the last error value recorded for the command. The command index of the first value (offset 4) is specified in word 3 of the block. The number of valid command errors in the block is set in word 2 of the block. Refer to the command error list to interpret the error codes reported.
204 to 248	Spare	Not Used
249	Block ID	This field contains the value of 9950 identifying the block type to the PLC.

5.4.5 Set ControlLogix Time Block (9970)

Block 9970 identification code requests the module's date and time. Use this data to set the PLC clock.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9970 identifying the block type to the module.
1 to 247	Not Used	Not Used

The module will respond to a valid block 9970 request with a block containing the requested date and time. The following table describes the format of this block.

Word Offset in Block	Data Field(s)	Description
0	Reserved	Reserved (0)
1	Block Write ID	This is the next block requested by the module.
2	Year	This field contains the four-digit year for the new time value.
3	Month	This field contains the month value for the new time. Valid entry for this field is in the range of 1 to 12.
4	Day	This field contains the day value for the new time. Valid entry for this field is in the range of 1 to 31.
5	Hour	This field contains the hour value for the new time. Valid entry for this field is in the range of 0 to 23.
6	Minute	This field contains the minute value for the new time. Valid entry for this field is in the range of 0 to 59.
7	Seconds	This field contains the second value for the new time. Valid entry for this field is in the range of 0 to 59.
8	Milliseconds	This field contains the millisecond value for the new time. Valid entry for this field is in the range of 0 to 999.
9 to 248	Not Used	Not Used
249	Block Read ID	This field contains the block identification code of 9970 for the block.

5.4.6 Set Module Time Block (9971)

Block identification code 9971 passes the clock time in the ControlLogix to the module. The date and time provided will be used to set the module's clock.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the block identification code of 9971 for the block.
1	Year	This field contains the four-digit year for the new time value.
2	Month	This field contains the month value for the new time. Valid entry for this field is in the range of 1 to 12.
3	Day	This field contains the day value for the new time. Valid entry for this field is in the range of 1 to 31.
4	Hour	This field contains the hour value for the new time. Valid entry for this field is in the range of 0 to 23.
5	Minute	This field contains the minute value for the new time. Valid entry for this field is in the range of 0 to 59.
6	Seconds	This field contains the second value for the new time. Valid entry for this field is in the range of 0 to 59.
7	Milliseconds	This field contains the millisecond value for the new time. Valid entry for this field is in the range of 0 to 999.
8 to 247	Not Used	Not Used

The module does not send a response block to the processor after receiving this block.

5.4.7 Warm Boot Block (9998)

Block 9998 performs a warm-boot operation on the module. The following table describes the format of the block constructed by the processor.

Offset	Description	Length
0	9998	1
1 to 247	Spare	247

In this version of the module, the warm and cold boot processes perform the same operation as many of the variables that must be initialized are fixed when the module first boots and cannot be changed after the application starts.

5.4.8 Cold Boot Block (9999)

Block 9999 performs a cold-boot operation on the module. The following table describes the format of the block constructed by the processor.

Offset	Description	Length
0	9999	1
1 to 247	Spare	247

In this version of the module, the warm and cold boot processes perform the same operation as many of the variables that must be initialized are fixed when the module first boots and cannot be changed after the application starts.

5.5 Master Driver

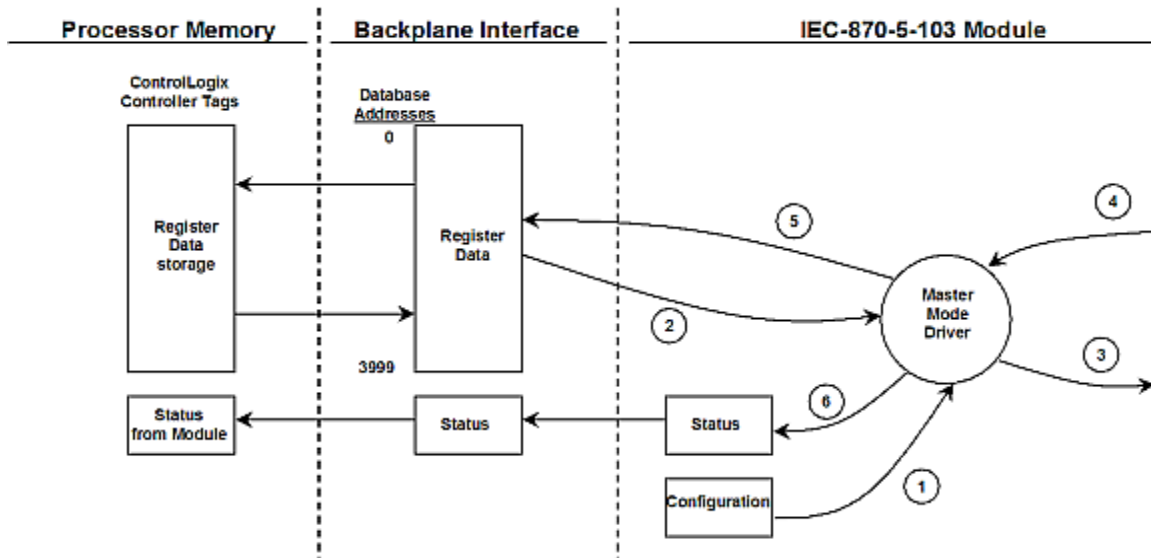
The Master driver supported on each of the two application ports of the module emulates an IEC 60870-5-103 Master device. Configuration of each port is independent and each port should be connected to physically separate serial networks.

Each port on the module communicates with one or more controlled stations using what are referred to as sessions. A session represents a controlled device (slave) with a unique Data Link layer address. Each session (controlled slave device) contains one or more data sets (sectors) that are defined by the vendor of the device.

Up to thirty-two sessions (or less on some modules) can be defined on the module, with each session being assigned to only one application port. Within each session, up to five sectors can be defined. This system permits a very flexible assignment of resources in the module. The definition of the data associated with each sector in the system is defined by the user in the configuration file.

Note: The IEC 60870-5-103 specification requires support only for unbalanced transmission mode. No support is given in the protocol for the balanced mode and the module does not support this mode.

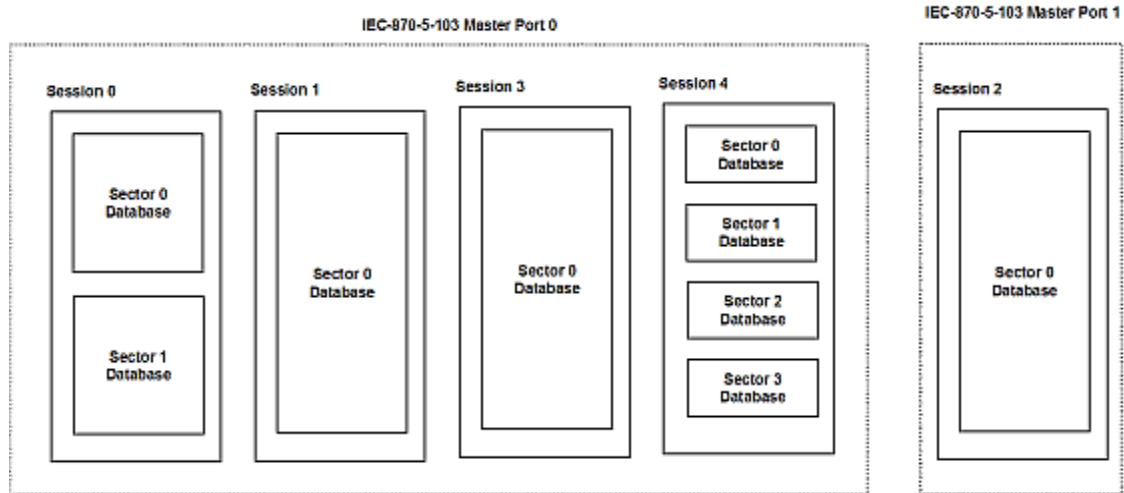
The following diagram shows the functionality of the Master driver:



- 1 The Master driver is configured as specified by the IEC103M.CFG file.
- 2 The Master will construct control commands using the data in the database.
- 3 The Master will send these commands and class polls out on the serial network.
- 4 Response messages or spontaneous messages generated by controlled devices on the serial network are received by the Master driver.
- 5 Monitor data received by the Master is passed to the module's database and passed to the processor.

- 6 Additionally, status data for the module is passed to the processor; for details, see Status Data Object (page 57).

The following illustration presents one of many possible combinations of these flexible configuration options.



In this example, Port 0 on the module communicates with 4 sessions (0, 1, 3, and 4), each of which has their own data set(s). Session 1 has only one sector (all data for this one device contained in a single database). This sector is addressed by the Master using the Common Address of ASDU value set for the sector in the configuration file. Session 0 contains two sectors, each with their own unique Common Address of ASDU value to identify the sector.

Port 1 is connected to one device on the network. This device is defined in the Session 2 section of the configuration file. In this example, all data from this device is stored in a single sector.

5.6 MVI56-103M Status Data Area

This section contains a listing of the data contained in the MVI56-103M status data object, configuration error word and module error codes.

5.6.1 MVI56-IEC 60870-5-103 Master Communication Module Error/Status Data Format

Status Table Word	Parameter	Description
0	Scan Count	This status value contains a counter incremented on each scan of the module's main loop.
1 to 2	Product Name	This two-word data area contains the text values representing the product name. These words contain the text "I3M5" for the MVI56 platform.
3 to 4	Revision	This two-word data area contains the text values for the revision number.
5 to 6	Op Sys #	This two-word data area contains the text values for the operating system number.
7 to 8	Run Number	This two-word data area contains the text values for the run number.
9	Read Blk Cnt	This word contains the total number of block read operations successfully executed.
10	Write Blk Cnt	This word contains the total number of block write operations successfully executed.
11	Parse Blk Cnt	This word contains the total number of write blocks successfully parsed.
12	Error Blk Cnt	This word contains the total number of block transfer errors.
13	Event Msg Cnt	This word contains the number of event messages waiting to send to the processor.
14	Event Msg Overflow	This word contains a value of 0 if the event message buffer has not overflowed. If the event buffer overflows, this word will be set to a value of 1.
15	Session Count	This word contains the number of session configured in the module.
16	Current Cmd	This word contains the index of the current command being executed in the command list.
17	Cmd Busy Flag	This word is set to zero if no command is currently being executed and waiting on a response. If the word is set to 1, a command is currently executing.
18	Cmd Count	This word contains the count of the number of commands configured for the module.
19	Cmd Delay	This word contains the command delay counter preset. There is a fixed delay between each command to permit the module to perform class polls on controlled stations.
20	Cmd Queue	This word is set to zero if the command executing is from the command list. If the executing command is from the command queue, the word will be set to 1.

Status Table Word	Parameter	Description
21	Cmd Queue Count	This word contains the number of active commands in the command queue for the module. Up to 100 commands can be buffered in this queue. These commands are transferred from the processor to the module using special command blocks.
22 to 23	Online Status	This double word value contains a bit for each of the 32 potential sessions in the module. If the bit is set for a session in the double word, the station is online. If the bit is clear, the station is offline. Use this value to determine if commands sent from the processor will have a chance of succeeding.
24	CH 0 State	This word contains the state machine value for Port 0.
25	Cmd Req	This word contains the number of commands transferred out Port 0.
26	Cmd Resp	This word contains the number of command response messages received on Port 0.
27	Cmd Err	This word contains the number of command errors recognized on Port 0.
28	Requests	This word contains the total number of messages transmitted on Port 0.
29	Responses	This word contains the total number of messages received on Port 0.
30	Err Sent	This word contains the number of error messages sent on Port 0.
31	Err Received	This word contains the number of error messages received on Port 0.
32	Cfg Err	This bit mapped word recognizes any configuration errors for Port 0. Refer to the configuration error word table for a definition of each bit.
33	Current Error	This word contains the error code for the current command executing on Port 0.
34	Last Error	This word contains the error code for the last error recognized on Port 0.
35	CH 1 State	This word contains the state machine value for Port 1.
36	Cmd Req	This word contains the number of commands transferred out Port 1.
37	Cmd Resp	This word contains the number of command response messages received on Port 1.
38	Cmd Err	This word contains the number of command errors recognized on Port 1.
39	Requests	This word contains the total number of messages transmitted on Port 1.
40	Responses	This word contains the total number of messages received on Port 1.
41	Err Sent	This word contains the number of error messages sent on Port 1.
42	Err Received	This word contains the number of error messages received on Port 1.
43	Cfg Err	This bit mapped word recognizes any configuration errors for Port 1. Refer to the configuration error word table for a definition of each bit.
44	Current Error	This word contains the error code for the current command executing on Port 1.
45	Last Error	This word contains the error code for the last error recognized on Port 1.

The following table defines the contents of the Configuration Error (Cfg Err) word. Each bit in the word corresponds to an error condition recognized when the module is configured. There is a separate word for each application port. This data is reported in the status data area previously defined.

Bit	Code	Description
0	0x0001	Invalid baud rate selected
1	0x0002	Invalid parity selected
2	0x0004	Received timeout set to 0
3	0x0008	Invalid Port selected for a session
4	0x0010	Invalid sector count for session
5	0x0020	Could not allocate memory for sector of a session.
6	0x0040	
7	0x0080	Invalid failure delay or confirm timeout for session.
8	0x0100	
9	0x0200	
10	0x0400	
11	0x0800	
12	0x1000	
13	0x2000	
14	0x4000	
15	0x8000	

The following table lists all potential errors that can be generated by the IEC 60870-5-103 Master driver:

5.6.2 MVI56-IEC 60870-5-103 Master Communication Module Error Codes

Error	Description
51	Physical layer error - Error transmitting message
52	Physical layer error - Intercharacter timeout occurred before message fully received.
53	Physical layer error - Frame not entirely received before timeout condition.
54	Physical layer error - Invalid frame length.
101	Link layer error - Invalid checksum received
102	Link layer error - Address unknown to module
103	Link layer error - Link established
104	Link layer error - Link failed
105	Link layer error - Received primary
106	Link layer error - FCB error discard
107	Link layer error - FCB error repeat
108	Link layer error - Invalid start character received
109	Link layer error - Invalid second character received
110	Link layer error - Invalid ending character received
111	Link layer error - Length mismatch error
112	Link layer error - Illegal function
113	Link layer error - No confirmation received

Error	Description
114	Link layer error - No ACK received
115	Link layer error - Sequence unknown
116	Link layer error - Out of sequence
117	Link layer error - Remote close
118	Link layer error - Unexpected ACK
119	Link layer error - Request cancelled
201	Application layer error - Length mismatch
202	Application layer error - Address unknown
203	Application layer error - Response late
251	RBE error - Clock event buffer overflow
252	RBE error - Event buffer overflow
271	Data error - Address unknown
281	Control error - Illegal operation
282	Control error - Illegal value
283	Control error - Not selected
301	Initialization error - Database
302	Initialization error - Out of memory
401	Channel open error
501	Session error - Database
502	Session error - Configuration
601	No memory to receive message
602	Session not reserved
603	Illegal session
604	Session is reserved
605	Session is not available
701	No memory to transmit message
702	ASDU not supported
703	Duplicate request
704	Illegal sector
705	Control mode is illegal
801	Partial stop request
802	Stop request failed
901	Response timeout
902	Negative COT in response
903	Session is offline
904	Session is disabled
905	Select confirmation received, waiting to execute
906	Execute confirmation has not be received

5.7 Configuration Data

This section contains a listing of the parameters and their definitions for the MVI56-103M module configuration file definition (IEC103M.CFG).

5.7.1 MVI56 IEC 60870-5-103 Master Communication Module Configuration

[Section]/Item	Value	Range	Description
[Backplane Configuration]			Backplane transfer parameters
Module Name:		0 to 80 characters	This parameter assigns a name to the module that can be viewed using the configuration/debug port. Use this parameter to identify the module and the configuration file.
Write Register Start:		0 to 3999	This parameter specifies the starting register in the module where the data transferred from the processor will be placed. Valid range for this parameter is 0 to 3999.
Write Register Count:		0 to 4000	This parameter specifies the number of registers to transfer from the processor to the module. Valid entry for this parameter is 0 to 4000.
Read Register Start:		0 to 3999	This parameter specifies the starting register in the module where data will be transferred from the module to the processor. Valid range for this parameter is 0 to 3999.
Read Register Count:		0 to 4000	This parameter specifies the number of registers to be transferred from the module to the processor. Valid entry for this parameter is 0 to 4000.
Failure Flag Count:		0 to 65535	This parameter specifies the number of successive transfer errors that must occur before the communication ports are shut down. If the parameter is set to 0, the communication ports will continue to operate under all conditions. If the value is set larger than 0 (1 to 65535), communications will cease if the specified number of failures occur.
Pass-Through Events:		Y or N	This parameter specifies if event messages received on the master ports will be passed to the processor. If the parameter is set to N, event messages will not be passed to the processor. If the parameter is set to Y, the module will pass all events received to the processor using block identifier 9903.
[Section]/Item	Value	Range	Description
[IEC 60870-5-103 MASTER]			Module level parameters

[Section]/Item	Value	Range	Description
Session Count:		1 to 32	This parameter specifies the maximum number of sessions to establish on the module. This corresponds to the number of slaves to communicate with the module. This value represents the total number of slaves on both ports, combined.

[Section]/Item	Value	Range	Description
[IEC 60870-5-103 MASTER PORT x]			Settings for each communication port on module
Baud Rate:		Value for baud rate	This parameter specifies the baud rate to be used on the communication channel (port). Values from 110 baud to 115200 bps are permitted. Maximum specified rate is 19200 bps.
Parity:		None, Odd, Even	This parameter sets the parity to be used on the port. The values correspond to the following settings: N=None, O=Odd, E=Even. Note: the specification requires only Even Parity be used.
RTS On:		0 to 65535	The parameter sets the RTS present delay. The value entered represents the number of milliseconds the module will wait after setting the RTS modem line before sending the data.
RTS Off:		1 to 65535	This parameter sets the RTS off delay. The value entered represents the number of milliseconds the module will wait after the data packet is sent before dropping the RTS modem line.
Minimum Delay:		1 to 60000	This parameter specifies the minimum number of milliseconds to delay before sending the message (setting RTS high). This can be used when the serial network requires time for units to turn off their transmitters.
Receive Timeout:		1 to 65535	This value represents the number of milliseconds to wait on a port from the time the first character is received until the last character in the longest message received on the port. This parameter should be set dependent on the baud rate. A value of 2000 should work with most applications.
Single char ACK F0,1 or 3:		Yes or No	This parameter specifies if the single E5 character will be used for ACK messages.

[Section]/Item	Value	Range	Description
[IEC-103 MASTER SESSION x]			Settings for each session utilized
Communication Port:		0 or 1	This parameter sets the port to which the controlled device is connected. On this module, values of 0 and 1 are permitted.

[Section]/Item	Value	Range	Description
Sector Count:		1 to 5	This parameter sets the number of sectors contained in this controlled device. This version of the application supports 1 to 5 sectors for each session.
Data Link Address:		0 to 65535	This parameter uniquely defines the data link address for this unit on the communication channel.
Failure Delay:		0 to 2000	This parameter sets the minimum number of seconds to delay before polling this session when it is not online. This parameter is only used in unbalanced mode.
Confirm Timeout:		0 to 4,294,967,296	This parameter sets the number of milliseconds to wait for a confirm response from the controlled device.
Retry Count:		0 to 255	This parameter sets the number of retries to be performed on the controlled device when a communication error occurs.
C1/C2 Poll Count Pend:		0 to 100	This parameter sets the maximum number of Class 1 and Class 2 polls performed on this session before trying the next session. This parameter prevents a session from monopolizing the communication port.
Class 1 Polls:		0 to 65535	This parameter sets the maximum number of class one polls performed on this session before switching to another session. This parameter prevents a session from monopolizing the communication port.
Class 1 Pend Delay:		0 to 4,294,967,296	This parameter sets the minimum number of milliseconds to delay between Class 1 polls for pending data.
Class 2 Pend Delay:		0 to 4,294,967,296	This parameter sets the minimum number of milliseconds to delay between Class 2 polls for pending data.
Class 1 Poll Delay:		0 to 4,294,967,296	This parameter sets the minimum number of milliseconds to delay between each Class 1 poll.
Class 2 Poll Delay:		0 to 4,294,967,296	This parameter sets the minimum number of milliseconds to delay between each Class 2 poll.
Response Timeout:		0 to 4,294,967,296	This parameter sets the maximum number of milliseconds to wait for a confirmation from the controlled station to a request from this module.
[Section]/Item	Value	Range	Description
[IEC-103 MASTER SESSION x SECTOR y]			This section sets the parameters for a specific sector of a session.

[Section]/Item	Value	Range	Description
Common ASDU Address:		0 to 255	This parameter sets the common ASDU address to association with this sector of the specified session. This parameter is usually set the same as the Data Link Address when only one sector is utilized.
Online Time Sync:		Yes or No	This parameter specifies if the sector in the controlled device will be sent a time synchronization command when the unit is first recognized as being online. This should only be utilized for devices that do not send an EOI message after initializing.
Online General Int:		Yes or No	This parameter specifies if the sector in the controlled device will be sent a general interrogation command when the unit is first recognized as being online. This should only be utilized for devices that do not send an EOI message after initializing.
EOI Time Sync:		Yes or No	This parameter specifies if the sector in the controlled device will be sent a time synchronization command after this module received an EOI message from the controlled unit.
EOI General Int:		Y or N	This parameter specifies if the sector in the controlled device will be sent a general interrogation command after this module received an EOI message from the controlled unit.
ion]/Item			Description

5.8 103M Protocol Support

This section describes the portions of IEC 60870-5-103 protocol that are supported by the module.

Note: Shaded areas are not supported by the module.

5.8.1 List of Type Identification Codes

In Monitor Direction

Type	Description
1	time-tagged message
2	time-tagged message with relative time
3	measurands I
4	time-tagged measurands with relative time
5	identification
6	time synchronization
8	general interrogation termination
9	measurands II
10	generic data
11	generic identification
23	list of recorded disturbances
26	ready for transmission of disturbance data
27	ready for transmission of channel
28	ready for transmission of tags
29	transmission of tags
30	transmission of disturbance values
31	end of transmission

In Control Direction

Type	Description
6	time synchronization
7	general interrogation
10	generic data
20	general command
21	generic command
24	order for disturbance data transmission
25	ack for disturbance data transmission

5.8.2 List of Cause of Transmission Codes

In Monitor Direction

COT	Description
1	spontaneous
2	cyclic
3	reset frame count bit (FCB)
4	reset communication unit (CU)
5	start/restart
6	power on
7	test mode
8	time synchronization
9	general interrogation
10	termination of general interrogation
11	local operation
12	remote operation
20	positive ack of command
21	negative ack of command
31	transmission of disturbance data
40	positive ack of generic write command
41	negative ack of generic write command
42	valid data response to generic read command
43	invalid data response to generic read command
44	generic write confirmation

In Control Direction

COT	Description
8	time synchronization
9	initiation of general interrogation
20	general command
31	transmission of disturbance data
40	generic write command
42	generic read command

5.8.3 List of Function Types

Fun	Description	Symbol
128	Distance protection	t(z)
160	Overcurrent protection	I>>
176	Transformer differential protection	ΔI_T
192	Line differential protection	ΔI_L
254	Generic function type	GEN
255	Global function type	GLB

5.8.4 Information Numbers Used in Monitor Direction

System functions

Inf	Description	GI	Type	Fun					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
0	end of general interrogation		8						X
0	time synchronization		6						X
2	reset FCB		5						*
3	reset CU		5						*
4	start/restart		5						*
5	power on		5						*

* - According to main function

Status Indications

Inf	Description	GI	Type	Fun					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
16	auto-recloser active	X	1	X	X		X		
17	teleprotection active	X	1	X	X				
18	protection active	X	1	X	X	X	X		
19	LED reset		1	X	X	X	X		
20	monitor direction blocked	X	1	X	X	X	X		
21	test mode	X	1	X	X	X	X		
22	local parameter setting	X	1	X	X	X	X		
23	characteristic 1	X	1	X					
24	characteristic 2	X	1	X					
25	characteristic 3	X	1	X					
26	characteristic 4	X	1	X					
27	auxiliary input 1	X	1	X	X	X	X		
28	auxiliary input 2	X	1	X	X	X	X		
29	auxiliary input 3	X	1	X	X	X	X		
30	auxiliary input 4	X	1	X	X	X	X		

Supervision indications

Inf	Description	GI	Type	Fun					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
32	measured supervision I	X	1	X	X				
33	measured supervision V	X	1	X	X				
35	phase sequence supervision	X	1	X	X				
36	trip circuit supervision	X	1	X	X	X	X		
37	I>>back-up operation	X	1	X					
38	VT fuse failure	X	1	X	X				
39	teleprotection disturbed	X	1	X	X		X		
46	group warning	X	1	X	X	X	X		
47	group alarm	X	1	X	X	X	X		

Earth fault indications

Inf	Description	GI	Type	Fun					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
48	earth fault L ₁	X	1	X	X				
49	earth fault L ₂	X	1	X	X				
50	earth fault L ₃	X	1	X	X				
51	earth fault forward (that is, line)	X	1	X	X				
52	earth fault reverse (that is, busbar)	X	1	X	X				

Fault indications

Inf	Description	GI	Type	Fun					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
64	start/pick-up L ₁	X	2	X	X		X		
65	start/pick-up L ₂	X	2	X	X		X		
66	start/pick-up L ₃	X	2	X	X		X		
67	start/pick-up N	X	2	X	X		X		
68	general trip		2	X	X	X	X		
69	trip L ₁		2	X	X	X	X		
70	trip L ₂		2	X	X	X	X		
71	trip L ₃		2	X	X	X	X		
72	trip I>> (back-up operation)		4	X					
73	fault location X in ohms		2	X	X				
74	fault forward/line		2	X	X				
75	fault reverse/busbar		2	X	X				
76	teleprotection signal transmitted		2	X	X				
77	teleprotection signal received		2	X	X				
78	zone 1		2	X					
79	zone 2		2	X					
80	zone 3		2	X					
81	zone 4		2	X					
82	zone 5		2	X					
83	zone 6		2	X					
84	general start/pick-up	X	2	X	X	X	X		
85	breaker failure		2	X	X				
86	trip measuring system L ₁		2			X			
87	trip measuring system L ₂		2			X			
88	trip measuring system L ₃		2			X			
89	trip measuring system E		2			X			
90	trip I>		2		X				
91	trip I>>		2		X				
92	trip IN>		2		X				
93	trip IN>>		2		X				

Auto-reclosure indications

Inf	Description	GI	Type	Fun					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
128	CB 'on' by AR		1	X	X		X		
129	CB 'on' by long-time AR		1	X	X		X		
130	AR blocked	X	1	X	X		X		

Measurands

Inf	Description	GI	Type	Fun						
				128 t(z)	160 l>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB	
144	measurand I		3.1	X	X					
145	measurands I, V		3.2	X	X					
146	measurands I, V, P, Q		3.3	X						
147	measurands I_N , V_{EN}		3.4	X	X					
148	measurands $I_{L1,2,3}$, $V_{L1,2,3}$, P, Q, f		9	X						

Generic functions

Inf	Description	GI	Type	Fun						
				128 t(z)	160 l>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB	
240	read headings of all defined groups		10					X		
241	read values or attributes of all entries of one group		10					X		
243	read directory of a single entry		11					X		
244	read value or attribute of a single entry	(x)	10					X		
245	end of general interrogation of generic data		10					X		
249	write entry with confirmation		10					X		
250	write entry with execution		10					X		
251	write entry aborted		10					X		

5.8.5 Information Numbers used in Control Direction

System functions

Inf	Description	Type	Fun							
			128 t(z)	160 l>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB		
0	initiation of general interrogation	7							X	
0	time synchronization	6							X	

General commands

Inf	Description	Com	Type	Function					
				128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB
16	auto-recloser on/off	On/Off	20	X	X		X		
17	teleprotection on/off	On/Off	20	X	X				
18	protection on/off	On/Off	20	X	X	X	X		
19	LED reset	On	20	X	X	X	X		
23	activate characteristic 1	On	20	X					
24	activate characteristic 2	On	20	X					
25	activate characteristic 3	On	20	X					
26	activate characteristic 4	On	20	X					

Generic functions

Inf	Description	Type	Function						
			128 t(z)	160 I>>	176 ΔI_T	192 ΔI_L	254 GEN	255 GLB	
240	read headings of all defined groups	21						X	
241	read values or attributes of all entries of one group	21						X	
243	read directory of a single entry	21						X	
244	read value or attribute of a single entry	21						X	
245	general interrogation of generic data	21						X	
248	write entry	10						X	
249	write entry with confirmation	10						X	
250	write entry with execution	10						X	
251	write entry abort	10						X	

5.8.6 Definition and Presentation of ASDUs In Monitor Direction

TYPE 1: Time-tagged

Bytes	Description	Spec
1	Value of 1	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
1	DPI (0 to 3)	7.2.6.5
4	4-octet binary time	7.2.6.28
1	SIN	7.2.6.23

TYPE 2: Time-tagged with relative time

Bytes	Description	Spec
1	Value of 2	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
1	DPI (0 to 3)	7.2.6.5
2	RET (relative time)	7.2.6.15
2	FAN (fault number)	7.2.6.6
4	4-octet binary time	7.2.6.28
1	SIN	7.2.6.23

TYPE 3: Measurands I

Bytes	Description	Spec
1	Value of 3	
1	i = value of 1, 2 or 4	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
2	Current L ₂	7.2.6.8
2	Voltage L ₁ -L ₂	7.2.6.8
2	Active power P	7.2.6.8
2	Reactive power Q	7.2.6.8
	ASD U3.1: i=1	
	ASDU 3.2: i=2	
	ASDU 3.3: i=4	
	ASDU 3.4: i=2 val1=I _N and val2=V _{EN}	

TYPE 4: Time-tagged measurands with relative time

Bytes	Description	Spec
1	Value of 4	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
4	SCL (short-circuit location (real))	7.2.6.20
2	RET (relative time)	7.2.6.15
2	FAN (fault number)	7.2.6.6
4	4-octet binary time	7.2.6.28

TYPE 5: Identification

Bytes	Description	Spec
1	Value of 5	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
1	COL (compatibility level 2 or 3)	7.2.6.3
1	Char 1	7.2.6.2
1	Char 2	7.2.6.2
1	Char 3	7.2.6.2
1	Char 4	7.2.6.2
1	Char 5	7.2.6.2
1	Char 6	7.2.6.2
1	Char 7	7.2.6.2
1	Char 8	7.2.6.2
1	Manufacture byte	Free assignment
1	Manufacture byte	Free assignment
1	Manufacture byte	Free assignment
1	Manufacture byte	Free assignment

TYPE 6: Time synchronization

Bytes	Description	Spec
1	Value of 6	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
7	7-Octet binary time	7.2.6.29

TYPE 8: Termination of general interrogation

Bytes	Description	Spec
1	Value of 8	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
1	SCN (scan number 0 to 255)	7.2.6.21

TYPE 9: Measurands II

Bytes	Description	Spec
1	Value of 9	
1	I = 1 to 9 for number of values	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
2	Current L ₁	7.2.6.8
2	Current L ₂	7.2.6.8
2	Current L ₃	7.2.6.8
2	Voltage L _{1-E}	7.2.6.8
2	Voltage L _{2-E}	7.2.6.8
2	Voltage L _{3-E}	7.2.6.8
2	Active power P	7.2.6.8
2	Reactive power Q	7.2.6.8
2	Frequency f	7.2.6.8
Value of I determines number of parameters passed in the message with a range of 1 to 9 but always starts with the L ₁ value.		

5.8.7 Definition and Presentation of ASDUs in Control Direction

TYPE 6: Time synchronization

Bytes	Description	Spec
1	Value of 6	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type = GLB (255)	
1	Information number	
7	7-Octet binary time	7.2.6.29

TYPE 7: Initiation of general interrogation

Bytes	Description	Spec
1	Value of 7	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type = GLB (255)	
1	Information number	
1	SCN (scan number 0 to 255)	7.2.6.21

TYPE 20: General command

Bytes	Description	Spec
1	Value of 20	
1	0x81	
1	COT	
1	Common address of ASDU	
1	Function Type	
1	Information number	
1	DCO (1=Off, 2=On)	7.2.6.4
1	RII	7.2.6.19
	RII is not to be processed within the protection equipment, but to be used as a SIN of the return message.	

5.9 IEC 60870-5-103 Master Protocol Interoperability Documentation

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

Note: In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

The selected parameters should be marked in the white boxes as follows:

<input type="checkbox"/>	Function or ASDU is not used
<input checked="" type="checkbox"/>	Function or ASDU is used as standardized (default)
R	Function or ASDU is used in reverse mode
B	Function or ASDU is used in standard and reverse mode

The possible selection (blank, X, R, B) is specified for each specific clause or parameter.

A black check box indicates that the option cannot be selected in this companion standard.

The pages in this section have been extracted from the 60870-5-103 © IEC:1997, pages 159 to 171.

5.9.1 Physical Layer

5.9.2 Electrical Interface

<input checked="" type="checkbox"/>	EIA RS-485
<input checked="" type="checkbox"/>	Number of loads 32. For one protection equipment

NOTE - EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

5.9.3 Optical Interface

<input type="checkbox"/>	Glass fiber
<input type="checkbox"/>	Plastic fiber
<input type="checkbox"/>	F-SMA type connector
<input type="checkbox"/>	BFOC/2,5 type connector

5.9.4 *Transmission speed*

<input checked="" type="checkbox"/>	9 600 bit/s
<input checked="" type="checkbox"/>	19 200 bit/s

5.9.5 *Link Layer*

There are no choices for the link layer.

5.9.6 *Application Layer*

5.9.7 *Transmission mode for application data*

Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

5.9.8 *Common Address of ASDU*

<input checked="" type="checkbox"/>	One Common Address of ASDU (identical with station address)
<input checked="" type="checkbox"/>	More than one Common Address of ASDU

5.9.9 *Selection of standard information numbers in monitor direction*

5.9.10 *System functions in monitor direction*

	INF	Semantics
<input checked="" type="checkbox"/>	<0>	End of general interrogation
<input checked="" type="checkbox"/>	<0>	Time synchronization
<input checked="" type="checkbox"/>	<2>	Reset FCB
<input checked="" type="checkbox"/>	<3>	Reset CU
<input checked="" type="checkbox"/>	<4>	Start/restart
<input checked="" type="checkbox"/>	<5>	Power on

5.9.11 Status indications in monitor direction

	INF	Semantics
<input checked="" type="checkbox"/>	<16>	Auto-recloser active
<input checked="" type="checkbox"/>	<17>	Teleprotection active
<input checked="" type="checkbox"/>	<18>	Protection active
<input checked="" type="checkbox"/>	<19>	LED reset
<input checked="" type="checkbox"/>	<20>	Monitor direction blocked
<input checked="" type="checkbox"/>	<21>	Test mode
<input checked="" type="checkbox"/>	<22>	Local parameter setting
<input checked="" type="checkbox"/>	<23>	Characteristic 1
<input checked="" type="checkbox"/>	<24>	Characteristic 2
<input checked="" type="checkbox"/>	<25>	Characteristic 3
<input checked="" type="checkbox"/>	<26>	Characteristic 4
<input checked="" type="checkbox"/>	<27>	Auxiliary input 1
<input checked="" type="checkbox"/>	<28>	Auxiliary input 2
<input checked="" type="checkbox"/>	<29>	Auxiliary input 3
<input checked="" type="checkbox"/>	<30>	Auxiliary input 4

5.9.12 Supervision indications in monitor direction

	INF	Semantics
<input checked="" type="checkbox"/>	<32>	Measurand supervision I
<input checked="" type="checkbox"/>	<33>	Measurand supervision V
<input checked="" type="checkbox"/>	<35>	Phase sequence supervision
<input checked="" type="checkbox"/>	<36>	Trip circuit supervision
<input checked="" type="checkbox"/>	<37>	I>> back-up operation
<input checked="" type="checkbox"/>	<38>	VT fuse failure
<input checked="" type="checkbox"/>	<39>	Teleprotection disturbed
<input checked="" type="checkbox"/>	<46>	Group warning
<input checked="" type="checkbox"/>	<47>	Group alarm

5.9.13 Earth fault indications in monitor direction

	INF	Semantics
<input checked="" type="checkbox"/>	<48>	Earth fault L ₁
<input checked="" type="checkbox"/>	<49>	Earth fault L ₂
<input checked="" type="checkbox"/>	<50>	Earth fault L ₃
<input checked="" type="checkbox"/>	<51>	Earth fault forward, that is, line
<input checked="" type="checkbox"/>	<52>	Earth fault reverse, that is, busbar

5.9.14 Fault indications in monitor direction

	INF	Semantics
<input checked="" type="checkbox"/>	<64>	Start /pick-up L ₁
<input checked="" type="checkbox"/>	<65>	Start /pick-up L ₂
<input checked="" type="checkbox"/>	<66>	Start /pick-up L ₃
<input checked="" type="checkbox"/>	<67>	Start /pick-up N
<input checked="" type="checkbox"/>	<68>	General trip
<input checked="" type="checkbox"/>	<69>	Trip L ₁
<input checked="" type="checkbox"/>	<70>	Trip L ₂
<input checked="" type="checkbox"/>	<71>	Trip L ₃
<input checked="" type="checkbox"/>	<72>	Trip I>> (back-up operation)
<input checked="" type="checkbox"/>	<73>	Fault location X in ohms
<input checked="" type="checkbox"/>	<74>	Fault forward/line
<input checked="" type="checkbox"/>	<75>	Fault reverse/busbar
<input checked="" type="checkbox"/>	<76>	Teleprotection signal transmitted
<input checked="" type="checkbox"/>	<77>	Teleprotection signal received
<input checked="" type="checkbox"/>	<78>	Zone 1
<input checked="" type="checkbox"/>	<79>	Zone 2
<input checked="" type="checkbox"/>	<80>	Zone 3
<input checked="" type="checkbox"/>	<81>	Zone 4
<input checked="" type="checkbox"/>	<82>	Zone 5
<input checked="" type="checkbox"/>	<83>	Zone 6
<input checked="" type="checkbox"/>	<84>	General start/pick-up
<input checked="" type="checkbox"/>	<85>	Breaker failure
<input checked="" type="checkbox"/>	<86>	Trip measuring system L ₁
<input checked="" type="checkbox"/>	<87>	Trip measuring system L ₂
<input checked="" type="checkbox"/>	<88>	Trip measuring system L ₃
<input checked="" type="checkbox"/>	<89>	Trip measuring system E
<input checked="" type="checkbox"/>	<90>	Trip I>
<input checked="" type="checkbox"/>	<91>	Trip I>>
<input checked="" type="checkbox"/>	<92>	Trip IN>
<input checked="" type="checkbox"/>	<93>	Trip IN>>

5.9.15 Auto-reclosure indications in monitor direction

	INF	Semantics
<input checked="" type="checkbox"/>	<128>	CB "on" by AR
<input checked="" type="checkbox"/>	<129>	CB "on" by long-time AR
<input checked="" type="checkbox"/>	<130>	AR blocked

5.9.16 Measurands in monitor direction

	INF	Semantics
<input checked="" type="checkbox"/>	<144>	Measurand I
<input checked="" type="checkbox"/>	<145>	Measurands I, V
<input checked="" type="checkbox"/>	<146>	Measurands I, V, P, Q
<input checked="" type="checkbox"/>	<147>	Measurands I _N , V _{EN}
<input checked="" type="checkbox"/>	<148>	Measurands I _{L1,2,3} , V _{L1,2,3} , P, Q, f

5.9.17 Generic functions in monitor direction

	INF	Semantics
<input type="checkbox"/>	<240>	Read headings of all defined groups
<input type="checkbox"/>	<241>	Read values or attributes of all entries of one group
<input type="checkbox"/>	<243>	Read directory of a single entry
<input type="checkbox"/>	<244>	Read value or attribute of a single entry
<input type="checkbox"/>	<245>	End of general interrogation of generic data
<input type="checkbox"/>	<249>	Write entry with confirmation
<input type="checkbox"/>	<250>	Write entry with execution
<input type="checkbox"/>	<251>	Write entry aborted

5.9.18 System functions in control direction

	INF	Semantics
<input checked="" type="checkbox"/>	<0>	Initiation of general interrogation
<input checked="" type="checkbox"/>	<0>	Time synchronization

5.9.19 General commands in control direction

	INF	Semantics
<input checked="" type="checkbox"/>	<16>	Auto-recloser on/off
<input checked="" type="checkbox"/>	<17>	Teleprotection on/off
<input checked="" type="checkbox"/>	<18>	Protection on/off
<input checked="" type="checkbox"/>	<19>	LED reset
<input checked="" type="checkbox"/>	<23>	Activate characteristic 1
<input checked="" type="checkbox"/>	<24>	Activate characteristic 2
<input checked="" type="checkbox"/>	<25>	Activate characteristic 3
<input checked="" type="checkbox"/>	<26>	Activate characteristic 4

5.9.20 Generic functions in control direction

	INF	Semantics
<input type="checkbox"/>	<240>	Read headings of all defined groups
<input type="checkbox"/>	<241>	Read values or attributes of all entries in one group
<input type="checkbox"/>	<243>	Read directory of a single entry
<input type="checkbox"/>	<244>	Read value or attribute of a single entry
<input type="checkbox"/>	<245>	General interrogation of generic data
<input type="checkbox"/>	<248>	Write entry
<input type="checkbox"/>	<249>	Write entry with confirmation
<input type="checkbox"/>	<250>	Write entry with execution
<input type="checkbox"/>	<251>	Write entry abort

5.9.21 Basic application functions

<input checked="" type="checkbox"/>	Test mode
<input checked="" type="checkbox"/>	Blocking of monitor direction
<input type="checkbox"/>	Disturbance data
<input type="checkbox"/>	Generic services
<input checked="" type="checkbox"/>	Private data (if ASDU type is supported by module)

5.9.22 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, that is, for each measurand there is only one choice.

Measurand Max. MVAL = rated value times

	1,2	or	2,4
Current L ₁	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Current L ₂	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Current L ₃	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L _{1-E}	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L _{2-E}	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L _{3-E}	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Active power P	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Reactive power Q	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Frequency f	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L ₁ - L ₂	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>

5.10 103M Network Design Forms

5.10.1 Form to Define Sector Database

Session Index #:

Sector Index #:

Data Type (1, 2, 3, 4, 5 or 9)	Database Address	Function Code	Point Index
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6 Support, Service & Warranty

In This Chapter

- ❖ Contacting Technical Support 141
- ❖ Return Material Authorization (RMA) Policies and Conditions..... 143
- ❖ LIMITED WARRANTY..... 145

Contacting 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. Detailed contact information for all our worldwide locations is available on the following page.

Internet	Web Site: www.prosoft-technology.com/support E-mail address: support@prosoft-technology.com
Asia Pacific (location in Malaysia)	Tel: +603.7724.2080, E-mail: asiapc@prosoft-technology.com Languages spoken include: Chinese, English
Asia Pacific (location in China)	Tel: +86.21.5187.7337 x888, E-mail: asiapc@prosoft-technology.com Languages spoken include: Chinese, English
Europe (location in Toulouse, France)	Tel: +33 (0) 5.34.36.87.20, E-mail: support.EMEA@prosoft-technology.com Languages spoken include: French, English
Europe (location in Dubai, UAE)	Tel: +971-4-214-6911, E-mail: mea@prosoft-technology.com Languages spoken include: English, Hindi
North America (location in California)	Tel: +1.661.716.5100, E-mail: support@prosoft-technology.com Languages spoken include: English, Spanish
Latin America (Oficina Regional)	Tel: +1-281-2989109, E-Mail: latinam@prosoft-technology.com Languages spoken include: Spanish, English
Latin America (location in Puebla, Mexico)	Tel: +52-222-3-99-6565, E-mail: soporte@prosoft-technology.com Languages spoken include: Spanish
Brasil (location in Sao Paulo)	Tel: +55-11-5083-3776, E-mail: brasil@prosoft-technology.com Languages spoken include: Portuguese, English

6.1 Return Material Authorization (RMA) Policies and Conditions

The following Return Material Authorization (RMA) Policies and Conditions (collectively, "RMA Policies") apply to any returned product. These RMA Policies are subject to change by ProSoft Technology, Inc., without notice. For warranty information, see Limited Warranty (page 145). In the event of any inconsistency between the RMA Policies and the Warranty, the Warranty shall govern.

6.1.1 Returning Any Product

- a) In order to return a Product for repair, exchange, or otherwise, the Customer must obtain a Return Material Authorization (RMA) number from ProSoft Technology and comply with ProSoft Technology 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 141). 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 Technology, 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 Technology using a shipment method other than that specified by ProSoft Technology, 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.

6.1.2 Returning Units Under Warranty

A Technical Support Engineer must approve the return of Product under ProSoft Technology'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 Technology 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 Technology'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 Technology to repair the unit by providing a purchase order for 30% of the current list price plus freight charges, duties and taxes as applicable.

6.1.3 Returning Units Out of Warranty

- a) Customer sends unit in for evaluation to location specified by ProSoft Technology, 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:

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

6.2 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 Technology, Incorporated (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.

6.2.1 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.

6.2.2 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.

6.2.3 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.

6.2.4 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.

6.2.5 Disclaimer of all Other Warranties

The Warranty set forth in What Is Covered By This Warranty (page 145) 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.

6.2.6 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.

6.2.7 Time Limit for Bringing Suit

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

6.2.8 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.

6.2.9 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.

6.2.10 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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