GE Fanuc Automation

Programmable Control Products

VersaMax™ System
Genius® Network Interface Unit

User's Manual

GFK-1535A November 2000

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

Contents

Contents

Chapter 1 Introduction

This manual explains how to install and use a VersaMax™ Genius® Network Interface Unit module to interface VersaMax I/O modules to a Genius bus.

NIU installation procedures are described in Chapter 2.

NIU operation is described in chapter 3. This chapter explains how the NIU interacts with the modules in its station, how it stores data, and how it exchanges data with the system host.

Configuration is described in chapter 4.

The **datagrams** that can be sent to an NIU are described in chapter 5.

Genius Bus and CPU **Redundancy** options are explained in chapter 6.

Bus operation is detailed in appendix A.

Appendix B lists I/O module scan time **performance data**.

Related Manuals

VersaMax Modules, Power Supplies, and Carriers User's Manual (catalog number GFK-1504)	Describes the many VersaMax I/O and option modules, power supplies, and carriers. This manual also provides detailed system installation instructions.
Remote I/O Manager User's Guide (catalog number GFK-1847).	Gives step-by-step instructions for using the Remote I/O Manager configuration software.
VersaMax Ethernet Network Interface Unit User's Manual (catalog number GFK-1860)	Describes the installation and operation of the Ethernet Network Interface Unit module.
VersaMax DeviceNet Communications Modules User's Manual (catalog number GFK-1533)	Describes the installation and operation of the DeviceNet Network Interface Unit module and the DeviceNet Network Slave Module.
VersaMax Profibus Communications Modules User's Manual (catalog number GFK-1534)	Describes the installation and operation of the Profibus Network Interface Unit module and the Profibus Network Communications Module.
VersaMax PLC User's Manual (catalog number GFK-1503)	Describes the installation and operation of the VersaMax CPU.
Genius System and Communications Manual (catalog number GEK-90486-1).	Provides detailed reference information about Genius communications and message formats.

The VersaMax™ Family of Products

The VersaMax family of products provides universally-distributed I/O that spans PLC and PC-based architectures. Designed for industrial and commercial automation, VersaMax I/O provides a common, flexible I/O structure for local and remote control applications. The VersaMax PLC provides big-PLC power with a full range of I/O and option modules. VersaMax I/O Stations with Network Interface Modules make it possible to add the flexibility of VersaMax I/O to other types of networks. VersaMax meets UL, CUL, CE, Class1 Zone 2 and Class I Division 2 requirements.

As a scaleable automation solution, VersaMax I/O combines compactness and modularity for greater ease of use. The 70-mm depth and small footprint of VersaMax I/O enables easy, convenient mounting as well as space-saving benefits. Modules can accommodate up to 32 points of I/O each.

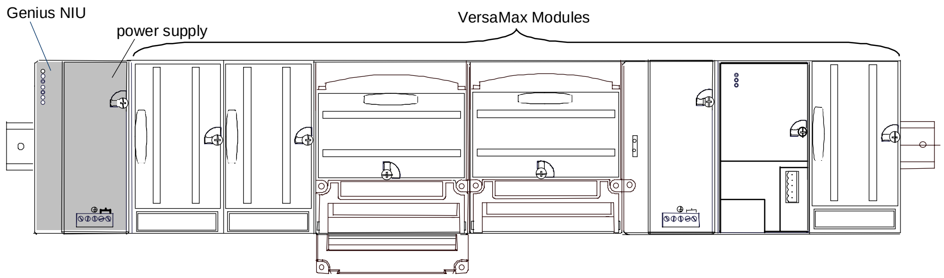
The compact, modular VersaMax products feature DIN-rail mounting with up to eight I/O and option modules per “rack” and up to 8 racks per VersaMax PLC or VersaMax I/O Station system. Expansion racks can be located up to 750 meters from the main VersaMax PLC or VersaMax I/O Station rack. Expansion racks can include any VersaMax I/O, option, or communications module.

VersaMax provides automatic addressing that can eliminate traditional configuration and the need for hand-held devices. Multiple field wiring termination options provide support for two, three, and four-wire devices.

For faster equipment repair and shorter Mean-Time-To-Repair, the hot insertion feature enables addition and replacement of I/O modules while a machine or process is running and without affecting field wiring.

The VersaMax Genius I/O Station

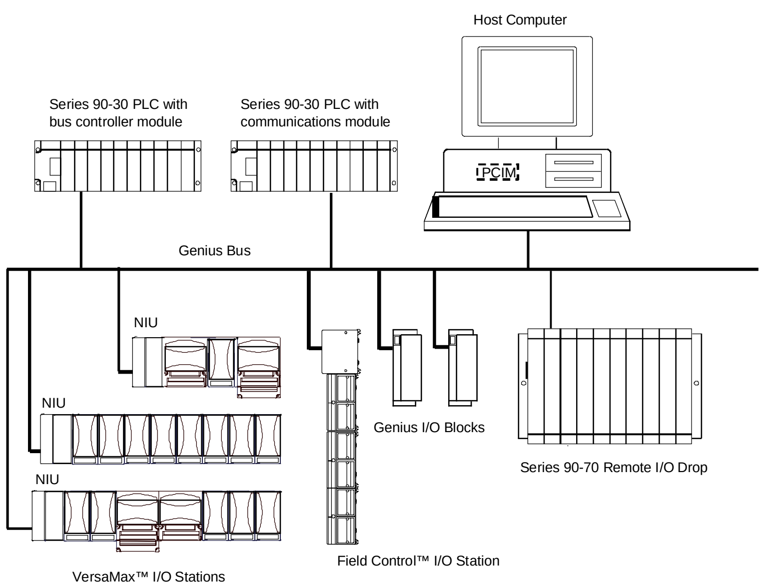
A VersaMax PLC consists of a group of VersaMax modules with a VersaMax CPU and attached power supply in the first position.



An I/O Station provides up to 64 analog channels and up to 1024 discrete points for 256 total bytes of I/O. The NIU operates as a device on a Genius bus, automatically exchanging I/O, diagnostic, and control data with a PLC or host computer.

VersaMax I/O in a Genius System

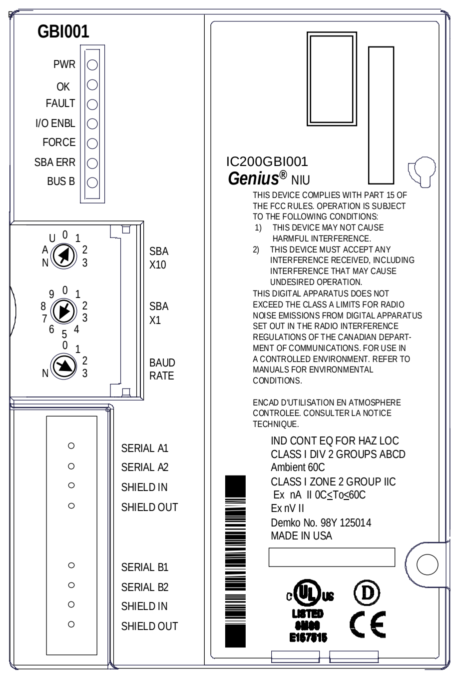
An I/O station can be used on the same bus as Genius I/O blocks, Field Control I/O stations, and Remote I/O drops.



VersaMax I/O stations can be used in redundant bus and redundant CPU applications. The Genius NIU provides built-in bus-switching capability. See chapter 6 for more information about using the NIU in a redundancy system.

The Genius NIU

The VersaMax Genius Network Interface Unit (IC200GBI001) interfaces a VersaMax I/O Station to a Genius I/O bus. The system host can be any PLC or computer capable of controlling the Genius bus.



The Network Interface Unit installs on a 35mm x 7.5mm conductive DIN rail. A VersaMax power supply module mounts directly on the righthand side of the NIU. LEDs on the lefthand side indicate the presence of power and show the operating mode and status of the NIU. Three rotary dials beneath a clear protective door are used to configure the NIU's address on the Genius bus and to set its communications baud rate. Removable connectors are used to install single or redundant bus cables. These connectors make it possible to disconnect a bus cable from the NIU without breaking the continuity of the bus, so other devices on the same bus can continue operating.

Genius NIU Specifications

Number of Modules	8 per rack, 64 per NIU/station
Network inputs per bus scan	128 bytes
Network outputs per bus scan	128 bytes
Discrete Input Memory	1024 points
Discrete Output Memory	1024 points
Analog Input Memory	64 channels
Analog Output Memory	64 channels
Power Consumption	+5V@250mA, +3.3V@10mA
Serial Bus Address	0 to 31
Network data rate	153.6 Kbaud extended, 153.6 Kbaud standard, 76.8 Kbaud, or 38.4 Kbaud.

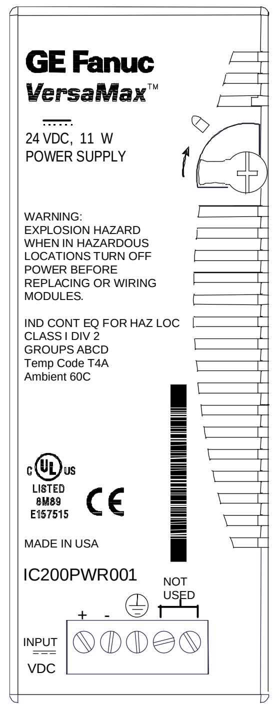
Genius NIU Compatibility

Network Interface Unit IC200GBI001 is compatible with:

- For a Series 90™-70 PLC
  - CPU firmware, release 3.0 or later.
  - Bus controller release 5.4 or later.
  - If the IC641SWP701/704 programming and configuration software is used, it must be release 3.0 or later:
- For a Series 90™-30 PLC
  - CPU firmware: any version. For expansion compatibility for CPUs 350, 352, 360, 363, and 364, version 10.0 or later is needed. Versions earlier than 10.0 of any Series 90-30 CPU will go to Stop/Faulted mode if an Add/Loss of Rack (expansion) fault is logged.
  - Bus Controller: any version.
- For a Series Six™ PLC:
  - CPU: rev. 105 or later
  - Programming Software: Release 4.02 or later
  - Bus controllers: IC660CBB902 or 903, version 1.7 or later

Power Supplies

An AC or DC Power Supply module installs directly on the NIU. The Power Supply provides +5V and +3.3V power to the modules in the station. Additional power supplies can be installed on special booster carriers if needed for systems where the number of modules creates the need for a booster. No booster supply is needed to power conventional I/O modules.



Available Power Supplies and Carrier

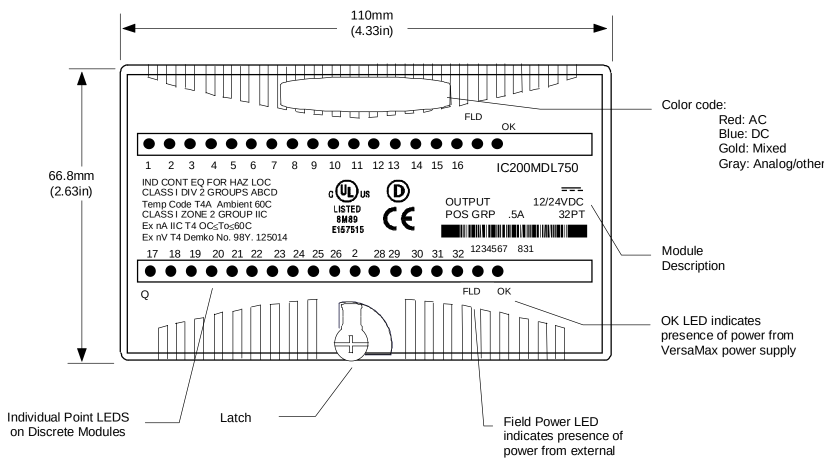
The following VersaMax power supplies and carrier are available:

24VDC Power Supply	IC200PWR001
24VDC Expanded 3.3V Power Supply	IC200PWR002
120/240VAC Power Supply	IC200PWR101
120/240VAC Expanded 3.3V Power Supply	IC200PWR102
12VDC Power Supply	IC200PWR201
12VDC Expanded 3.3V Power Supply	IC200PWR202
Power Supply Booster Carrier	IC200PWB001

Power supplies are described in the *VersaMax Modules, Power Supplies, and Carriers User's Manual* (GFK-1504).

I/O Modules

VersaMax IO and option modules are approximately 110mm (4.3in) by 66.8mm (2.63in) in size. Modules can be mounted either horizontally or vertically on several types of available I/O Carriers. Modules are 50mm (1.956 in) in depth, not including the height of the carrier or the mating connectors.



VersaMax I/O modules are described in the *VersaMax Modules, Power Supplies, and Carriers User's Manual* (GFK-1504).

Available I/O Modules

The following types of VersaMax I/O Modules are available:

Discrete Input Modules	
Input 120VAC 8 Point Grouped Module	IC200MDL140
Input 240VAC 8 Point Grouped Module	IC200MDL141
Input 120VAC 8 Point Isolated Module	IC200MDL143
Input 240VAC 4 Point Isolated Module	IC200MDL144
Input 120VAC (2 Groups of 8) 16 Point Module	IC200MDL240
Input 240VAC (2 Groups of 8) 16 Point Module	IC200MDL241
Input 120VAC 16 Point Isolated Module	IC200MDL243
Input 240VAC 8 Point Isolated Module	IC200MDL244
Input 125VDC Positive/Negative Logic Grouped 8 Point Module	IC200MDL631
Input 125VDC Positive/Negative Logic Grouped 16 Point Module	IC200MDL632
Input 48VDC Positive/Negative Logic Grouped 16 Point Module	IC200MDL635
Input 48VDC Positive/Negative Logic Grouped 32 Point Module	IC200MDL636
Input 24VDC Positive/Negative Logic (2 Groups of 8) 16 Point Module	IC200MDL640
Input 5/12VDC (TTL) Positive/Negative Logic 16 Point Module	IC200MDL643
Input 5/12VDC (TTL) Positive/Negative Logic Grouped 32 Point Module	IC200MDL644
Input 24VDC Positive/Negative Logic (4 Groups of 8) 32 Point Module	IC200MDL650
Discrete Output Modules	
Output 120VAC 0.5A per Point Isolated 8 Point Module	IC200MDL329
Output 120VAC 0.5A per Point Isolated 16 Point Module	IC200MDL330
Output 120VAC 2.0A per Point Isolated 8 Point Module	IC200MDL331
Output 24VDC Positive Logic 2.0A per Point (1 Group of 8) w/ESCP 8 Point Module,	IC200MDL730
Output 12/24VDC Positive Logic 0.5A per Point (1 Group of 16) 16 Point Module	IC200MDL740
Output 24VDC Positive Logic 0.5A per Point (1 Group of 16) w/ESCP 16 Point Module	IC200MDL741
Output 24VDC Positive Logic 0.5A per Point (2 Groups of 16) w/ESCP 32 Point Module	IC200MDL742
Output 5/12/24VDC Negative Logic 0.5A per Point (1 Group of 16) 16 Point Module	IC200MDL743
Output 5/12/24VDC Negative Logic 0.5A per Point (2 Groups of 16) 32 Point Module	IC200MDL744
Output 12/24VDC Positive Logic 0.5A per Point (2 Groups of 16) 32 Point Module	IC200MDL750
Output Relay 2.0A per Point Isolated Form A 8 Point Module	IC200MDL930
Output Relay 2.0A per Point Isolated Form A 16 Point Module	IC200MDL940

Discrete Mixed I/O Modules	
Mixed 24VDC Positive Logic Input Grouped 20 Point / Output Relay 2.0A per Point Grouped 12 Point Module	IC200MDD840
Mixed 24VDC Positive Logic Input 20 Point / Output 12 Point / (4) High Speed Counter, PWM, or Pulse Train Configurable Points	IC200MDD841
Mixed 16 Point Grouped Input 24VDC Pos/Neg Logic / 16 Pt Grouped Output 24VDC Pos. Logic 0.5A w/ESCP	IC200MDD842
Mixed 24VDC Positive Logic Input Grouped 10 Point / Output Relay 2.0A per Point 6 Point Module	IC200MDD843
Mixed 24 VDC Pos/Neg Logic Input Grouped 16 Point / Output 12/24VDC Pos. Logic 0.5A 16 Point Module	IC200MDD844
Mixed 16 Point Grouped Input 24VDC Pos/Neg Logic / 8 Pt Relay Output 2.0A per Pt Isolated Form A	IC200MDD845
Mixed 120VAC Input 8 Point / Output Relay 2.0A per Point 8 Point Module	IC200MDD846
Mixed 240VAC Input 8 Point / Output Relay 2.0A per Point 8 Point Module	IC200MDD847
Mixed 120VAC Input 8 Point / Output 120VAC 0.5A per Point Isolated 8 Point Module	IC200MDD848
Mixed 120VAC In Isolated 8 Point / Output Relay 2.0A Isolated 8 Point Module	IC200MDD849
Mixed 240VAC In Isolated 4 Point / Output Relay 2.0A Isolated 8 Point Module	IC200MDD850
Analog Input Modules	
Analog Input Module, 12 Bit Voltage/Current 4 Channels	IC200ALG230
Analog Input Module, 16 Bit Voltage/Current, 1500VAC Isolation, 8 Channels	IC200ALG240
Analog Input Module, 12 Bit Voltage/Current 8 Channels	IC200ALG260
Analog Input Module, 16 Bit RTD, 4 Channels	IC200ALG620
Analog Input Module, 16 Bit Thermocouple, 7 Channels	IC200ALG630
Analog Output Modules	
Analog Output Module, 12 Bit Current, 4 Channels	IC200ALG320
Analog Output Module, 12 Bit Voltage 4 Channels. 0 to +10VDC Range	IC200ALG321
Analog Output Module, 12 Bit Voltage 4 Channels. -10 to +10VDC Range	IC200ALG322
Analog Output Module, 16 Bit Voltage/Current, 1500VAC Isolation, 4 Channels	IC200ALG331
Analog Mixed I/O Modules	
Analog Mixed Module, Input Current 4 Channels, Output Current 2 Channels	IC200ALG430
Analog Mixed Module, 0 to +10VDC Input 4 Channels, Output 0 to +10VDC 2 Channels	IC200ALG431
Analog Mixed Module, 12 Bit -10 to +10VDC, Input 4 Channels / Output -10 to +10VDC 2 Channels	IC200ALG432

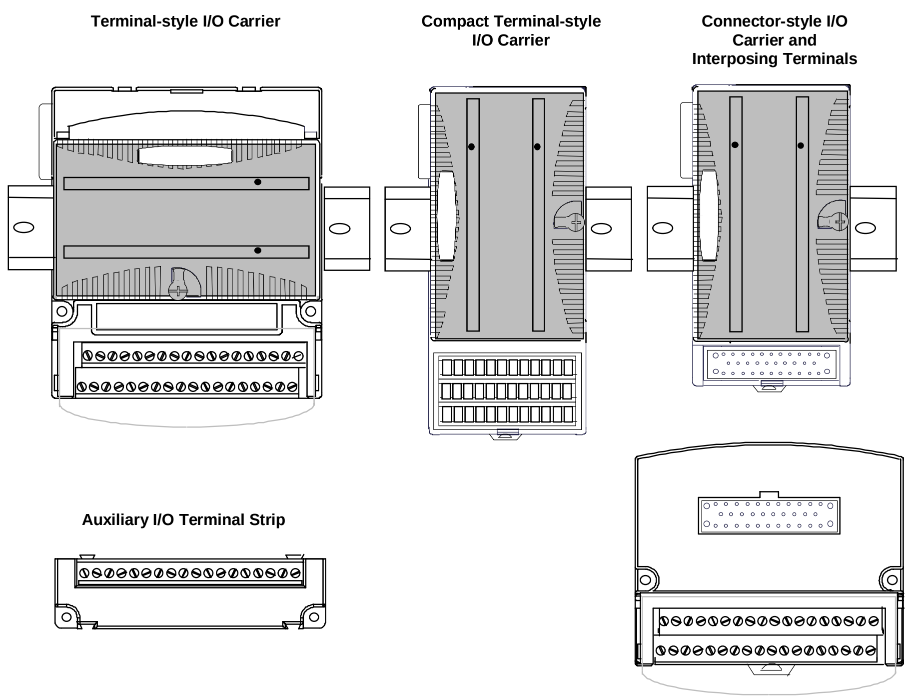
Carriers

Carriers provide mounting, backplane communications, and field wiring connections for all types of VersaMax modules. I/O modules can be installed on carriers or removed without disturbing field wiring.

There are three basic I/O Carrier types:

- Terminal-style I/O carriers. Modules mount parallel to the DIN rail.
- Compact Terminal-style I/O Carriers. Modules mount perpendicular to the DIN rail.
- Connector-style I/O Carriers. Modules mount perpendicular to the DIN rail. These carriers are normally used with Interposing I/O Terminals as illustrated below.

See the *VersaMax Modules, Power Supplies, and Carriers User's Manual* (GFK-1504) for information about VersaMax I/O Carriers and Terminal Strips.



Available I/O Carriers and Terminal Strips

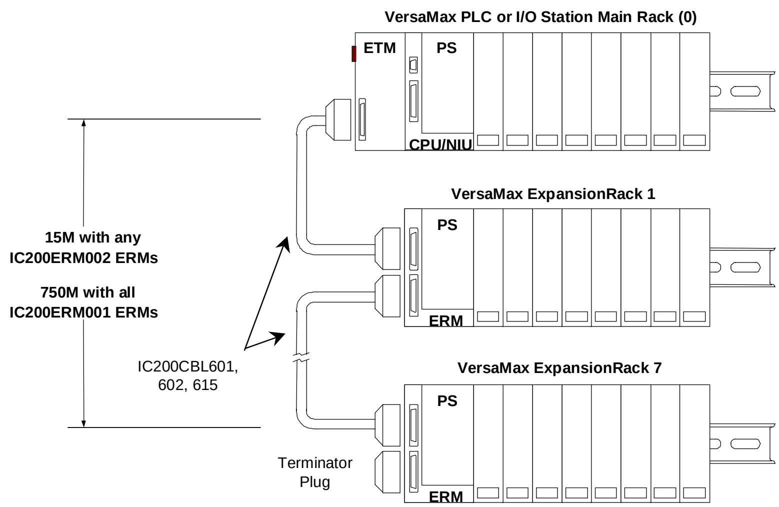
The following types of I/O Carriers, terminals, and cables are available:

Terminal-Style I/O Carriers	
Barrier-Style Terminal I/O Carrier	IC200CHS001
Box-Style Terminal I/O Carrier	IC200CHS002
Spring-Style Terminal I/O Carrier	IC200CHS005
Compact Terminal-Style I/O Carriers	
Compact Box-Style I/O Carrier	IC200CHS022
Compact Spring-Style I/O Carrier	IC200CHS025
Connector-Style I/O Carrier	
Connector-Style I/O Carrier	IC200CHS003
Interposing Terminals for use with Connector-Style Carrier	
Barrier-Style Interposing I/O Terminals	IC200CHS011
Box-Style Interposing I/O Terminals	IC200CHS012
Thermocouple-Style Interposing I/O Terminals	IC200CHS014
Spring-Style Interposing I/O Terminals	IC200CHS015
Cables for use with Connector-Style I/O Carriers	
2 connectors, 0.5m, no shield	IC200CBL105
2 connectors, 1.0m, no shield	IC200CBL110
2 connectors, 2.0m, no shield	IC200CBL120
1 connector, 3.0m, no shield	IC200CBL230
Auxiliary I/O Terminal Strips for use with Terminal-style I/O Carriers and Interposing Terminals	
Barrier-Style Auxiliary I/O Terminal Strip	IC200TBM001
Box-Style Auxiliary I/O Terminal Strip	IC200TBM002
Spring-Style Auxiliary I/O Terminal Strip	IC200TBM005
Other Carriers	
Communications Carrier	IC200CHS006
Power Supply Booster Carrier	IC200PWB001

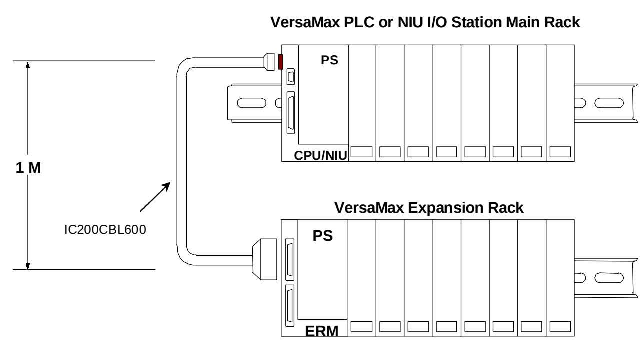
Expansion Modules

Expansion modules can be used to extend the I/O Station and add more modules. There are two basic types of VersaMax I/O expansion systems, Multi-Rack and Two-Rack Local:

- **Multi-Rack:** A VersaMax PLC or NIU I/O Station with an Expansion Transmitter Module (IC200ETM001) and one to seven expansion "racks", each with an Expansion Receiver Module (IC200ERM001 or IC200ERM002). If all the Expansion Receivers are the Isolated type (IC200ERM001), the maximum overall cable length is 750 meters. If the expansion bus includes any non-isolated Expansion Receivers (IC200ERM002), the maximum overall cable length is 15 meters.



- **Two-Rack Local:** A PLC or NIU I/O Station connected directly to one expansion rack with non-isolated Expansion Receiver Module (IC200ERM002). Maximum cable length is 1 meter.



VersaMax Modules for Expansion Racks

All types of VersaMax I/O and communications modules can be used in expansion racks. Some VersaMax analog modules require specific module revisions as listed below:

Module	Module Revision
IC200ALG320	B or later
IC200ALG321	B or later
IC200ALG322	B or later
IC200ALG430	C or later
IC200ALG431	C or later
IC200ALG432	B or later

Available Expansion Modules

The following Expansion Modules and related products are available:

Expansion Modules	
Expansion Transmitter Module	IC200ETM001
Expansion Receiver Module, Isolated	IC200ERM001
Expansion Receiver Module, Non-isolated	IC200ERM002
Cables	
Expansion Cable, 1 meter	IC200CBL601
Expansion Cable, 2 meters	IC200CBL602
Expansion Cable, 15 meters	IC200CBL615
Firmware Update Cable	IC200CBL002
Terminator Plug (included with ETM)	IC200ACC201
Connector Kit	IC200ACC302

See the *VersaMax Modules, Power Supplies, and Carriers User's Manual* (GFK-1504) for information about VersaMax Expansion modules.

VersaMax General Product Specifications

VersaMax products should be installed and used in conformance with product-specific guidelines as well as the following specifications:

Environmental		
Vibration	IEC68-2-6	1G @57-150Hz, 0.012in p--p @10-57Hz
Shock	IEC68-2-27	15G, 11ms
Operating Temp.		0 deg C to +60 deg C ambient
		-40 deg C to +60 deg C ambient for I/O carriers, interposing I/O terminals, and auxiliary I/O terminals
Storage Temp.		-40 deg C to +85 deg C
Humidity		5% to 95%, noncondensing
Enclosure Protection	IEC529	Steel cabinet per IP54: protection from dust & splashing water
EMC Emission		
Radiated, Conducted	CISPR 11/EN 55011	Industrial Scientific & Medical Equipment (Group 1, Class A)
	CISPR 22/EN 55022	Information Technology Equipment (Class A)
	FCC 47 CFR 15	referred to as FCC part 15, Radio Devices (Class A)
EMC Immunity		
Electrostatic Discharge	EN 61000-4-2	8KV Air, 4KV Contact
RF Susceptibility	EN 61000-4-3	$10V_{rms}$ /m, 80Mhz to 1000Mhz, 80% AM
	ENV 50140/ENV 50204	$10V_{rms}$/m, 900MHz +/-5MHZ 100%AM with 200Hz square wave
Fast Transient Burst	EN 61000-4-4	2KV: power supplies, 1KV: I/O, communication
Surge Withstand	ANSI/IEEE C37.90a	Damped Oscillatory Wave: 2.5KV power supplies, I/O [12V-240V]; 1KV communication
	IEC255-4	Damped Oscillatory Wave: Class II, power supplies, I/O [12V-240V]
	EN 61000-4-5	2 kV cm(P/S); 1 kV cm (I/O and communication modules)
Conducted RF	EN 61000-4-6	$10V_{rms}$, 0.15 to 80Mhz, 80%AM
Isolation		
Dielectric Withstand	UL508, UL840, IEC664	1.5KV for modules rated from 51V to 250V
Power Supply		
Input Dips, Variations	EN 61000-4-11	During Operation: Dips to 30% and 100%, Variation for AC +/-10%, Variation for DC +/-20%

Chapter 2

Installation

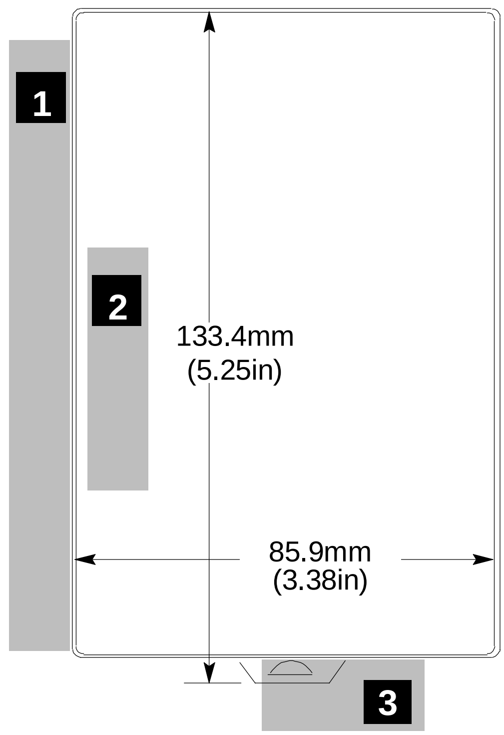
This section gives instructions for installing the Network Interface Unit and the Genius® bus.

- Module clearance
- Thermal considerations
- Mounting instructions
- Panel-mounting
- Installing an Expansion Transmitter Module
- Installing an Expansion Receiver Module
- Installing Power Supply Modules
- Installing Additional Modules
- Setting the SBA and baud rate
- Special switch settings on the NIU
- Selecting a cable type
- Making bus connections
- Observing the LEDs
- CE Mark installation requirements

Additional installation instructions are located in the *VersaMax Modules, Power Supplies, and Carriers Manual*, GFK-1504.

Module Clearance

Maintain a clearance of 2 inches (5.1cm) above and below the equipment and 1 inch (2.54cm) to the left. Additional clearance requirements are shown below.

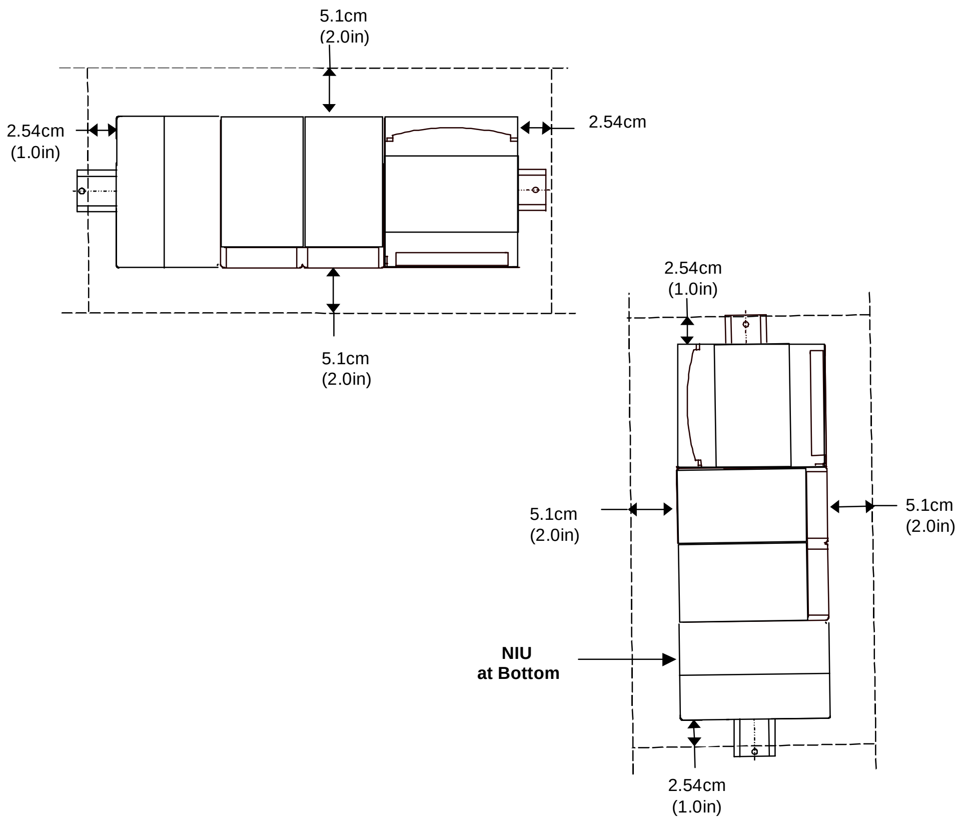


1. Allow sufficient finger clearance for opening NIU door.
2. Allow adequate clearance for communications cables.
3. Allow adequate space for power wiring.

Thermal Considerations

The thermal performance specified for VersaMax I/O modules requires a clearance of 2 inches (5.1cm) above and below the modules and 1 inch (2.54cm) on each side of the modules as shown below, regardless of the orientation of the DIN rail.

When using a vertical DIN rail, the NIU module must be installed at the bottom.



Mounting Instructions

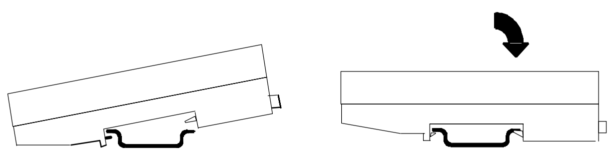
Each rack in a VersaMax I/O Station must be installed on a single section of 7.5mm X 35mm DIN rail. “Rack” is the term used for an NIU or Expansion Receiver, plus up to 8 physically-connected I/O carriers. The first rack in a system is called Rack 0. If there are multiple expansion racks, Rack 0 also includes an Expansion Transmitter module installed in the leftmost position, before the NIU.

The DIN rail used in a VersaMax installation must be electrically grounded to provide EMC protection. The rail must have a conductive (unpainted) corrosion-resistant finish. DIN rails compliant with DIN EN50032 are preferred.

For vibration resistance, the DIN rail should be installed on a panel using screws spaced approximately 5.24cm (6 inches) apart. DIN-rail clamps (available as part number IC200ACC313) can also be installed at both ends of the station to lock the modules in position.

For applications requiring maximum resistance to mechanical vibration and shock, the NIU and DIN-rail-mounted carriers should also be mounted on the panel, as described on the next page.

The base snaps easily onto the DIN rail. No tools are required for mounting or grounding to the rail.

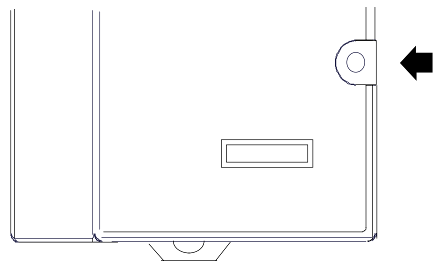


Removing the NIU from the DIN Rail

1. Turn off power to the power supply.
2. (If the NIU is attached to the panel with a screw) remove the power supply module. Remove the panel-mount screw.
3. Slide the NIU along the DIN rail away from the other modules until the connector disengages.
4. With a small flathead screwdriver, pull the DIN rail latch tab outward while tilting the other end of the module down to disengage it from the DIN rail.

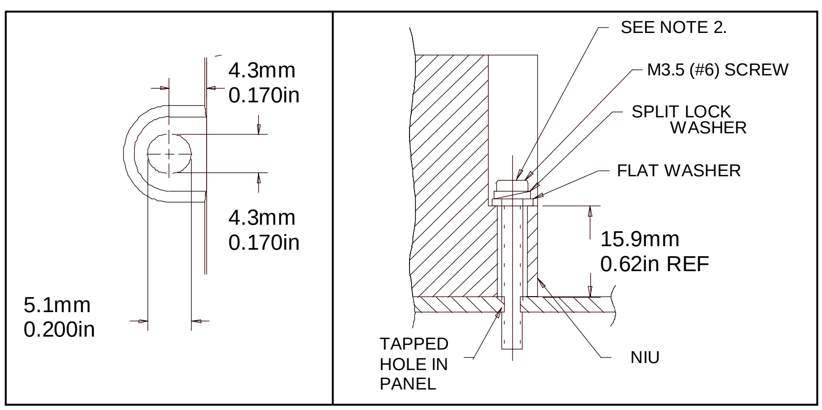
Panel-Mounting

For maximum resistance to mechanical vibration and shock, the DIN-rail-mounted module must also be installed on a panel. Using the module as a template, mark the location of the module's panel-mount hole on the panel. Drill the hole in the panel. Install the module using an M3.5 (#6) screw in the panel-mount hole.



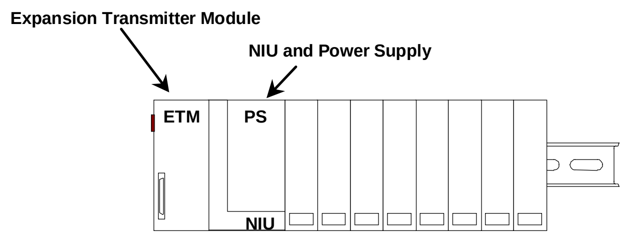
Note 1. Tolerances on all dimensions are +/-0.13mm (0.005in) non-cumulative.

Note 2. 1.1-1.4Nm (10-12 in/lbs) of torque should be applied to M3.5 (#6-32) steel screw threaded into material containing internal threads and having a minimum thickness of 2.4mm (0.093in).



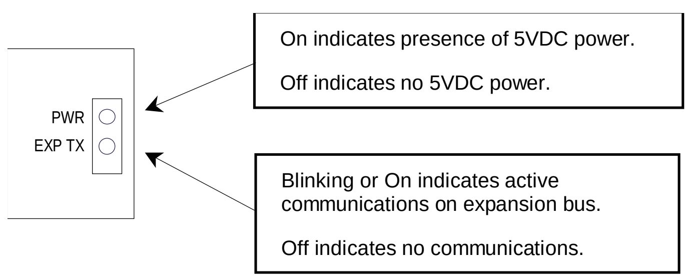
Installing an Expansion Transmitter Module

If the I/O Station will have more than one expansion rack or one expansion rack that uses an Isolated Expansion Receiver Module (IC200ERM001) as its interface to the expansion bus, an Expansion Transmitter Module must be installed to the left of the NIU. The Expansion Transmitter Module must be installed on the same section of DIN rail as the rest of the modules in the main "rack" (rack 0).



VersaMax I/O Station Main Rack (0)

1. Make sure rack power is off.
2. Attach the Expansion Transmitter to DIN rail to the left of the NIU position.
3. Install the NIU as instructed. Connect the modules and press them together until the connectors are mated.
4. After completing any additional system installation steps, apply power and observe the module LEDs.



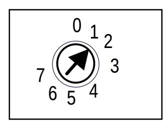
Removing an Expansion Transmitter Module

1. Make sure rack power is off.
2. Slide module on DIN rail away from the NIU in the main rack.
3. Using a small screwdriver, pull down on the tab on the bottom of the module and lift the module off the DIN rail.

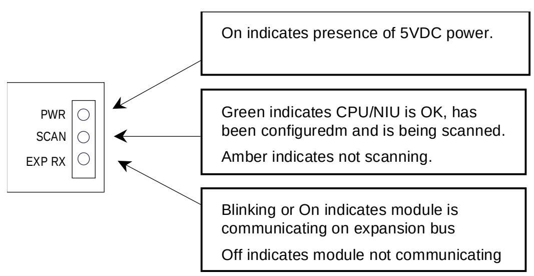
Installing an Expansion Receiver Module

An Expansion Receiver Module (IC200ERM001 or 002) must be installed in the leftmost slot of each VersaMax expansion “rack”.

1. Insert the label inside the access door at the upper left corner of the module.
2. Attach the module to the DIN rail at the left end of the expansion rack.
3. Select the expansion rack ID (1 to 7) using the rotary switch under the access door at upper left corner of the module. Duplicate Rack IDs are not permitted. In a single-ended expansions system, the receiver Rack ID must be set to 1.



4. Install the Power Supply module on top of the Expansion Receiver.
5. Attach the cables. If the system includes an Expansion Transmitter Module, attach the terminator plug to the EXP2 port on the last Expansion Receiver Module.
6. After completing any additional system installation steps, apply power and observe the module LEDs.



Removing an Expansion Receiver Module

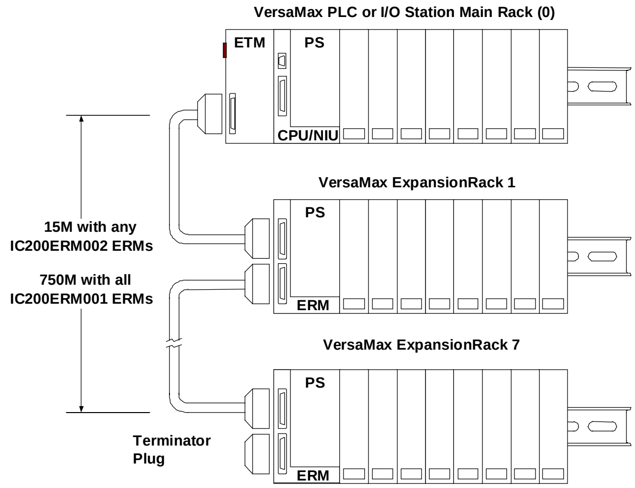
1. Make sure rack power is off.
2. Un-install the Power Supply module from the Expansion Receiver Module.
3. Slide the Expansion Receiver Module on DIN rail away from the other modules.
4. Using a small screwdriver, pull down on the tab on the bottom of the module and lift the module off the DIN rail.

Expansion Rack Power Sources

Power for module operation comes from the Power Supply installed on the Expansion Receiver Module. If the expansion rack includes any Power Supply Booster Carrier and additional rack Power Supply, it must be tied to the same source as the Power Supply on the Expansion Receiver Module.

Connecting the Expansion Cable: RS-485 Differential

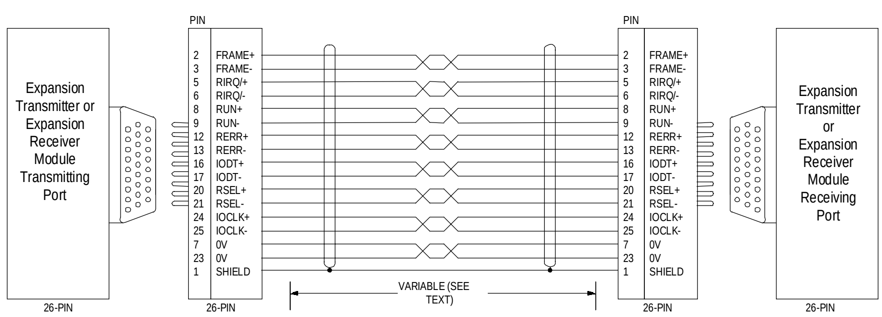
For a multiple-rack expansion system, connect the cable from the expansion port on the Expansion Transmitter to the Expansion Receivers as shown below. If all the Expansion Receivers are the Isolated type (IC200ERM001), the maximum overall cable length is 750 meters. If the expansion bus includes non-isolated Expansion Receivers (IC200ERM002), the maximum overall cable length is 15 meters.



Install the Terminator Plug (supplied with the Expansion Transmitter module) into the lower port on the last Expansion Receiver. Spare Terminator Plugs can be purchased separately as part number IC200ACC201 (Qty 2).

Note: Do not disconnect an expansion cable while the system is operating. It will cause momentary disruptions in bus communications.

RS-485 Differential Inter-Rack Connection (IC200CBL601, 602, 615)

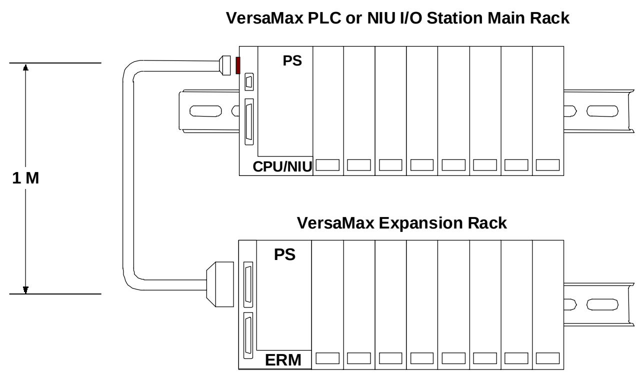


Building a Custom Expansion Cable

Custom expansion cables can be built using Connector Kit IC200ACC202, Crimper AMP 90800-1, and Belden 8138, Manhattan/CDT M2483, Alpha 3498C, or equivalent AWG #28 ($0.089mm^2$) cable.

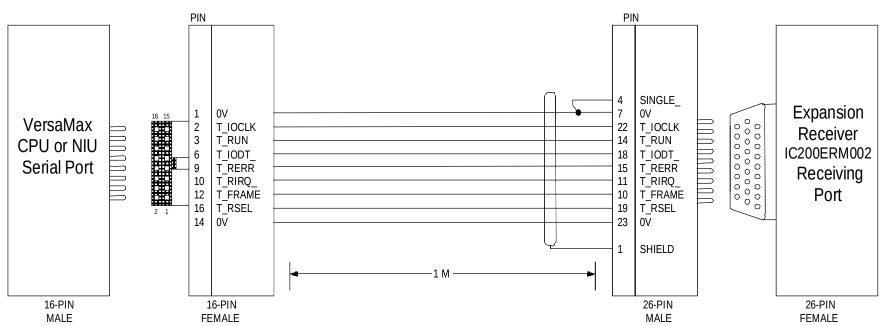
Connecting the Expansion Cable: Single-ended

For a system with one non-isolated expansion rack (IC200ERM002) and NO Expansion Transmitter, connect the expansion cable from the serial port on the VersaMax NIU to the Expansion Receiver as shown below. The maximum cable length is one meter. Cables cannot be fabricated for this type of installation; cable IC200CBL600 must be ordered separately. Note: Do not disconnect an expansion cable while the system is operating. It will cause momentary disruptions in bus communications.



No Terminator Plug is needed in a single-ended installation; however, it will not impede system operation if installed.

Single-Ended Inter-Rack Connection (IC200CBL600)



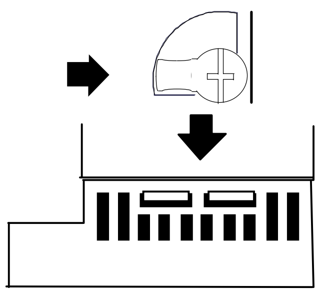
Power Sources for Single-Ended Expansion Rack Systems

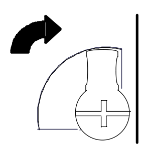
When operating the system in single-ended mode, the power supplies for the main rack and expansion rack must be fed from the same main power source. The main rack and expansion racks cannot be switched ON and OFF separately; either both must be ON or both must be OFF for proper operation.

Power for module operation comes from the Power Supply installed on the Expansion Receiver Module. If the expansion rack includes any Power Supply Booster Carrier and additional rack Power Supply, it must be tied to the same source as the Power Supply on the Expansion Receiver Module.

Installing Power Supply Modules

Power supply modules install directly onto the NIU module, Expansion Receiver Modules, and supplementary power supply carriers. The power supply provides +5V and +3.3V to downstream modules through the mating connector. The number of modules that can be supported depends on the power requirements of the modules. Additional booster power supplies can be used as needed to meet the power needs of all modules. The configuration software provides power calculations with a valid hardware configuration. If a rack includes more than one power supply, additional power supplies must be installed so that they can be turned at the same time as the main power supply.

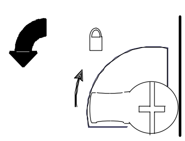


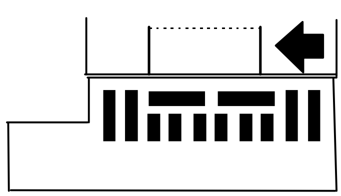


1. The latch on the power supply must be in the unlocked position.
2. Align the connectors and the latch post and press the power supply module down firmly, until the two tabs on the bottom of the power supply click into place. Be sure the tabs are fully inserted in the holes in bottom edge of the NIU, ERM, or carrier.
3. Turn the latch to the locked position to secure the power supply.

Removing the Power Supply

Exercise care when working around operating equipment. Devices may become very hot and could cause injury.



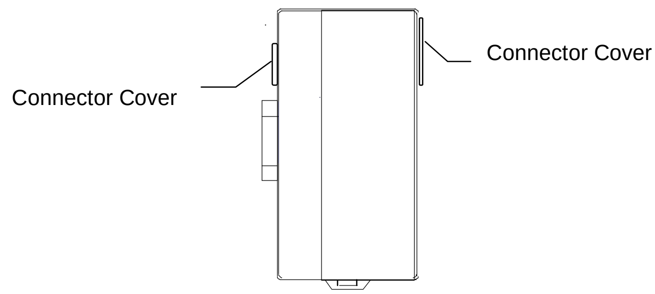


1. Remove power.
2. Turn the latch to the unlocked position as illustrated.
3. Press the flexible panel on the lower edge of the power supply to disengage the tabs on the power supply from the holes in the carrier.
4. Pull the power supply straight off.

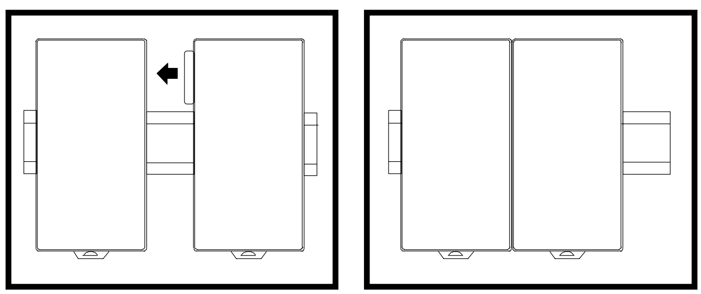
Installing Additional Modules

Before joining carriers to the NIU, remove the connector cover on the righthand side of the NIU. Do not discard this cover; you will need to install it on the last carrier. It protects the connector pins from damage and ESD during handling and use.

Do not remove the connector cover on the lefthand side.



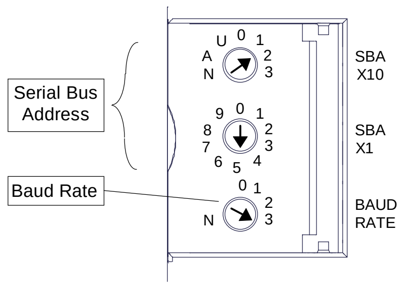
Install additional modules by mounting modules on their carriers and sliding them along the DIN rail to fully engage the connectors in the sides of the carriers.



Setting the SBA and Baud Rate

Open the clear protective door by pulling upward at the indentation in the side of the NIU. Use a 2.44mm (3/32in) flat screwdriver to adjust the rotary switches.

(Refer to the heading Special Switch Settings if the NIU is being configured using datagrams or for information about upgrading the NIU firmware).



Select the serial bus address with the two upper rotary switches, SBA X10 (for the tens digit) and SBA X1(for the ones digit). Each device on a bus must have a unique serial bus address in the range 0 - 31.

Select the baud rate to match that used by the other devices on the bus by setting the bottom rotary switch: (3) 153.6 Kbaud extended, (2) 153.6 Kbaud standard, (1) 76.8 Kbaud, or (0) 38.4 Kbaud.

Cycle power to the NIU after changing the switch settings.

Selecting a Baud Rate

All devices on a bus must use the same baud rate.

If the cable length is between 4500 and 7500 feet, you must select 38.4 Kbaud. This data rate only supports a maximum of 16 devices on the bus.

If the cable length is between 3500 and 4500 feet, select 76.8 Kbaud.

If cable length is between 2000 and 3500 feet, select 153.6 Kbaud extended.

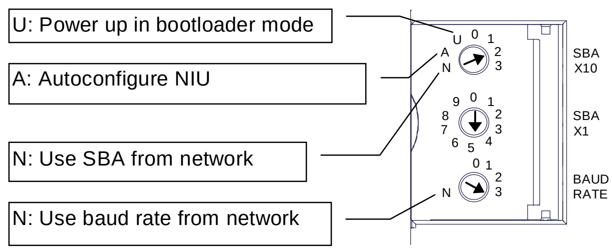
If the cable length is less than 2000 feet, either 153.6 Kbaud standard or 153.6 Kbaud extended can be used. 153.6 Kbaud extended is recommended, especially if the system will include a dual bus. In noisy environments, 153.6 Kbaud extended provides improved noise immunity with little effect on bus scan time.

Selection of an appropriate baud rate for the system may also be determined by the type of cable used. For more information, see *Selecting a Cable Type*.

Special Switch Settings on the NIU

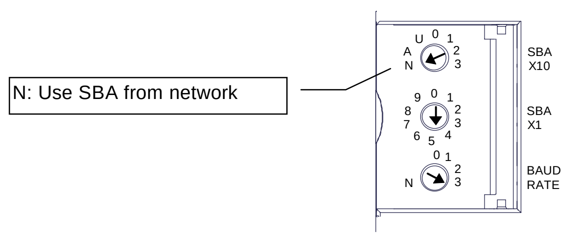
The lettered positions of the rotary switches can optionally be used to:

- Use a serial bus address that has been sent from the network.
- Use a baud rate that has been sent from the network.
- Re-enable autoconfiguration.
- Put the NIU in “bootloader” mode to accept a firmware upgrade.



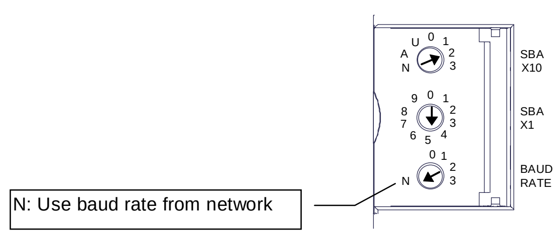
Using a Network Serial Bus Address

To use a Serial Bus Address previously received via a Set SBA datagram from the network instead of the switch settings, set the upper switch (SBAx10) to the N (network) position and cycle power to the NIU



Using the Network Baud Rate

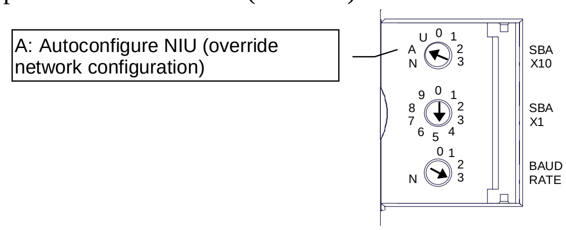
To use a baud rate previously received via Set Baud Rate datagram from the network, set the lower switch (Baud Rate) to the N (Network) position and cycle power to the NIU.



Overriding a Network Configuration

The NIU can also be configured via a message from the network. A network configuration can be set up to deliberately disable the auto-configuration function. If autoconfiguration has previously been disabled by a network configuration, you can restore the autoconfiguration function by following the steps below.

1. Set the upper SBA select switch (SBAx10) on the NIU to the A position.



2. Cycle power.
3. Reset the upper SBA switch to select the tens digit of the SBA.
4. Cycle power again.

Changing the SBA to a normal SBA does not disable autoconfiguration again. Once autoconfiguration has been enabled, it cannot be disabled manually. A configuration message sent to the NIU over the network or from the Remote I/O Manager configuration tool disables autoconfiguration.

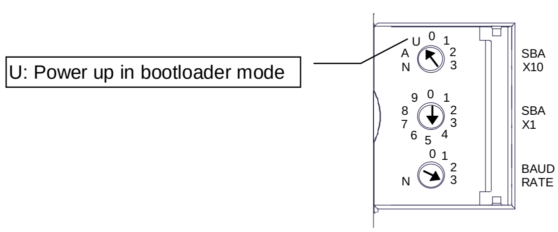
Reenabling Network Configuration

To reenable a network configuration that has been overridden as described above:

1. Set the SBA select switches on the NIU to a valid address between 0 and 31.
2. Cycle power.

Upgrading the NIU Firmware

1. Connect the cable (IC200CBL002) from the programming device to the port on the lefthand side of the NIU.
2. Set the upper switch (SBAx10) to the U (Upload) position.



3. Cycle power to the NIU. The NIU will power up in bootloader mode.
4. Follow the instructions supplied with the upgrade to transfer new NIU firmware to the NIU.

Selecting a Cable Type

Proper cable selection is critical to successful operation of the system. Each bus in the system can be any cable type listed in the table below.

Cable # & Make	NEC (USA) Type	Outer Diameter	Terminating Resistor* -10%to+20% 1/2 Watt	Number of Conductors/ AWG	Dielectric Voltage Rating	Ambient Temp Rating	Maximum Length Cable Run, feet/meters at baud rate			
							153.6s	153.6e	76.8	38.4 •
(A)9823 (C)4596 (M)M39240	none CL2 CM	.350in 8.89mm	150 ohms	2 / #22	30v	60°C	2000ft 606m	3500ft 1061m	4500ft 1364m	7500ft 2283m
(B)89182	CL2P	.322in 8.18mm	150 ohms	2 / #22	150v	200°C	2000ft 606m	3500ft 1061m	4500ft 1364m	7500ft 2283m
(B)9841 (M)M3993	CM CL2	.270in 6.86mm	120 ohms	2 / #24	30v	80°C	1000ft 303m	1500ft 455m	2500ft 758m	3500ft 1061m
(A)9818C (B)9207 (M)M4270	CL2 CM CM	.330in 8.38mm	100 ohms	2 / #20	300v	80°C	1500ft 455m	2500ft 758m	3500ft 1061m	6000ft 1818m
(A)9109 (B)89207 (C)4798 (M)M44270	CL2P CM * CMP	.282in 7.16mm	100 ohms	2 / #20	150v	200°C	1500ft 455m	2500ft 758m	3500ft 1061m	6000ft 1818m
(A)9818D (B)9815	none *	.330in 8.38mm	100 ohms	2 / #20			1500ft 455m	2500ft 758m	3500ft 1061m	6000ft 1818m
(O)911264 **	none	.260in 6.60 mm	100 ohms	2 / #22 flexing	250V	80°C	1500ft 455m	2000ft 606m	3000ft90 9m	4500ft 1364m
(E)532185 BBDN	CM	approx .50in (12.7mm)	100 ohms	4 pairs #24 (solid)	>150V	80°C	1500ft 455m	2000ft 606m	3000ft 909m	4500ft 1364m
(A)9818 (B)9855 (M)M4230	* CM CM	.315in 8.00mm	100 ohms	4 (two pair) #22	150v	60°C	1200ft 364m	1700ft 516m	3000ft 909m	4500ft 1364m
(A)9110 (B)89696 (B)89855	none CMP CMP	.274in 6.96mm	100 ohms	4 (two pair) #22	150v	200°C	1200ft 364m	1700ft 516m	3000ft 909m	4500ft 1364m
(A)9814C) (B)9463 (M)M4154	none CM CL2	.243in 6.17mm	75 ohms	2 / #20	150v	60°C	800ft 242m	1500ft 455m	2500ft 758m	3500ft 1061m
(A)5902C (B)9302 (M)M17002	none CM CM	.244in 6.20mm	75 ohms	4 (two pair) #22	300v	80°C	200ft 60m	500ft 152m	1200ft 333m	2500ft 758m

Notes: A = Alpha, B = Belden, C = Consolidated, E = Essex, M = Manhattan, O = Olflex
• = Limited to 16 taps at 38.4 Kbaud
* = not known
**= Suitable for applications requiring high flexibility, continuous flex or vibration.

NEC classes are based on data obtained from manufacturers and are subject to change. CANADIAN CEC codes are similar. Other countries may vary.

The serial bus can be treated as a Class 2 circuit when appropriate wiring practices are followed. Maximum available bus lengths may be affected when installation requires the high voltage CM (Communications) rating. CM types can replace CL2, but not vice versa.

Do not mix cables of different impedance, regardless of cable run length. Do not mix cable types in long and/or noisy installations. Other, small-size twisted pair shielded wire of unspecified impedance can be used for short runs of 50 feet or less, using 75 ohm terminations. Selection of wire type may be limited by local and national codes and industry standards. Consult the cable manufacturer to determine the cable's suitability for a particular type of installation.

Conservative wiring practices and national and local codes require physical separation between control circuits and power distribution or motor power. Refer to sections 430 and 725 of the National Electric Code.

Using Other Cable Types

The cable types listed in the preceding table are recommended. If the cable types listed above are not available, the cable selected must meet the following guidelines.

1. High quality construction. Most important is uniformity of cross section along the length of the cable. Poor quality cable may cause signal distortion, and increase the possibility of damage during installation.
2. Precision-twisted shielded wire of EIA RS422 standard type, having a uniform number of twists per unit of length. This type of cable may also be listed as twinaxial cable, data cable, or computer cable.
3. Relatively high characteristic impedance; 100 to 150 ohms is best; 75 ohms is the minimum recommended.
4. Low capacitance between wires, typically less than 20pF/foot (60pF/meter). This may be accomplished by inner dielectrics of foamed type, usually polypropylene or polyethylene, having a low dielectric constant. Alternatively, the conductors may be spaced relatively far apart. Lower impedance types have smaller cross-sections and provide easier wiring for shorter total transmission distances.
5. Shield coverage of 95% or more. Solid foil with an overlapped folded seam and drain wire is best. Braided copper is less desirable; spiral wound foil is least desirable.
6. An outer jacket that provides appropriate protection, such as water, oil, or chemical resistance. While PVC materials can be used in many installations, Teflon, polyethelene, or polypropylene are usually more durable.
7. Electrical characteristics: cable manufacturers' information about pulse rise time and NRZ data rate is useful for comparing cable types. The Genius bit consists of three AC pulses; the equivalent NRZ bit rate is about three times as great.

For assistance in selecting a specific cable type, please consult your local GE Fanuc application engineer.

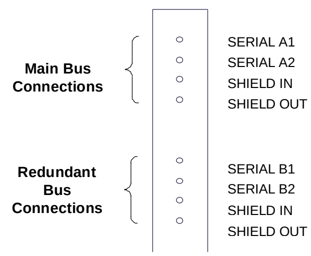
Bus Length

The maximum bus length for shielded, twisted-pair cable is 7500 feet. Some cable types are restricted to shorter bus lengths. In turn, the bus length determines which baud rate may be selected. Refer to the heading ***Selecting a Baud Rate.***

Making Bus Connections

The NIU has two bus connectors. The upper connector is for the main bus cable; it is always used. The lower connector is for an optional redundant bus cable. The NIU has built-in bus switching capability. In a dual-bus installation, do not attach a separate bus switching device to the NIU. (The NIU can be located on a bus stub downstream of a bus-switching device, however).

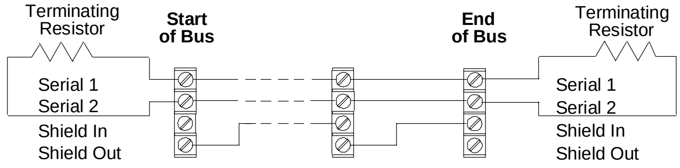
The maximum exposed length of unshielded wires should be 5cm (2in). For protection, each shield drain wire should be insulated with spaghetti tubing to keep the Shield In and Shield Out wires from touching each other or the signal wires.



1. Connect Serial 1 to the Serial 1 terminals of the previous and next devices.
2. Connect Serial 2 to the Serial 2 terminals of the previous and next devices.
3. Connect Shield In to Shield Out of the preceding device. Connect Shield Out to Shield In of the next device. If the NIU is the first device on a bus, Shield In can be left unconnected. If it is the last device on a bus, Shield Out can be left unconnected.
4. When inserting two wires into the same terminal, the wire size must be $0.86mm^2$ (18AWG) or smaller. Both wires should be the same size and type. Do not mix stranded with solid wire in the same position.

Terminating a Bus

If the bus terminates at the NIU, connect a 75, 100, 120, or 150-ohm terminating resistor across Serial 1 and Serial 2. The use of a ferrule is recommended to crimp each resistor lead to the corresponding serial line. If ferrules are not used, twist each resistor lead with the corresponding serial line and solder them together before inserting the wires into the terminal.



Lightning Transient Suppression

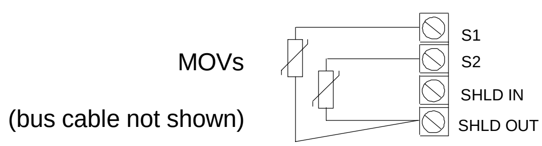
Running the bus cable outdoors or between buildings may subject it to lightning transients beyond the 1,500 volt transient rating of the system. Installing cable underground reduces the probability of a direct lightning strike. However, buried cables can pick up hundreds of amperes of current when lightning contacts the ground nearby.

Therefore, it is important to protect the installation by including surge protectors on underground data lines. The cable shields should be grounded directly. Surge suppressors and spark gaps should be used to limit the voltage that might appear on the signal lines. It is recommended to install two (only) silicon surge suppressors or spark gaps to control transients of 1 to 25 Kilovolts from 100 to 1000 amps or more. These devices should be installed close to the entrance of the bus to the outdoors.

In extreme situations, such as totally-isolated power systems, additional protection against lightning damage should be provided. Such suppressors should be installed from incoming power leads to ground.

Adding Suppression at the Communications Line

For an individual NIU, suppression can be supplied by connecting two small metal oxide varistors (MOVs) from Serial 1 and Serial 2 to the Shield Out terminal:



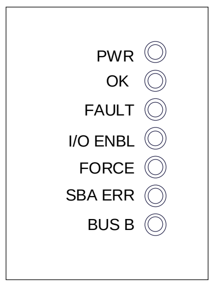
Suitable MOVs include Harris part number V220MA2A, Panasonic ERZ-CO5FK221U, and Siemens 505K140. If necessary, higher energy-rated devices can also be used.

The use of a ferrule is recommended to crimp each MOV lead to the corresponding serial line. If ferrules are not used, twist each MOV lead with the corresponding serial line and solder them together before inserting the wires into the terminal block.

It is important to be sure that the MOV leads do not cause any shorts between the serial data and shield connectors.

Observing the LEDs

The LEDs indicate the presence of power and show the operating mode and status of the NIU.



PWR	Indicates that the NIU is receiving power.
OK	Indicates diagnostics executed successfully.
FAULT	Is ON if there are one of more faults.
I/O ENBL	This bicolor LED is green if the I/O scan is enabled and data is being received from the bus. Otherwise, this LED is amber.
FORCE	Is ON if one of more I/O points is forced* or bus switching is forced.
SBA ERR	Is ON if a duplicate device SBA or no valid SBA is selected.
BUS B	Is ON if bus B is active.

* Forcing inputs and outputs from the programmer does not force the actual input and output points on the NIU. Forcing actual I/O points requires the use of datagrams from the PLC to the NIU.

CE Mark Installation Requirements

The following requirements for surge, electrostatic discharge (ESD), and fast transient burst (FTB) protection must be met for applications that require CE Mark listing:

- The VersaMax I/O Station is considered to be open equipment and should therefore be installed in an enclosure (IP54).
- This equipment is intended for use in typical industrial environments that utilize anti-static materials such as concrete or wood flooring. If the equipment is used in an environment that contains static material, such as carpets, personnel should discharge themselves by touching a safely grounded surface before accessing the equipment.
- If the AC mains are used to provide power for I/O, these lines should be suppressed prior to distribution to the I/O so that immunity levels for the I/O are not exceeded. Suppression for the AC I/O power can be made using line-rated MOVs that are connected line-to-line, as well as line-to-ground. A good high-frequency ground connection must be made to the line-to-ground MOVs.
- AC or DC power sources less than 50V are assumed to be derived locally from the AC mains. The length of the wires between these power sources and the PLC should be less than a maximum of approximately 10 meters.
- Installation must be indoors with primary facility surge protection on the incoming AC power lines.
- In the presence of noise, serial communications could be interrupted.

Chapter 3 Operation

This section explains how the NIU interacts with the modules in its station, how it stores data, and how it exchanges data on the bus.

- NIU data memories
- Scanning inputs and outputs in the I/O Station
- Data transfer between the Genius NIU and the bus
- Genius bus scan time

Genius Hand-held Monitor Use

The Network Interface Unit does not have a Hand-held Monitor connection. A Genius Hand-held Monitor cannot be used to configure, monitor I/O, or force and unforce I/O.

If there is a Hand-held Monitor elsewhere on the bus, it will display the presence of the NIU on the bus as an “unsupported device”.

NIU Data Memories

All of the data for the I/O station utilizes the NIU's four I/O data memories.

The NIU has 128 bytes of memory available for each of the four types of data (discrete inputs and outputs, data types I and Q, and analog inputs and outputs, data types AI and AQ). During NIU configuration, data for individual modules is assigned to specific areas of this memory.

NIU Memory Type	Typically Used For	Amount Available in NIU
I	discrete inputs, and status data from intelligent modules (each byte contains 8 input points)	128 bytes
Q	discrete outputs, and fault clearing for intelligent modules (each byte contains 8 output points)	128 bytes
AI	analog inputs (requires 2 bytes per channel)	128 bytes
AQ	analog outputs (requires 2 bytes per channel)	128 bytes

Data always starts at the beginning of each table.

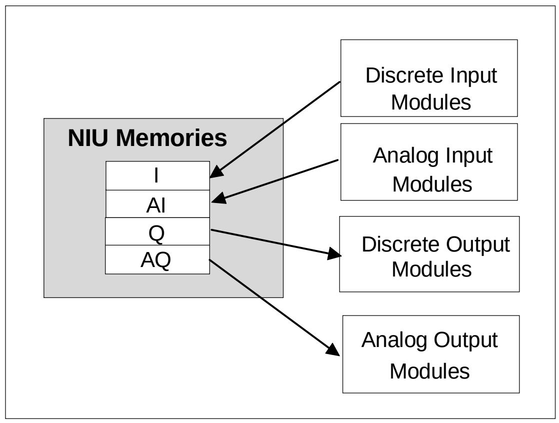
Each table starts at 1 internally. The combination of analog channels and discrete points must not exceed 128 bytes for inputs and 128 bytes for outputs.

Scanning Inputs and Outputs in the I/O Station

The NIU performs a regular I/O scan of all inputs and outputs.

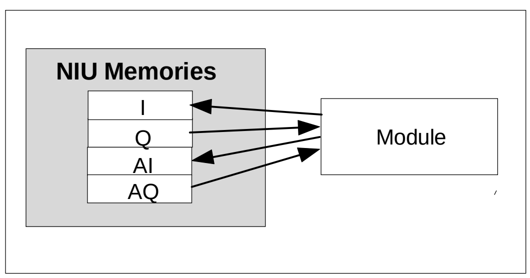
During each I/O scan, the NIU reads inputs from all discrete and analog input modules and places the data into its I and AI memories.

The NIU also sends outputs from its Q and AQ memories to all discrete and analog output modules.



Data Handling for Modules with More than One Data Type

Some modules have multiple types of I/O data. The NIU reads all input data from these modules and sends all their output data during every I/O scan.



Data Transfer Between the NIU and the Bus

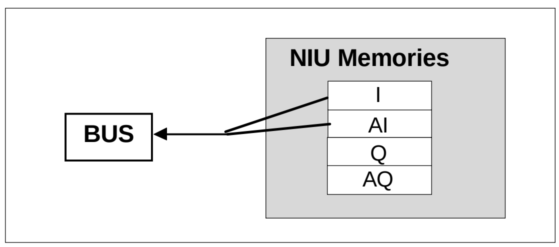
Each bus scan, an NIU exchanges the following data with the bus:

- It sends an input message with up to 128 bytes of discrete and/or analog inputs.
- It receives an output message with up to 128 bytes of discrete and/or analog outputs.

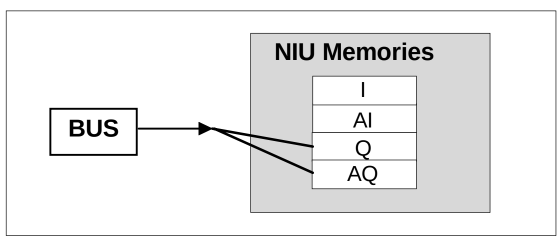
The exact length of these messages is determined by the network I/O map configured for the NIU.

Communications on the Genius Bus

After the NIU completes a successful login on the bus, it starts sending input data and accepting output data on the bus. The NIU communicates on the bus repetitively and asynchronously relative to the I/O scan. When the NIU receives the bus communications token, it sends the most recent data from its I and AI memories.



The NIU receives new outputs from the bus when the PLC or computer bus controller has the communications token. The NIU places these outputs its Q and AQ output tables.

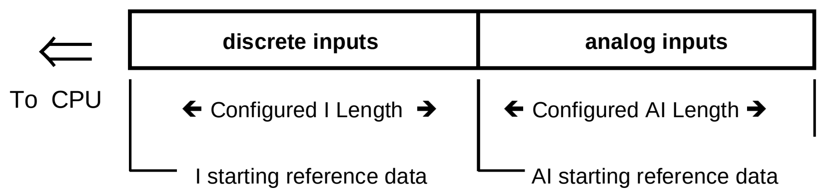


These outputs are then passed to the devices in the station on the NIU's next internal I/O scan.

Input Data Format

When the NIU takes its turn on the bus, it sends one input data message containing the latest values for all configured discrete inputs followed by all configured analog inputs. Because they are broadcast, they can be obtained by any bus controller on the bus.

Input Data Message
(up to 128 bytes)



The data lengths are equal to the lengths of I and AI data configured in the NIU. Either length may be zero.

Discrete inputs appear in the input message in the same sequence as their assigned input references. Each discrete input module occupies one byte per eight circuits.

Analog inputs are also in the same sequence as their input references. Each analog input module occupies two bytes (one word) for each analog channel.

Input Defaults

If an input module is removed or fails to operate correctly, its configured default state is substituted for actual input data. A diagnostic message is provided to indicate loss of module. Forced input data is not affected.

I/O Data Handling by the PLC or Computer

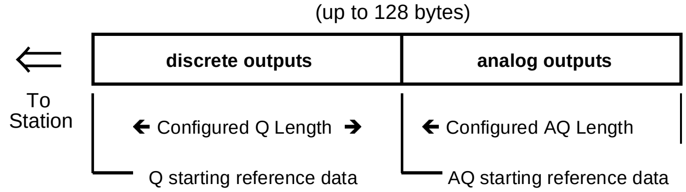
How a PLC or computer handles input data from the NIU depends on its type:

- A VersaMax or Series 90 PLC places the data in the %I and %AI references selected during PLC configuration. These must be the same references selected during NIU configuration.
- A Series Six or Series Five PLC places the data into I/O table or register memory. A beginning address in Series Six or Series Five I/O Table memory can be entered during station configuration.
- A host computer with a PCIM places the data into the input table segment that corresponds to the serial bus address (Device Number) of the NIU.

Output Data Format

Each time the PLC or computer that controls the NIU has the bus communications token, it sends fresh output data on the bus. Outputs for the NIU are sent in one output data message, with all configured discrete outputs followed by all configured analog outputs.

Output Data Message
(up to 128 bytes)



The data lengths are equal to the configured lengths of Q and AQ data selected for the NIU (regardless of the host type or the amount of output data needed for the modules physically present in the station). Either length may be zero.

When generating the output data message, a Series 90 bus controller automatically places the Q data ahead of the AQ data. Other types of controllers must send an output message consisting of the correct number of bytes of discrete output data followed by the correct number of bytes of analog output data. The output data format shown above is required by the NIU.

As soon as new output data is received, the NIU checks to be sure the data is error-free and of the correct length. After verifying the accuracy of the data, the NIU puts the data in its Q and AQ tables. Each discrete output module receives one byte of data for every eight points. Each analog output module receives two bytes (one word) for each analog channel.

Output Defaults

Except for outputs that have been previously forced, all other outputs are set to their programmed defaults during the first Genius bus scan after powerup. The previously-forced outputs are immediately set to their forced values.

If the NIU loses contact with its host for three successive bus scans or 1.2 seconds, whichever occurs first, the NIU takes control of the outputs. The NIU sets output data to the configured values. If the NIU loses contact with its host for 3 bus scans or 1.2 seconds, and it has been configured in “Hot Standby” or “Duplex” Redundancy mode, or if configured as a “BSM Controller”, or as “BSM present”, the NIU operates as described in the *Genius I/O System and Communications Manual.*

Genius Bus Scan Time

The Genius bus scan time is dependent on the number of devices and amount of data traffic on the bus. The bus scan time may vary from 3-400ms, but 20-30ms is typical. It cannot be less than 3ms.

The Genius bus scan time contribution for the NIU depends on its I/O data usage. The table below shows the scan time contribution, at each baud rate, for stations with a total of 16, 32, 64, 128, and 256 bytes, when the NIU receives outputs from *only one bus controller at a time.*
To find the exact scan time contribution for the NIU, follow the procedure below.

Total Amount of Input and Output Data	Contribution time in ms at each baud rate			
	153.6 Kb std	**153.6 Kb ext**	**76.8 Kb**	**38.4 Kb**
16 bytes	2.09	2.16	3.83	7.16
32 bytes	3.24	3.31	6.12	11.74
64 bytes	5.52	5.60	10.69	20.89
128 bytes	10.10	10.17	19.85	39.20
256 bytes (fully-loaded)	19.25	19.32	38.15	75.80

Procedure for Estimating Bus Scan Time

1. Find the total number of input bytes and output bytes. (Each analog channels is 2 bytes. Each eight discrete points are one byte).

   number of input bytes = ________
   number of output bytes = ________
   total bytes = ________

2. With this total, calculate a scan time contribution using the formula below that corresponds to the Genius bus baud rate.

   Formula for 153.6 Kbaud Standard:

   0.943ms + (0.0715 x total bytes) = ________ ms

   Formula for 153.6 Kbaud Extended:

   1.015ms + (0.0715 x total bytes) = ________ ms

   Formula for 76.8 Kbaud:

   1.538ms + (0.143 x total bytes) = ________ ms

   Formula for 38.4 Kbaud:

   2.583ms + (0.286 x total bytes) = ________ ms

Timing Responsiveness

If an output in the station is tied to an input in the same station, the output changes state (or value, in the case of an analog output module) within a few milliseconds of the new output being sent from the bus controller to the NIU. (To guarantee that an output changes state, that state must be present for at least one NIU sweep time or one Genius bus scan time, whichever is greater.

The input which is tied to the output responds as soon as any load-effects have settled out and input filtering is completed. This may occur as soon as the NIU's next I/O scan.

If the host is a PLC, an input must be present for at least one PLC sweep time plus one Genius bus scan time plus one NIU sweep time to guarantee its detection by the PLC. If the input changes state only briefly, and then changes again before the input data is sent on the bus, the interim state may be overwritten in the NIU's internal memory by some new input state or value before it can be sent.

Chapter 4

Configuring a Genius NIU and I/O Station

This chapter explains how a Genius NIU and the modules in an I/O Station can be configured. Configuration determines certain characteristics of module operation and also establishes the program references that will used by each module in the system.

This chapter describes:

- Using autoconfiguration or programmer configuration

  The Genius NIU and I/O Station can be either autoconfigured or configured from a programmer using the Remote I/O Manager configuration software.

- Configuring racks and slots

  Even though a VersaMax I/O Station does not have a module rack, both autoconfiguration and software configuration use the traditional convention of “racks” and “slots” to identify module locations.

- Software configuration of the Genius NIU and I/O Station

  Software configuration provides greater flexibility than autoconfiguration in setting up an I/O Station. Software configuration is done using the Remote I/O Manager configuration software.

- Autoconfiguration of the Genius NIU and I/O Station

  Autoconfiguration provides a default configuration for the NIU and I/O Station and does not require the use of a programmer. I/O modules that have software-configurable features always use their default settings when autoconfigured.

Using Autoconfiguration or Programmer Configuration

The Genius NIU and I/O Station can be either autoconfigured, or configured from a programmer using the Remote I/O Manager configuration software. The choice of which configuration method to use depends on the nature of the system.

Autoconfiguration

Autoconfiguration is done by the NIU itself. It provides a default configuration for the NIU and I/O Station and does not require the use of a programmer. If there is not a stored configuration already present at powerup, the NIU sees which modules are installed and automatically creates a configuration for the I/O Station. I/O modules that have software-configurable features can only use their default settings when the I/O Station is autoconfigured. Autoconfiguration is described later in this chapter.

Software Configuration

Using the configuration software makes it possible to reassign I/O table addresses, and to configure many I/O module features. The configuration software runs on a computer that connects to the NIU via the NIU expansion port.

The configuration software can be used to:

- Create a customized configuration
- Store (write) a configuration to the NIU
- Load (read) an existing configuration from an NIU
- Compare the configuration in an NIU with a configuration file stored in the programmer
- Clear an auto-configuration that was previously stored to the NIU (“autoconfigure”)

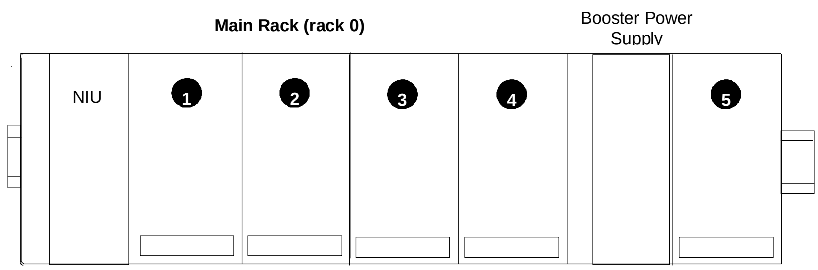
The NIU retains a software configuration across power cycles. Storing a configuration disables autoconfiguration, so the PLC will not overwrite the configuration during subsequent startups.

However, actually clearing a configuration from the programmer does cause a new autoconfiguration to be generated. In that case, autoconfiguration is enabled until a configuration is stored from the programmer again.

Software configuration is summarized later in this chapter. Instructions for installing and using the configuration software are in the *Remote I/O Manager Software User’s Guide* (GFK-1847).

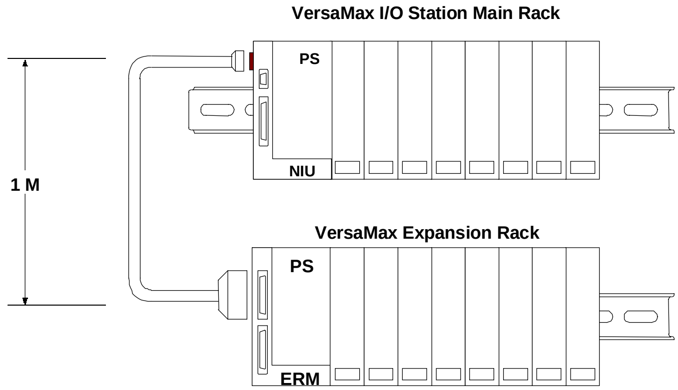
Configuring "Racks" and "Slots"

Even though a VersaMax I/O Station does not have a module rack, both autoconfiguration and software configuration use the traditional convention of "racks" and "slots" to identify module locations. Each logical rack consists of the NIU or an Expansion Receiver module plus up to 8 additional I/O and option modules mounted on the same DIN rail. Each I/O or option module occupies a "slot". The module next to the NIU or Expansion Receiver module is in slot 1. Booster power supplies do not count as occupying slots.

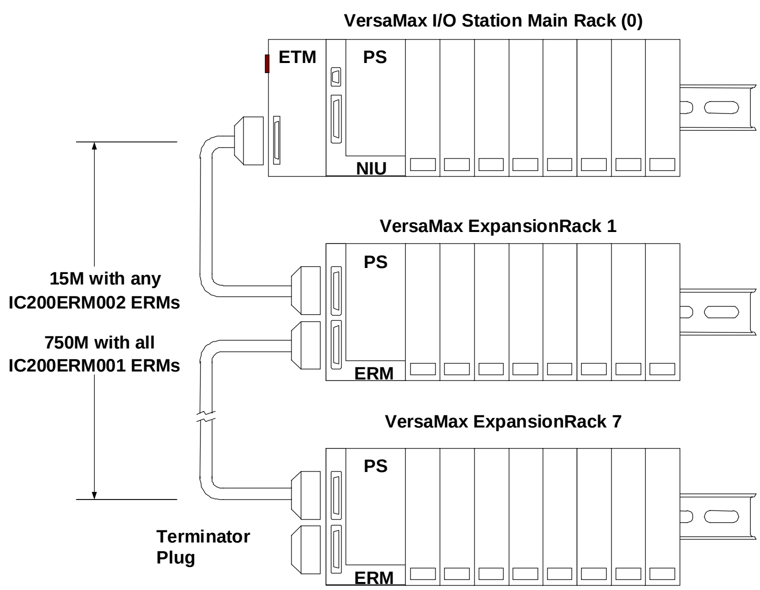


The main rack is rack 0. Additional racks are numbered 1 to 7.

In an I/O Station that has one expansion rack attached to the expansion bus by a non-isolated Expansion Receiver Module (IC200ERM002), the expansion rack must be configured as rack 1.



In an I/O Station with an Expansion Transmitter Module (IC200BTM001) and up to seven expansion "racks", each with an Expansion Receiver Module (IC200ERM001 or IC200ERM002), the additional racks are configured as rack 1 through rack 7.



Software Configuration of the Genius NIU and I/O Station

Software configuration provides greater flexibility than autoconfiguration in setting up an I/O Station. Software configuration is done using the Remote I/O Manager configuration software. The software is available with a programmer cable as catalog number IC641CFG110, or without a programmer cable as catalog number IC641CFG100. It can also be done using the VersaPro programming/configuration software, version 1.5 or later.

The Remote I/O Manager software can be used to configure I/O Stations with different types of NIUs (for example: an Ethernet, Genius, or Profibus NIU). It can also be used for CPU configuration. Details of installing and working with the configuration software are given in the *Remote I/O Manager Software User's Guide* (GFK-1847).

The Remote I/O Manager software runs on a computer equipped with Windows 95/98, NT 4.0, or Windows 2000. Note that VersaPro 1.1 and the NIU Configuration software cannot be installed on the same machine. If VersaPro 1.1 is present, you will be prompted to un-install it.

Notes on Using the Configuration Software

1. The same Remote I/O Manager software can configure different types of VersaMax NIUs and all supported IO modules.
2. Empty slots are allowed in an NIU configuration (unlike an autoconfiguration).
3. The I/O Station cannot include the following communication modules: IC200BEM002 and IC200BEM103.
4. The reference addresses assigned to modules in the I/O Station can be edited. Addresses do not need to be consecutive.

Basic Steps of Software Configuration

The Remote I/O Manager software provides a simple default configuration that you edit to match the actual system modules. The default configuration consists of a power supply (PWR001) and an NIU (either a Genius NIU or the NIU that was saved last time the software was used). Carriers and modules are then added in the same sequence as the hardware installation.

The basic configuration steps are listed below.

- Configure the rack type (non-expanded, single-ended expanded, or multi-rack expanded). This automatically adds the appropriate types of expansion modules to the racks.
- Configure the power supply type and any booster power supplies and carriers.
- Configure the NIU. This includes changing the NIU type if necessary, and assigning its parameters as described on the next page.
- Configure the expansion modules if the system has expansion racks.
- Add module carriers and define wiring assignments.
- Place modules on carriers and select their parameters. Configurable parameters of I/O modules are described in the *VersaMax Modules, Power Supplies, and Carriers User's Manual* (GFK-1504).
- Save the configuration file so that it can be stored to the NIU.

For step-by-step instructions, please refer to the *Remote I/O Manager Software User's Guide* (GFK-1847).

Configuring NIU Parameters

NIU configuration establishes the basic operating characteristics of the Network Interface Unit.

When a programmer is first connected, the NIU communicates using the default communications parameters: 19,200 baud, odd parity, one start bit, one stop bit, and eight data bits. If these parameters are re-configured, the new configuration for the serial port is not actually installed until the programmer is removed. Once these new settings take effect, they will be used at powerup instead.

Feature	Description	Default	Choices
Data Rate (bps)	Data transmission rate (in bits per second).	19200	4800, 9600, 19200
Parity	Determines whether parity is added to words	Odd	Odd, Even, None
Stop Bits	Number of stop bits used in transmission. (Most serial devices use one stop bit; slower devices use two.)	1	1, 2
Expansion Bus Speed	In an expansion system with one or more Isolated Expansion Receiver Modules (IC200ERM001), the default bus speed is 250kHz (“Extended Distance”). If the bus is less than 250 meters, this parameter can be changed to “Normal” (1MHz). If no Isolated Receiver Module is present, the bus speed defaults to Normal (3Mhz).	Extended Distance	Extended, Normal

Configuring I/O References

As I/O modules are added to the configuration, the configuration software keeps a running total of input/output memory. If the modules added consume more than the maximum memory available, the configuration software displays the reference address of the module that caused the error, and an error message.

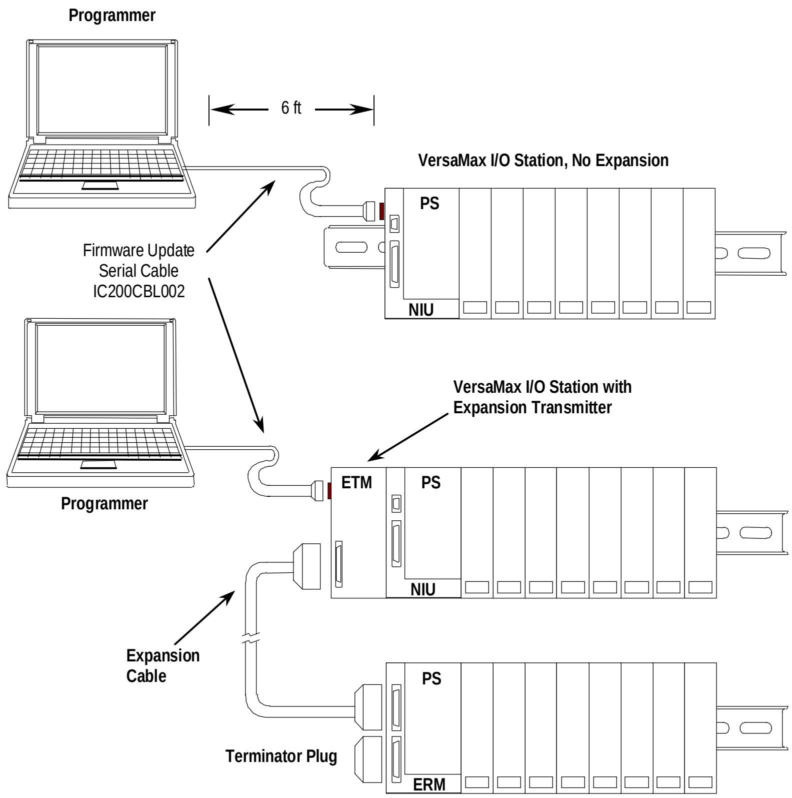
The I/O Station, including all expansion racks, can include up to 128 bytes of inputs and 128 bytes of outputs.

You can change the I/O references assigned to a module when configuring that module.

Software Configuration: Load, Store, Verify, Clear

To transfer and check the contents of a configuration, use the Load/Store/Verify functions from the Tools menu. A configuration file must be saved in the programmer before using the load/store/verify functions.

The computer connects to the expansion port. on the side of the Genius NIU or the pass-through serial port on an Expansion Transmitter Module.



The programmer must be communicating with the NIU. The configuration software has a set of communications parameters that need to be correctly set for communicating with the Genius NIU. To check these parameters, in the Tools menu, select Communications Setup.

If the communications parameters shown are not correct, you can change them. Choose DEFAULT on the Devices tab to select COM1 as the serial port and <NULL> as the SNP ID. You can make additional changes by selecting Edit or by going to the Ports tab.

Storing a Configuration to the Genius NIU

After completing a configuration in the programmer, the configuration must be *stored* to the Genius NIU. In the Tools menu, select Load/Store/Verify and click on Store. When a configuration is stored, the NIU automatically drops off the bus until the store is complete. The NIU then comes back on the bus.

Storing a configuration disables autoconfiguration, so the NIU will not overwrite a software configuration with an autoconfiguration during subsequent startups. If a store operation is aborted, autoconfiguration may occur. The NIU also autoconfigures if the programmer cable is disconnected or power is cycled on the NIU before the store completes.

If there are any mismatched, missing, or extra modules, the store operation continues. Modules that are mismatched or extra in the stored configuration will not be scanned. The NIU will generate faults for these conditions.

Loading a Configuration from the NIU to the Programmer

The programming software can *load* a previously-stored configuration from the Genius NIU back to the programmer. In the Tools menu, select Load/Store/Verify and click on Load.

Note that the following modules share hardware module IDs:

IC200MDL650 loads as IC200MDL636
IC200MDL750 loads as IC200MDL742
IC200MDL331 loads as IC200MDL329
IC200MDD844 loads as IC200MDD842
IC200MDL141 loads as IC200MDL140

If an *autoconfiguration* containing these modules is loaded, an incorrect catalog number and description may be displayed by the software. Edit any incorrect modules using the programmer before storing the configuration back to the NIU. Once this has been done, you will be able to load the configuration properly.

Comparing Configurations in the Programmer and NIU

Use the *verify* function to compare a configuration file in the programmer with a configuration that was previously-stored to the Genius NIU In the Tools menu, select Load/Store/Verify and click on Verify.

Deleting a Software Configuration from the NIU

Use the *clear* function to remove a previously-stored configuration from the NIU. Clearing a configuration causes a new autoconfiguration to be generated. Autoconfiguration remains enabled until a configuration is stored from the programmer again.

Autoconfiguration of the Genius NIU and I/O Station

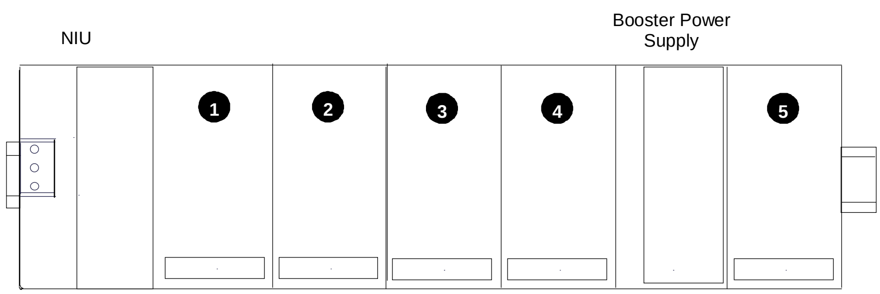
Autoconfiguration is done by the NIU itself. It provides a default configuration for the NIU and I/O Station and does not require the use of a programmer. I/O modules that have software-configurable features always use their default settings when autoconfigured.

When autoconfiguration is enabled and no previous autoconfiguration exists, at powerup the NIU automatically reads the default configuration of the modules installed in the system.

Once this autoconfiguration is complete as described below, the NIU retains this configuration until it is either cleared or powered up with I/O modules added to the existing configuration.

Autoconfiguration Sequence

Each module is considered to occupy a “slot”. The position adjacent to the NIU is slot #1. Booster power supplies do not count as occupying slots.



Autoconfiguration starts at slot 1 of rack 0 (the main rack) and continues in the same order the modules occupy in the I/O Station.
Autoconfiguration stops at the first empty slot or faulted module. For example, if there are modules in slots 1, 2, 3, 5 and 6 but slot 4 is empty, the modules in slots 5 and 6 are not autoconfigured. The NIU reports *Extra I/O Module* faults.

For the autoconfiguration process to work as expected, any additional power supplies in the I/O Station must be powered up at exactly the same time or before the main power supply.

Autoconfiguration Assigns Reference Addresses

The NIU stores data internally as discrete input bits, discrete output bits, analog input words, and analog output words.

The NIU Data Memories	
I	*discrete input bits*
AI	*analog input words*
Q	*discrete output bits*
AQ	*analog output words*

During autoconfiguration, the NIU automatically looks at the modules installed in the I/O Station and assigns them to addresses in this internal I/O map. Reference addresses are assigned in ascending order. For modules that have multiple data types (for example, mixed I/O modules), each data type is assigned reference addresses individually.

Modules that have software-configurable features use their default settings when autoconfigured. These features are described in the *VersaMax Modules, Power Supplies, and Carriers Manual* (GFK-1504).

Adding I/O modules to an Autoconfigured I/O Station

If additional I/O modules are added to an existing I/O Station, they do not become part of the autoconfiguration until the NIU is power-cycled.

Clearing an Autoconfiguration

To clear an existing autoconfiguration, power down the NIU, disconnect the NIU from the first I/O module, disconnect the expansion rack cable if present, and power up the NIU. The configuration in the NIU is then cleared. (An existing software configuration is cleared from the programmer, as described previously in this chapter.)

Hot Inserting I/O Modules

It is possible to hot insert I/O modules in an I/O Station. If the module being replaced already exists in the configuration, no other action is necessary to make the module operable.

Autoconfiguring an I/O Station with Expansion Racks

- The Expansion Receiver modules must have their rack ID selection dials set correctly. Any available rack number can be used for a new expansion rack but they must all be unique (no duplicate rack numbers). It is best to assign expansion racks numbers from lowest (1) to highest (7) as they are installed.
- If a new expansion rack is added in the future, it should be assigned a rack number that is higher than the racks that are already installed. If a new expansion rack with a lower rack number is added and the system is then auto-configured, the racks numbered higher than the new rack number have their I/O reference addresses shifted in the reference tables. Any existing program logic using those references would need to be adjusted to use the new references.
- When autoconfiguring an I/O Station with expansion racks, either all racks must be powered from the same source or the expansion racks must be powered up before the main rack.
- To add another expansion rack to the I/O Station, the I/O Station must be powered down. After adding the expansion rack, power up the I/O Station. It will then autoconfigure.
- To force autoconfiguration for expansion racks, first power down the NIU. Remove the transmitter module from the NIU or remove the expansion cable at the transmitter. Power up the NIU and let it autoconfigure. Power the NIU down again, reattach the transmitter or cable and power up the NIU again.

How Autoconfiguration Handles Equipment Changes

Previously-configured modules are not removed from the configuration during autoconfiguration unless no modules are present in the system during the autoconfiguration.

Module Present But Non-Working During Autoconfiguration: if a module is physically present but not working during autoconfiguration, the module is not configured and the NIU generates an *extra module* diagnostic.

Empty Slot During Autoconfiguration: Autoconfiguration stops at the first empty slot. Modules located after the empty slot are not autoconfigured. The NIU generates an *extra module* diagnostic for each of them.

If a module that was not previously-configured or present at powerup is installed-after powerup, the NIU generates an *extra module* diagnostic and the module is not added to the system configuration.

Previously-Configured Modules Not Present During Autoconfiguration: Previously-configured modules are not removed from the configuration during autoconfiguration unless no modules are present in the system. For example, if modules are configured in slots 1, 2, and 3 then power is removed and the module in slot 1 is removed, when power is reapplied the modules in slots 2 and 3 operate normally. The original module in slot 1 is not removed from the configuration. The NIU generates a *loss of module* diagnostic for slot 1.

Different Module Present During Autoconfiguration: If a slot was previously-configured for one module type but has a different module installed during autoconfiguration, the NIU generates a *configuration mismatch* diagnostic. The slot remains configured for the original module type.

Unconfigured Module Installed After Autoconfiguration: If a module that was not previously-configured is installed-after powerup, the NIU generates an *extra module* diagnostic and the module is not added to the configuration.

Previously-configured Module Installed After Autoconfiguration : If a module that was previously-configured but missing at powerup is installed after powerup, the NIU generates an *addition of module* diagnostic and the module is added back into the I/O scan.

All Modules Removed After Autoconfiguration: If all modules are absent at powerup, the NIU clears the configuration. This allows modules to be inserted and added to the configuration at the next powerup.

Chapter 5 Datagrams

This section lists datagrams that can be sent to or from a Genius Network Interface Unit, and shows the datagrams for VersaMax modules that are different from the formats used by other modules.

It also shows the format of configuration data for the Network Interface Unit and the modules in the station.

- Read Map
- Read Map Reply
- Report Fault Datagram Format
- Configuration Data
- Set Network Interface Unit Operating Mode

Unless otherwise noted, all multi-byte fields are stored with the least significant byte in the lowest memory location followed by the most significant byte. For double word data, the least significant word is stored in the lowest memory location.

For Additional Information, Also See:

The ***User's Manual*** for the PLC or computer, which should explain the specific programming used to send datagrams.

The ***Genius I/O System and Communications Manual***, which describes Genius datagrams and data formats.

Datagram Types

The table below shows the primary datagrams that may be acted upon by the NIU.

Datagram Type	Subfunction Code (hexadecimal)	Network Interface Unit Action
Read Identification	00	send Read ID Reply
Read Configuration	02	send Read Configuration Reply
Write Configuration	04	process (possibly send configuration changes)
Assign Monitor	05	process
Begin Packet Sequence	06	start sequence
End Packet Sequence	07	end/check sequence
Read Diagnostics	08	send Read Diagnostics Reply
Clear All Faults	13	process
Set Baud Rate	14	process (send Set Baud Rate Reply)
Set Serial Bus Address (SBA)	16	process
Set Status Table Address	17	process
Force I/O	18	process
Unforce I/O	19	process
Force BSM	1A	process (send config. change)
Unforce BSM	1B	process (send config. Change when last point is unforced)
Switch BSM	1C	process
Configuration Protect	23	process
Configuration Unprotect	24	process
Read Map	2A	send Read Map Reply
Set Operating Mode	39	process
Read I/O Forces(future)	40	send Read I/O Forces Reply (future)
Read Slot Diagnostics (future)	42	send Read Slot Diagnostics Reply (future)
Read Operating Mode	44	send Read Operating Mode Reply

Read Map

Subfunction Code: 2A hex

This datagram is used to read the reference addresses and lengths that have been configured for the NIU's network I/O map.

Data Field Format: none

Read Map Reply

Subfunction Code: 2B hex

An NIU sends this reply datagram after receiving a Read Map datagram. It contains the previously-configured NIU network map addresses. The network map defines the NIU memory locations of the data that is exchanged on the bus. It provides no information about the I/O assignments of individual I/O modules in the station. However, the checksums indicate whether the overall configuration has been changed.

Byte No.	Byte Description
0	Not used
1	Starting reference for discrete input (I) data (LSB)
2	Starting reference for discrete input (I) data (MSB)
3	Length of discrete input (I) data (in bytes)
4, 5	Starting reference of analog input (AI) data
6	Length of analog input (AI) data (in bytes)
7, 8	Starting reference of discrete output (Q) data
9	Length of discrete output (Q) data (in bytes)
10,11	Starting reference of analog output (AQ) data
12	Length of analog output (AQ) data (in bytes)
13	8-bit Additive Checksum Unused (always 0)
14, 15	16-bit CRC Critical Checksum (lsb in 14, msb in 15) READ ONLY
16	8-bit Additive Checksum. Unused (always 0)
17, 18	16-bit CRC Non-Critical Checksum (lsb in 17, msb in 18) READ ONLY

Starting references in I, AI, Q, and AQ memory are returned. For each memory type, a data length is also supplied. If a length is zero, the associated starting reference can be ignored; it is not meaningful.

Report Fault Datagram Format

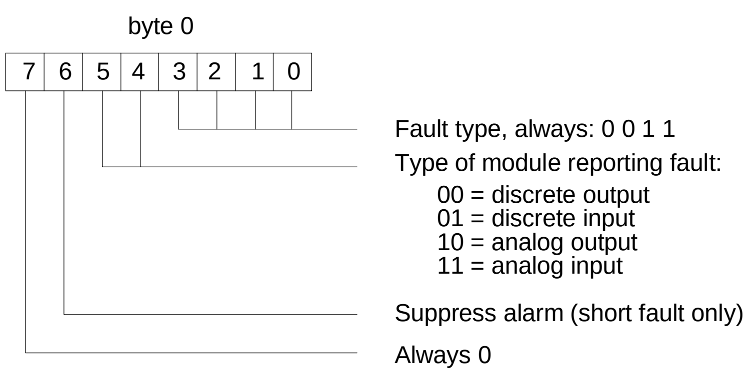
The format of Report Fault datagrams sent by an NIU is shown below. A Series 90 PLC interprets this information automatically; no datagram programming is required. If the host is a Series Six or Series Five PLC, this information is ignored. If the host is a computer, this information can be retrieved from the unsolicited datagram queue, and interpreted as needed for the application.

Note: The NIU can store up to 32 untransmitted fault messages. If an event occurs that causes more than 32 faults when the NIU is unable to transmit fault messages over the network, some messages will be lost. When communications are restored, it is possible that the order in which the remaining messages are sent will differ from the order in which the faults occurred.

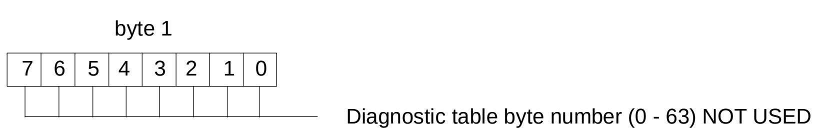
Subfunction Code: 0F hex

Byte #	Description
0	Fault Byte 1
1	Fault Byte 2
2	Fault byte 3
3	Fault byte 4
4	Fault byte 5
5	Fault byte 6
6	Fault byte 7

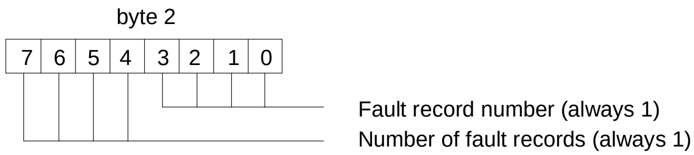
Fault Byte 1



Fault Byte 2

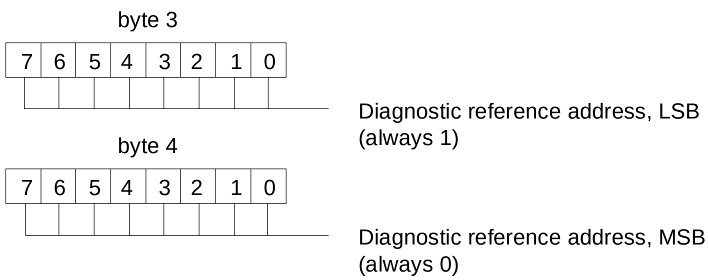


Fault Byte 3



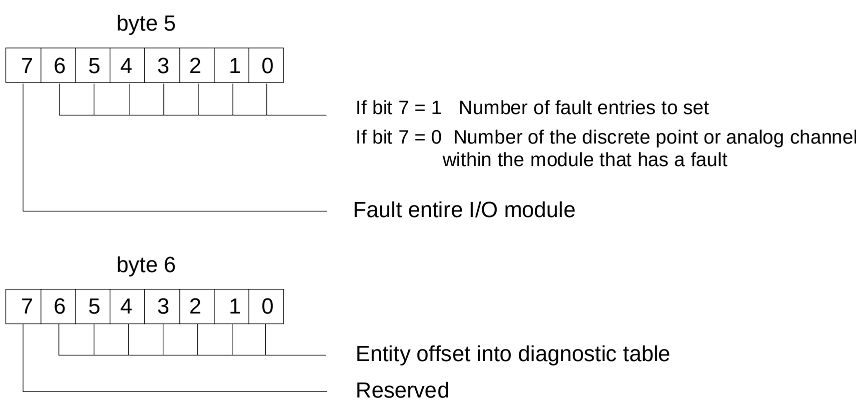
Fault Bytes 4 and 5

Fault bytes 4 and 5 (bytes 3 and 4 of the datagram) identify the reference offset (within the NIU itself) assigned to the faulted module. This is an internal reference.



Fault Bytes 6 and 7

Fault bytes 6 and 7 (datagram bytes 5 and 6) are interpreted by a Series 90-70 PLC automatically. They are not relevant to other types of host.



Configuration Data

Datagrams can be used to read and write configuration data for an I/O Station. However, most systems will instead use the Remote I/O Manager or VersaPro software for configuration.

For a Network Interface Unit, the configuration data specifies the "rack" and slot number of a specific device in the station. The length specified must exactly match the length of the configuration data for the module (Network Interface Unit or other module in the I/O station); partial configuration data cannot be read or written. For programming instructions, you should refer to the documentation set for the PLC.

Configuration files for conventional I/O modules can be read or written one module per message. However, the configuration files of intelligent modules may exceed the 128-byte maximum length of a Genius message. Therefore, any Write Configuration to an intelligent module must be contained within a Begin/End Packet Sequence.

Read Configuration Data

Subfunction Code: 02 hex

The Read Configuration Datagram is used to read configuration data from the NIU.

Read Configuration Data Format

Byte #	Description
0	Rack Number (0,…, 7)
1, 2	Length (must match the length for the specific device whose configuration will be written. Maximum=128)
3	Slot (0,…, 9. Note that in datagrams, the slot numbering is different that the number described elsewhere in the manual. In datagrams only: Power Supplies and Carriers are "slot" 0 Network Interface Unit or Expansion Receiver Module is "slot" 1) Modules are "slots" 2-9
4, 5	Offset into slot configuration data, used to read module configuration data that is greater than 64 words in length

Read Configuration Reply Data

Subfunction Code: 03 hex

This datagram is a reply to the Read Configuration datagram. Bytes 0-5 are like the Read Configuration datagram above. Bytes 6-133 contain the module data, and are like the Write Configuration datagram..

Read Configuration Data Format

Byte #	Description
0	Rack Number (0,…, 7)
1, 2	Length (must match the length for the specific device whose configuration will be written. Maximum=128)
3	Slot (0,…, 9. Note that in datagrams, the slot numbering is different that the number described elsewhere in the manual. In datagrams only: Power Supplies and Carriers are "slot" 0 Network Interface Unit or Expansion Receiver Module is "slot" 1) Modules are "slots" 2-9
4, 5	Offset into slot configuration data
6 - 31	"Rack/slot" record for the slot
32 to end	Context dependent data (optional)

Multiple byte fields in datagrams are transmitted in *little-endian format.* In this format, the least significant byte of a word is stored in the lowest memory location or transmitted first in time. The most significant byte follows.

Write Configuration Data

Subfunction Code: 04 hex

The Write Configuration datagram is used to send configuration data for the NIU or a module in the I/O Station. The context-dependent slot configuration data is the same as the Read Configuration Reply.

For each “rack” in the I/O Station, slot 0 configuration data includes the power supply, I/O carriers, and any booster power supplies present. Because configuration datagrams consider power supplies and carriers to be “slot 0”, this numbering scheme is different that the actual slot numbering described elsewhere in the manual. In rack 0, slot 1 configuration is the NIU. In expansion racks 1-7, slot 1 is used for the Expansion Receiver Module. Up to eight I/O modules per “rack” can be configured as slots 2 through 9.

Do not send partial configuration data; it will be rejected by the NIU. If the data is more than 128 bytes in length, multiple packets may be used. Use the Begin and End Packet sequence messages to ensure that a sequence of Write Configuration messages is treated as a single entity. Each packet should be in slot order. Multiple packets for a slot must also be in order. Multiple packets must be 128 bytes in length except the last which may be shorter.

Note: Multiple byte fields in datagrams are transmitted with the least significant byte of a word in the lowest memory location or transmitted first in time. The most significant byte follows.

Example:

Begin Packet Sequence	(subfunction code 06 hex)
Write Configuration 1	(subfunction code 04 hex)
Write Configuration 2	
Write Configuration N	
End Packet Sequence	(subfunction code 07 hex). The total number of BYTES in all Write Configuration packets. The End Packet Sequence has 2 bytes. Byte 0 is the least significant byte of the data length; byte 1 is the most significant.

Write Configuration Data Format

Byte #	Description
0	Rack Number (0,…, 7)
1	Length of this message (must match the length for the specific device whose configuration will be written.)
2	Slot (0,…, 9. Network Interface Unit is 1)
3	Packet number (0, 1, 2, …)
4, 5	Slot length (bytes)
6 - 31	“Rack/slot” record for the slot
32 to end	Context dependent data (optional)

Power Supply and Carriers Configuration Data Format (Rack 0-7, slot 0)

(Byte in Message)	(Byte in Record)	Byte Description
6, 7	0, 1	not used (00,00)
8	2	major type (01)
9	3	power supply type: 0 = none 5 = IC200PWR001 10 = IC200PWR002 15 = IC200PWR101 20 = IC200PWR1021 40 = IC200PWB001 (carrier)
10,…, 13	4,…, 7	ASCII string Set to zeros during auto-configuration, the programmer may fill this field with an arbitrary identification string.
14	8	2
15	9	Additive checksum for entire station configuration
16, 17	10, 11	CRC checksum for entire station configuration
18	12	number of racks present (1)
19	13	number of slots (maximum 10)
20, 21	14, 15	Feature list (00 00). A bitmapped word reserved for forward compatibility with future releases. In the initial product release, this value is zero.
22,…, 29	16,…, 23	not used
30, 31	24, 25	Length of additional data (52)
32, 33	0, 1	not used (00,00)
34	2	61h (97)
35	3	9
36,…, 39	4,…, 7	reserved (must be 00, 00, 00, 00)
40	8	first I/O module slot carrier type: 0 = none 5 = IC200CHS001 10 = IC200CHS002 15 = IC200CHS005 20 = IC200CHS010 25 = IC200CHS011 30 = IC200CHS015 35 = IC200CHS003
41	9	second I/O module slot carrier type
42	10	third I/O module slot carrier type
43	11	fourth I/O module slot carrier type
44	12	fifth I/O module slot carrier type
45	13	sixth I/O module slot carrier type
46	14	seventh I/O module slot carrier type
47	15	eighth I/O module slot carrier type
48,…, 55	16,.., 23	not used
56, 57	24, 25	Length of additional data (00, 00)

Power Supply and Carriers Configuration Data Format (continued)

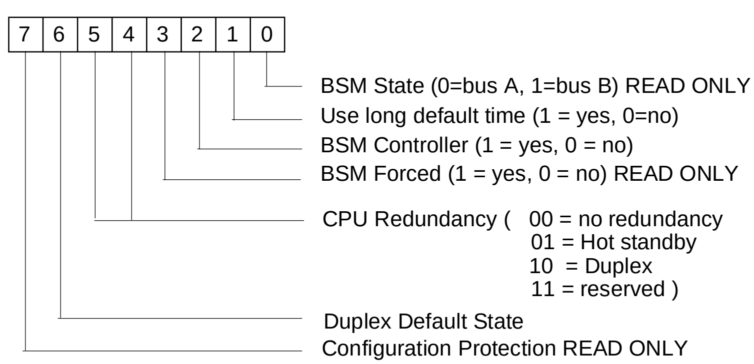
(Byte in Message)	(Byte in Record)	Byte Description
58, 59	0, 1	Must be 00, 00
60	2	61h (97)
61	3	0Ah (10)
62,…, 65	4,…, 7	Reserved (must be 00, 00)
66	8	first booster PS Carrier type: 0 = none 5 = IC200PWR001 10 = IC200PWR002 15 = IC200PWR101 20 = IC200PWR102 40 = IC200PWB001 (carrier)
67	9	first booster PS, Power Supply type (see above)
68	10	second booster PS Carrier type
69	11	second booster PS, Power Supply type
70	12	third booster PS Carrier type
71	13	third booster PS, Power Supply type
72	14	fourth booster PS Carrier type
73	15	fourth booster PS, Power Supply type
74	16	fifth booster PS Carrier type
75	17	fifth booster PS, Power Supply type (see above)
76	18	sixth booster PS Carrier type
77	19	sixth booster PS, Power Supply type
78	20	seventh booster PS Carrier type
79	21	seventh booster PS, Power Supply type
80,…, 81	22,…., 23	Reserved (must be 00, 00)
82, 83	24, 25	Additional Length (00, 00)

The “bytes in message offsets” are shown for configuration data included in a Read Configuration Data Reply datagram. For inclusion in a Write Configuration Data datagram, each offset is increased by one.

Network Interface Unit Configuration Data Format (Rack 0, slot 1)

(Byte in Message)	(Byte in Record)	Byte Description
6, 7	0, 1	not used (00,00)
8	2	major type (03=NIU)
9	3	minor type (01)
10,…, 13	4,…, 7	reserved (must be 00, 00, 00, 00)
14	8	autoconfiguration enable (enabled=1)
15,…, 29	9,…, 23	not used, must be 0
30, 31	24, 25	Length of additional data (52)
32, 33	0, 1	not used (00,00)
34	2	major type (05=Expansion Module)
35	3	Expansion Transmitter Present (00=no, 01=yes)
36,…, 39	4,…, 7	reserved (must be 00, 00, 00, 00)
40,…, 55	8,… 23	not used (00,00)
56, 57	24, 25	Length of additional data (00, 00)
58	0	Redundancy and BSM (see below)
59	1	Report faults (enable=0, disable=128)
60	2	Serial Bus Address (SBA) 0-31. 255 = factory default. Note: the factory default settings for SBA and baud rate must be changed to valid values before commanding the NIU to use configuration values for SBA or baud rate.
61	3	Baud Rate(read only): 0 = 153.6Kb ext 1 = 153.6 Kb std 2 = 76.8 Kb 3 = 38.4 Kb, 15=factory default (see above).
62	4	Default time: 0 =3 bus scans, 25 = 2.5 seconds, 100 = 10.0 seconds
63, 64	5, 6	Status Table Address (used only by Series Six PLC host)
65,…, 68	7,…, 10	47h, 4eh, 49h, 55h ("GNIU")
69,…, 81	11,…, 23	not used (00)
82, 83	24, 25	Additional Length (00, 00)

Byte 58



Expansion Receiver Module Format (Rack 1-7, slot 1)

(Byte in Message)	(Byte in Record)	Byte Description
6, 7	0, 1	not used (must be 0)
8	2	major type (05=Expansion Module
9	3	Type of Expansion Receiver (02=Isolated, 03=Non-isolated)
10,…, 13	4,…, 7	not used (must be 0)
14,…, 29	8,…, 23	not used (must be 0)
30, 31	24, 25	Length of additional data (0)

I/O Module Format

Configuration data follows the same format for all non-intelligent I/O modules, analog or discrete, input, output or mixed. The configuration datagram contains a VersaMax configuration message header, a rack/slot header, fixed I/O configuration fields, variable-length configuration fields and module-specific data. The total length of fixed and variable I/O configuration fields and module-specific data must be a multiple of 26 bytes. Pad bytes set to a value of 0 are appended to the end of the module-specific data to meet this requirement. Fixed and variable-length configuration fields appear according to the mapping shown in the table below.

I/O Module Format (Rack 0-7, slot 2-9)

(Byte in Message)	(Byte in Record)	Byte Description
Rack/slot header		
6, 7	0, 1	secondary board ID (MSB in 0, LSB in 1)
8, 9	2, 3	primary board ID (MSB in 2, LSB in 3)
10,…, 13	4,…, 7	ASCII string. Set to zeros during auto-configuration, the programmer may fill this field with an arbitrary identification string.
14,,…, 15	8,…, 9	Length of additional data (excluding pad bytes)
16,…, 29	10,…, 23	not used (must be 0)
30, 31	24, 25	Length of additional data (excluding pad bytes)
Fixed I/O configuration fields		
32, 33	0, 1	secondary board ID (same as above.)
34, 35	2, 3	primary board ID(same as above)
36, 37	4, 5	offset from the start of fixed I/O configuration fields to module-specific data.The length of module-specific data is given at offset 18 below.
38, 39	6, 7	Number of discrete input reference description fields listed in the input segments list below. (may be 00)
40, 41	8, 9	Number of discrete output reference description fields listed in the output segments list below. (may be 00)
42, 43	10, 11	Number of analog input reference description fields listed in the input segments list below. (may be 00)
44, 45	12, 13	Number of analog output reference description fields listed in the output segments list below.(may be 00)
46, 47	14, 15	Module setup, a bitmapped word bit 0 indicates whether defaults are defined in the configuration structure. If this bit is '1', then input segments mode, output segments mode, default input values and default output values fields are included below. bit 1 enables fault reporting for the module. bits 2-15 are reserved, must be set to zero.
48, 49	16, 17	Reserved (must be 00)
50, 51	18, 19	Length in bytes of module-specific data
52, 53	20, 21	Reserved (must be 00)
54, 55	22, 23	Reserved (must be 00)

I/O Module Format (Rack 0-7, slot 2-9) (continued)

(Byte in Message)	(Byte in Record)	Byte Description
Optional I/O configuration fields		
56,… N		Input segments list, an eight-byte reference description field for each discrete or analog input segment, see below.
		Output segments list, an eight-byte reference description field for each discrete or analog output segment.
		Input segments mode, a bitmapped word with a bit representing each reference description in the input segments list. If the bit is '1', then inputs hold last state. If the bit is '0', then the inputs default to values in the default input values field below.
		Output segments mode, a bitmapped word with a bit representing each reference description in the output segments list. If the bit is '1', then outputs hold last state. If the bit is '0', then the outputs default to values in the default output values field below.
		Default input values (one byte for each byte of inputs defined for module)
		Default output values (one byte for each byte of outputs defined for module)
Module-specific data		
		Context dependent data fields Pad bytes (must be 00) round the bytes in the record up to the next larger multiple of 26.

Reference Description Field

(Byte in Message)	(Byte in field)	Byte Description
varies	0	Sequence number, an arbitrary value that controls the order in which segments are reported.
	1	Reference type: discrete input reference, %I = 16 discrete output reference, %Q = 18 analog input reference, %AI = 10 analog output reference, %AQ = 12
	2,3	Byte offset within reference memory. For analog references, this must be an even number. During auto-configuration, the GNIU sets this field to the next available reference address.
	4,5	The byte length of memory used by this segment. For an analog module, this is the number of channels multiplied by two. For a discrete module, this is the number of points divided by eight, rounded up.
	6,7	Offset from the start of fixed I/O configuration fields to the beginning of default values associated with this segment.

The NIU fills out the configuration data fields based on the content of the primary and secondary board ID fields. The NIU reads these fields from the I/O module. Bit fields in the module board ID indicate whether the module is discrete or analog, the number of input points or channels, the number of output points or channels and whether diagnostic bits are returned by the module. The NIU calculates values of the fixed and variable-length configuration fields from these parameters.

The primary and secondary board ID fields in Write Configuration Data and Read Configuration Data datagrams are transmitted with the most significant byte in the lowest memory location or transmitted first in time. The least significant byte follows. All other word length data fields appear in the opposite order.

NON-INTELLIGENT I/O *Board_id* REGISTER

byte 0								byte 1							
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
1		0		0		Module type		Addtl data		diag bits		output points or channels		input points or channels	

module type	00 = discrete DC module 01 = discrete AC module 10 = analog voltage module 10 = analog current module
addtl data	analog module: 0 = voltage, 1 = current discrete module: always = 0
diag bits	The number of diagnostic bits per point or channel
output points/channels	For discrete modules, this is the number of **pairs** of output points for the module; For analog modules, this is the number of analog output channels for the module.
input points/channels	For discrete modules, this is the number of **pairs** of input points for the module; For analog modules, this is the number of analog input channels for the module.

Module-specific data is unique to the type of module. For analog and discrete I/O modules, two bytes of module-specific data are returned. The content of these bytes is defined in the following tables.

DISCRETE MODULE-DEPENDENT DATA

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	**IN**	**FS**	

IN	**In**terrupts enabled	TRUE indicates the module is configured to interrupt the head end
FS	**F**ilter **S**election	0 = 0 ms 1 = 1 ms 2 = 7 ms

ANALOG MODULE-DEPENDENT DATA

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**BP**

BP	**B**i**P**olar	0 = unipolar 1 = bipolar

Example: Configuration message for IC200MDD844

The following example shows the Read Configuration Data Reply datagram for a mixed discrete I/O module, the IC200MDD844. This module contains a 16-point output board as its primary board and a 16-point input board as its secondary slot.

(Byte in Message)	(Byte in Record)	Content	Byte Description
VersaMax configuration message header			
0	0	0	Rack (e.g., Rack 0, the rack containing the GNIU)
1, 2	1, 2	82	Message length (e.g., 82 bytes total length)
3	3	3	Slot (e.g., 3, the second I/O slot)
4,5	4,5	0, 0	Offset into configuration data (e.g., zero because the configuration fits in one message)
Rack/slot header			
6, 7	0, 1	0x80, 0x08	secondary board ID (e.g., the ID is 0x8008. The LSB is in byte 0, and the MSB is in byte 1.)
8, 9	2, 3	0x80, 0x80	primary board ID (e.g., the ID is 0x8080. The LSB is in byte 2, and the MSB is in byte 3.)
10,…, 13	4,…, 7	0x44, 0x38, 0x34, 0x34	ASCII string. Set to zeros during auto-configuration, the programmer may fill this field with an arbitrary identification string. (e.g., this is the ASCII label “D844”)
14, 15	8, 9	50, 0	Length of additional data, excluding pad bytes
16,…, 29	10,…, 23	0	not used (must be 0)
30, 31	24, 25	52, 0	Total Length of additional data (e.g., 52 bytes)
Fixed I/O configuration fields			
32, 33	0, 1	0x80, 0x08	secondary board ID (same as above.) (e.g., discrete DC type, no diagnostic bits, no outputs, eight pairs of inputs)
34, 35	2, 3	0x80, 0x80	primary board ID (same as above) (e.g., discrete DC type, no diagnostic bits, eight pairs of outputs, no inputs; there are two boards in this module.)
36, 37	4, 5	48, 0	offset from the start of fixed I/O configuration fields to module-specific data. The length of module-specific data is given at offset 18 below.
38, 39	6, 7	1, 0	Number of discrete input reference description fields listed in the input segments list below. (may be 00)
40, 41	8, 9	1, 0	Number of discrete output reference description fields listed in the output segments list below. (may be 00)
42, 43	10, 11	0, 0	Number of analog input reference description fields listed in the input segments list below. (may be 00)
44, 45	12, 13	0, 0	Number of analog output reference description fields listed in the output segments list below.(may be 00)
46, 47	14, 15	3, 0	Module setup, a bitmapped word bit 0 indicates whether defaults are defined in the configuration structure. If this bit is ‘1’, then input segments mode, output segments mode, default input values and default output values fields are included below. bit 1 enables fault reporting for the module. bits 2-15 are reserved, must be set to zero. (e.g., defaults are defined and fault reporting is enabled by this setting.)
48, 49	16, 17	0, 0	Reserved (must be 00)
50, 51	18, 19	2, 0	Length in bytes of module-specific data (e.g., two bytes)
52, 53	20, 21	0, 0	Reserved (must be 00)
54, 55	22, 23	0, 0	Reserved (must be 00)

(Byte in Message)	(Byte in Record)	Content	Byte Description
VersaMax configuration message header			
0	0	0	Rack (e.g., Rack 0, the rack containing the GNIU)
1, 2	1, 2	82	Message length (e.g., 82 bytes total length)
3	3	3	Slot (e.g., 3, the second I/O slot)
4,5	4,5	0, 0	Offset into configuration data (e.g., zero because the configuration fits in one message)
Rack/slot header			
6, 7	0, 1	0x80, 0x08	secondary board ID
8, 9	2, 3	0x80, 0x80	primary board ID
10,…, 13	4,…, 7	0x44, 0x38, 0x34, 0x34	ASCII string. Set to zeros during auto-configuration, the programmer may fill this field with an arbitrary identification string. (e.g., this is the ASCII label "D844")
14,…, 29	8,…, 23	0	not used (must be 0)
30, 31	24, 25	50, 0	Length of additional data (e.g., 50 bytes)
Fixed I/O configuration fields			
32, 33	0, 1	0x80, 0x08	secondary board ID (same as above.) (e.g., discrete DC type, no diagnostic bits, no outputs, eight pairs of inputs)
34, 35	2, 3	0x80, 0x80	primary board ID (same as above) (e.g., discrete DC type, no diagnostic bits, eight pairs of outputs, no inputs; there are two boards in this module.)
36, 37	4, 5	48, 0	offset from the start of fixed I/O configuration fields to module-specific data. The length of module-specific data is given at offset 18 below.
38, 39	6, 7	1, 0	Number of discrete input reference description fields listed in the input segments list below. (may be 00)
40, 41	8, 9	1, 0	Number of discrete output reference description fields listed in the output segments list below. (may be 00)
42, 43	10, 11	0, 0	Number of analog input reference description fields listed in the input segments list below. (may be 00)
44, 45	12, 13	0, 0	Number of analog output reference description fields listed in the output segments list below.(may be 00)
46, 47	14, 15	3, 0	Module setup, a bitmapped word bit 0 indicates whether defaults are defined in the configuration structure. If this bit is '1', then input segments mode, output segments mode, default input values and default output values fields are included below. bit 1 enables fault reporting for the module. bits 2-15 are reserved, must be set to zero. (e.g., defaults are defined and fault reporting is enabled by this setting.)
48, 49	16, 17	0, 0	Reserved (must be 00)
50, 51	18, 19	2, 0	Length in bytes of module-specific data (e.g., two bytes)
52, 53	20, 21	0, 0	Reserved (must be 00)
54, 55	22, 23	0, 0	Reserved (must be 00)

Example: Configuration message for IC200MDD844, a mixed discrete I/O module (continued)

(Byte in Message)	(Byte in Record)	Content	Byte Description
			Optional I/O configuration fields
			Input segments list, an eight-byte reference description field for each discrete or analog input segment. (e.g., one discrete input segment)
56	24	1	Sequence number (e.g., 1)
57	25	16	Reference type (e.g., discrete input, %I)
58, 59	26, 27	17, 0	Offset in reference memory; this value filled in by programmer indicates these are bits %I17 through %I32)
60, 61	28, 29	2, 0	Byte length (e.g., two bytes for 16 bit input segment)
62, 63	30, 31	44, 0	Offset to defaults (e.g., see offset 44 below)
			Output segments list, an eight-byte reference description field for each discrete or analog output segment. (e.g., one discrete input segment)
64	32	2	Sequence number (e.g., 2)
65	33	18	Reference type (e.g., discrete output, %Q)
66, 67	34, 35	8, 0	Offset in reference memory; this value filled in by programmer indicates these are bits %Q8 through %Q24)
68, 69	36, 37	2, 0	Byte length (e.g., two bytes for 16 bit output segment)
70, 71	38, 39	46, 0	Offset to defaults (e.g., see offset 46 below)
72	40	0, 0	Input segments mode, a bitmapped word with a bit representing each reference description in the input segments list. If the bit is ‘1’, then inputs hold last state. If the bit is ‘0’, then the inputs default to values in the default input values field below. (e.g., only bit 0 is meaningful; use of default values is indicated)
74	42	0, 0	Output segments mode, a bitmapped word with a bit representing each reference description in the output segments list. If the bit is ‘1’, then outputs hold last state. If the bit is ‘0’, then the outputs default to values in the default output values field below. (e.g., only bit 0 is meaningful; use of default values is indicated)
			Default input values
76	44	0	defaults for input points 0-7 (e.g., all zeros)
77	45	0	defaults for input points 8-15 (e.g., all zeros)
			Default output values
78	46	0xFF	defaults for output points 0-7 (e.g., all ones)
79	47	0xFF	defaults for output points 8-15 (e.g., all ones)
			Module-specific data
			Context dependent data fields
80	48	2	bit map for discrete module parameters (e.g., select input filter = 7 milliseconds, Interrupts Disabled)
81 82, 83	49 50, 51	0 0, 0	reserved bits Pad bytes extend the length of this record to 52 bytes (=2x26)

Set NIU Operating Mode

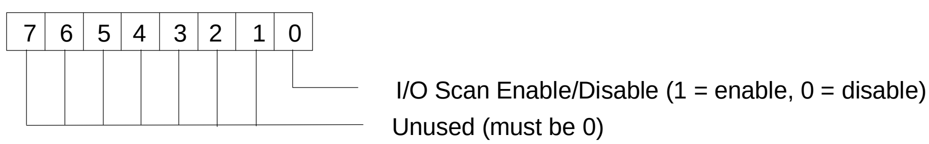
Subfunction Code: 39 hex

This datagram can be used to set the operating mode of the NIU.

Byte No.	Byte Description
0	Mode
1	Mode

This message has two copies of the mode parameter. These copies must be equal for the command to be accepted by the NIU.

If you disable I/O scanning, the NIU sends no inputs and receives no outputs.



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Chapter 6 Redundancy

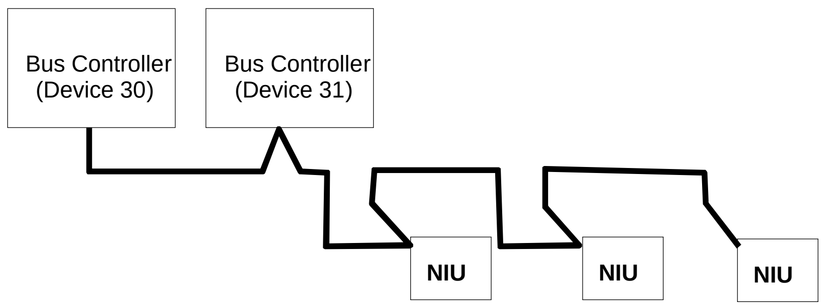
Most systems use only one CPU to control the I/O on the Genius bus. CPU redundancy, which can be used for backup CPU/Bus Controller protection in critical applications, is described in detail in the Genius documentation. The discussion that follows summarizes how the NIU can fit into a Genius CPU Redundancy system.

- CPU/Bus Controller Redundancy
- Using the NIU in a Genius Bus Redundancy System

CPU/Bus Controller Redundancy

In CPU redundancy, two Bus Controllers on the same bus can send control outputs at the same time. Both Bus Controllers automatically receive inputs and fault reports from all devices on the bus that have been configured as being in "CPU Redundancy" mode. The Bus Controllers must use serial bus addresses 30 and 31.

VersaMax I/O Stations can be used on a bus controlled by redundant CPUs/Bus Controllers.



How the two sets of outputs from the dual CPUs are handled by an NIU depends on whether the NIU is set up for Hot Standby or Duplex redundancy, as explained below. *If the station contains any analog modules, the only form of CPU redundancy permitted is Hot Standby.*

Hot Standby CPU Redundancy

An NIU configured for Hot Standby mode is normally controlled by the Bus Controller assigned to serial bus address 31. If no outputs are available from 31 for three bus scans, the NIU accepts outputs from the Bus Controller assigned to serial bus address 30. If outputs are not available from either Bus Controller, outputs go to their configured defaults or hold their last state. In Hot Standby redundancy, Bus Controller 31 always has priority; when it is online, it has control of the outputs.

Duplex CPU Redundancy

An NIU configured for Duplex mode compares outputs it receives from the two bus controllers to determine if they match. If corresponding outputs are the same, the NIU sets the output to that state. If corresponding outputs are not the same, the NIU sets the output to its configured ON or OFF Duplex Default State. If either bus controller stops sending outputs to an NIU, its outputs are directly controlled by the remaining device. *Only discrete I/O modules can operate in Duplex redundancy mode; do not use Duplex mode if the station contains any analog I/O modules.*

Using the NIU in a Genius Bus Redundancy System

In Genius bus redundancy, there are two bus cables each connected to a Bus Controller or PCIM. I/O devices such as the NIU may be connected to either one bus of the pair, or to both. A device that is connected to both busses actually communicates on only one bus at a time. Before the alternate bus can be used for communications, a bus switchover must occur and the device must "log in" with the Bus Controller(s) on the alternate bus.

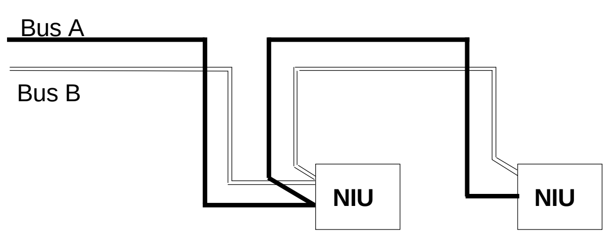
The NIU contains a built-in bus switching relay that is used to switch busses in a dual bus system. Other types of devices with this capability are Field Control BIUs, Bus Switching Modules and Series 90-70 Remote I/O Scanner modules. These are the only types of devices that can be directly connected to both redundant bus cables.

An NIU cannot be used as the BSM Controller for a bus stub. Other devices cannot be located on a stub downstream of an NIU.

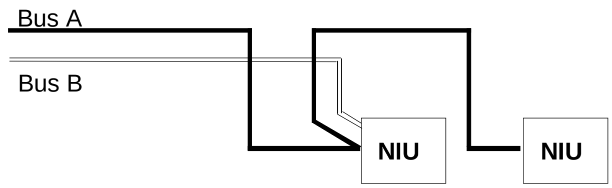
Redundant Bus Configurations

Many different redundant bus configurations are possible. Three basic ways of using an NIU with a redundant bus are described below.

- **An NIU can be installed directly on both cables of the dual bus pair.** The NIU is configured to operate as a bus switching device in addition to performing its normal functions. Here, two NIUs are installed on a dual bus. Each NIU would be set up as a bus switching device.

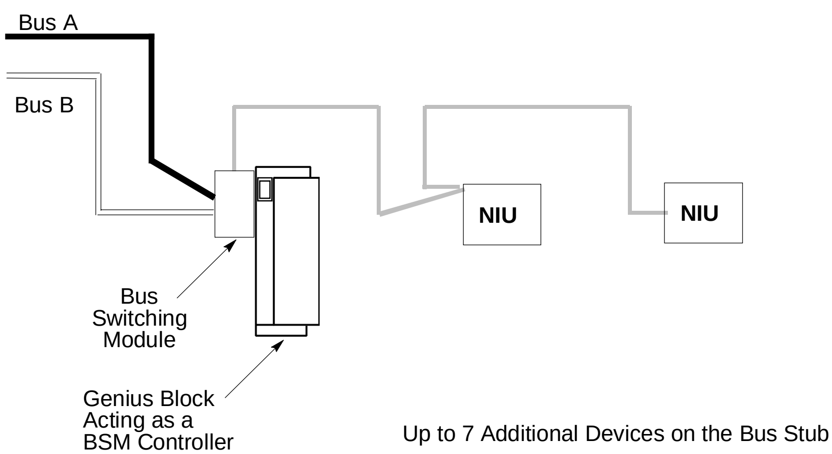


- **An NIU can be located on one bus of a redundant bus pair**, if bus redundancy is not needed for the modules in that station. In this example, the NIU on the left is connected to both Bus A and Bus B and is configured as a bus switching device. The NIU on the right, which serves non-critical I/O modules, is connected to Bus A only, and is not configured as a bus switching device.



- **An NIU can be located on a bus stub.** A Network Interface Unit can also be located on a bus stub, which is a short length of unterminated cable downstream of another type of bus switching device, such as a Genius I/O block/Bus Switching Module combination, or a Remote I/O Scanner connected to a dual bus. Because the bus stub cable itself is not redundant, this type of installation does not provide as much protection as connecting directly to a dual bus. The bus switching device to which the bus stub is connected can be another Genius block with a Bus Switching Module attached, as shown below, or a Series 90-70 Remote I/O Scanner.

In this example, there are two I/O stations installed on a bus stub. Each is configured as "BSM Present" but not configured as a "BSM Controller"



Up to seven devices can be installed on a bus stub. Each device on a bus stub counts toward the total of 32 devices on the Genius bus.

Restrictions on the number and length of bus stubs that may be used on a dual bus are explained in the *Genius I/O System and Communications User's Manual.*

Appendix A

Operation of the Genius Bus

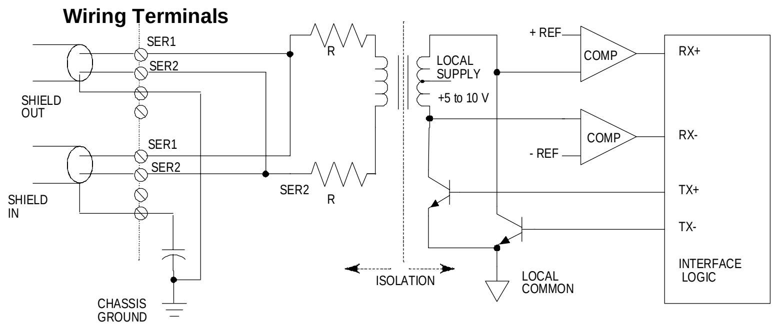
This section describes the characteristics of the bus that links Genius devices. This information supersedes the equivalent text portion of chapter 2 of the *Genius I/O System and Communications Manual* (GEK-90486-1) “The Communications Bus”.

This section includes the following information:

- Electrical interface
- Serial bus waveforms
- Maximum bus length
- Serial data format
- Genius transceiver electrical specifications
- Bus errors

Electrical Interface

All stations must receive in order to track the present token value and take their appropriate turn on the bus, regardless whether the data is to be used locally. The transmit sequence is the same as the serial bus address (SBA) set into each location during configuration. A simplified interface circuit is shown below:



Signal coupling to the bus is via a high frequency, high isolation pulse transformer. The pulse waveforms are bipolar to reduce DC baseline offsets in the waveform.

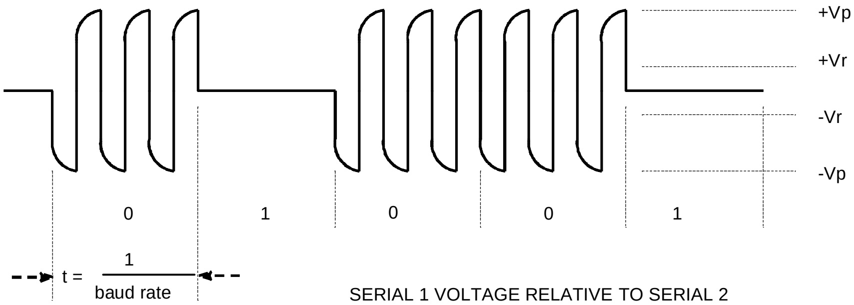
The daisy-chained bus is shown on the left above. The SER 1 and SER 2 lines are tapped at the intermediate locations along the bus. These connections must be consistent since the signal is polarized. The shield of the cable is broken into segments at each location. Each shield segment is DC grounded at one end (SHIELD OUT), and terminated with a small capacitor at the other (SHIELD IN). The segmenting breaks up long ground loop paths. The capacitor termination reduces common mode noise from high frequency pickup, while preventing large ground loop currents in the shield at low frequencies.

The alternately switching transistors produce a negative pulse followed by a positive pulse across SERIAL 1 relative to SERIAL 2. The bit waveform is a series of these pulses. The transformer provides isolation (2500 volts test) between the bus and the local logic, permitting these to be at different voltages. The internal resistors in each line provide current limit and some termination during transmission.

The balanced (differential) signals on the twisted pair provide high noise immunity due to the magnetic (H field) cancellation effect of the twisting, as well as electric (E field) reduction by the shielding. Most remaining noise pickup is common mode: the transformer provides a high common mode noise rejection by looking only at the differential signal across the SER 1-2 lines. The two input comparators detect the positive polarity input pulses separately from the negative; these are sent to a custom interface logic chip which digitally filters these for timing and sequence, then reconstructs the NRZ digital data. Voltages between the two thresholds are ignored. This filtering and the high input threshold of the comparators are highly effective in rejecting both random impulse noise and low-level line reflections. Finally a CRC-6 checksum check is performed before the data is sent to the local processor (not shown).

Serial Bus Waveforms

The actual waveforms seen on the cable depend on the cable impedance and the distance from the station presently transmitting. A data “0” is a series of three AC pulses, while a “1” is no pulse.



SERIAL 1 VOLTAGE RELATIVE TO SERIAL 2

Use caution when connecting instrumentation to the bus. A differential probe or a summation of two probes relative to ground is required. Inadvertent grounding of one side of the bus can cause loss of data or data errors.

The pulse frequency is three times the baud frequency, for example 460.8 KHz at 153.6 Kb.

The peak transmitted voltage Vp and the receiver thresholds Vr are per the electrical specification in this section. The peak voltages measured will decline with distance along the cable from the transmitting station, so different stations will have varying amplitudes. The wave shape will also become more rounded with distance.

The minimum amplitude pulses seen during a “0” should exceed the receiver threshold Vr of 900 millivolts by 50% (about 1.4 volts) for best reliability. An occasional pulse at or below the threshold may still not cause the bit to be missed, due to a voting algorithm in the logic, however.

Likewise, no pulses greater than Vr should exist during logic “1” intervals. Occasional extra pulses during this interval are also rejected by the logic.

Line reflections will show up as notch distortion during the pulse or low level pulses during “1” intervals, and their appearance is synchronized to the baud frequency. These cause no problem if they do not cause violation of the amplitude criteria of the previous paragraphs.

The Serial 1 and Serial 2 lines should always have a termination resistor equal to the characteristic impedance of the cable connected at each extreme end.

Maximum Bus Length

Three effects limit the maximum length bus available at any baud rate:

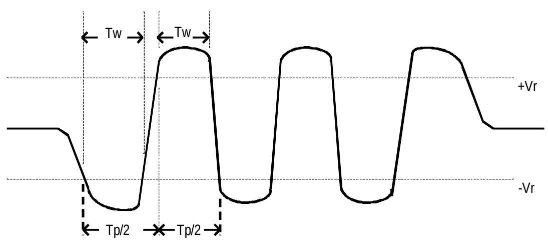
1. Voltage attenuation
2. Waveform distortion (frequency dispersion)
3. Propagation delays

Attenuation

The transmitter output levels and receiver thresholds determine the maximum attenuation that can be tolerated. This is the principal determinant when using recommended cables.

Distortion

Waveform distortion is due to the limited bandwidth of wire media, which causes the various frequency components of a pulse waveform to travel at different speeds and arrive separately in time (called dispersion). As a result, the received pulse appears rounded and distorted. The signal at the extreme end from the transmitter may look rounded and skewed as shown below. Distortion is most apparent near the beginning and end of a pulse train where it may appear as a change in phase or a frequency shift. Critical timing for a logic 0 transmission is shown below in a more detailed version of the waveform:



Note the first and last half-cycle look wider. The most critical to operation is the first full cycle of the first start bit of the transmission. Detection of this pulse establishes the time synchronization of the receiver to the incoming waveform. Missing this first pulse does not cause the data to be missed, but may compromise the noise immunity with respect to extra or missing pulses. The frequency of the AC pulse is 3X the baud rate as noted earlier. This means the normal period Tp(normal) is:

- 2.17 microseconds at 153.6 Kb
- 4.34 microseconds at 76.8 Kb
- 8.68 microseconds at 38.4 Kb.

The half cycle pulse width, when measured between the positive and negative receiver thresholds, denoted as Tp/2 in the figure, will vary along the waveform due to dispersion, and resembles a frequency shift.. The digital input filter essentially is a band pass filter which looks at the half cycle timing Tp/2, and the duration above the thresholds, Tw. The limits are:

- Tp/2 = 0.6 Tp(normal) maximum
- Tw = 0.188 Tp(normal) minimum

These measurements can be taken when evaluating the maximum length of an unspecified cable. Dispersion is much less of a problem with fiber optic links since the media is much wider bandwidth, and therefore has less distortion.

Propagation Delay

The propagation delay is caused by travel time of the signal down the cable. Typical signal velocity in data grade cables is around 65- 78% of the speed of light. This requires about 3 microseconds to travel a 2000 foot long bus. This is about half a bit time at 153.6 Kb. This skew could affect the bus access sequence since only one bit of quiet bus (skip) time is usually allocated between transmission of adjacent addresses. The signal must reach all devices on the bus within the period of one bit. Propagation delay causes the ultimate limitation in bus length, even with ideal media. Propagation speed through fiber optic is not significantly different than wire, and delays through the interfaces must be accounted for.

Serial Data Format

The Genius protocol produces maximum throughput of data by using a minimum overhead of control and synchronizing characters.

Each character is 11 bits long, comprising a start bit (always 0), next a control bit, followed by 8 bits of data, sent LSB first. The last bit is a stop bit, always 1. Successive characters are sent with no time space between them. The control bit indicates the type of character being sent. A 1 indicates a control character, and 0 a data character.

A minimum transmission has a Start character, one or more data characters, and a Stop character. The Start character data contains the address and whether the transmission is directed to a specific address or broadcast to all. The End character contains the CRC-6 checksum. Complex transmissions may have additional start and end of block characters to break up the message into blocks of data. For example, a Bus Controller can send device specific messages (blocks of data) to all devices on the bus during one transmission cycle.

Bus Access

All devices receive the current SBA and the stop character even though the data is not used. After receiving the stop control character, each device starts a timer. The time delay is equal to a skip time, times the difference between the device SBA and the last SBA received. The device will transmit after the time delay if no other start bits are detected first. Thus each device takes turn in order of SBA. Unused SBAs result in longer times between messages. All devices must detect messages within this skip time delay. A bus "collision" (two sources transmitting simultaneously) results if this sequence is missed. The skip time is equal to one bit period, except at the 153.6e rate, where it is two bit periods long. The longer interval accommodates greater propagation delays cause by longer bus cables or fiber optic or other repeaters. The worse case is when adjacent SBAs are physically located at opposite ends of a long bus. For example, assume SBA 4 and 6 are at one end of a 2000 foot bus and SBA5 at the other, operating at 153.6s Kb. When SBA 4 end character is detected, SBA6 immediately starts timing 2 skip times (52 µSec) to start of its transmission. SBA5 receives the end character 3 µSec later, and starts timing 1 skip time (26 µSec). Thus SBA 5 will start transmitting 29 µSec after SBA 4 quit. This allows 23µSec for the signal to get back to SBA6 to cancel it's transmission turn. The 3µSec transmission delay leaves only 20 µSec to do this and avoid a collision between SBA5 and 6.

Bus collisions result in missing data or detected CRC errors. Problems resulting from bus collisions can be fixed by skipping an SBA, resequencing SBAs in order along the bus, going from 153.6s baud to the 153.6e, or a lower baud rate.

Genius Transceiver Electrical Specification

Property	Min	Max
Normal peak voltage Vp into 78 ohm terminated cable (1)	3.5 volts	5.5 volts
Normal peak voltage Vp into 150 ohm terminated cable (1)	6.0 volts	9.5 volts
Rated bus impedance (2)	78 ohms	
Maximum output voltage (SER 1 and 2 open) (3) :		Peak: 35 volts RMS: 15 volts
Maximum output current (SER 1 and 2 shorted together) :		Peak: 180 milliamp RMS: 50 milliamp
Transmitter source resistance	80 ohms	140 ohms
Transmitter source inductance (transformer leakage inductance)		10 microhenries
Receiver input threshold; +Vr, -Vr (4)	0.7 volt	1.1 volt
Receive mode input impedance	10 K ohm	
Receive mode load inductance (transformer shunt inductance)	6 millihenries	12 millihenries
Receiver common mode rejection (DC to 1 MHZ)	60 dB	
Shield capacitor termination	0.1 microfarad	
Isolation, serial bus to circuit, continuous	240 volts AC	

(1) Vp may vary among various module types.
(2) Rated load is half cable impedance when termination is included.
(3) Peak open circuit voltage contains underdamped ringing due to lack of termination.
(4) Input voltages between +Vr and -Vr thresholds are ignored.

Bus Errors

Most capacitively- and magnetically-coupled noise shows up as common mode voltage on the bus. The bus provides a 60 dB common mode rejection ratio. A noise spike above 1000 volts would be required to corrupt the data. The bus receivers filter out corrupted data and perform a 6-bit cyclic redundancy check to reject bad data. Corrupted signals due to noise show up as missed data rather than incorrect data. The bus continues operating to the maximum extent possible when bus errors are detected; random bus errors do not shut down communications. Bad data is rejected by the receiving device and excessive errors are reported to the controller.

Appendix B Performance Data

This section lists approximate scan times in microseconds for modules in a VersaMax Genius NIU I/O Station. Each module was configured with its default settings and user power was applied when applicable. This information is provided as a guideline for determine I/O scanning times. Actual timing may vary.

Module Catalog Number	Description	Main Rack	Expansion Rack	
			Non-isolated	Extended or Isolated
IC200ALG230	Analog Input Module, 12 Bit Voltage/Current 4 Channels	448	x	x
IC200ALG240	Analog Input Module, 16 Bit Voltage/Current 1500VAC Isolation, 8 Channels	968	1480	5857
IC200ALG260	Analog Input Module, 12 Bit Voltage/Current Isol. 8 Ch.	737	x	x
IC200ALG320	Analog Output Module, 12 Bit Current, 4 Channels	1258	x	x
IC200ALG321	Analog Output Module, 12 Bit Voltage 4 Channels, 0 to +10VDC Range	1258	x	x
IC200ALG322	Analog Output Module, 12 Bit Voltage 4 Channels, –10 to +10VDC Range	1258	x	x
IC200ALG331	Analog Output Module, 16 Bit Voltage/Current, 1500VAC Isolation, 4 Channels	1652	2156	6644
IC200ALG430	Analog Mixed 12 Bit Input Current 4 Channels / Output Current 2 Channels	1308	x	x
IC200ALG431	Analog Mixed 12 Bit 0 to +10VDC Input 4 Channels / Output 0 to +10V 2 Channels	1308	x	x
IC200ALG432	Analog Mixed 12 Bit –10 to +10VDC Input 4 Channels / Output –10 to +10V 2 Channels	1308	x	x
IC200ALG620	Analog Input, 16 Bit RTD, 4 Channels	843	1299	5257
IC200ALG630	Analog Input, 16 Bit Thermocouple, 7 Channels	897	1398	5731
IC200MDD840	Mixed 24VDC Positive Logic Input Grouped 20 Point/ Output Relay 2.0A per Point Grouped 12 Point Module	821	1009	2836
IC200MDD841	Mixed 24VDC Positive Logic Input 20 Point/ Output 12 Point / 4 High-Speed Counter, PWM or Pulse Train Points	6593	7905	20744
IC200MDD842	Mixed 16 Point Grouped Input 24VDC Pos/Neg Logic / 16 Pt Grouped Output 24VDC Pos. Logic 0.5A w/ESCP	777	873	1848
IC200MDD843	Mixed 24VDC Positive Logic Input Grouped 10 Point / Output Relay 2.0A per Point 6 Point Module	659	763	1687

Module Catalog Number	Description	Main Rack	Expansion Rack	
			Non-isolated	Extended or Isolated
IC200MDD844	Mixed 24 VDC Pos/Neg Logic Input Grouped 16 Point / Output 12/24VDC Pos. Logic 0.5A 16 Point Module	780	867	1842
IC200MDD845	Mixed 16 Point Grouped Input 24VDC Pos/Neg Logic / 8 Pt Relay Output 2.0A per Pt Isolated Form A	660	759	1689
IC200MDD846	Mixed 120VAC Input 8 Point / Output Relay 2.0A per Point 8 Point Module	675	777	1676
IC200MDD847	Mixed 240VAC Input 8 Point / Output Relay 2.0A per Point 8 Point Module	675	777	1676
IC200MDD848	Mixed 120VAC Input 8 Point / Output 120VAC 0.5A per Point Isolated 8 Point Module	675	777	1676
IC200MDL140	Input 120VAC 8 Point Grouped Module	269	322	766
IC200MDL141	Input 240VAC 8 Point Grouped Module	269	322	766
IC200MDL240	Input 120VAC (2 Groups of 8) 16 Point Module	286	390	1256
IC200MDL241	Input 240VAC (2 Groups of 8) 16 Point Module	286	390	1256
IC200MDL329	Output 120VAC 0.5A per Point Isolated 8 Point Module	400	450	901
IC200MDL330	Output 120VAC 0.5A per Point Isolated 16 Point Module	516	563	1038
IC200MDL331	Output 120VAC 2.0A per Point Isolated 8 Point Module	400	450	901
IC200MDL640	Input 24VDC Positive Logic (2 Groups of 8) 16 Point Module	286	390	1256
IC200MDL650	Input 24VDC Positive Logic (4 Groups of 8) 32 Point Module	271	363	1225
IC200MDL730	Output 24VDC Positive Logic 2.0A per Point (1 Group of 8) with ESCP 8 Point Module	469	568	1461
IC200MDL740	Output 24VDC Positive Logic 0.5A per Point (1 Group of 16) 16 Point Module	516	563	1038
IC200MDL741	Output 24VDC Positive Logic 2.0A per Point (1 Group of 16) with ESCP 16 Point Module	518	563	1042
IC200MDL742	Output 24VDC Positive Logic 0.5A per Point (2 Groups of 16) with ESCP 32 Point Module	786	881	1870
IC200MDL750	Output 24VDC Positive Logic 0.5A per Point (2 Groups of 16) 32 Point Module	786	881	1870
IC200MDL930	Output Relay 2.0A per Point Isolated Form A 8 Point Module	400	450	901
IC200MDL940	Output Relay 2.0A per Point Isolated Form A 16 Point Module	516	563	1038

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