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GE Fanuc Automation

Programmable Control Products

Genius™ I/O
Discrete and Analog Blocks

User's Manual

GEK-90486D -2 *September 1993*

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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.

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Preface

This manual is a reference to the features, installation, and configuration of most Genius™ I/O blocks. For some blocks, such as the High–speed Counter, a separate book is available. They are not included here.

Content of this Manual

Chapter 1. Introduction: Chapter 1 is an overview of the features and operation of Genius I/O blocks.

Chapter 2. Installation: Chapter 2 explains block mounting and wiring. It also explains how to remove and replace a block or its Electronics Assembly after installation.

Chapter 3. Configuration: Chapter 3 explains how to start block configuration.

Chapters 4 through 15 describe the features, installation, and configuration of specific types of Genius I/O blocks.

- Chapter 4. 115VAC 8 Circuit Grouped I/O Blocks
- Chapter 5. 115VAC/125VDC Isolated I/O Blocks
- Chapter 6. 115VAC 16 Circuit Input Block
- Chapter 7. 115 VAC Relay Output Blocks
- Chapter 8. 16 Circuit DC Input/Output Blocks
- Chapter 9. 32 Circuit DC Input/Output Blocks
- Chapter 10. Analog Input/Output Blocks
- Chapter 11. Current–source Analog I/O Blocks
- Chapter 12. Current–source Analog Output Blocks
- Chapter 13. Current–source Analog Input Blocks
- Chapter 14. RTD Input Blocks
- Chapter 15. Thermocouple Input Blocks

Chapter 16. Sizing Enclosures: This chapter explains how to size enclosures for Genius I/O blocks.

Chapter 17. I/O Point Redundancy: Chapter 16 explains how some Genius I/O blocks can be used to back up critical I/O points for failsafe operation.

Chapter 18. I/O Block Troubleshooting: Chapter 17 describes LED indications and gives troubleshooting guidelines.

Appendix A. Ordering Information: This appendix lists catalog numbers for Genius I/O blocks, their component assemblies, and related products.

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Related Publications

For more information, refer to these publications:

Genius I/O System and Communications User's Manual (GEK–90486–1).

Series 90–70 Bus Controller User's Manual (GFK–0398)

Series Six Bus Controller User's Manual (GFK–0171)

Series Five Bus Controller User's Manual (GFK–0248)

PCIM User's Manual (GFK–0074)

Genius PowerTRAC Block User's Manual (GFK–0450)

Genius High–speed Counter Block User's Manual (GFK–0415)

Logicmaster 90–70 User's Manual (GFK–0263)

Series 90–70 Remote I/O Scanner User's Manual (GFK–0579)

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At GE Fanuc automation, we strive to produce quality technical documentation. After you have used this manual, please take a few moments to complete and return the Reader's Comment Card located on the next page.

Jeanne Grimsby

Senior Technical Writer

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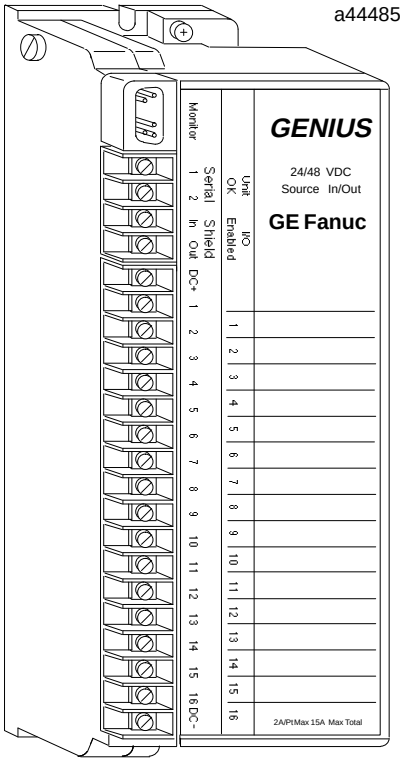
Chapter 1 Introduction

This chapter contains the following basic information about Genius™ I/O blocks:

- Block description
- Types of blocks available
- Locations for Genius I/O blocks, and environmental specifications
- Description of basic block operation
- Features and benefits

Block Description

Genius I/O blocks are intelligent, self-contained, configurable I/O modules.



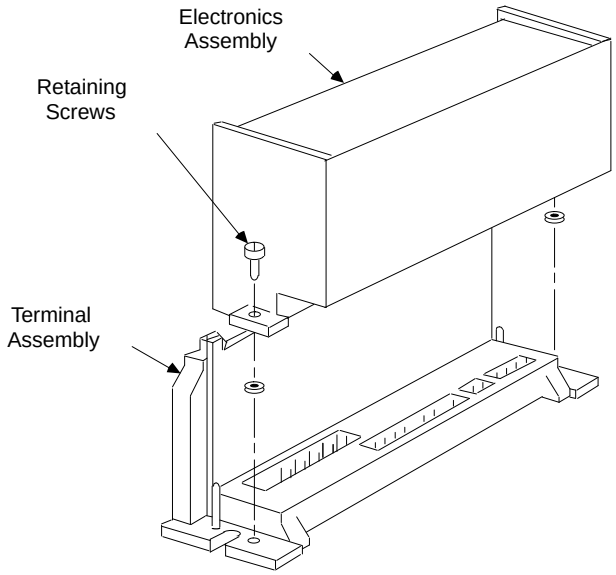
A Genius I/O block is made of cast aluminum, and weighs about 4 pounds (1.8 Kg). Block size is approximately 9” (22 cm) x 4” (10 cm) x 3” (9 cm).

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Parts of an I/O Block

A block consists of a matching Terminal Assembly and Electronics Assembly.. The Terminal Assembly forms the base of the block. It is electrically and mechanically keyed to accept only an Electronics Assembly of the same type (voltage, number of circuits, wiring configuration). All field wiring connections are made to the Terminal Assembly.

All active components, I/O and communications circuits are located in the Electronics Assembly. The Electronics Assembly can be removed without disturbing field wiring. The block's configuration is stored in the Terminal Assembly, so there is no need to reconfigure the block if the Electronics Assembly is changed.



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Types of Genius I/O Blocks

Many types of Genius I/O blocks are available, to interface a wide range of field devices to a Genius communications bus.

Discrete Blocks	I/O Circuits	For information, see:
115 VAC Grouped I/O Block 115 VAC Grouped I/O Block, Low–leakage	8, I/O configurable	chapter 4
115VAC/125VDC Isolated I/O Block with output Failed Switch diagnostic 115VAC/125VDC Isolated I/O Block, no output Failed Switch diagnostic	8, I/O configurable	chapter 5
115 VAC 16–circuit Input Block	16 inputs	chapter 6
115VAC/230VAC Relay Output Block, Normally–Closed outputs 115VAC/230VAC Relay Output Block, Normally–Open	16 relay	chapter 7
24 VDC Source I/O Block, 16 Circuit 24/48 VDC Source I/O Block, 16 Circuit 24 VDC Sink I/O Block, 16 Circuit 24/48 VDC Sink I/O Block, 16 Circuit	16, I/O configurable	chapter 8
12/24 VDC Source I/O Block, 32 Circuit 5/12/24 VDC Sink I/O Block, 32 Circuit	32, I/O configurable	chapter 9
115 VAC/125VDC Analog I/O Block 24/48 VDC Analog I/O Block	4 inputs, 2 outputs	chapter 10
115 VAC/125VDC Current–source Analog I/O Block 24/48 VDC Current–source Analog I/O Block	4 inputs, 2 outputs	chapter 11
115VAC/125VDC Current–source Output Block 24/48 VDC Current–source Output Block	6 outputs	chapter 12
115VAC/125VDC Current–source Input Block 24/48 VDC Current–source Input Block	6 inputs	chapter 13
115 VAC/125VDC RTD Input Block 24/48 VDC RTD Input Block	6 RTD inputs	chapter 14
115 VAC/125VDC Thermocouple Input Block 24/48 VDC Thermocouple Input Block	6 t'couple inputs	chapter 15
High–speed Counter	Configurable count-e inputs/modes	*High–speed Counter User's Manual* GFK–0415
PowerTRAC Block	Inputs from 1–3 PTs, 1–3 CTs	*PowerTRAC Block User's Manual* GFK–0450

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Locations for Genius I/O Blocks

Unlike conventional rack–mounted I/O modules, Genius I/O blocks can be installed virtually anywhere, up to 7500 feet from the PLC or computer. They can be mounted on equipment, in junction boxes, inside panels, behind operator stations, and in other locations where space is limited. Blocks should be located in an area which is clean and free of airborne contaminants. There should be adequate cooling airflow. In many applications, Genius I/O blocks are installed in NEMA enclosures. Chapter 15 gives guidelines for determining enclosure sizes.

Environmental Specifications

Genius I/O blocks meet the following specifications for vibration, noise. and ambient temperature.

Vibration

Genius I/O blocks are compact and sturdy; they perform well in conditions where vibration is a factor. All Genius I/O block designs are vibration–tested (according to Mil–Std 810C and IEC 68–2–6) to meet the following specifications:

5 to 10 Hz .200 in displacement (peak to peak)
10 to 200 Hz at 1 g
Shock: 15G

Noise

Genius I/O blocks are resistant to noise levels found in most industrial applications when installed according to accepted industry practices. This includes proper separation of wiring by voltage and power levels, as explained in the *Genius I/O System User's Manual*.

Blocks are tested to the following noise specifications:

Radiated:	FCC part 15, section J, class A, Computing Devices
Received:	NEMA ICS 2–230 ANSI/IEEE C37.90 (Relay and relay systems associated with Electrical Power Apparatus)

Temperature

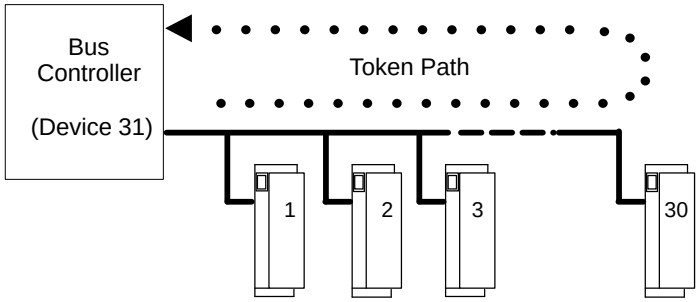
I/O blocks operate reliably in temperatures up to 60C (140F). Temperatures are measured adjacent to the block at the bottom of the Electronics Assembly. Between 35C and 65C (95–149F) each 10C reduction in the ambient temperature increases the electronics Mean Time Between Failures by a factor of two.

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Block Operation

A Genius I/O block is an intelligent module that sends and receives messages on a communications bus.

The devices on the bus pass an implicit token, which rotates among the devices in sequence from device 0 to device 31. This sequence is called a bus scan.



A block can send:

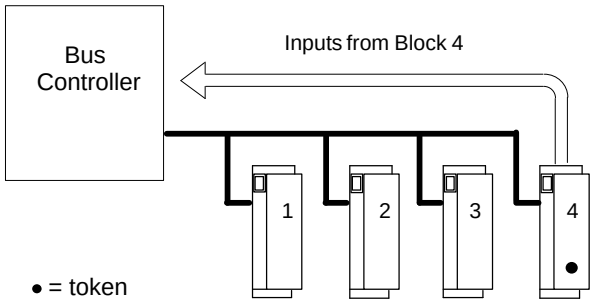
- Input data (if the block has inputs).
- Diagnostic fault reports.

A block can receive:

- Output data from the CPU.
- Commands from the CPU and Hand–held Monitor.

Inputs

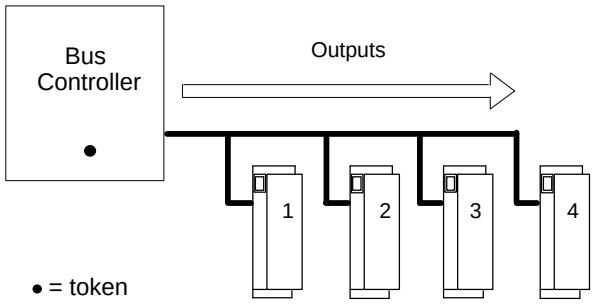
A block (with inputs) continuously monitors data from its input devices and updates the corresponding data. When the block receives the bus token, it broadcasts ALL its current input data. The bus controller stores this data, making it available to the CPU. Even blocks with no inputs put out a message when they get the token, to notify the bus controller that they are present and on–line.



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Outputs

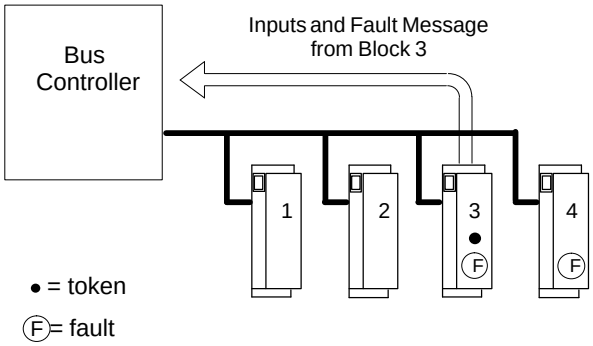
As the application program executes, the CPU sends outputs and any commands to the bus controller. The bus controller stores this data until it receives the bus token. Then, it directs output data to each of the blocks on the bus, and commands to the appropriate devices. Even blocks that have no outputs receive a null message from the bus controller while it has the token. This permits the blocks to indicate that they are on–line with the CPU, and to detect loss of communications should that occur.



Diagnostics

If a block detects a fault, the following things happen:

1. The block's Unit OK LED blinks to show that a fault exists.
2. Unless the fault reporting feature has been disabled for the circuit where the fault occurred, the block automatically sends a fault message to the bus controller and / or monitoring CPU on the next available bus scan. This fault information is always available to the Hand–held Monitor, which continually polls the block for updates.



3. For certain types of faults, the block takes corrective action in order to prevent possible hazardous operation, or damage to the block. For example, for some output faults, the block automatically turns the output off.

Faults may be cleared from the Hand–held Monitor or the CPU. If the condition that caused the fault has not been corrected, the block sends another fault message after the fault is cleared. If the block has shut down a circuit in response to a fault condition and the condition has been corrected, the block restores that circuit to full operation as soon as the fault is cleared.

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Features and Benefits of Genius I/O

The potential benefits to be derived from using Genius I/O products include:

- Reduced software engineering
- Faster startup
- Installation cost savings
- Reduction in costly downtime

Genius I/O provides these cost savings through:

Configuration Flexibility: Many discrete Genius I/O blocks have programmable I/O circuits, allowing any mix of inputs and outputs. That means a single 8–circuit block would be field–configurable to any of 256 distinct combinations of inputs and outputs.

Intelligence: With a Genius I/O system, you can program many conventionally hard–wired features of I/O systems. With Genius I/O, filter time constants, default values, and other characteristics can be field–configured and customized for the attached devices. Analog blocks have built–in engineering unit scaling. The cost and productivity benefits are reduction in initial custom engineering and improved use of equipment.

Reduced installation costs: for wiring, terminal blocks, conduit, and junction boxes. Because Genius I/O blocks are mounted at the point of control, the distribution panels, ducts, and auxiliary power supplies associated with most remote I/O systems are largely avoided. Reduced installation cost comes from the simpler wiring and reduction in custom panels and ducting – saving both materials and labor. Before programming begins, the entire I/O system can be tested and possible malfunctions can be prevented. Blocks can be removed and inserted without disturbing field wiring, which is connected to the separate Terminal Assembly.

Advanced Diagnostics: In addition to being able to detect internal faults, a Genius I/O system can detect open circuits, short circuits, overloads, and a variety of other faults in the attached devices. Many faults can be detected before they cause a malfunction in equipment. The system can detect the integrity of a control circuit before the circuit must actually be energized. This is made possible by periodic “pulse–testing” under microprocessor control within a Genius I/O block. The system can specifically isolate and identify faults to the circuit level for prompt and accurate maintenance.

Circuit Protection: Many Genius I/O blocks provide electronic fusing and overload protection. Blocks can shut circuits down within 5 microseconds of detecting circuit faults, providing far more effective protection than thermal fuses. Short circuits and overloads may be reset from the programmable controller or Hand–held Monitor. Productivity benefits include reduced maintenance time and better protection of equipment.

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Beyond these benefits, the flexibility, power, and intelligence built into the Genius I/O system can make production and equipment–design engineering easier; Genius I/O systems will monitor, control and diagnose the next generation of devices in tomorrow's factories.

- High–level analog signals on can be mixed on one block: (" 10 volts DC, " 5 volts DC, 0–10 volts DC, 0–5 volts DC, 1–5 volts DC, or 4–20 mA).
- Linear conversions can be established for analog blocks, converting analog values to engineering units.
- High–level and low–level alarms on analog inputs will automatically warn of undesired analog levels.
- Over–range and under–range diagnostics automatically report analog values that are out of range.
- The Hand–held Monitor can force I/O on and off and perform wiring diagnostics with or without the CPU connected. A system can be wired and debugged in stages without a program ever having been written.
- Diagnostics will detect I/O block additions and deletions at remote locations.
- Selectable Input Filter Times permit customizing input response to ambient electrical environment. Longer filter times can be used to reject electrical noise in harsh environments.
- Redundancy features can be used to provide protection from cable breaks, interface module failure, or CPU failure. Redundancy features also permit the use of multiple CPUs for distributed control or data monitoring.

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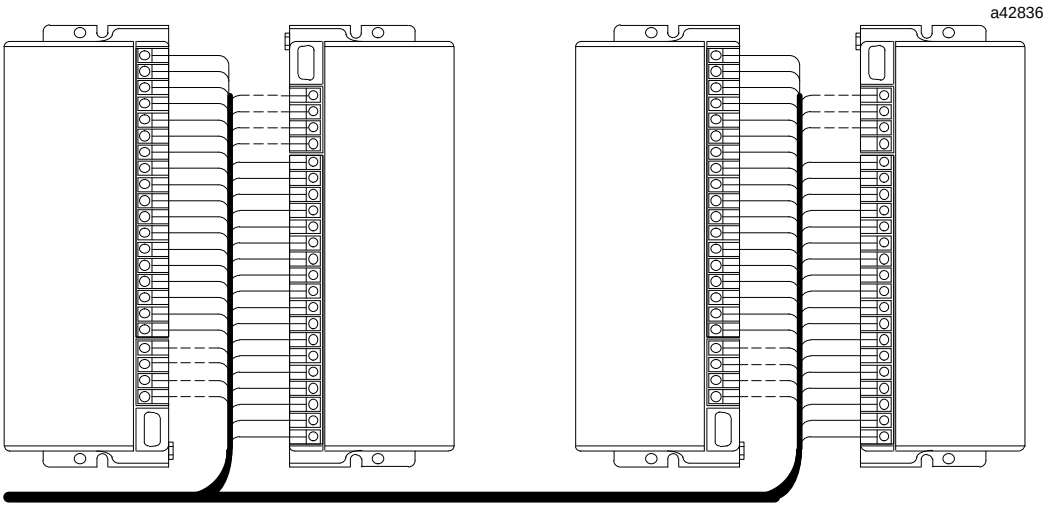
Chapter 2 Installation

This chapter includes installation instructions for:

- Mounting I/O blocks
- Making bus connections
- Grounding I/O blocks
- Installing additional suppression for certain types of output loads.
- Interfacing small loads to some discrete AC blocks
- Adding or removing a block's Electronics Assembly
- Replacing a block or Terminal Assembly

Mounting I/O Blocks

Genius I/O blocks can be mounted in any position. For adequate heat dissipation, vertical mounting is recommended. If alternate blocks are mounted upside down, bundles of wiring can be run between blocks.



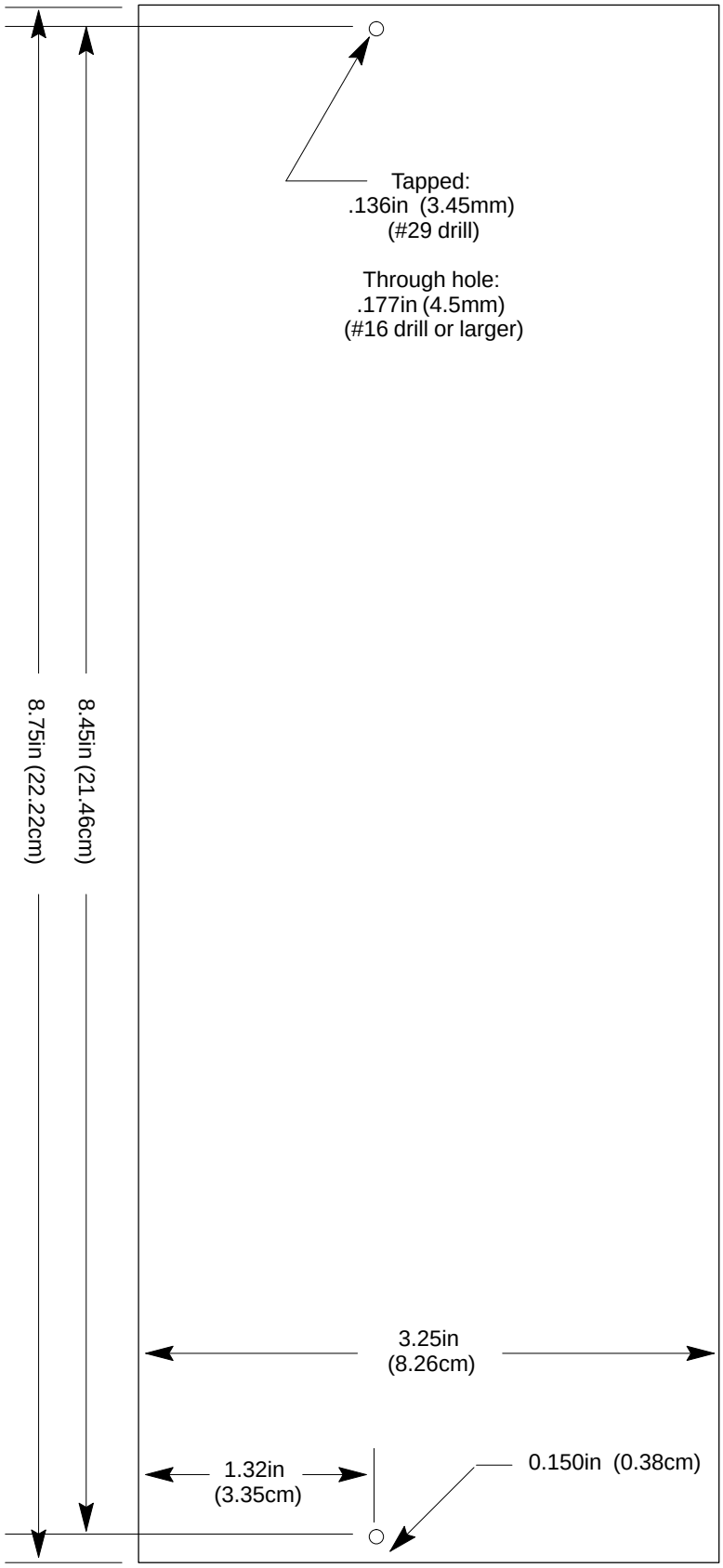
Leave at least 1-1/2 inch (3.84 cm) of space between blocks, and 3 inches (7.62 cm) above and below each block. This allows room for future use of a Block Puller to remove the block's Electronics Assembly. It also provides space for wiring (more space is desirable, especially if wiring will be bundled together). If blocks will be located close together, it may be easier to complete wiring before mounting the blocks. This is particularly true for analog blocks and 32–Circuit DC blocks; wiring for those blocks enters the terminal strip from the side.

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If blocks are mounted in an enclosure, there must be space for free flow of air along each block's Electronics Assembly (the side opposite the Terminal Assembly). Do not allow wiring conduits, shelves, or other components (including projections on the cover or door) to inhibit cooling airflow around the blocks. If an enclosure must be located in direct sunlight, consider placing a shade over it and / or painting it white to reflect heat.

Mounting Footprint

For each block, drill two screw or bolt holes for 8–32 hardware. Notice that the mounting holes are not centered. Position the block so that the notches in the upper and lower flanges line up with the mounting holes. Attach the block using 8–32 hardware.



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Making Bus Connections

Make the bus connections to I/O blocks using the cable type selected for the application. Recommended cable types are listed in the *Genius I/O System User's Manual.*

Caution

Do not mix cable types on a bus. Unreliable communications could result.

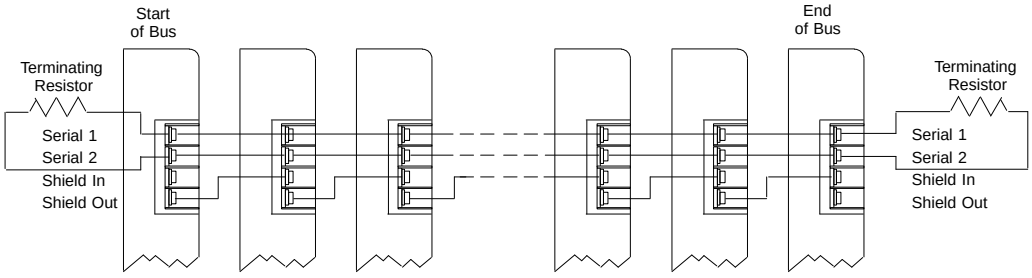
Bus connections can be made using either a slotted screwdriver (0.25" x 0.04" or 6.35mm x 1.0mm maximum blade size) or a Phillips screwdriver (size 0 or 1). The tie–down screws can be removed to accommodate ring–type connectors.

Note

On new block, the tie–down screws are tightened. If a block is to be moved after the tie–down screws have been loosened, they should be re–tightened to prevent loose screws from falling into the packaging material or equipment.

The bus cable connects to the Serial 1, Serial 2, Shield In and Shield Out terminals (terminals 1–4). Connect the Serial 1 terminal of each block to the Serial 1 terminals of the previous device and the next device. Connect the Serial 2 terminal of each block to the Serial 2 terminals of the previous device and the next device.

Shield In of each block must be connected to Shield Out of the preceding device. For the first device on the bus, Shield In can be left unconnected. For the last device on the bus, Shield Out can be left unconnected.



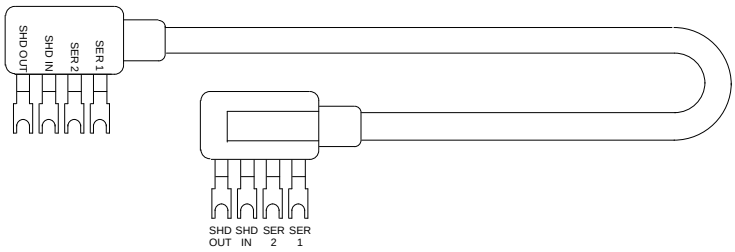
Note

Do not strip more insulation than necessary from the cable wires. The maximum exposed length of bare wires should be two inches. For added protection, each shield drain wire should be insulated with spaghetti tubing to prevent the Shield In and Shield Out wires from touching each other.

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Prefabricated Cables

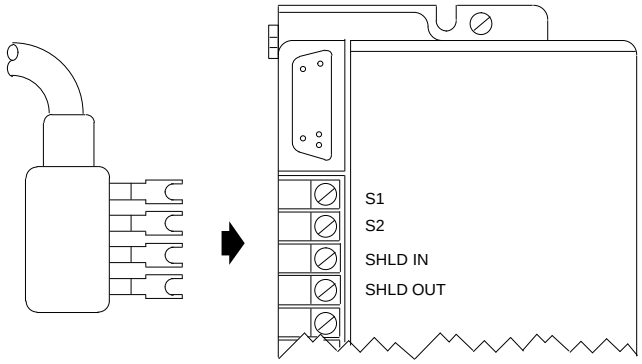
For applications using Belden 9182 cable only, prefabricated cables in 15" (IC660BLC001) and 36" (IC660BLC003) lengths are available. These cables terminate in mating connectors that simplify wiring between I/O blocks.



Terminating the Bus at an I/O Block

For devices on either end of the bus, install the appropriate terminating resistor across the Serial 1 and Serial 2 terminals. Impedance will be 75, 100, 120, or 150 ohms. 150 ohm (IC660BLM506) and 75 ohm (IC660BLM508) resistor plugs can be ordered.

If blocks are connected using the prefabricated cables described above, attach the cable to the first or the last block to exit toward the top of the block. A 150 ohm terminating plug should then be installed across Serial 1 and Serial 2.



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Bus Connections for Critical Processes

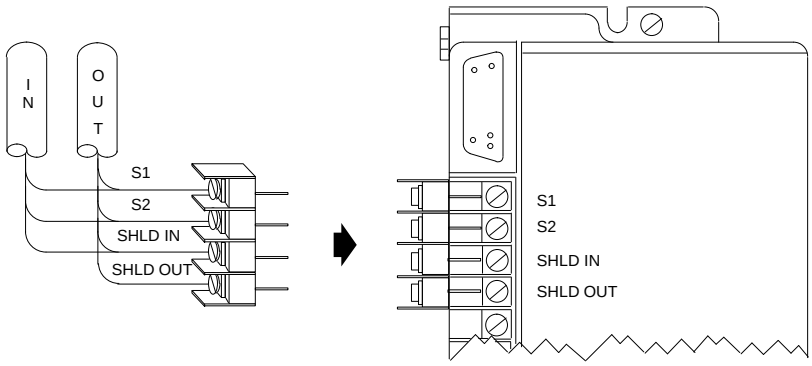
The recommended method of connecting the bus to an I/O block is to wire it directly to the block's Terminal Assembly as described above. These bus connections are normally considered permanent.

Caution

Bus connections should never be removed while the completed system is in operation; the resulting unreliable data could cause hazardous control conditions.

If the possible removal or replacement of a block's Terminal Assembly would result in breaking the continuity of the bus, the bus should first be turned off.

If the bus controls critical processes that cannot be shut down, blocks can be wired to the bus via an intermediate connector, as shown below.



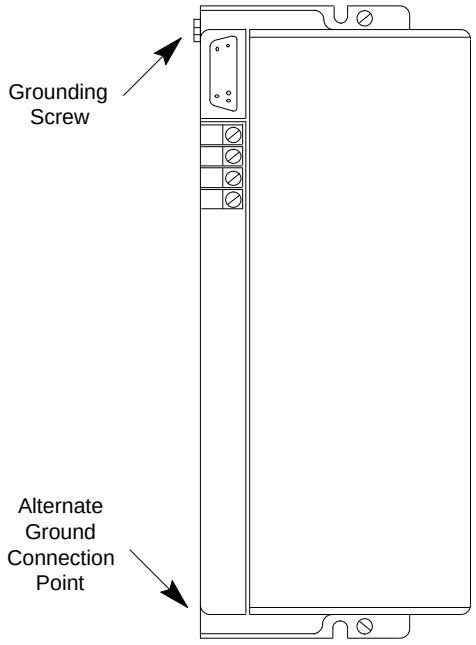
This will allow the block's Terminal Assembly to be removed while maintaining data integrity on the bus. The connector shown is #A107204NL from Control Design, 458 Crompton Street, Charlotte NC, 28134. If blocks are connected to the bus in this way, field wiring to the blocks should also provide a means of disconnecting power to individualblocks.Alternatively, the wire ends can be soldered together before inserting them into the terminals. When removing the Terminal Assembly, cover the ends of the wires with tape to prevent shorting the signal wires to one another or to ground.

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Grounding I/O Blocks

The Shield Out termination of each block is connected directly to the block's chassis ground. The Shield Out termination is capacitively coupled to Shield In. This breaks up any differences in small ground voltages which may be present at different blocks on the bus (up to 50V of continuous difference of ground potential).

Within each cabinet, use hardware such as star washers to provide ground integrity. A ground wire (minimum size AWG #12) must be connected from the ground screw on each Genius I/O block to the panel.



Warning

If the mounting screws do not make good ground connection and the grounding screw is not connected to a reliable ground, the block is not grounded, Electrical shock hazard exists. Death or personal injury may result.

Normally a ground (green) ground conductor is routed from the building power system to each control cabinet. Metal wire conduits should NOT be used as the only earth ground connection.

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Installing Additional Suppression

Additional suppression may be needed in some applications. Suppression may located in the following places, depending on the source of the disturbance:

A. At the communications line.

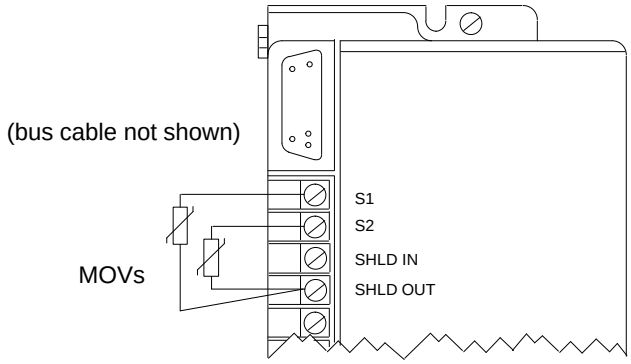
B. Across the power line.

C. At the I/O points.

Suppression at the Communications Line

High transients on the communications bus may render some I/O blocks inactive and turn their LEDs off. If that happens, cycling block power restores operation. To guard blocks from the affects of high transients, suppression can be added at the communications line.

For an individual block, suppression can be supplied by connecting two small MOVs from Serial 1 and Serial 2 to the block's 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. It is important to be sure that the MOV leads do not cause any shorts between the serial data and shield connectors.

For blocks installed together in an enclosure, suppression can be added at the point where the bus cable and power lines enter the enclosure, as shown on the next page.

Chapter 2 of the *Genius I/O System and Communications Manual* (GEK-90486-1) describes the noise-rejection and filtering capabilities of the Genius bus. It explains bus wiring practices for all applications. Chapter 2 also gives additional instructions for installing a bus outdoors or between buildings, including recommendations for adding suppression at the point where the bus enters a building.

Note

MOVs do a good job of absorbing transients on communications, control, and power lines, provided the total energy of those transients does not exceed the rating of the device. If the energy of the transient exceeds the rating of the device, the MOV may be either damaged or destroyed. *This failure may not be visibly or electrically evident.* MOVS should be regularly inspected for signs of damage to assure continued protection against transients. For some applications, periodic replacement of critical MOVs, even if they do not show signs of damage, is recommended.

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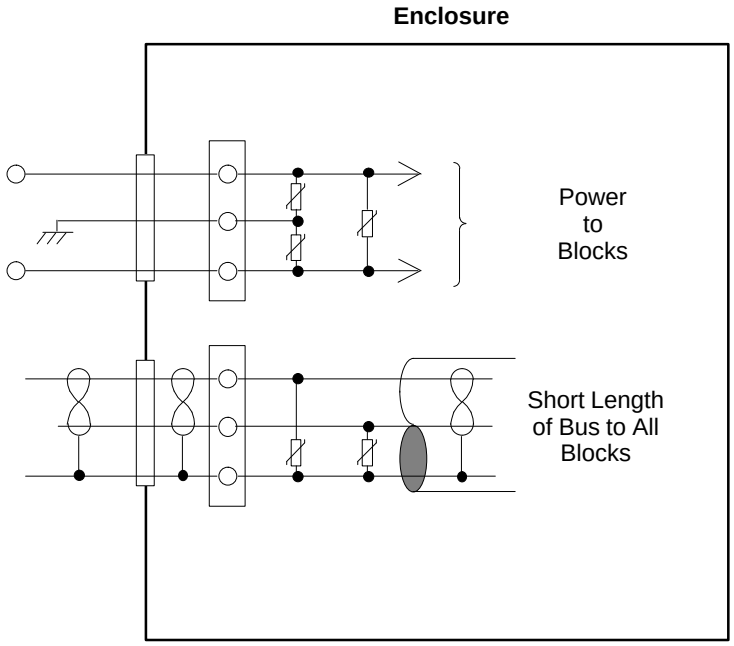
Suppression at the Power Line

Power line transients can affect any Genius block that has separate power inputs, such as AC Isolated blocks and low level analog blocks.

Protection can be provided by connecting MOVs across the power lines (for instance, between Hot and Neutral) and from line to frame ground (safety ground). This triangular configuration requires three MOVs for each long power feed. If the total power feed length is about 100 feet or less, one set of MOVs should be sufficient for any number of blocks.

For a group of blocks installed in an enclosure, the MOVs can be installed at the point where the power lines enter the enclosure. Ideally, MOVs should be used at each cabinet in the system for maximum protection.

The following illustration shows suppression on both power lines and the communications bus for blocks in an enclosure.



The axial-leaded LA series of MOVs from Harris is often used for this application. The 14mm size, model V130LA10 rated at 38 joules is usually sufficient. The MOVs used should be capable of handling the line transients expected. Measurement of actual transients may be required in extreme cases to decide what MOVs to use.

Suppression at I/O Points

Suppression may be needed:

A. At the inputs of some sensitive blocks, such as RTD blocks. Instructions for wiring MOVs to RTD inputs are included with the RTD wiring information in chapter 14.

B. At a discrete output load, if there is excessive stored load energy, or if there is a mechanical contact in series with a driven output coil.

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Suppression at the Output Load

Most solid state controls include load suppression within the output drive. AC solid state relays and proximity switches turn off at low currents with some internal suppression. DC devices usually specify suppression if not included with the device. Additional suppression is required if:

1. The stored load energy to be dissipated exceeds the rating of the block's output suppressor during the turn–off discharge time.
2. A mechanical contact is used in series with a driven output coil. Install additional suppression such as a series resistor capacitor snubber to counteract electrical noise that occurs when the coil is switched by the external contact instead of the block.

Resistor–capacitor suppressors are preferred for low-current high-inductance loads that generate a high rate of change in voltage (dv / dt). High power loads beyond the capacity of RCs use voltage clamping devices such as MOVs, which are usually available from the manufacturer of the device. Resistor-capacitor suppressors are also preferred to MOVs or transorbs because they reduce EMI in addition to absorbing load energy.

In general, the capacitor for an RC snubber should be the same value in microfarads as the coil current in amperes, with the voltage rating at least twice the peak supply voltage. The resistor is usually equal to the DC resistance of the coil. With DC coils, the capacitor is usually replaced with a "flyback" diode oriented with the anode to the negative terminal of the coil. The resistor helps maintain a fast dropout of the device; it can be eliminated if this is not of concern.

Most control and contactor manufacturers make suppressor accessories that can be conveniently mounted on their devices. The following types are available from GE General Purpose Control, Bloomington, IL:

Type	Voltage	Part Number
RC	110 – 180 VAC 380 – 480 VAC 24 – 48 VAC	CR4XS1B CR4XS1C CR4ZS1J
Diode	12 – 250 VDC	CR4XS2P
Varistor	24 VDC 36 – 48 VDC 110 – 150 VDC 220 – 250 VDC	CR4XS3L CR4XS3M CR4XS3N CR4XS3P

For NEMA size 0 – 6 contactors: CR305X146C

Consult other manufacturers for recommendations of equivalent suppressors for their devices. Discrete components can also be used as discussed earlier. Pheonix Contact Inc., Weidmuller Inc., and other manufacturers make DIN rail mount suppressors for both load snubbing and line surge protection.

If noise is generated by a protective contact that operates only in abnormal conditions, not as part of the normal machine cycle, the best way to handle possible control shutdown which may occur during machine faults depends on the application. Normally, re–cycling block control power will enable resumption of operation.

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Interfacing Small Loads to AC Blocks

The 115 VAC Low–Leakage 8 Circuit Grouped I/O block (IC660BBD101) is designed to interface small loads to the bus without added resistance at the load. For other types of discrete AC blocks, if individual output circuits will drive inductive loads drawing less than 50mA, it may be necessary to add resistance to the circuit at the load.

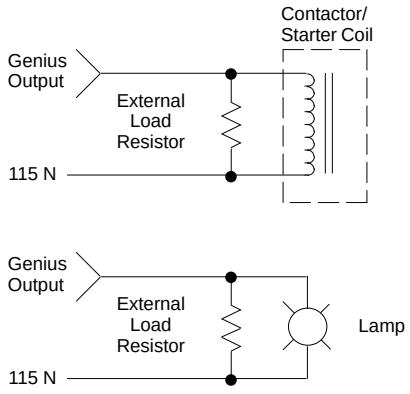
When closed, electromechanical devices such as contactors, starters, or relays have very high inductance combined with a low value of holding current.

When the output is off, the inductance of the coil can interact with the block's suppression capacitor to maintain a relatively high current level (15mA to 25mA) over the entire voltage range. That can make dropout operation (opening the contacts) marginal, or cause the device to remain in the ON position. When the device releases, the increased air gap reduces the coil inductance to a low value. That causes the current leakage to decrease to the nominal 10mA to 13mA range, and the load voltage drops to a very low value. Since the current required to pick up (energize) the device is usually higher than the holding current, the leakage seldom causes a related device to pick up. This interaction between leakage currents and load characteristics may falsely suggest that a relay is stuck for mechanical rather than electrical reasons. If this happens, test the device. If necessary, add additional load resistance across the load.

External Load Resistance for Coils and Lamps

If added resistance is needed, locate it *at the load*, not at the I/O block. The added resistance should bring the total current up to 100mA. For example, for the General Electric CR4CA contactor the holding current is specified as 9.1VA. This equates to about 79mA of load current. To increase the load current to 100 mA, a 4K ohm resistor would be added in parallel across the relay coil. In case of doubt, use a lower resistance/higher wattage value.

Resistive loads are less critical than inductive loads. The OFF state open circuit voltage of the output circuit is approximately 80 volts. The voltage decreases linearly as lower resistance loads are applied. For a 1000–ohm resistor load, the typical output OFF state voltage is 14 volts. Incandescent lamps rated at less than 5 watts may glow dimly. To prevent this, use parallel resistance.



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Adding or Removing a Block's Electronics Assembly

All field wiring connections to a Genius I/O block are made to the block's Terminal Assembly, which is ordinarily permanently installed. This means the block's Electronics Assembly can be removed and replaced without disturbing field wiring, entering addressing, or reconfiguring the block. The Terminal Assembly is mechanically keyed to accept only an Electronics Assembly of the same type (voltage, number of circuits, wiring configuration).

Removing an Electronics Assembly

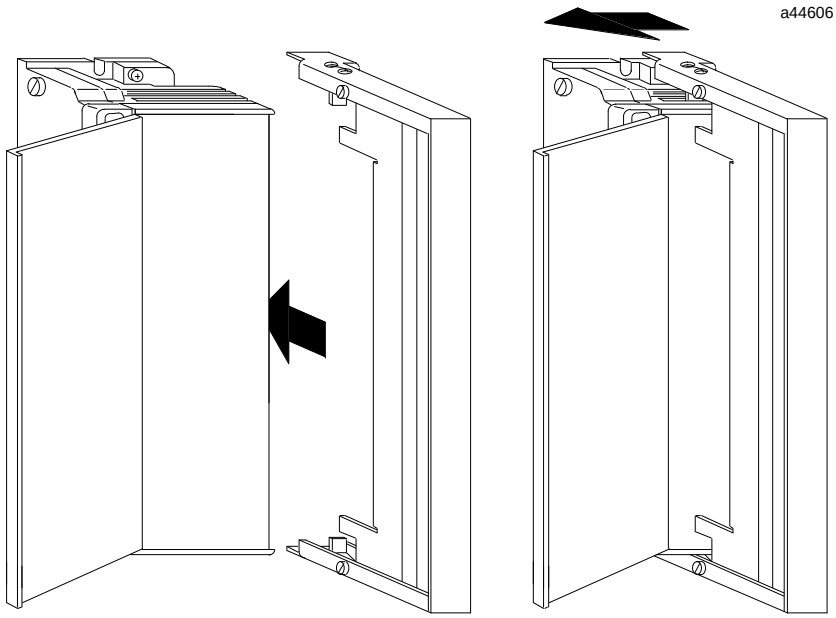
A Block Puller (IC660BLM507) should always be used to remove or insert an Electronics Assembly.

Caution

Use of a Block Puller prevents damage to the block connectors that can result from manual removal. Such damage may result in unreliable operation under high vibration conditions.

To remove an Electronics Assembly:

1. Unscrew the retaining screws at the top and bottom of the block.
2. Engage the tabs on the Block Puller in the first vent slots. Move the tool to the center of the block and squeeze the handle.



3. Pull the Electronics Assembly straight away from the Terminal Assembly.

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An operating block may be hot to the touch. Test the surface of the block before grasping it.

Warning

If power is applied to the field terminals, power is also exposed on the connector pins at the base of the Terminal Assembly, and electrical shock hazard exists. Do not touch the connector pins! Death or injury may result.

Installing an Electronics Assembly

To replace an Electronics Assembly:

1. Align the Electronics Assembly within the guides and push it down quickly.

Caution

Do not exert excessive force. Damage to the equipment might result.

If unusual resistance is met, remove the Electronics Assembly. If power is applied to the block, DO NOT TOUCH THE CONNECTOR PINS! Inspect the Terminal Assembly, connector receptacle, and connector edge board (on the Electronics Assembly). Be sure the keying matches. Remove any obstacles and reinsert the Electronics Assembly. Pay close attention to the alignment of the guide pins.

2. Secure the Electronics Assembly with the screws on the top and bottom of the Terminal Assembly.

Caution

If the retaining screws are loose, the connector pins may not make contact correctly. This could result in faulty block operation.

Replacing a Block or Terminal Assembly

Do not add or remove a Genius I/O block or Terminal Assembly while the system is operating unless the bus has been attached using a bus connector (see page 2-5), or the bus wires have been soldered together.

Caution

Adding or removing an entire Genius I/O block or a Terminal Assembly without taking these precautions may disrupt communications. This may cause erratic operation or lead to system shutdown.

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If a removable connector has been used or the signal wires are soldered together, the block's Terminal Assembly can be replaced without powering down the bus.

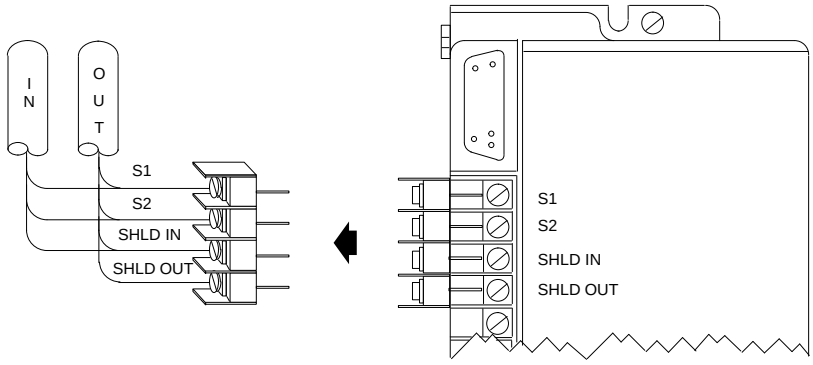
If possible, do not remove the Terminal Assembly until a replacement is available. Then replace the Terminal Assembly or block by following these steps carefully:

1. If the block is still receiving power, remove power from the block. Take care to ensure continued operation of any other devices wired to the same power supply.

Warning

Hazardous voltages may be present at the block's field wiring terminals while the block is receiving power. Death or injury may result from contact with field wiring terminals.

2. If a bus connector has been used, remove the bus connector from the Terminal Assembly. *Do not remove the bus wiring from the connector.* The connector will maintain continuity of data transfer on the bus.



Place the connector, with the bus still attached, in a protected location. Insulate the connector's protruding pins.

Caution

If the connector pins come in contact with conductive material, data on the bus may be corrupted, possibly causing the system to shut down.

If the signal wires have been joined by soldering instead of using a bus connector, remove and tape each wire pair carefully. Do not allow the signal wires to contact each other or any conductor.

3. Remove the block's Electronics Assembly.
4. Remove field wiring from the Terminal Assembly.
5. Remove and replace* the Terminal Assembly.

Reverse the procedure to install the new Terminal Assembly.

* If removal of the block is permanent (no replacement is anticipated) the bus should be rewired using unbroken cable at the earliest opportunity.

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Chapter 3 Configuration

This chapter explains:

- What block configuration includes.
- How to get started configuring I/O blocks.
- How to set up a block for offline configuration.
- The features of the configuration Main Menu.
- How to assign a block's required features.
- How to assign additional block features.

Configuration Overview

Configuration is the process of selecting the features that will be used by a Genius I/O block. Configuration includes:

1. Assigning a Device Number to the block. This step, which requires a Hand–held Monitor, must be done before any additional configuration can take place.
2. For some CPU types, it is necessary to assign a Reference Address for the block's I/O. This also must be done with a Hand–held Monitor.
3. Making sure the block's configured baud rate matches that of other devices on the bus.
4. Selecting other features that are appropriate for the application. Block configuration is simple, since all blocks come supplied with a set of default selections for each feature. Therefore, configuration is only a matter of changing those features that are appropriate for the application. Among the features of Genius I/O blocks that can be configured are fault reporting, redundancy, and the assignment of inputs and outputs on most discrete blocks. This configuration is usually done with a Hand–held Monitor, but it can be done from the CPU.
5. Protecting the block's selected features so they will not be accidentally changed.

Many of a block's configurable features can be changed at any time, even while the system is in operation.

Blocks can be configured before or after installation on a properly–terminated serial bus. If a new, factory–shipped block is to be added to an existing bus running at a baud rate other than 153.6 Kbaud standard, the block must first be configured off–line. In general, special care must be taken when adding new blocks to existing systems. Always verify beforehand that the baud rate programmed for use by the new block corresponds to that of the system – never mix baud rates on a single bus.

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Preliminary Steps

Block configuration should be carefully planned, and recorded on copies of the configuration worksheets provided in this manual. Before block configuration starts, you should already know:

- What each block's Device Number (address on the bus) should be.
- The beginning Reference Address for each block's I/O, if required for the type of CPU controlling the bus.
- The baud rate that will be used by the bus and all its devices.
- Which of the block's default features (for example, I/O mixture, Input Filter Time or Alarm Thresholds) should be changed by configuration.

If you do not have the necessary information, do not try to configure any blocks.

Configuration Protection

All Genius I/O blocks can be configured for Configuration Protection, which prevents unwanted or accidental changes. On a new block, Configuration Protection is disabled, so the block is ready to configure for the application.

Removing Configuration Protection

On a previously–configured block, it may be necessary to disable Configuration Protection to make changes. Configuration Protection can only be set and removed with a Hand–held Monitor; it CANNOT be changed from the application program.

Use the HHM to step through the block configuration screens (the HHM does not have to be connected directly to the block). The final screen that appears is the Configuration Protection screen.

1. Press F2 (Toggle) to select DISABLED.
2. Press F3 (Enter) to save the selection.
3. Press F4 (Next) to go to the first block configuration display, or ΔMENU to return to the Configuration menu, or HOME to return to the Home menu.

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Setting Up a Block for Off–line Configuration

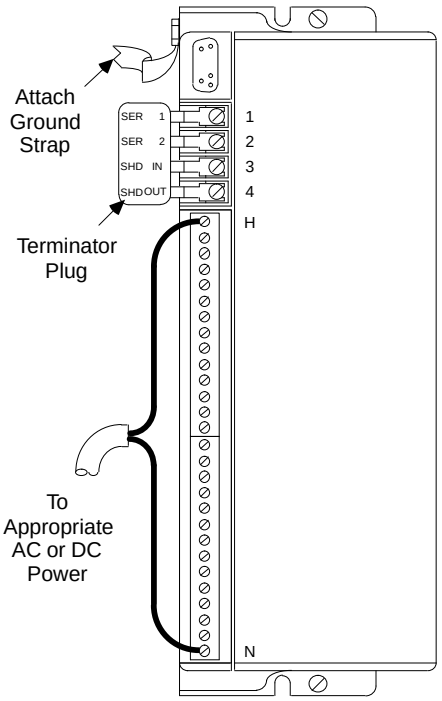
It may be most convenient to configure new I/O blocks offline at a central location. Each block will need to be connected to an appropriate source of power and to earth ground. To prepare a block for off–line configuration:

1. Connect a 75 ohm resistor across the Serial 1 and Serial 2 terminals, or use the 75 ohm terminator plug (IC660BLM508). Two of these plugs are provided with each Bus Controller.
2. Attach a grounding strap to the ground screw on the side of the block. Be sure that the strap is connected to earth ground.

Warning

If the block is not properly grounded, hazardous voltages may exist. Death or injury may result.

3. Wire the block to the power source.



Warning

DO NOT TOUCH the connectors or wiring after powering up the block. Hazardous voltages exist, and death or injury may result.

4. Apply power to the block. Continue with the configuration instructions that follow.

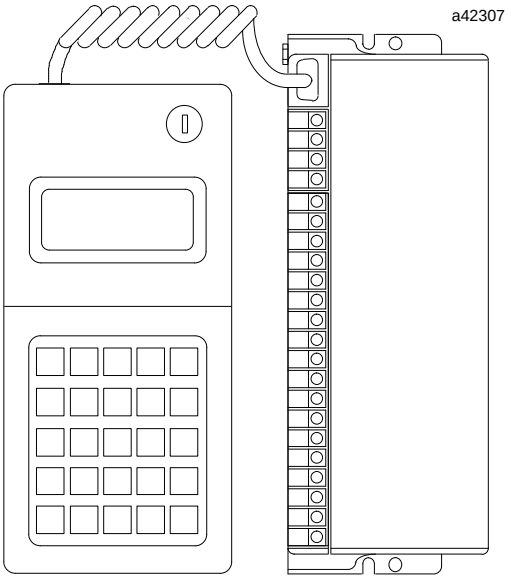
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Starting Configuration

Note

If you are configuring a block that is on an operating bus, the HHM must be the ONLY Hand–held Monitor plugged into a block on the bus.

1. Begin with the Hand–held Monitor turned off. Attach the HHM to the block.

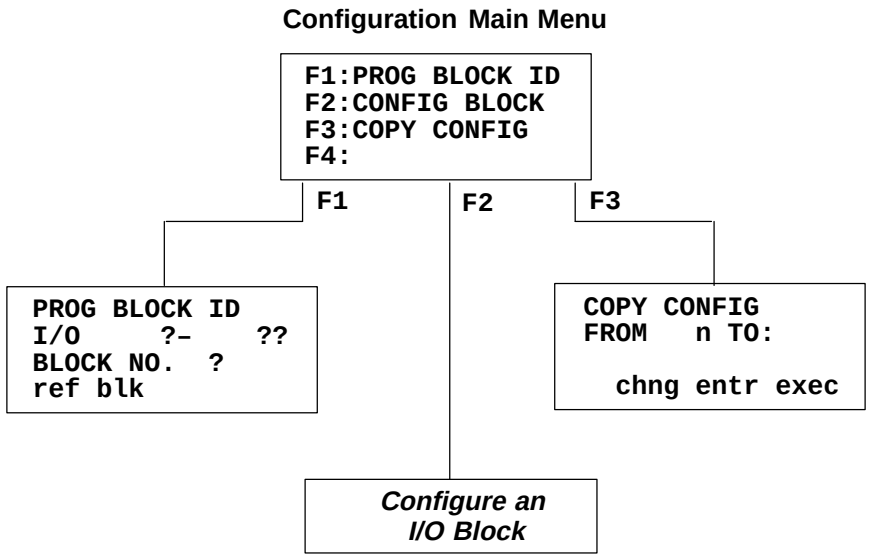


2. Turn the Hand–held Monitor on. After the HHM completes its powerup sequence, the Home menu appears. The Hand–held Monitor's Change Block Configuration option must be enabled to complete the instructions in this section. For a new block, the HHM's Change Block ID and Change Block Baud options must also be enabled.

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Displaying the Configuration Main Menu

To begin block configuration, select F3 (Configuration). The configuration Main Menu appears.



From the configuration Main Menu, you can:

- Go to the Program Block ID screen (F1) to configure a block's required features. *For new blocks, this must be done first*.
- Select Block Configuration (F2) to complete a sequence of Block Configuration screens. Configurable features for each block type are described in later chapters of this book.
- If the block is on an operating bus, select Copy Configuration (F3) to copy the configuration of a similar block on the same bus.

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I/O Block Configuration Messages

If an error message appears on the Hand–held Monitor during block configuration, look it up in the list below.

P W R U P E R R O R # 4

or:

P W R U P E R R O R # 5

Be sure the baud rate of the Hand–held Monitor matches the baud rate currently configured for the block. If it is a new block, it is operating at the default baud rate 153.6 kbaud, standard. Change the HHM's baud rate to match the block's.

E : F N C T N D I S A B L E D

Press the Clear key. Go to the HHM Utilities (HHM configuration) and enable this function.

E : C O M M E R R O R

The HHM has lost communication with the I/O block. Press the Clear key and try again. *Note: If working with a stand–alone block, be sure a 75Ω terminating resistor is connected across the Serial 1 and Serial 2 terminals.*

E : D U P B L O C K N O

The Device Number has already been assigned to a block on the bus. This message only appears if the block is connected to an operating bus. Another number must be assigned to one of the blocks in conflict.

E : D U P L I / O R E F

The Reference Address conflicts with or overlaps the Reference Number assigned to another block on the bus. This message only appears if the block is connected to an operating bus. Press the Clear key. Assign a different reference to either of the blocks in conflict.

E : I N V A L D B L K C F G

The entry just made is not valid for the block being configured. Press the Clear key.

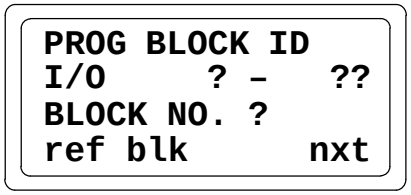
E : E E P R O M F A I L U R E

Clear the message and go to Block Status menu. Press the Clear key. If the block's UNIT OK LED continues to blink, replace the block's Terminal Assembly, configuring the replacement to match the original block.

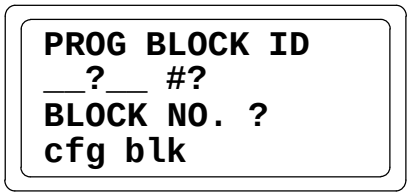
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Assigning a Block's Required Features

With the HHM plugged directly into the block, select Program Block ID (F1) from the Configuration menu to begin configuring a block. The HHM displays:



If the controller is a PCIM, QBIM, or GENI, the Program Block ID screen looks like this instead:



The features configured on Program Block ID screen must be selected using a Hand–held Monitor; they cannot be configured from the application program. Use this screen to configure:

1. The block's Device Number (serial bus address).
2. The beginning CPU Reference Address for the block's I/O data. This is not entered if the controller is a PCIM, QBIM, or GENI.
3. For discrete blocks with configurable I/O, the Block I/O Type.

After completing this screen, select the next screen to configure the block's baud rate.

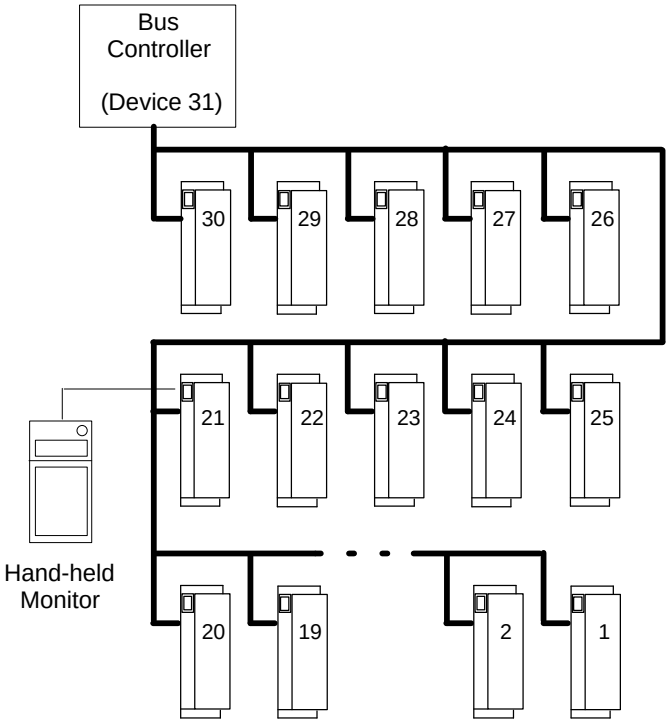
Continue with the instructions on the following pages.

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Device Number

The first step in configuring a new block is to assign its Device Number. This is a number from 0 to 31 representing the serial bus address of the device.

There are 32 available addresses on a serial bus. One is needed for the Hand–held Monitor, typically this is device number 0. Another is needed for the bus interface module. Typically, this is device number 31. I/O blocks are usually assigned device numbers 1–30. When shipped from the factory, an illegal Device Number is assigned. This means that a legal number must be assigned before doing anything else. Duplicate Device Numbers disrupt communications and are not permitted.



Configuration Steps

1. Press F2 (Block). Then, enter the block's Device Number (1–30). If you make a mistake, press F2 again, then enter the correct number.
2. Press the F3 (Enter) key. All currently–available blocks test the bus to ensure that their assigned Device Number is not already in use. If it is, the block will not transmit until the Device Number is changed. If you are configuring the block on an operating bus, an error message appears if the number has been used for another device. If the block is not online, be sure to assign a unique Device Number, or there will be a Device Number conflict when the block is powered up on the bus.

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Reference Address

A block's Reference Address is the beginning CPU reference for its I/O data.

For a **Series 90 PLC**, this entry may be optional, depending on the Logicmaster 90 software version and Hand–held Monitor version.

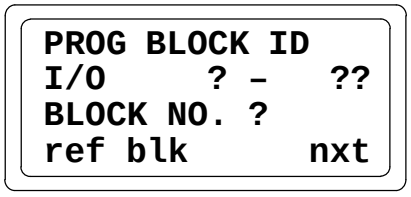
With some Hand–held Monitors, a Reference Address cannot be entered with the HHM in Series 90/PCIM mode. If the Hand–held Monitor permits entry of a Reference Number in Series 90 host mode, enter in the same reference assigned to the block with the Logicmaster 90 programming software. The Series 90 PLC and Hand–held Monitor will not check that the reference assignments match, so be sure to enter the correct Reference Address.

For a **Series Six PLC**, this is a required entry.

Note

If you select register references for a Series Six PLC, the PLC will not receive automatic fault reports from the block.

For a **Series Five PLC**, this is a required entry. Either an I/O or register reference can be selected. You may prefer to use register references for analog I/O block to save space in I/Omemory. If you select register references, all Genius I/O features will be available.



Configuration Steps

1. The Reference Address is entered in the same PROG BLOCK ID display. Press F1 (Reference).
2. Press the F2 (Toggle) key to toggle the memory type. With the correct memory type displayed, press F3 (Enter).
3. Key in the number of the block's beginning I/O reference. The Hand–held Monitor will accept any number up to 65,535; the number you enter must be appropriate for the PLC. If you make a mistake entering the number, press F2 (Change), F1 (Reference), then enter the correct number. Press the F3 (Enter) key. The HHM will automatically supply the range of references correct for the block.

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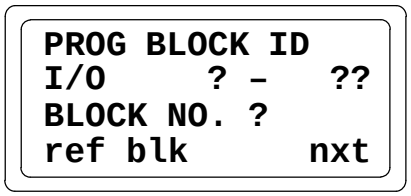
Block I/O Type

For a discrete block with configurable I/O types, select whether the block will be an inputs–only , outputs–only, or combination block. The default is inputs–only.

If all circuits will be regular inputs or tristate inputs, the block can be configured as Inputs Only. It will require 1 input reference per circuit, and NO output references.

If all circuits will be outputs, and no feedback analysis will be needed, configure the block as Outputs Only. The block will require 1 output reference per circuit, and NO input references.

Configure the block as Combination if it will have both inputs and outputs, or if output feedback analysis will be done on a block with all outputs. The block will require 1 input reference AND 1 output reference per circuit. For example, a 16–circuit discrete block configured as a combination block uses 16 input references and 16 output references.



Configuration Steps

1. If the HHM is set up for Series Five, Series Six, or Series 90-70 PLC operation, after you enter a reference the cursor moves to the right side of line 2. (For some older Hand-held Monitors, when Series 90-70 PLC operation has been selected, I/O type configuration works as described in step 2 below, instead).
2. If the HHM is set up for PCIM / QBIM / GENI operation, press F1 (CFG) on the Program Block ID display to move the cursor to the right side of line 2.
3. Press F2 (Toggle) to select:

I	for Inputs–only.
O	for Outputs–only.
O_I	for Combination.

4. Press F3 (Enter) to save the entry.
5. Press F4 to check the block's currently–assigned baud rate, and change it if it does not match the intended bus baud rate.

Using Output Feedback

When a block is configured as a Combination I/O block, each circuit is assigned both an input reference and an output reference. For each circuit configured as an output, the block will automatically return the actual state of the output in the corresponding input reference. For example, if circuit 1 is configured as an output, then input reference 1 will show the state of output 1.

The application program can compare the feedback information with the output data it has sent to the block (after an appropriate delay) to verify that the output switching device has operated properly and that the load has the proper voltage and current applied.

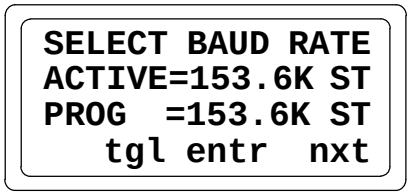
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Baud Rate

Genius I/O blocks can use four different baud rates: 153.6 Kbaud standard, 153.6 Kbaud extended, 76.8 Kbaud, or 38.4 Kbaud. The default is 153.6 K baud (standard).

Lower baud rates may be needed for longer cable lengths. However, this increases bus scan time. 153.6 Kbaud extended provides better noise immunity and allows longer cable lengths than 153.6 Kbaud standard; there is a slight increase in scan time. *Each block's baud rate must be the same as that used by all other devices on the bus,* or the bus will not operate. If baud rate is changed for one device, it must be changed for all of them. If there are any phase A Genius I/O products on the bus (see the *Genius I/O System User's Manual* for a list of phase A devices), the baud rate for all devices on the bus must be 153.6 Kbaud standard.

HHM Display



Configuration Steps

1. If the baud rate should be changed, press F2 (toggle). Press F3 (enter).
2. If the baud rate is changed on any block that is currently installed on an operating bus, it must be changed on all devices on that bus. After changing the baud rate, you must cycle power at the same time to all devices on the bus to use the new baud rate.

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Configuring Other I/O Block Features

All Genius I/O blocks have additional features, which can be configured either from a Hand–held Monitor or using Write Configuration datagrams from the CPU.

Descriptions of these features, and instructions for configuration, are included in the chapters that follow. For each configurable feature, there is a default selection which is suitable for many applications.

If the block is online to an operating bus, a simple alternative to selecting individual features is to copy the configuration of one block to another as explained below.

Copying Block Configuration

Features can be copied from one block to another block on the same bus. This feature is very convenient when a number of blocks are to be configured similarly. The block being copied TO (the target block) must have had its Device Number, baud rate, and reference number (for a PLC) previously entered.

Copy Configuration Steps

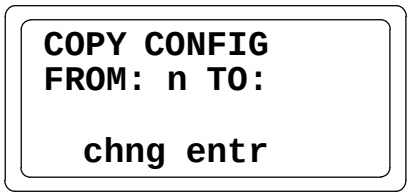
1. The block whose option selections are to be copied must be the active block (if necessary, go to the Block/Bus Status screen to select and activate the block to be copied):

   A. Put the Hand–held Monitor into the Block/Bus Status menu.

   B. Locate the target block.

   C. Press the F4 (ACTV) key. The letters A C T appear on the second line of the display. Return to the Home Menu. Select F3 (Configuration).

2. From the Configuration menu, press F3 (Copy Configuration). The HHM Shows:



3. The Device Number of the active block appears next to the word FROM. Enter the Device Number of the block you want to copy the configuration options TO. Press F3 (Enter).

4. Press the F4 (Execute) key. The configuration will be copied to the other block. The Reference Address is not copied. It can be entered as previously described via the Program Block ID screen.

5. If the target block is similar but not identical to the source block, use the Configure Block screens to finish up configuration.

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Block Groups for Copying Configuration

The block being copied from (the source block) and the target block must be of the same type. Within each group shown below, any block may be used as the target block or the source block. If the target block has more features than the source block, these can be individually configured later. If the target block has fewer features than the source block, the extra features are not copied.

115 VAC 8 Circuit Grouped Block (IC660CBD100) 115 VAC Low–leakage 8 Circuit Grouped Block (IC660BBD101) 115VAC / 125VDC Isolated I / O Block (IC660CBS100)* 115VAC / 125VDC Isolated I / O Block (IC660BBS100 or BBS102) 115VAC / 125VDC Isolated I / O Block, w / o Failed Switch (IC660BBS101 or BBS103)
24 / 48 VDC 16 Circuit Source I / O Block (IC660CBD020)* 24 / 48 VDC 16 Circuit Source I / O Block (IC660BBD020) 24 / 48 VDC 16 Circuit Sink I / O Block (IC660CBD021)* 24 / 48 VDC 16 Circuit Sink I / O Block (IC660BBD021) 24 VDC 16 Circuit Source I / O Block (IC660BBD022) 24 VDC 16 Circuit Sink I / O Block (IC660BBD023)
115 VAC 16 Circuit Input Block (IC660BBD110)
16 Circuit Relay Block, Normally–Closed (IC660BBR100) 16 Circuit Relay Block, Normally–Open (IC660BBR101)
12 / 24 VDC 32 Circuit Source I / O Block (IC660BBD024) 5 / 12 / 24 VDC 32 Circuit Sink I / O Block (IC660BBD025)
24 / 48 VDC 4 Input / 2 Output Analog Block (IC660CBA020)* 24 / 48 VDC 4 Input / 2 Output Analog Block (IC660BBA020) 115 VAC 4 Input / 2 Output Analog Block (IC660CBA100)* 115 VAC 4 Input / 2 Output Analog Block (IC660BBA100)
115VAC / 125VDC Current–source Analog Block (IC660BBA104) 24 / 48VDC Current–source Analog Block (IC660BBA024)
115VAC / 125VDC Current–source Output Block (IC660BBA105) 24 / 48VDC Current–source Output Block (IC660BBA025)
115VAC / 125VDC Current–source Input Block (IC660BBA106) 24 / 48VDC Current–source Input Block (IC660BBA026)
24 / 48 VDC RTD Input Block (IC660BBA021) 115 VAC RTD Input Block (IC660BBA101)
24 / 48VDC Thermocouple Input Block (IC660BBA023) 115VAC / 125VDC Thermocouple Input Block (IC660BBA103)

* These older block versions have been superceded, and are no longer available.

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Finishing Up

If you have finished block configuration and the Hand–held Monitor will not be used for more configuration changes, you should disable the Block Configuration feature in the HHM Utilities menu and remove the key. Turn off HHM power.

After a Block is Configured Offline

When you finish configuring a block that is not installed, turn off power to the block. Remove the power wiring and resistor. The configuration you have entered will be saved in the block's Terminal Assembly EEPROM.

Entering Information on the Block

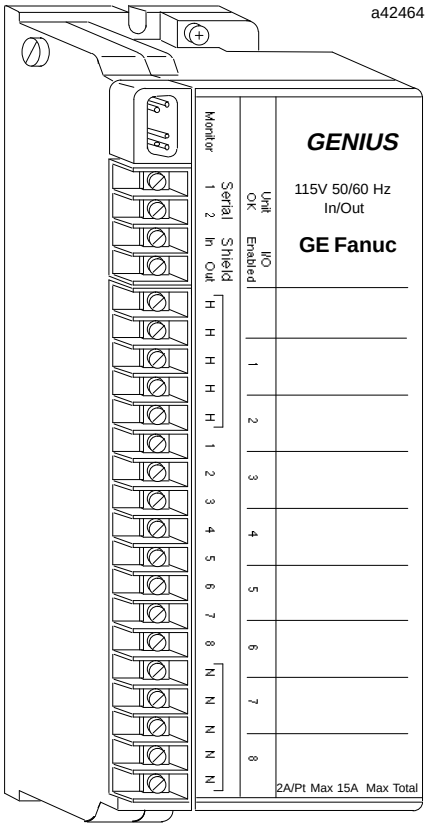
After configuring a block, record circuit information (such as a circuit's I/O type and Reference Address) on the block's label. That is especially important if you are configuring many similar blocks off–line prior to installation. In addition, be sure to indicate the block's configured baud rate on the label.

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Chapter 4

115 VAC 8 Circuit Grouped I/O Blocks

A 115 VAC 8 Circuit Grouped I / O Block (IC660BBD101) has one group of 8 discrete circuits, rated to operate at a nominal 115 volts AC. Each circuit can be an input, a tristate input, or an output.



Features

Control power for the block is tapped off the input / output device voltages wired to the terminals. No separate block power supply is needed.

Configurable features include:

- Output Pulse Test capability
- Selectable Input Filter Time from 10mS to 100mS
- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy type
- Bus Switching Module control

Each circuit has electronic fusing that shuts down the circuit in 5µS if output current exceeds 30 amps at turnon, or 20 amps after 2 cycles. The circuit is easily restored by command from a Hand–held Monitor or the CPU.

Additional diagnostics include:

- Overtemperature Failed Switch
- Open Wire for tristate inputs
- Overload Detection and Shutdown
- No–load Detection

Fault reporting can be enabled or disabled circuit–by–circuit.

This block is suitable for installations where a Class 1 Division 2 rating is required for Factory Mutual.

Compatibility

This block is fully compatible with Hand–held Monitor model IC660HHM501. It may be used with IC660HHM500. However, HHM501 is required to change baud rate configuration, or to configure the block for redundancy.

The blocks may be used with any GE Fanuc bus controller, PCIM or QBIM module.

This block is backward compatible with blocks IC660CBD100 and IC660BBD100, and may be used to replace them. Electronics Assembly IC660EBD100 replaces Electronics Assembly IC660ELD100. Electronics Assembly IC660EBD101 replaces both IC660ELD100 and IC660EBD100.

Terminal Assemblies IC660TSD100E and later are not compatible with earlier versions of the Electronics Assembly. If the Terminal Assembly will be used to replace Terminal Assembly IC660TSD100D or earlier, the Electronics Assembly must be either replaced with version IC660EBD101F or later, or upgraded with kit #44A286380–G02.

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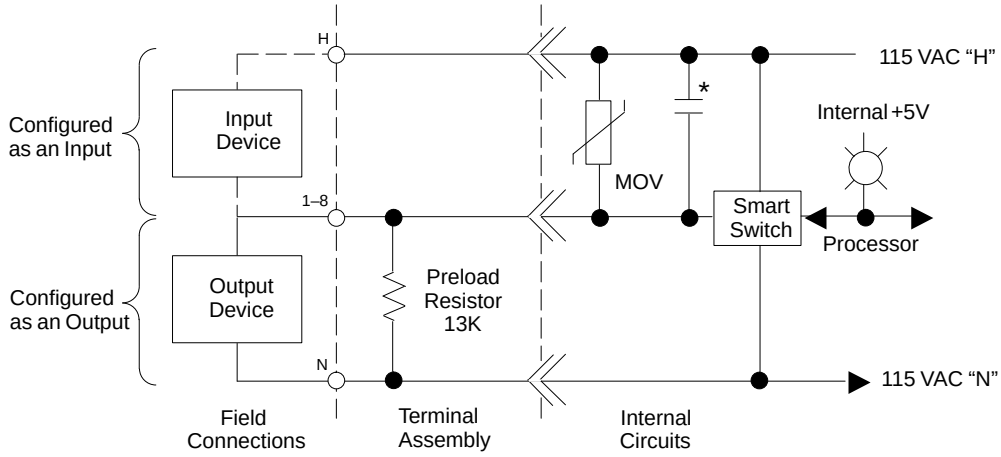
Specifications

Block type:	8 circuit combination input and output
Catalog Numbers:	
Block:	IC660BBD101
Terminal Assembly only:	IC660TSD100
Electronics Assembly only:	IC660EBD101
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)
Weight:	4 lbs. (1.8 kg)
LED's (I/O block):	Unit OK, I/O Enabled
LED's (each circuit):	On logic side of switch
Block to Block Isolation:	1500 V
Heat Dissipation:	16W maximum with 8 inputs 43.5W maximum with 8 outputs on at 2 amps.
Standby power (all inputs and outputs off):	8.5 Watts
Operating voltage (single source):	93–132 VAC
Frequency:	47–63 Hz
Power supply dropout time:	1 cycle (16.7mS at 60Hz, 20mS at 50Hz)
Input Characteristics:	
Non–tristate input, OFF state:	
Minimum voltage across input device (IN to H)	60 VRMS
Maximum leakage through input device	1.5 mA
Non–tristate input, ON state:	
Maximum voltage across input device (IN to H)	20 VRMS
Maximum switch current threshold	6 mA RMS
Tristate input, OFF state:	
Acceptable voltage across input device (IN to H)	16 VRMS–40 VRMS
Tristate input, ON state:	
Maximum voltage across input device (IN to H)	4 VRMS
Input load network:	
Resistor to N	13K ohms
Capacitor to H	.10 µf
Input processing time (typical)	2mS + filter
Selectable input filter times	10 to 100mS in 10mS increments
Input diagnostics	Open Wire, Overtemperature, Failed Switch
Output Characteristics:	
Circuit output current (steady state)	2 amps RMS
Maximum inrush current up to 2 cycles	25 amps peak
Maximum inrush current 2–6 cycles	14 amps peak
Maximum block output current	15 amps at 35C, 7.5 amps at 60C
Output Leakage @ 115 VAC:	
Current at 0 volt output (OUT to N)	< 7mA
Voltage at open output (OUT to N)	65 volts
Output switch (OFF to ON / ON to OFF)	Zero crossing
Maximum switching frequency	Once per second (high inrush currents)
Turn–on delay (maximum)	0.5 Hz + 1mS
Voltage drop (at 2 amps)	2.5 volts
Voltage drop (at 30 amps inrush)	10 volts
Recommended min. load, resistive (No Load disabled):	25mA
Recommended min. load, inductive (No Load disabled):	40mA
No Load enabled threshold	50mA
Fusing	Internal electronic short circuit trip. 100ms long time trip
Output diagnostics	Short Circuit, Overload, No Load, Failed Switch, Overtemperature
Environmental:	
Operating Temperature	0 to +60 C (32 to +140 F)
Storage Temperature	–40 to +100 C (–40 to +212 F)
Humidity	5% to 95% (non–condensing)
Vibration	5–10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G

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Block Operation

An 8 Circuit Grouped I/O Block has eight identical circuits rated to operate at a nominal 115VAC.



* .2µF for Block IC660BBD100
.1µF for Block IC660BBD101

Circuit LEDs

Each circuit has its own LED. If the circuit is configured as an input, the LED indicates the presence of threshold voltage at the input terminal. If the circuit is configured as an output, the LED indicates the state commanded by the CPU.

Inputs and Outputs

The block can be configured as combination input/output block, inputs–only or outputs–only blocks. Regardless, the block always broadcasts one byte of data each bus scan, and accepts one byte of data each bus scan.

If the block is configured as a combination block, circuits can be any mix of inputs and/or outputs. In this configuration, the block will use 8 input references and 8 output references. The actual state of each output circuit will be returned to the CPU in the corresponding input reference location. The CPU can monitor the feedback state to verify (after an appropriate delay) that the output switching device has operated properly and that the load has the proper voltage and current applied.

If the block is configured as an inputs–only block, all circuits must be regular inputs or tristate inputs. The block will use 8 input references and NO output references.

If the block is configured as an outputs–only block, all circuits must be outputs; no feedback analysis will be performed. The block will use 8 output references and NO input references.

Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

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Input Data Format

A 115 VAC 8 Circuit Grouped I/O Block broadcasts 1 byte of input data each bus scan.

Byte #	Description
0	Inputs 1 – 8 (input 1 in bit 0)

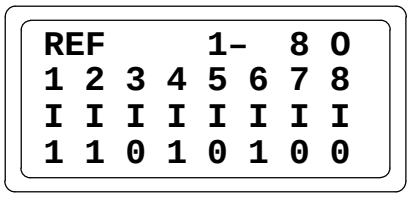
Output Data Format

Byte #	Description
0	Outputs 1 – 8 (output 1 in bit 0

The block receives 1 byte of output data from the bus controller each bus scan.

Hand–held Monitor I/O Display

The Hand–held Monitor displays the I/O types (line 3) and current states (line 4) of all circuits on the Monitor Block screen.



Individual circuits are displayed on the Monitor/Control Reference screen (which also shows a circuit's fault and force status).

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Diagnostics

115 VAC 8 Circuit Grouped I/O Blocks perform the diagnostics described below. A block reports all faults to the Hand–held Monitor, and takes appropriate corrective action. Individual circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Overtemperature Diagnostic

Each circuit has a built–in thermal sensor. If the block's internal temperature exceeds 100C, the block sends an OVERTEMPERATURE message and turns off the circuit to protect its internal electronics. This diagnostic is always performed for both inputs and outputs.

Short Circuit Diagnostic

Automatic output diagnostic. Output circuits are protected by a short circuit level sensor at the switching device. If the instantaneous current on an output exceeds 30 amps during the first two line cycles or 20 amps thereafter, the block turns the output off within microseconds. The block will try to restart the load; if several attempts are unsuccessful, the output circuit is forced off and the block sends a SHORT CIRCUIT message. To restore normal operation to output the cause of the current surge must be removed, then the diagnostic must be cleared from the HHM or the CPU.

Failed Switch Diagnostic

The block automatically monitors all circuits for several types of faults, which may be reported as Failed Switch diagnostics.

For an output, Failed Switch is reported if the circuit's switch state is not the same as its commanded state. The block sends a FAILED SWITCH message identifying the failed circuit. The logic state of the circuit is set to OFF.

When an output fault occurs, the actual condition of the output switch is not known. If the output switch has failed shorted (or closed), current flow is not interrupted when the block forces the output state OFF. Action external to the block must be taken to remedy the problem. The FAILED SWITCH message can alert personnel or cause program logic to be activated, possibly shutting off power to the block, I/O section, or process.

Note

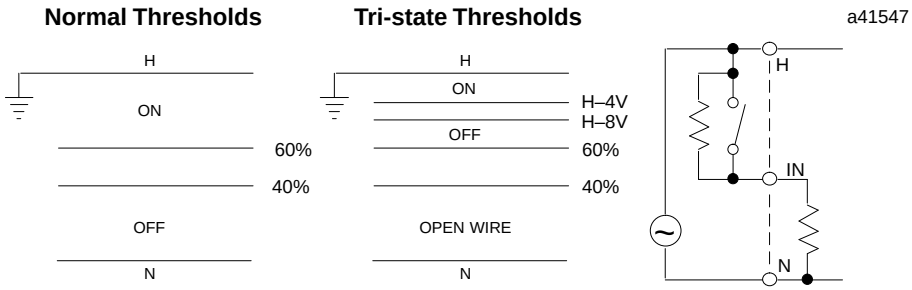
False Failed Switch diagnostics may be reported if an external device like a manual switch is wired in parallel with an output. Even if Fault Reporting for the circuit is disabled, it will be necessary to clear each Failed Switch fault detected by the block. If the application requires such a configuration, 115VAC/125VDC Isolated I/O Block version IC660BBS101 (no Failed Switch diagnostic) should be used instead.

Several additional switch faults independent of the output state are detected and reported as Failed Switch faults on both input and output–configured circuits. Examples include loss of communications with the block's internal microprocessor and some internal power supply faults.

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Open Wire Diagnostic

The block automatically performs this diagnostic on any circuit configured as a tristate input. It will detect an electrical (not mechanical) malfunction. In addition to being configured as a tristate input, the circuit must have a 5.1K ohm, 1/2 Watt or larger non–inductive resistor placed as close as possible to the actual dry contacts (such as across the field device terminals).



With the switch closed (ON state), the circuit senses the low source impedance. With the switch open (OFF state), the circuit senses the added resistance. If a wire is broken, cut or removed, impedance becomes very high. The block will transmit 0 as the state of the input, and send an OPEN WIRE message.

Since faulty input circuit option monitoring requires specific current flows, devices as photo–sensors, electronic high–speed counters, instrumentation, fiber optic sensors, and similar electronic devices cannot be monitored for Open Wire conditions. Such devices should be set up as standard, not tristate, inputs.

GE offers compatible input devices including a 5.1K ohm monitoring resistor with its line of General Purpose Control sensor devices.

No Load Diagnostic

The optional No Load diagnostic can be enabled or disabled for individual outputs.

For a new block, outputs are configured to report No–Load conditions. In this configuration, energizing the output activates a no–load current level. If the load does not continuously draw 50 mA from the output circuit, the block sends a NO LOAD message. Because this diagnostic monitors both current and voltage, a No Load condition may cause an HHM monitoring an operating block to display 0 for the circuit although there is voltage at the output and the circuit LED is on.

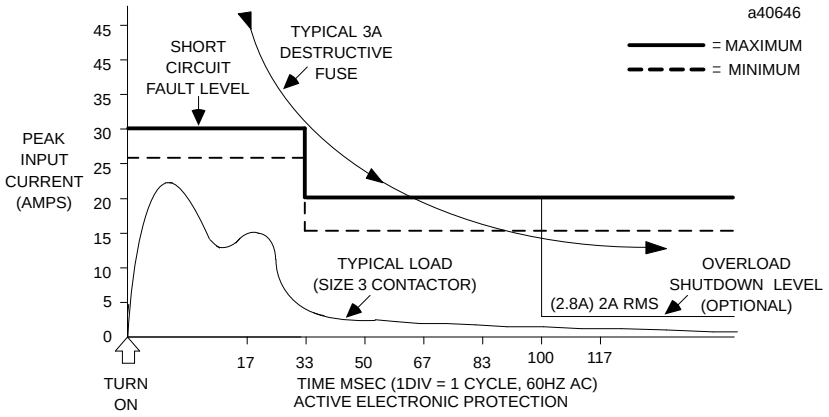
This diagnostic should be disabled for circuits on which very small loads (small relays, transformers, or indicating lamps) will draw less than 50 mA.

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Overload Diagnostic

Like No–Load detection, this diagnostic is optional for individual outputs.

In addition to the protection provided by the block's built–in Short Circuit detection, Overload Shutdown provides further protection for output loads, field wiring, and switching devices. If a load exceeds 2.8 amps (2.0 amps RMS) continuously for 100mS, the block will turn the output off and send an OVERLOAD message if Overload Shutdown is enabled.



For loads that require more than 2 amps RMS, individual outputs can be configured not to shut off at this level or send the OVERLOAD message. These restrictions apply:

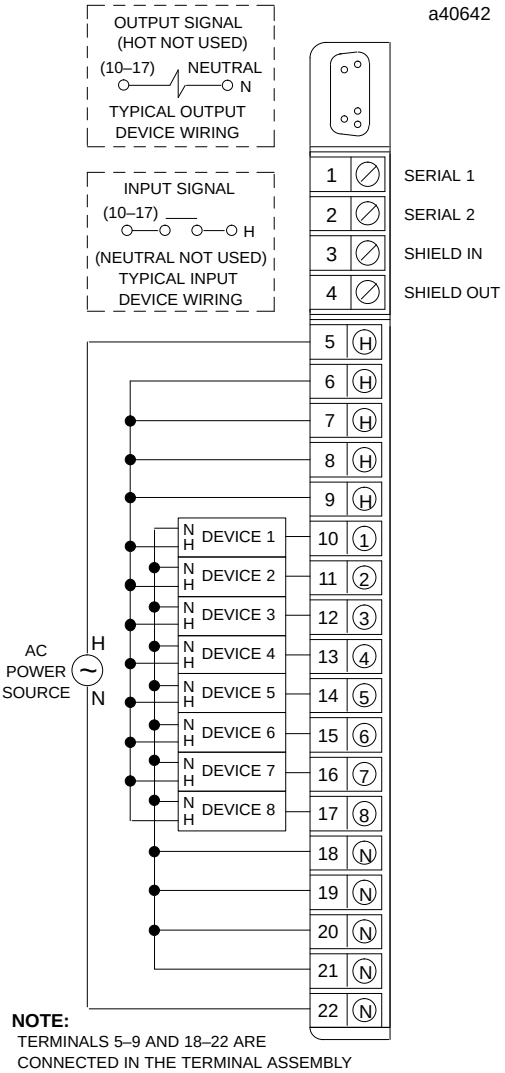
1. Maximum load current: 10 amps RMS
2. Maximum duty cycle: limit duty cycle so that: (Load current) x (% ON) is less than 1.0 amp.
3. Maximum ON time: 1 minute
4. Maximum total current of all outputs ON at the same time is less than 15 amps.

For example, a maximum 10 amp load can be pulsed at a 10% duty cycle, or up to 1 minute ON and 9 minutes OFF. Higher repetition rates can be used if the duty cycle is maintained. Exceeding the 10 amp limit may cause a short circuit fault to be generated. The duty cycle derating to an average of 1 amp output current and the ON time limit are necessary to avoid overheating due to the increased power dissipation in the block at these high currents. Exceeding these limits may cause an overtemperature fault.

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Field Wiring

Field wiring connections are standard screw, clamp–type terminals which can be operated with a flat or phillips–head screwdriver. Each terminal accepts one AWG #12 or two AWG #14 wires. The minimum recommended wire size is AWG #22. The terminals can accommodate spade or ring terminals up to 0.27 inch (6.85 mm) in width with a minimum opening for a #6 screw, and up to 0.20 inch (5.1 mm) depth from the screw center to the back barrier. Be sure unshielded wire ends are not longer than 2 inches (5 cm).



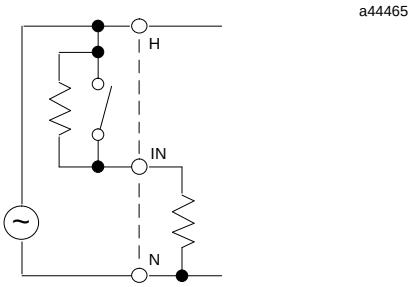
Connect a 115 volt AC source to one of the H terminals on the terminal strip.

Connect neutral to an N terminal. All H terminals are internally bussed, as are all N terminals. Extra power terminals are for convenience. Depending on the physical layout and current loads, hot connections can be bussed together and made by one wire to the block or power source. Neutral connections can also be bussed together and made by one wire.

Any circuit can be an input or output. The power source is connected through an input device (such as a switch) to a discrete input circuit on the block. For outputs, power is routed through the block electronics to a discrete circuit and applied to a load. The load return connects to the N terminal.

Wiring for Tristate Inputs

If an input circuit should report open wire conditions, install a 5.1K ohm, 1/2 Watt or larger non–inductive resistor across the dry contacts of the input device. The same circuit must be configured as a Tristate Input.



Added Resistance for Small Loads

Block IC660BBD101 drives small loads without added resistance. For block IC660BBD100, it may be necessary to add resistance for loads drawing less than 50mA. See page 2-10 for more information.

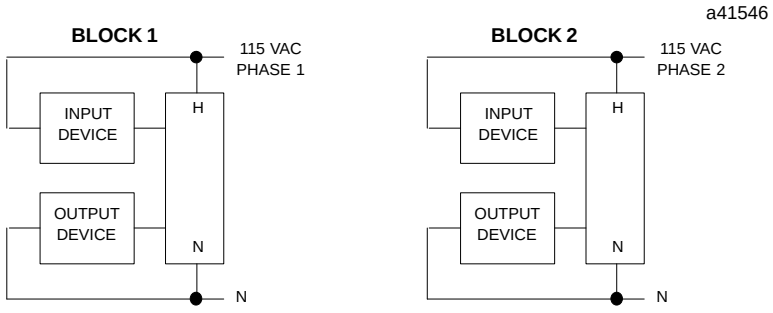
Wiring for a Bus Switching Module

If the block will be a BSM Controller, attach the BSM like a load to circuit 1. Connect either BSM pigtail wire to terminal 10, and the other to an N terminal.

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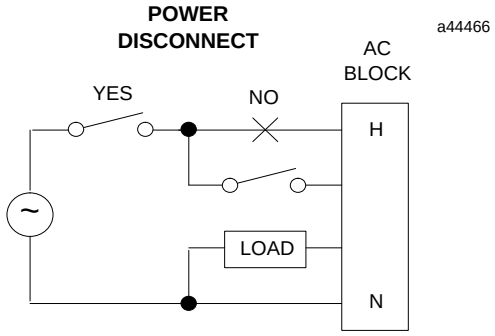
Block Power

Make all power connections on the block to the same 120 VAC phase. Different blocks can have different phases between them.



Block Power Disconnects

Since block power is the same as circuit power, it is important to wire block power disconnects so that block power and input power will be removed *at the same time.*



Caution

If input power is not removed when block power is removed, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.

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Block Configuration

Configurable features are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Block I / O Type*	Block	input	input, output, combination
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Pulse Test for Outputs	Block	enabled	enabled, disabled
Input Filter Time	Block	20mSec	10–100mSec in 10mS steps
Circuit I / O Type	Circuit	input	input, output, tristate input
Report Faults	Circuit	yes	yes, no
Hold Last State	Circuit	no	yes, no
Output Default State	Circuit	off	on, off
Report No Load	Circuit	yes	yes, no
Overload Shutdown	Circuit	yes	yes, no
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 or 10 sec
CPU Redundancy	Block	none	none, hot standby, duplex
Duplex Default	Block	off	on, off
Configuration Protection	Block	disabled	enabled, disabled

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

Note

If the block will be used on a bus *controlled* by a Series Five PLC or a host computer and the block will be configured as an all-inputs block, the GENI daughterboard on the Series Five bus controller or computer bus interface module must be version 1.5 or later. If not, the block cannot be used as a BSM Controller, and its I / O Enabled LED will not operate properly.

The daughterboard can be upgraded using kit 44A286366–G03 (or later).

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115 VAC 8 Circuit Grouped I/O Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____

Block Number (0–31) _____ Block Type (Input/Output/Combination) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Pulse Test (Enabled/Disabled) _____ Input Filter Time (10–100) mS _____

Redundancy Features:

Redundancy Mode (None/Standby/Duplex)_____ Duplex Default (on/off) _____

BSM Present (Y/N) ____ BSM Controller (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

Ckt #	Reference Number	I/O Type (I/O/I_T*)	Report Faults (yes/no)	(output) Hold Last State (yes/no)	(output) Default State (ON/OFF)	(output) Report No Load (yes/no)	(output) Overload Shutdown (yes/no)
1							
2							
3							
4							
5							
6							
7							
8							

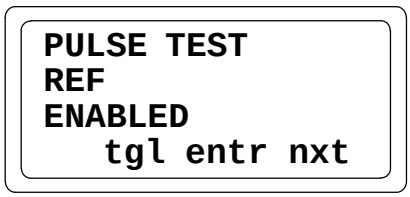
* I_T (Tristate Input) must have 5.1K Ω resistor across dry contacts of input device

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Pulse Test

A new block is configured to enable Pulse Testing (see below). Pulse Testing should remain enabled if the block has loads that hold one state for long periods of time, *unless any load(s) are sensitive to pulses or interruptions of up to 8mS*. It should be disabled if the block's loads will normally change state as the program executes. These outputs will report faults during normal operation, and do not need to be pulsed.

Hand-held Monitor Configuration Steps



1. Line 3 of the Pulse Test screen shows whether the feature is currently enabled for the block. If you want to change the selection, press F2 (tgl).
2. Press F3 (enter).
3. Press F4 (next) to advance to the next configuration display.

Pulse Testing Outputs

Outputs can be pulse–tested from a Hand–held Monitor or by sending a Pulse Test command from the application program.

Pulse Testing tests the continuity of each output circuit including the switch device, power source, wiring, interposing devices (fuses, circuit breakers, terminals), and output device. It works whether or not there is minimum current to check for a No–Load condition. Pulse testing does not activate mechanical devices such as motor starters, relays, or solenoid valves.

Pulse Testing should momentarily cause outputs that are OFF to turn ON and outputs that are ON to go OFF. Pulse testing may generate the following diagnostics:

Failed Switch: If the output does not change state when pulsed.

Short Circuit: If the load on an output that was OFF exceeds 30 amps when pulsed ON.

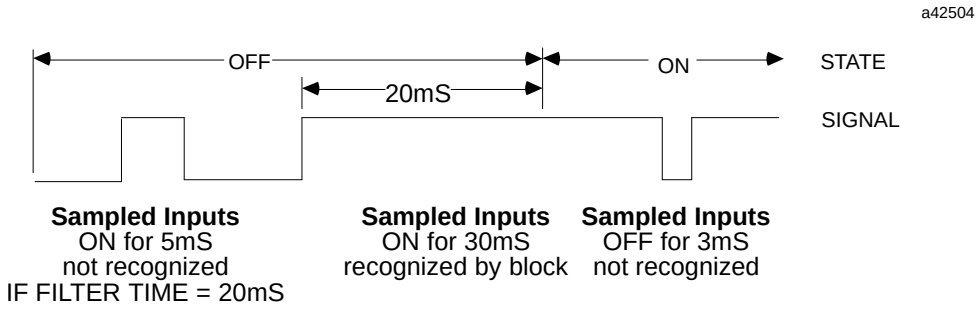
No Load: If the load on an output that was OFF draws less than 50 mA when pulsed ON.

If the output was OFF, no current flow when the output is pulsed indicates an open circuit or failed switch. Similarly, continued current flow when ON outputs are pulsed OFF indicates a shorted switch (both malfunctions are reported to the CPU).

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Input Filter Time

The block continuously samples each input for the length of the configured input filter time period. If the input remains either ON or OFF during that time, the block recognizes its state. For example:



The input filter helps reject spurious noise spikes and multiple inputs generated by the bounce of mechanical devices. An input filter time of 10mS to 100mS can be selected for the block. The default filter time is 10mS (no filter).

In controlled, noise–free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, no additional filter time is needed.

In noisy environments, use a longer filter time to prevent noise from possibly causing erratic or unsafe system operations.

For a block with tristate inputs, the minimum recommended Input Filter Time is 50mS.

Hand-held Monitor Configuration Steps

```
INPUT FILTR TIME
REF
FILTER=   10mS
   tgl entr nxt
```

1. The screen displays the currently–selected filter time. If this time should be changed, press F2 (tgl) to display the other filter times.
2. To save a new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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I/O Circuit Type

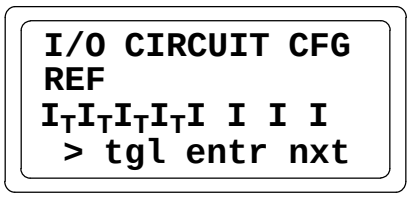
Selecting Block I/O type (on the Program Block ID screen) determined whether the block would be an all–inputs, all–outputs, or combination block. The I/O type of each circuit is specified on the screen shown below. If you haven't selected the Block I/O Type, and the block should be an outputs-only or combination I/O block, see page 3-10 for instructions before continuing.

If the Block I/O Type selected was Combination, each circuit can now be configured as an input (I), output (O), or tristate input (I_T). Select **Tristate Input** for any input circuit that should report the Open Wire diagnostic (resistance must be added at the input device).

If the Block I/O Type is all–inputs, each circuit can be either an regular input (I) or a tristate input (I_T). Select **Tristate Input** for any input circuit that should report the Open Wire diagnostic.

If the Block I/O Type is all–outputs, each circuit must be an output (O).

Hand-held Monitor Configuration Steps



1. Line 3 shows the I/O type of each circuit. To select a circuit, press F1 (>).
2. To change a circuit's I/O type, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Report Faults to CPU

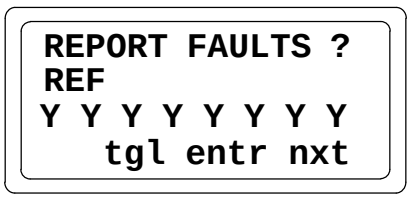
Fault reports to the host can be disabled or enabled for any circuit.

If fault reporting is disabled, the block does not send fault reports to the CPU for that circuit. If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit.

Regardless of whether fault *reporting* is enabled, the block detects faults on the circuit and takes appropriate action. If a fault occurs, the Unit OK LED blinks and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



1. The screen displays the current Fault Reports configuration of all circuits on the block.
2. To select a circuit for configuration, press F1 (>).
3. To change the Report Faults configuration of a circuit, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

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Hold Last State

Each output can be configured to either hold its last state or to go to its powerup default state if the block loses CPU communications for at least 3 bus scans.

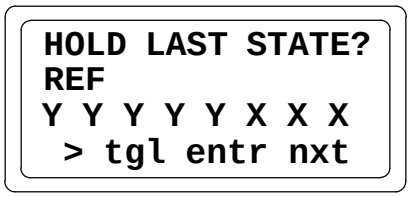
For a new block, Hold Last State is disabled for each output. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output in its current state instead of setting it to the powerup default.

Outputs remain in their last state or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Hold Last State configuration of each circuit:

   Y = hold last state.

   N = go to default state (configured on the next HHM screen)

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>). To change the selection for a circuit, press F2 (tgl).

3. To save the new selection, press F3 (entr). Press F4 (next) when you are ready to advance to the next configuration display.

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Output Default State

An output goes to its powerup default state when the block is first powered up.

If the Hold Last State feature is NOT enabled, the block also defaults the output if CPU communications are lost. On a non–redundant system, default occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed. Additional default time for redundancy is explained on page 4-19.

Hand-held Monitor Configuration Steps

```
OUTPUT DEFAULT
REF
0 0 1 1 1 X X X
 > tgl entr nxt
```

1. Line 3 shows the Output Default State configuration of all circuits:

   0 = the output default state is off.

   1 = the output default state is on.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) to advance to the next configuration display.

Report No Load

On a new block, each output is configured to report No–Load diagnostics. This diagnostic activates a no–load current level when the output is energized. If the load does not continuously draw 50mA from the output circuit, the block sends a NO LOAD message.

You should disable this diagnostic for any output where a very small load (small relay, transformer, or indicating lamp) will draw less than 50 mA.

Hand-held Monitor Configuration Steps

```
REPORT NO LOAD?
REF
Y Y Y N N X X X
 > tgl entr nxt
```

1. Line 3 shows the Report No Load configuration of all circuits:

   Y = the output will report No Load conditions.

   N = the output will not report No Load conditions.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr). Press F4 (next) when you are ready to advance to the next configuration display.

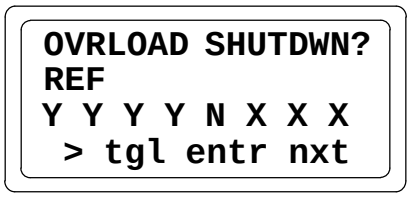
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Overload Shutdown

The Overload Shutdown feature protects output loads, field wiring, and switching devices from excessive current. If a load exceeds 2.8 amps (2.0 amps RMS) continuously for 100mS and Overload Shutdown is enabled, the block turns the output off and sends an OVERLOAD message.

Under certain conditions (see page 4-7) Overload Shutdown detection and reporting can be disabled for output loads that require more than 2 amps RMS.

Hand-held Monitor Configuration Steps



1. Line 3 shows the Overload Shutdown configuration of all circuits:

   Y = output will shut down and report diagnostic if overload occurs.

   N = output will NOT shut down or report Overload diagnostic.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

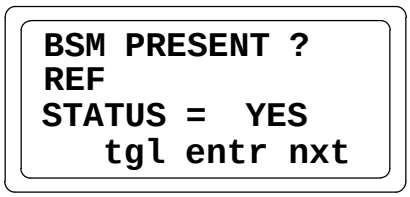
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO (the default).

Select YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



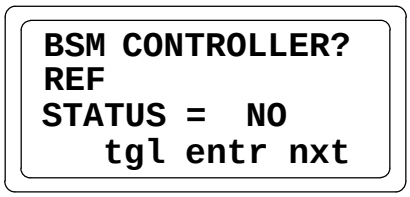
1. To change the BSM Present configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. Selecting a block to be a BSM Controller block has no effect on the block's I/O type – the block can still be configured as an inputs–only block, but circuit #1 cannot be physically used as an input. The first circuit will not be under CPU control.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If the Hold Last State feature is set to YES, outputs will remain in their last state while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State is set to NO for any output on a block, and total bus scan time will exceed 100mS, you should change this selection to 10 seconds.

Hand-held Monitor Configuration Steps

```
OUTPUT DEF.TIME
REF
TIME = 2.5 SECS
   tgl entr nxt
```

1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

These blocks can be configured for No CPU Redundancy, Hot Standby or Duplex redundancy. For new blocks, it is set to No Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus controller with Device Number 31. If those outputs are not available, the block uses outputs from the bus controller with Device Number 30. If no outputs from a CPU are available, outputs either Hold Last State or default (as configured).

In Duplex redundancy mode, a block compares outputs received from two CPUs and sets any outputs for which there is disagreement to their Duplex Default state.

Hand-held Monitor Configuration Steps

```
CPU REDUNDANCY
REF
NO CTRL REDUND
   tgl entr nxt
```

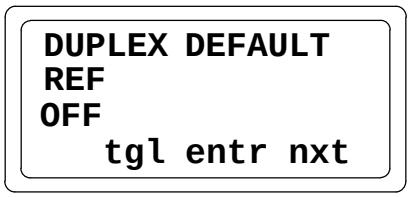
1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

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Duplex Default State

In Duplex Redundancy mode, if the block receives different output states for given points from the two CPUs, the block breaks the tie by outputting the Duplex Default State to those points. For new blocks, OFF is selected for all outputs. Change it if outputs should be ON.

Hand-held Monitor Configuration Steps



1. To change the Duplex Default state, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

Note

If the block loses communications with BOTH CPUs, individual outputs go to their configured Hold Last State or Output Default State.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

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Chapter 5

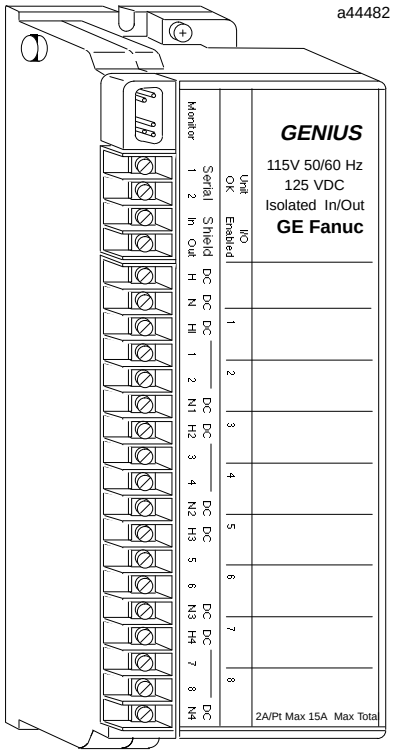
115 VAC/125 VDC Isolated I/O Blocks

115 VAC / 125 VDC Isolated Genius I / O blocks have four isolated groups of two I / O circuits, each rated to operate at a nominal 115 volts AC or 125 volts DC.

- **115VAC/125VDC 8 Circuit Isolated I/O Blocks** (IC660BBS102 and BBS100). These blocks report a Failed Switch diagnostic if any output's commanded state is not the same as the actual state of the block's own internal switch.
- **115 VAC/125VDC Isolated I/O Blocks without Failed Switch Diagnostic** (IC660BBS103 and BBS101). For applications where field wiring such as manual switches will be wired in parallel with block outputs. These blocks ignore differences between an output's commanded state and the actual state of the block's internal switch.

Isolation is rated to withstand 250 VAC / VDCcontinuous between any group and ground or between any two groups. Transient rating is 2000V peak for 10 sec.

Control power for the block is tapped off the input / output device voltages wired to the terminals. The block has terminals for a separate power source for the internal electronics. The block power supply can be independently either AC or DC. The block need not be powered in the same manner as the circuits.



Features

Configurablefeatures of these blocks include:

- AC / DCcircuitvoltage
- Output Pulse Testcapability
- Selectable Input Filter Time from 10mS to 100mS
- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy type
- Bus Switching Module control

Electronic fusing is built into each circuit used as an output. The circuit is shut down 5µS after a short occurs. It can be easily restarted from a Hand–held Monitor or from the CPU. The blocks perform these additional diagnostic checks:

- Overtemperature Open Wire for tristate inputs.
- Detection of loss of I / O power on pairs of circuits
- Overload Detection and Shutdown
- No–Load Detection

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Specifications

Block Type:	8 ckt isolated input / output in 4 isolated pairs	
115VAC / 125VDC Isolated I / O Block:	IC660BBS102, replaces IC660BBS100	
Terminal Assembly Only:	IC660TSS100	
Electronics Assembly Only:	IC660EBS100	
115VAC / 125VDC Isolated I / O Block, No Failed Switch:	IC660BBS103, replaces IC660BBS101	
Terminal Assembly Only:	IC660TSS100	
Electronics Assembly Only:	IC660EBS101	
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" x (10.00cm)	
Weight:	4 lbs. (1.8 kg)	
LED's (I/O Block):	Unit OK, I / O Enabled	
LED's (each circuit):	On logic side of switch	
Block to Block Isolation:	1500 V	
Heat Dissipation:	16.8W max. with 8 inputs on, 45.6W max. with 8 outputs at 2 amps	
Operating Temperature	–0 to +60C (32 to +140F)	
Storage Temperature	–40 C (–40 to +212F)	
Humidity	5% to 95% (non–condensing)	
Vibration	5–10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G	
Required control power (block only):	8 Watts maximum	
Operating voltage (four sources):	**93–132 VAC**	**105–132 VDC**
Frequency/ripple:	47–63 Hz	10% max. ripple
Power supply dropout time:	1 cycle	10mS
Input Characteristics:	**For AC**	**For DC**
Non–tristate input, OFF state:		
Minimum voltage across input device (IN to H)	60 VRMS	70 VDC
Maximum leakage through input device	1 mA	2 mA
Non–tristate input, ON state:		
Maximum voltage across input device (IN to H)	20 VRMS	35 VDC
Maximum switch current threshold	6 mA RMS	5 mA
Tristate input:		
OFF, acceptable voltage across input device (IN to H)	16 VRMS–40 VRMS	16 VDC–35 VDC
ON, maximum voltage across input device (IN to H)	4 VRMS	3.5 VDC
Input load network:		
Resistor to N	13K ohms	13K ohms
Capacitor to H: for blocks BBS100 and BBS101	.22 µf	.22 µf
Capacitor to H: for blocks BBS102 and BBS103	.1 µf	.1 µf
Input processing time (typical)	2mS + filter	0.8mS + filter
Selectable input filter times	10 to 100mS in 10mS increments	
Input diagnostics	Open Wire, Overtemperature, Loss of I / O Power, Failed Switch	
Output Characteristics:	**For AC**	**For DC**
Output current (steady state)	2 amps	2 amps resistive 9 (1 amp inductive*)
Maximum inrush current	25 amps (2 cycles)	25 amps (10mS peak)
Output Leakage:		
Current at 0 volt output: for blocks BBS102 and 103	7 mA	2 mA
Current at 0 volt output: for blocks BBS100 and 101	13mA	2 mA
Voltage at open output: for blocks BBS102 and 103	65 volts	40 volts
Voltage at open output: for blocks BBS100 and 101	95 volts	40 volts
Output switch (OFF to ON / ON to OFF)	Zero crossing	—
Rated switching frequency at maximum inrush	Once per second	Once per second
Turn–on delay (maximum)	0.5 Hz + 1mS	1mS
Voltage drop (at 2 amps)	2.5 volts	2.5 volts
Voltage drop (at 20 amps inrush)	10 volts	10 volts
Minimum load (No Load disabled)		
Resistive: for blocks BBS102 and BBS103	25 mA	10 mA
Resistive: for blocks BBS100 and BBS101	30 mA	10 mA
Inductive: for blocks BBS102 and BBS103	40 mA	10 mA
Inductive: for blocks BBS100 and BBS101	100 mA	10 mA
No Load enabled threshold	50 mA	50 mA
Maximum block output current	15 amps at 35 C, 7.5 amps at 60C	
Fusing	Internal electronic short circuit trip. 100ms(AC), 10ms (DC) long time trip	
Output diagnostics	Short Circuit, Overload, No Load, Overtemp., Loss of I / O Power. Also, for blocks BBS100 and BBS 102 only: Failed Switch	

* DC inductive load rating is 2 amps with external flyback diode or other coil suppression.

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Compatibility

Hand-held Monitor: These blocks are fully compatible with a Hand–held Monitor identified by catalog number IC660HHM501. They may also be used with HHM500. HHM501 is required to change baud rate configuration, or to configure the block for redundancy.

Bus Controller: The blocks may be used with any GE Fanuc Genius bus controller, PCIM or QBIM.

I/O Blocks: These blocks are backward–compatible with previous block versions (IC660CBS100, IC660BBS100, and IC660BBS101). They may be used as replacements for earlier versions. However, their Terminal Assemblies are not backward–compatible, as explained below.

Electronics Assembly: Electronics Assembly IC660EBS100H may be used to replace any Electronics Assembly IC660ELS100 or IC660EBS100. Electronics Assembly IC660EBS101C may be used to replace any version IC660ELS100, EBS100, or EBS101. These Electronics Assemblies draw lower leakage current (7mA) than earlier versions (which drew 13mA).

Terminal Assembly: The Terminal Assembly for these blocks (IC660TSS100E) is *not compatible with some earlier versions of their Electronics Assemblies* (IC660EBS100A to G, or IC660EBS101A or B). If Terminal Assembly IC660TSS100E will be used to replace an earlier version of the Terminal Assembly, it will also be necessary to upgrade the Electronics Assembly. This can be done by replacing the entire Electronics Assembly with version IC660EBS100H or IC660EBS101C, or later. It can also be done by upgrading the Electronics Assembly firmware using one of these update kits:

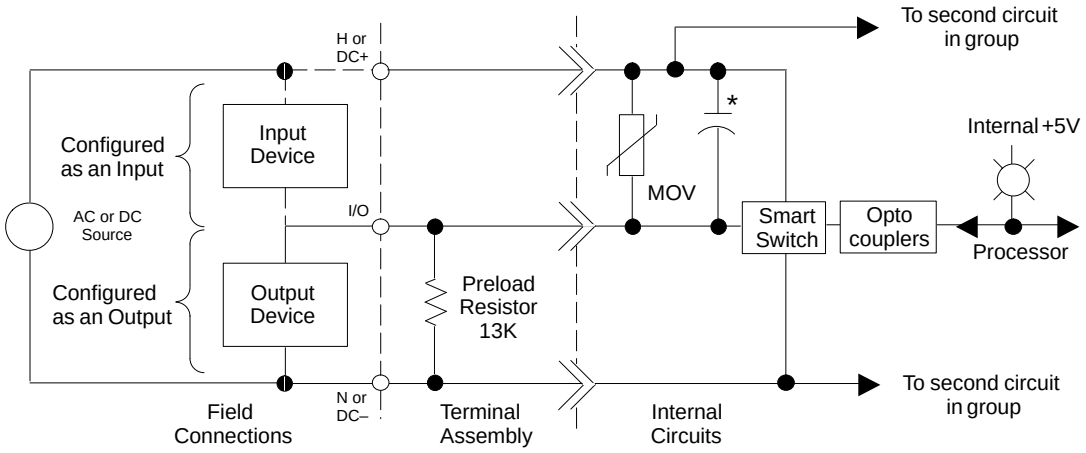
44A286357–G06 (with Failed Switch Diagnostics)

44A286390–G03 (without Failed Switch Diagnostics)

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Block Operation

An Isolated block has four isolated groups of two I/O circuits, each rated to operate at a nominal 115VAC or 125VDC.



* . µF 2 f o r B l o c k I C 6 6 0
.1µF for Block IC660BBS102 and 103

Circuit LEDs

Each circuit has its own LED. If the circuit is configured as an input, the LED indicates the presence of threshold voltage at the input terminal. If the circuit is configured as an output, the LED indicates the state commanded by the CPU.

Inputs and Outputs

An Isolated Block can be configured as an inputs–only, outputs–only, or combination block. For a new block, the default is inputs–only. Regardless, the block always broadcasts one byte of data each bus scan, and accepts one byte of data each bus scan.

If the block is configured as a combination block, circuits can be any mix of inputs and/or outputs. The block will use 8 input references and 8 output references. The actual state of each output will be returned to the CPU in the corresponding input reference location. The CPU can monitor the feedback state to verify (after an appropriate delay) that the output switching device has operated properly and that the load has the proper voltage and current applied.

If the block is configured as an inputs–only block, all circuits must be regular inputs or tristate inputs. The block will use 8 input references and NO output references.

If the block is configured as an outputs–only block, all circuits must be be outputs; no feedback analysis will be performed. The block will use 8 output references and NO input references.

Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

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Input Data Format

The block broadcasts 1 byte of input data each bus scan.

Byte #	Description
0	Inputs 1 – 8 (input 1 in bit 0)

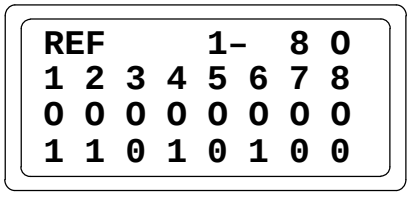
Output Data Format

The block receives 1 byte of output data from the bus controller each bus scan.

Byte #	Description
0	Outputs 1 – 8 (output 1 in bit 0)

Hand–held Monitor I/O Display

The Hand–held Monitor displays the I/O types (line 3) and current states (line 4) of all circuits on the Monitor Block screen.



Individual circuits are displayed on the Monitor/Control Reference screen (which also shows a circuit's fault and force status).

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Diagnostics

115 VAC / 125 VDC Isolated I / O blocks perform the following diagnostic checks. The block reports all faults to the Hand–held Monitor, and takes appropriate corrective action.

Individual circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using Read Diagnostic datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Loss of I/O Power Diagnostic

An Isolated I / O block operates as long as power is supplied to terminals 5 and 6. The Loss of I / O Power diagnostic, which is unique to these blocks, indicates that one pair of circuits is disconnected from field power.

If either circuit of the pair is an input, the block sets it to 0. If either circuit is an output, the block turns it off. The block automatically sends a Loss of I / O Power diagnostic message to the Hand–held Monitor. However, the message is not sent to the CPU unless the block is Pulse Tested. The Unit OK LED does *not* blink. When I / O power is restored, the circuits begin operating as soon as power reaches the minimum level.

If I / O power to the block itself is lost, the block cannot send diagnostic messages to the CPU. The bus controller responds as it would to any other loss of block condition.

Overtemperature Diagnostic

Each circuit has a built–in thermal sensor. If the block's internal temperature exceeds 100C, the block sends an OVERTEMPERATURE message and turns off the circuit to protect its internal electronics. This diagnostic is always performed for both inputs and outputs.

Short Circuit Diagnostic

Automatic output diagnostic. Output circuits are always protected by a short circuit level sensor at the switching device. An output will turn off within several microseconds after the instantaneous current exceeds 25 amps at turn–on, or 15 amps after 2 cycles AC or 10mS for DC. The block will try to restart the load; if several attempts are unsuccessful, the output circuit is forced off and the block sends a SHORT CIRCUIT message. To restore normal operation, the cause of the current surge must be removed, then the diagnostic must be cleared from the HHM or the CPU.

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Failed Switch Diagnostic

BOTH Isolated block versions will report Failed Switch diagnostics for internal faults independent of the output state, on both input and output–configured circuits. Examples include loss of communications with the block's internal microprocessor and some internal power supply faults.

Block version IC660BBS100 will also report this diagnostic if an output's switch state is not the same as its commanded state. The block sends a Failed Switch message identifying the failed circuit. The logic state of the circuit is set to OFF.

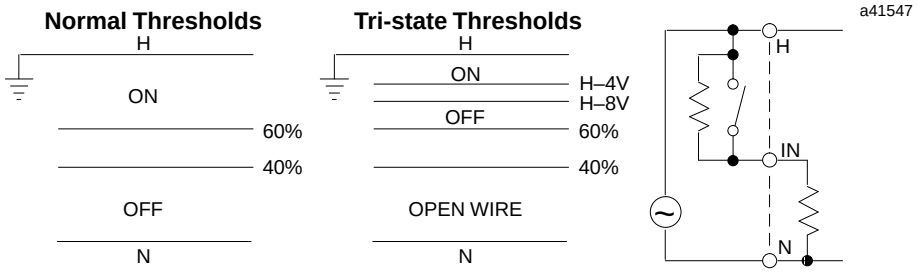
When an output fault occurs, the actual condition of the output switch is not known. If the output switch has failed shorted (or closed). current flow is not interrupted when the block forces the output state OFF. Action external to the block must be taken to remedy the problem. The FAILED SWITCH message can alert personnel or cause program logic to be activated, possibly shutting off power to the block, I/O section, or process.

Note

False Failed Switch diagnostics may be reported if an external device like a manual switch is wired in parallel with an output. Even if fault reporting for the circuit is disabled, it will be necessary to clear each Failed Switch fault detected by the block. If the application requires such a configuration, block version IC660BBS101 (no Failed Switch diagnostic) should be used.

Open Wire Diagnostic

The block automatically performs this diagnostic on any circuit configured as a tristate input. It will detect an electrical (not mechanical) malfunction. In addition to being configured as a tristate input, the circuit must have a 5.1K ohm, 1/2 Watt or larger non–inductive resistor installed across the actual dry contacts of the input device (such as across the field device terminals).



With the switch closed (ON state), the circuit senses the low source impedance. With the switch open (OFF state), the circuit senses the added resistance. If a wire is broken, cut or removed, impedance becomes very high. The block will transmit 0 as the state of the input, and send an OPEN WIRE message.

Devices such as photo–sensors, electronic high–speed counters, instrumentation, fiber optic sensors, and similar electronic devices cannot be monitored for Open Wire conditions. Such devices should be set up as standard, not tristate, inputs.

GE offers compatible input devices including a 5.1K ohm monitoring resistor with its line of General Purpose Control sensor devices.

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No Load Diagnostic

This optional diagnostic can be enabled or disabled for individual outputs.

For a new block, outputs are configured to report No–Load conditions. In this configuration, energizing the output activates a no–load current level. If the load does not continuously draw 50mA from the output circuit, the block sends a NO LOAD message. Because this diagnostic monitors both current and voltage, a No Load condition may cause an HHM monitoring an operating block to display 0 for the circuit although there is voltage at the output and the circuit LED is on.

This diagnostic should be disabled for circuits on which very small loads (small relays, transformers, or indicating lamps) will draw less than 50mA.

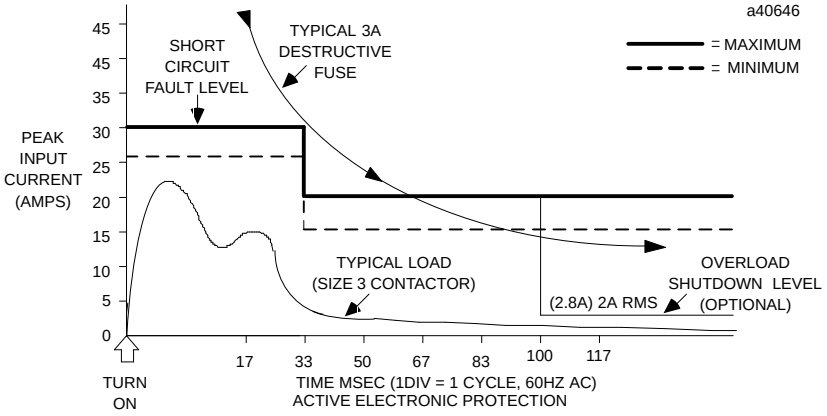
Overload Shutdown

Like No–load reporting, this diagnostic is also optional for individual outputs on the block.

In addition to the protection provided by the block's built–in Short Circuit detection, Overload Shutdown provides further protection for output loads, field wiring, and switching devices.

AC Output Overload

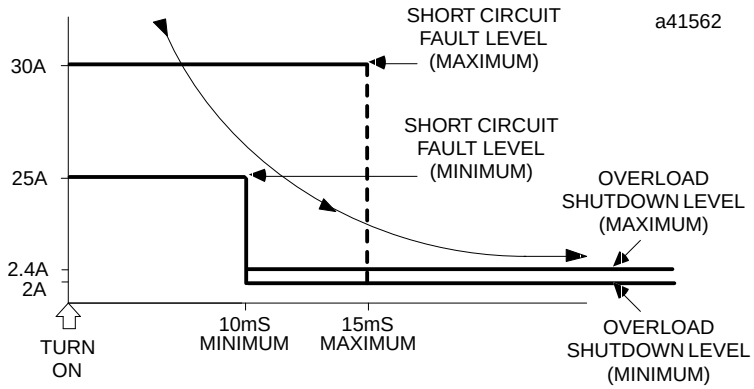
For an AC output, overload occurs if a load exceeds 2.8 amps (2.0 amps RMS) continuously for 100mS. The block will turn the output off and send an OVERLOAD message if Overload Shutdown is enabled.



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DC Output Overload

For a DC output, overload occurs if the output exceeds 2 amps continuously for 10mS after the initial 10mS turn–on period. DC circuit protection is shown below.



Individual outputs can be configured not to shut off at this level or send the OVERLOAD message. These restrictions apply:

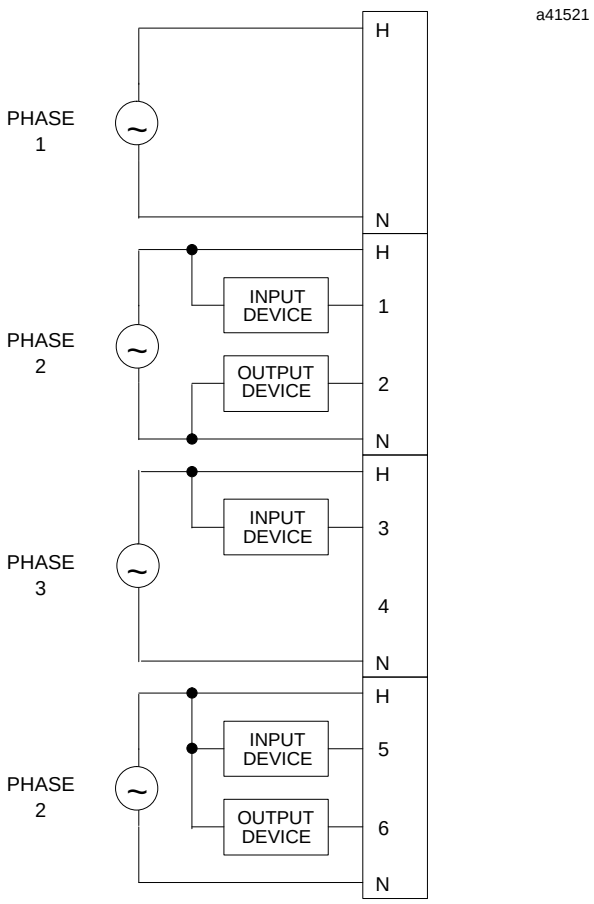
1. Maximum load current: 10 amps
2. RMS Maximum duty cycle: limit duty cycle so that: (load current) x (% ON) is less than 1.0 amp.
3. Maximum ON time: 1 minute
4. Maximum total current of all outputs ON at the same time is less than 15 amps.

For example, a maximum 10 amp load can be pulsed at a 10% duty cycle, or up to 1 minute ON and 9 minutes OFF. Higher repetition rates can be used if the duty cycle is maintained. Exceeding the 10 amp limit may cause a short circuit fault to be generated. The duty cycle derating to an average of 1 amp output current and the ON time limit are necessary to avoid overheating due to the increased power dissipation in the block at these high currents. Exceeding these limits may cause an overtemperature fault.

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Field Wiring

All field wiring connections to these blocks are standard screw, clamp–type terminals which can be operated with a flat or phillips–head screwdriver. Each terminal accepts one AWG #12 or two AWG #14 wires. The minimum recommended wire size is AWG #22. The terminals can accommodate spade or ring terminals up to 0.27 inch (6.85 mm) in width with a minimum opening for a #6 screw, and up to 0.20 inch (5.1 mm) depth from the screw center to the back barrier.



Power Connections

Up to five separate power sources can be connected to the Terminal Assembly. Circuit power and block power do not have to be the same type. Block power may be DC while circuit power is AC, or the reverse. Isolation is rated to withstand 250 volts AC or DC continuous between any group and ground, or between any two groups.

For block power, connect a 115 volt AC or 125 VDC source to the top H terminal (5). Connect neutral to the N terminal (6). All H terminals are internally bussed, as are all N terminals.

Circuit Power

Each circuit pair can have its own power supply. All circuits on an Isolated block must use either AC or DC power.

If circuit power is AC, both circuits of a pair must be wired to the same AC phase. However, different pairs of circuits can be wired to different AC phases.

Caution

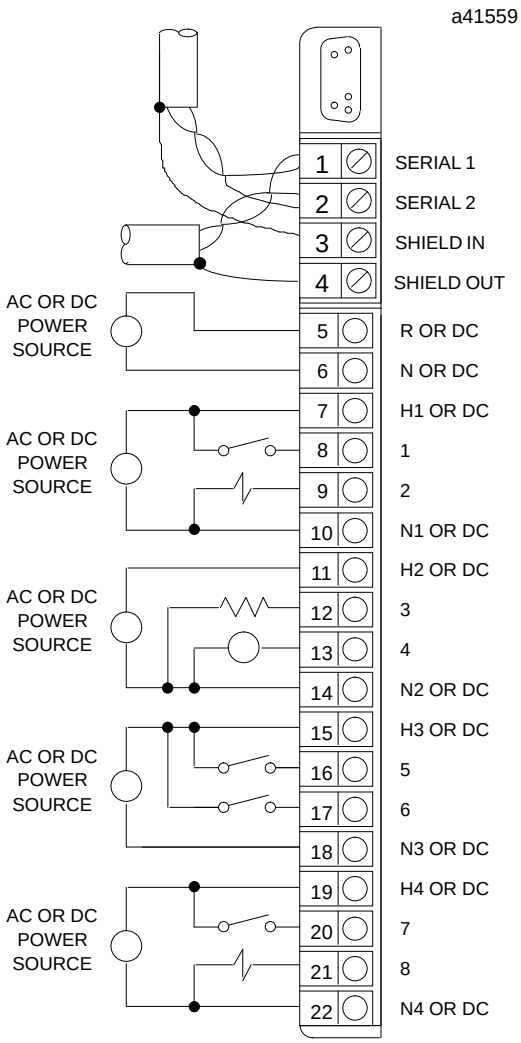
If separate AC power is used for any group of circuits on a block, all power connections within the group must be wired to that same 120 VAC source.

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Wiring for I/O Devices

For each input device, connect one terminal to the Hot side of AC power or positive side of 125 VDC. Connect the other to the I/O block at terminal 8, 9, 12, 13, 16, 17, 20, or 21.

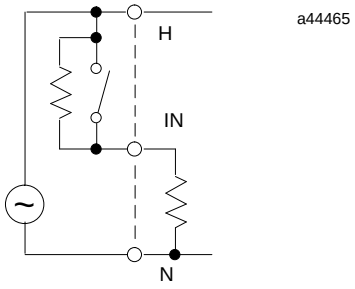
For each output, connect one terminal to block terminal 8, 9, 12, 13, 16, 17, 20, or 21. Connect the other to the neutral side of AC power or the negative side of 125 VDC. The block must have both sides of power connected to it.



Only one wire need be run to the field device. Depending on physical layout and current loads, hot connections can be bussed together and made by one wire to the block or power source. Neutral connections can also be bussed together and made by one wire.

Wiring for Tristate Inputs

If any input circuit is configured as a tristate input, install a 5.1K ohm, 1/2 Watt or larger non–inductive resistor across the dry contacts of the input device. This added resistance is required to use the Open Wire diagnostic.



Interfacing Small Loads to an Isolated Block

If any output will drive an inductive load drawing less than 50 mA, it may be necessary to add resistance at the load. See page 2-10 for instructions.

Wiring for a Bus Switching Module

If the block will be a BSM Controller, attach the BSM like a load to circuit 1. Connect either BSM pigtail wire to terminal 8, and the other to neutral or DC– (such as terminal 10).

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Block Configuration

The configurable features of a 115VAC / 125VDC 8 Circuit Isolated Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Block I / O Type*	Block	input	input, output, combination
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
AC / DC Circuit Voltage	Block	AC, DC	AC
Pulse Test for Outputs	Block	enabled	enabled, disabled
Input Filter Time	Block	20mSec	10–100mSec in 10mS steps
Circuit I / O Type	Circuit	input	input, output, tristate input
Report Faults	Circuit	yes	yes, no
Hold Last State	Circuit	no	yes, no
Output Default State	Circuit	off	on, off
Report No Load	Circuit	yes	yes, no
Overload Shutdown	Circuit	yes	yes, no
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 sec or 10 sec
Redundancy Mode	Block	none	none, hot standby, duplex
Duplex Default State	Block	off	on, off
Configuration Protection	Block	disabled	enabled, disabled

Features with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Instructions for configuring these features using a Hand–held Monitor are given on the following pages.

Before configuration begins, the blocks features should be decided on and recorded on copies of the Configuration Worksheet printed on the next page.

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115 VAC/125 VDC Isolated I/O Block Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ AC/DC Circuit Voltage _____

Block Number (0–31) _____ Block Type (Input/Output/Combination) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Pulse Test (Enabled/Disabled) _____ Input Filter Time (10–100) mS _____

Redundancy Features:

Redundancy Mode (None/Standby/Duplex)_____ Duplex Default (on/off) _____

BSM Present (Y/N) BSM Controller (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

Ckt #	Reference Number	I/O Type (I/O/I_T*)	Report Faults (yes/no)	(output) Hold Last State (yes/no)	(output) Default State (ON/OFF)	(output) Report No Load (yes/no)	(output) Overload Shutdown (yes/no)
1							
2							
3							
4							
5							
6							
7							
8							

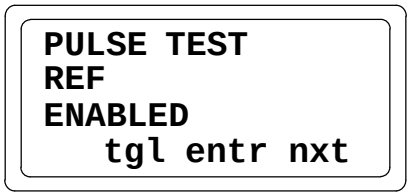
* I_T (Tristate Input) must have 5.1K Ω resistor across dry contacts of input device

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Pulse Test

A new block is configured to enable Pulse Testing. Pulse Testing should remain enabled if the block has loads that hold one state for long periods of time, *unless any load(s) are sensitive to pulses or interruptions of up to 8mS or 1mS (DC).* It should be disabled if the block's loads will normally change state as the program executes. These outputs will report faults during normal operation, and do not need to be pulsed.

Hand-held Monitor Configuration Steps



1. Line 3 of the Pulse Test screen shows whether the capability is currently enabled. If you want to make a change, press F2 (tgl). Press F3 (enter).
2. Press F4 (next) to advance to the next configuration display.

Pulse Testing Outputs

Outputs can be pulse–tested from a Hand–held Monitor or by sending a Pulse Test command from the application program.

Pulse Testing tests the continuity of each output circuit including the switch device, power source, wiring, interposing devices (fuses, circuit breakers, terminals), and output device. For Isolated I/O blocks, Pulse Testing also allows the CPU to easily check for Loss Of I/O Power conditions.

It works whether or not there is minimum current to check for a No–Load condition. Pulse testing does not activate mechanical devices such as motor starters, relays, or solenoid valves.

Pulse Testing should momentarily cause outputs that are OFF to turn ON and outputs that are ON to go OFF. Pulse testing may cause the following diagnostics:

Failed Switch: If the output does not change state when pulsed.

Short Circuit: If the load on an output that was OFF exceeds 30 amps when pulsed ON.

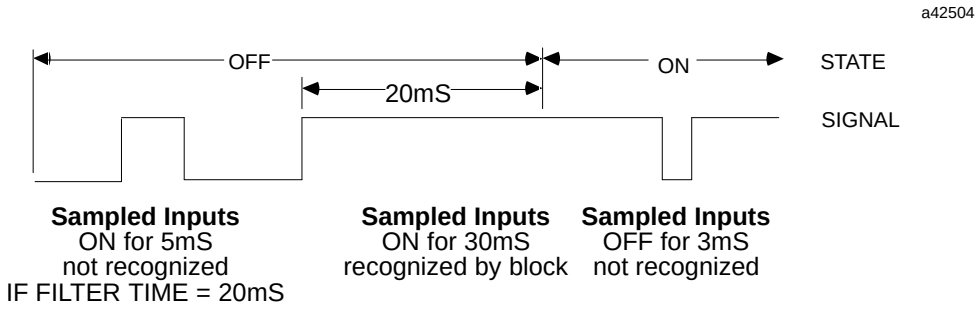
No Load: If the load on an output that was OFF draws less than 50mA when pulsed ON.

Loss of I/O Power: Indicates that a pair of circuits is disconnected from field power. This diagnostic is only reported to the CPU following a Pulse Test, although it is available to the Hand–held Monitor at all times.

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Input Filter Time

The block continuously samples an input for the length of the configured filter time period. If the input remains either on or off for the length of the Filter Time, the block recognizes its state. For example:



The input filter helps reject spurious noise spikes and multiple inputs generated by the bounce of mechanical devices. An input filter time of 10mS to 100mS can be selected for the block. The default filter time is 10mS (no filter).

In controlled, noise–free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, no additional filter time is needed.

In noisy environments, use a longer filter time to prevent noise from possibly causing erratic or unsafe system operations.

For a block with tristate inputs, the minimum recommended Input Filter Time is 50mS.

Hand-held Monitor Configuration Steps

```
INPUT FILTR TIME
REF
FILTER=   10mS
   tgl entr nxt
```

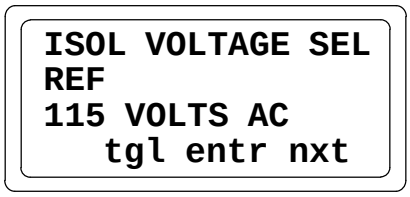
1. The screen displays the currently–selected filter time. If this time should be changed, press F2 (tgl) to display other times.
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Isolated Voltage Selection

Select whether the block's I/O circuits will use 115 VAC or 125 VDC. All I/O circuits on the block must use the same type of power (it does not have to be the same as block power).

Hand-held Monitor Configuration Steps



1. Line 3 shows the currently–selected voltage.
2. To change the current selection, press F2 (tgl). Press F3 (enter).
3. Press F4 (next) to advance to the next configuration display.

I/O Circuit Type

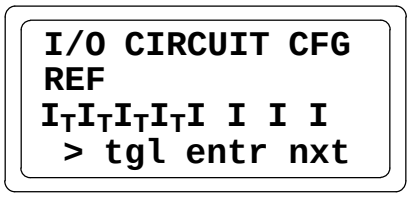
An earlier configuration step selected the Block I/O type (on the Program Block ID screen). That step determined whether the block would be assigned all input references, all output references, or both. On the screen shown below, the I/O type of each circuit can be specified.

If the Block I/O Type is Combination, each circuit can be configured as an input (I), an output (O), or a tristate input (I_T). Select Tristate Input for any input circuit that should report the Open Wire diagnostic.

If the Block I/O Type is Input, each circuit can be either a regular input (I) or a tristate input (I_T). Select Tristate Input for any input circuit that should report the Open Wire diagnostic.

If the Block I/O Type is Output, each circuit must be an output (O).

Hand-held Monitor Configuration Steps



1. Line 3 shows the I/O type of each circuit. To select a circuit, press F1 (>).
2. To change a circuit's I/O type, press F2 (tgl). To save the selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit.

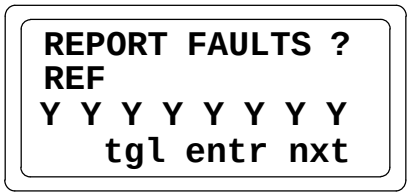
If fault reporting is enabled for a circuit, the block sends a message to the host if any fault occurs on that circuit.

If Fault reporting is disabled, the block does not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block detects faults on the circuit and takes appropriate action. The Unit OK LED blinks when a fault occurs, and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using a Read Diagnostics datagram, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



1. The screen displays the current Fault Reports configuration of all circuits on the block.
2. To select a circuit for configuration, press F1 (>).
3. To change the Report Faults configuration of a circuit, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

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Hold Last State

Each output can be configured to either hold its last state or go to its powerup default state if the block loses CPU communications for at least 3 bus scans.

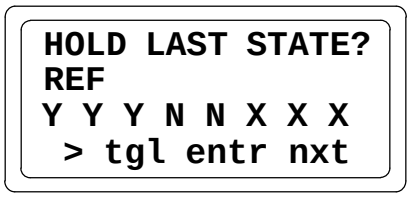
For a new block, Hold Last State is disabled for each output. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output in its current state instead of setting it to the powerup default.

Outputs remain in their last state or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Hold Last State configuration of each circuit:

   Y = hold last state.

   N = go to default state (configured on the next HHM screen)

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>). To change the selection for a circuit, press F2 (tgl).
3. To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

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Output Default State

An output goes to its powerup default state when the block is first powered up.

If Hold Last State is NOT enabled for an output, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed. (Additional default time for redundancy is explained on page 5-22).

Hand-held Monitor Configuration Steps

```
OUTPUT DEFAULT
REF
0 0 1 1 1 X X X
 > tgl entr nxt
```

1. Line 3 shows the Output Default State configuration of all circuits:

   0 = the output default state is off.

   1 = the output default state is on.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>). To change the selection for a circuit, press F2 (tgl).

3. To save the new selection, press F3 (entr). Press F4 (next) to advance to the next configuration display.

Report No Load

By default, each output is configured to report No–Load diagnostics. Energizing the output activates a no–load current level. If the load does not continuously draw 50mA from the output circuit, the block sends a NO LOAD message.

Disable this diagnostic for any output where a very small loads (small relay, transformer, or indicating lamp) will draw less than 50 mA.

Hand-held Monitor Configuration Steps

```
REPORT NO LOAD?
REF
Y Y Y N N X X X
 > tgl entr nxt
```

1. Line 3 shows the Report No Load configuration of all circuits:

   Y = the output will report No Load conditions.

   N = the output will not report No Load conditions.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>). To change the selection for a circuit, press F2 (tgl).

3. To save the new selection, press F3 (entr).

4. Press F4 (next) when you are ready to advance to the next configuration display.

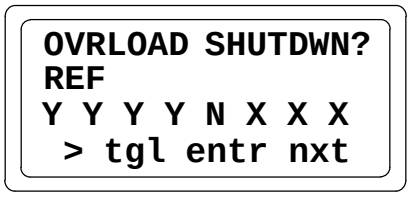
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Overload Shutdown

Overload Shutdown protects output loads, field wiring, and switching devices. If a load exceeds 2.8amps (2.0 amps RMS) continuously for 100mS and Overload Shutdown is enabled, the block will turn the output off and send an OVERLOAD message.

Under certain conditions (see page 5-8), Overload Shutdown detection and reporting can be disabled for output loads that require more than 2 amps RMS.

Hand-held Monitor Configuration Steps



1. Line 3 shows the Overload Shutdown configuration of all circuits:

   Y = output will shut down and report diagnostic if overload occurs.

   N = output will NOT shut down or report Overload diagnostic.

   X = the circuit has been configured as an input.

1. To select a circuit, press F1 (>). To change the selection for a circuit, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) when you are ready to advance to the next configuration display.

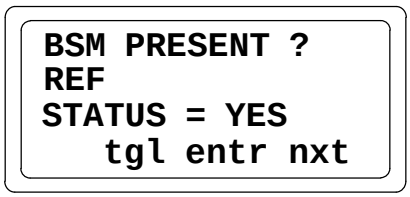
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO.

Select YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



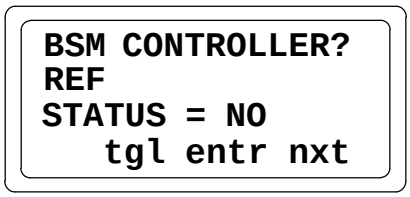
1. To change the BSM Present configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. Selecting a block to be a BSM Controller block has no effect on the block's I/O type – the block can still be configured as an inputs–only block, but circuit #1 cannot be physically used as an input. The first circuit will not be under CPU control.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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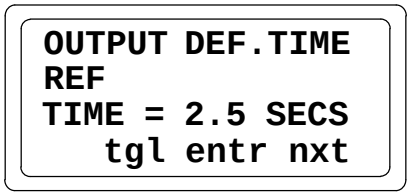
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, outputs will remain in their last state while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any output on a block, and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller Redundancy, Hot Standby or Duplex redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus controller with Device Number 31. If those outputs are not available, the block uses outputs from the bus controller with Device Number 30. If no outputs from a CPU are available, outputs either Hold Last State or default (as configured).

In Duplex redundancy mode, a block compares outputs received from two CPUs and sets any outputs for which there is disagreement to their Duplex Default state.

Hand-held Monitor Configuration Steps



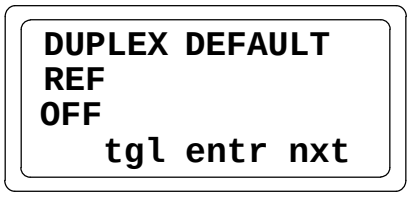
1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

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Duplex Default State

In Duplex Redundancy mode, if the block receives different output states for given points, the block breaks the tie by outputting the Duplex Default State to those points. For new blocks, OFF is selected for all outputs. Change it if outputs should be ON.

Hand-held Monitor Configuration Steps



1. To change the Duplex Default state, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

Note

If the block loses communications with BOTH CPUs, individual outputs go to their configured Hold Last State or Output Default State.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

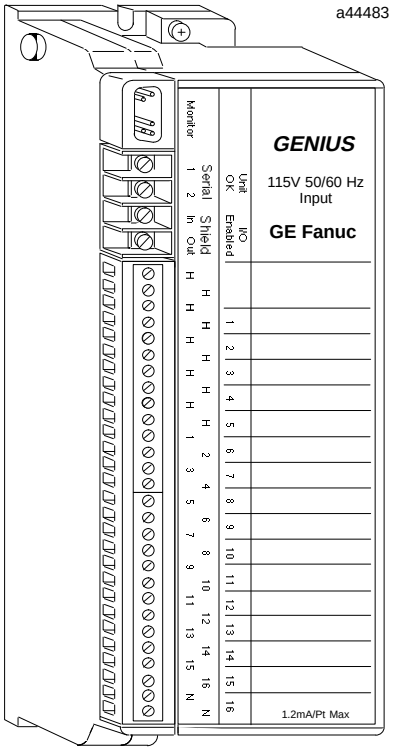
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Chapter 6

115 VAC 16 Circuit Input Block

The **115 VAC 16 Circuit Input Block** (IC660BBD110) has sixteen discrete input circuits in two banks of eight circuits each. Typical inputs are contact closures from switches, pushbuttons, or limit switches. The block can be used with both 2–wire and 3–wire proximity switch inputs.

Control power for the block comes from the power line that supplies the inputs. No separate block power supply is needed.



Features

The block provides:

- Separate On / Off thresholds for each group of 8 inputs. On / Off thresholds are configurable from 25% to 85% of the incoming line voltage, allowing the use of a wide variety of input sensors.
- Optional Open Wire detection is selectable for individual inputs. The Open / Off threshold is configurable from 25% to 85% of the incoming line voltage.
- Separate Open / Off thresholds can be selected for each group of 8 inputs. Optional Short Circuit detection at 10% and 90% of the incoming line voltage can be selected for individual inputs.

Fault reporting can be enabled or disabled circuit–by circuit. Block LEDs verify proper block operation and CPU communications.

Compatibility

A 115VAC 16 Circuit Input block is designed for use with Hand–held Monitor version IC660HHM501 only. It is not compatible with version IC660HHM500.

The block can be used with any GE Fanuc Genius bus controller. It may also be used with any PCIM or QBIM module.

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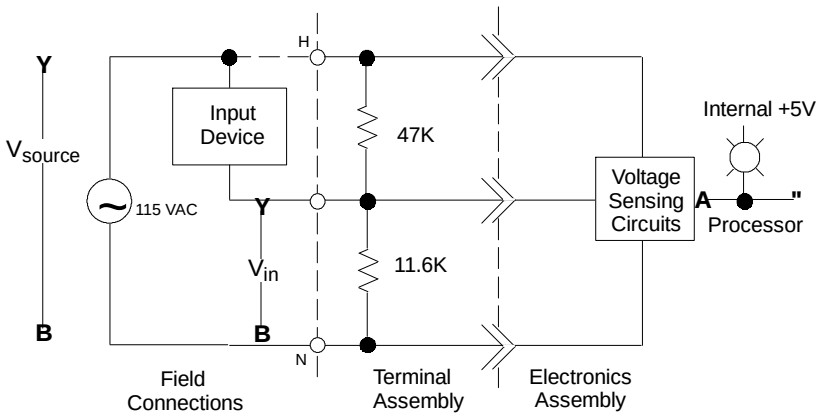
Specifications

Block Type:	16 circuits, inputs only
Catalog Numbers:	
115 VAC 16 Circuit Input Block	IC660BBD110
Terminal Assembly Only	IC660TBD110
Electronics Assembly Only	IC660EBD110
Size (height x width x depth): **Weight:** **LEDs (I/O block):** **LEDs (each circuit):**	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm) 4 lbs. (1.8 Kg) Unit OK, I / O Enabled Reflect state of input (logic side)
Input to ground (or serial bus) isolation	1500V
Terminal board rating (input or feedthrough current)	5.0 Amps
Heat Dissipation:	28 Watts maximum with 16 inputs on at full current.
Operating voltage:	93–132 VAC
Frequency:	47–63 Hz
Required power (block only):	80 mA maximum block current, plus 200 mA maximum input circuit current
Power Supply Dropout Time:	1 cycle (16.7 mS at 60 Hz / 20 mS at 50 Hz)
Input Characteristics:	
Input off state, input on state	Programmable threshold (25% to 85%)
Input impedance (typical)	11.6 Kohms
Input open wire	Programmable threshold (25% to 85%)
Input shorted wire	Fixed 10%–90% thresholds
Input processing time (typ)	1 mS (plus selectable filter time)
Selectable input filter times	10 to 100 mS in 10 mS increments
Input diagnostics	Open Wire, Short Circuit
Environmental:	
Operating temperature	0C to +60C (32F to +140F)
Storage temperature	–40C to +100C (–40F to +212F)
Humidity	5% to 95% (non–condensing)
Vibration	5–10 Hz 0.2" (5.08 mm) displacement, 10–200 Hz at 1G

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Block Operation

The input circuitry is resistive. The resistive load is sufficient to activate most 2-wire proximity switch devices. Input resistance is 11.6K ohms, which provides a preload current of 9.9 mA at 115 volts.



Circuit LEDs

Each circuit has its own LED that indicates the presence of On/Off threshold voltage.

Input Data Format

A 115 VAC 16 Circuit Input Block broadcasts 2 bytes of input data each bus scan. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Byte #	Description
0	Inputs 1 - 8 (input 1 in bit 0)
1	Inputs 9 - 16 (input 9 in bit 0)

The block uses 16 input references and no output references. The value 1 in a bit indicates that the input is at or above its configured threshold voltage. Each bank of 8 inputs can have a different On/Off threshold. The factory configured default On/Off thresholds are 50% of the incoming line voltage. The default is suitable for most applications, or it can be changed within the range of 25% to 85% of the incoming voltage.

Hand-held Monitor Input Display

The HHM displays the current states of all inputs on line 4 of the Monitor Block screen

```
REF      1- 16 I
1234567890123456
IIIIIIIIIIIIIIII
1101000101011101
```

Individual circuits are displayed on the Monitor/Control Reference screen (which also shows a circuit's fault status).

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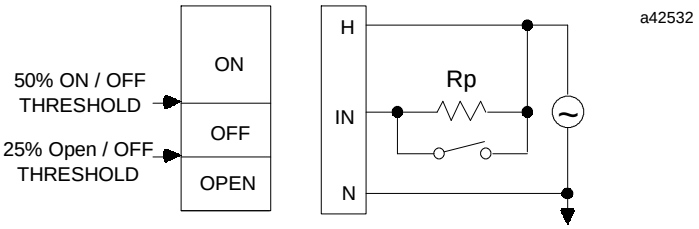
Optional Diagnostics

115VAC 16 Circuit Input blocks can be configured to perform Open Wire and Shorted Wire detection on any circuit. These diagnostics are optional; for a new block, both are disabled.

Open Wire Detection

If Open Wire Detection is enabled, the block monitors three voltage levels to sense On/Off/Open Wire conditions. To use this diagnostic, the Open Wire detection feature must be enabled for the circuit during configuration and resistance must be added across the terminals of the input device during installation.

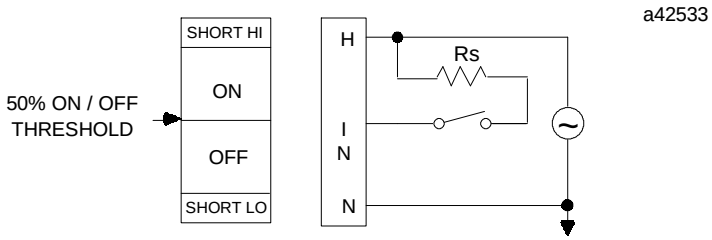
With the switch closed, the circuit senses a low source impedance. With the switch open, it sees the resistor (R_P in the illustration below). If a wire is broken, cut, or removed the circuit sees a high impedance. The block then transmits 0 as the state of the input, and sends an OPEN WIRE message.



The resistor used for R_P must be compatible with the block's thresholds. For dry contact sensors, the default thresholds are not changed, and a 22K ohm resistor can be used for R_P .

Shorted Wire Detection

This option establishes four voltage levels for On/Off/Short Hi/Short Low. A series resistor (R_S, below) near the input device allows the block to detect a shorted wire from a dry contact sensor to the input terminal high or neutral. Result: Block sets input state to 1 for short high or 0 for short low and issues a Short Circuit diagnostic.

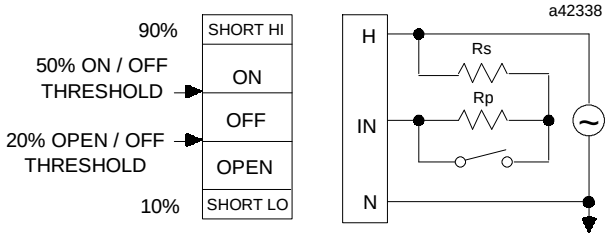


With the switch closed, the circuit senses the resistor. With the switch open, the circuit sees a high impedance. If the input is shorted to the high or low side of the line, the circuit sees a low impedance. Short low and high limits are 10% and 90% respectively. R_S must be compatible with the thresholds. For the default thresholds and a dry contact input, use a 3.9K ohm resistor for R_S.

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Using Open Wire and Shorted Wire Diagnostics Together

Open Wire and Shorted Wire diagnostics can be selected for the same circuit. The circuit must include both a series resistor (R_S) and a parallel resistor (R_P) to detect Open/Short conditions from a dry contact sensor. For the default thresholds, use a 3.9K ohm resistor for R_S and a 22K ohm resistor for R_P.



If sensors with non-zero voltage On state drop or non-zero Off state leakage current are used, the On/Off and Open/Off thresholds can be changed. This flexibility provides diagnostics capability with a wide range of sensors. Some solid state sensors may not require additional external resistance to be used. Consult the sensor manufacturer's specifications.

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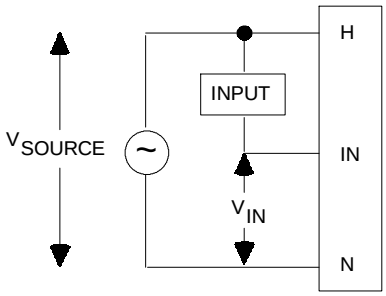
Selecting Thresholds and Resistor Values

For most applications, the default threshold levels and recommended resistor values are not changed. However, the ability to select thresholds extends the use of Open Detect and/or Short Detect diagnostics to circuits with many types of input devices and sensors. To obtain the diagnostic information, resistors must be located in the circuit as previously described. The bias levels these resistors provide to the block must be compatible with the thresholds selected for each bank of eight inputs.

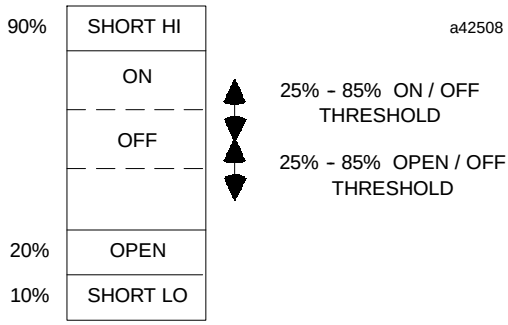
Selecting Thresholds

If a solid state sensor is being used and Open Wire or Shorted Wire detection is required, follow the procedure below.

1. Wire the sensor to the input block and apply power.
2. Measure V_{SOURCE}.
3. Measure V_{IN} with the sensor in the Off state.
4. Measure V_{IN} with the sensor in the On state.

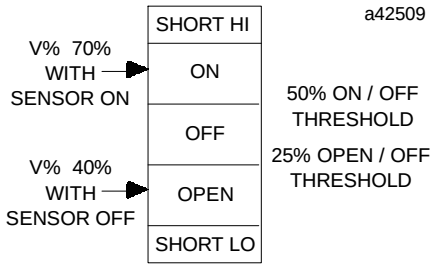


5. Configure the On/Off and Open/Off thresholds so that V_{IN} in the On state and V_{IN} in the Off state are within the proper limits.



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For example, if V_{IN} with the sensor on is 70% and V_{IN} with the sensor OFF is 40%, then the On/Off threshold can be set for 50% and the Open/Off threshold can be set for 25%.



If the resulting V% is too close to a threshold, then reconfigure the threshold to a appropriate operating margin for the circuit.

If the thresholds cannot be selected so that V% with the sensor on and off falls within proper ranges, then external resistors must be added to the circuit. If external resistors are already wired into the circuit, then their values must be changed.

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Selecting Resistor Values

Accurate values for R_S and R_P cannot typically be directly calculated because more information is required about the sensor than may be readily available. An estimate and test method can be used to select proper resistance values for R_S and R_P. After R_S and R_P values are estimated, appropriate ON/OFF and Open/Off thresholds should be configured. If the thresholds cannot be selected so that V% with the sensor on and off fall within proper ranges, then the external resistor values must be changed.

Bias voltage levels can be calculated when the external resistance between H and IN is known:

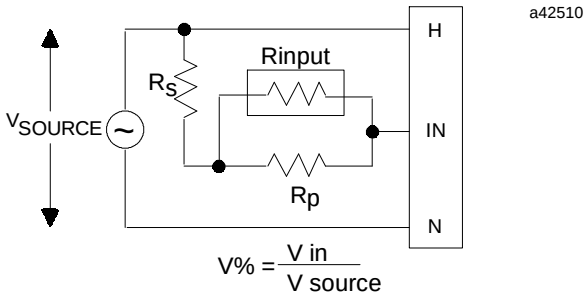
$$V\% = \frac{(11.6 \times R_T) + 545.2}{(58.6 \times R_T) + 545.2}$$

In this equation, V% is the bias level (V_{IN}/V_{SOURCE}). V% with the sensor on and V% with the sensor off must be calculated.

R is the total resistance in the external circuit in K ohms. If the resistors are already in the circuit, actual V% can be found using a voltmeter.

$$R_T = R_S + \frac{(R_P \times R_{INPUT})}{R_P + R_{INPUT}}$$

R_{input} is the equivalent resistance of the sensor. This value of R_{input} will be different in the on state and off state of the sensor. R_{input} will not typically be readily available from the sensor manufacturer.



Calculating Resistor Values when V% is Known

If V% in the On state and V% in the Off state are known, resistor values can be found with the following equation.

$$R_T = \frac{545.2 - (V\% \times 545.2)}{(V\%) \times 58.6 - 11.6}$$

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Field Wiring

Terminals 5 – 32 are for field devices. They take a single wire up to AWG #14. Minimum recommended size is AWG #20.

Power Source Wiring

Connect the hot side of a 115 VAC source to an H terminal and the neutral to an N terminal.

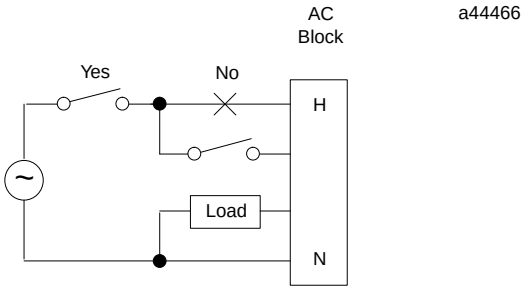
The power supply should not be fused higher than 5 amps.

Caution

Do not daisy–chain the power bus to other blocks through the extra H and N terminals. These terminals are for wiring convenience only; using them as power distribution points may result in damage to the block.

Block Power Disconnects

Since block power is the same as circuit power, it is important to wire block power disconnects so that block power and input power will be removed at the same time.

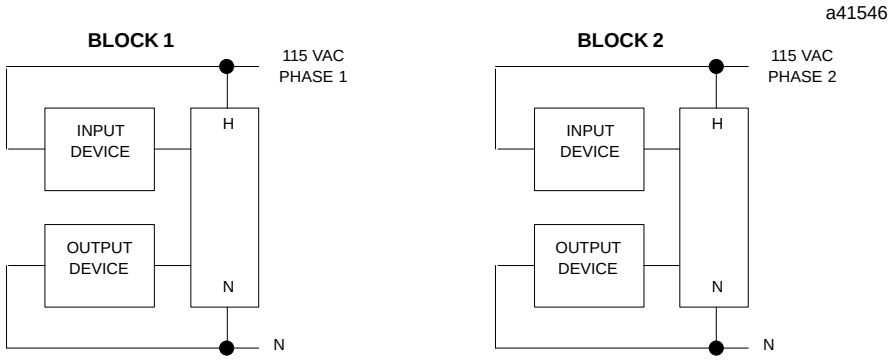


Caution

If the power disconnect does not remove circuit power and block power at the same time, the block may power up when multiple inputs are activated, even though one leg of power has been removed.

Caution

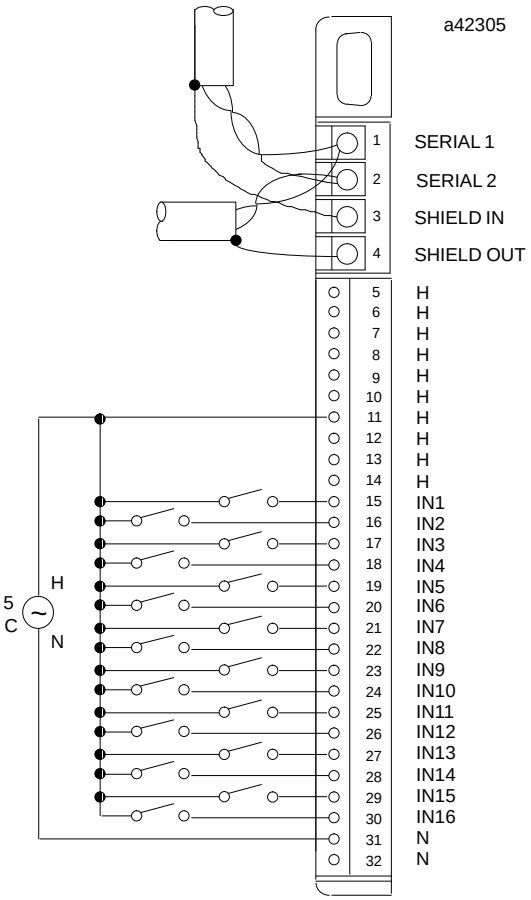
Make all power connection in the block to the same 120 VAC phase. Other blocks can use different phases.



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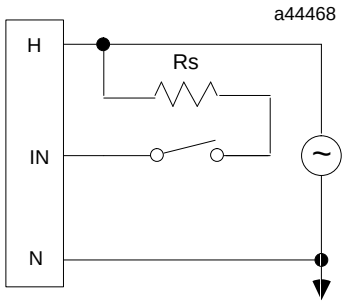
Wiring for I/O Devices

Run one signal wire for each device. Returns can be made to one or more of the H terminals; all H terminals are internally bussed, as are the N terminals. Extra power terminals are for convenience. Depending on layout and current loads, hot connections can be bussed together and made by one wire back to the block or power source. Neutral connections can also be bussed and made with one wire.



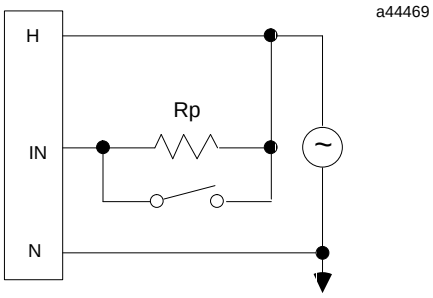
Wiring for Shorted Wire Detection

For any circuit which is configured to use the Shorted Wire detection option, install an appropriate resistor in series with the input device. Selection of a resistor depends on the configuration. See page 6-4.



Wiring for Open Wire Detection

For any circuit which is configured to use the Wire detection option, install an appropriate resistor across the terminals of the input device. Selection of a resistor depends upon the configuration. See page 6-4.



Open Wire and Shorted Wire diagnostics can be selected for the same input. The input circuit must then include both a series resistor and a parallel resistor to detect Open / Short conditions from a dry contact sensor. See page 6-5.

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Block Configuration

The configurable features of a 115 VAC 16 Circuit Input Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Input Filter Time	**	10 mSec	10–100 mSec in 10mS steps
Open / OFF Threshold	**	25%	25%–85%
ON / OFF Threshold	**	50%	25%–85%
Shorted Wire Detect	Circuit	no	yes, no
Open Wire Detect	Circuit	no	yes, no
Report Faults*	Circuit	yes	yes, no
Configuration Protection	Block	disabled	enabled, disabled

** Set up separately for each bank of 8 circuits.

Features marked with one asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on copies of the Configuration Worksheet printed on the next page.

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16 Circuit AC Input Block Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____

Block Number (0–31) _____ Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Input Filter Time (10–100 mS): circuits 1–8 _____ circuits 9–16 _____

Open/OFF Threshold: circuits 1–8 _____ circuits 9–16 _____ % of line voltage

ON/OFF Threshold: circuits 1–8 _____ circuits 9–16 _____ % of line voltage

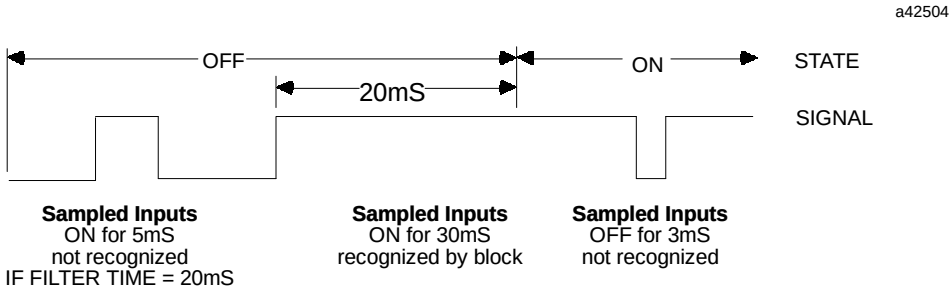
Circuit Features:

	Reference Address	Report Faults (yes?no)	Enable Shorted Wire Detect (yes/no)	Enable Open Wire Detect (yes?no)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

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Input Filter Time

The block continuously samples an input for the length of the configured filter time period. If the input remains either on or off for the length of the Filter Time, the block recognizes its state. For example:



An input filter helps reject spurious noise spikes and multiple inputs generated by the bounce of mechanical devices. An input filter time of 10mS to 100mS can be selected for the block. The default filter time is 10mS (no filter).

In controlled, noise-free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, no additional filter time is needed.

In noisy environments, use a longer filter time to prevent noise from possibly causing erratic or unsafe system operations.

For a block with tristate inputs, the minimum recommended Input Filter Time is 50mS.

Hand-held Monitor Configuration Steps

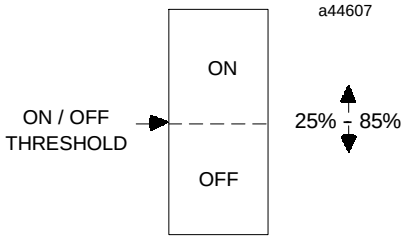
```
INPUT FILTR TIME
REF
FILTER=   10mS
   tgl entr nxt
```

1. The screen displays the selected filter time for circuits 1 – 8. If this is not appropriate, press F2 (tgl) to change it. To save the new selection, press F3 (entr).
2. Press F4 (next) to configure the filter time for circuits 9 – 16. If the time shown is not appropriate, press F2 to change it.
3. Press F4 (next) to advance to the next configuration display.

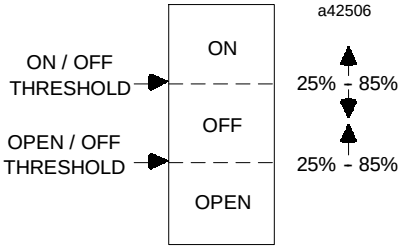
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Thresholds

On this block, each group of eight circuits has two voltage thresholds: an On/Off threshold and an optional Open/Off threshold.



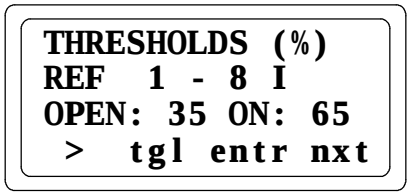
On/Off Threshold: The On/Off threshold determines when inputs are considered to be On or Off. The default On/Off threshold is 50% of the incoming line voltage. This threshold is suitable for most applications. If necessary, a different On/Off threshold can be configured for each group of eight circuits. The selectable range is 25% to 85% of incoming line voltage in 5% increments.



Open/Off Threshold: The optional Open/Off threshold is used if the Open Wire diagnostic is enabled for any input in a group. Detection of open wire conditions requires a resistor across the terminals of the input device.

The default Open/Off threshold for each group of 8 inputs is 25% of the incoming line voltage. If necessary, it can be reconfigured in 5% increments from 25% to 85%.

Hand-held Monitor Configuration Steps



1. The screen displays the configured Open Threshold and On Threshold for the first 8 inputs. If Open Wire detection is **NOT** enabled, **X X** will appear beside the word **OPEN**. Details of selecting appropriate Thresholds were given above.

   The F1 (>) key moves the cursor between **OPEN** and **ON**.

2. Enter a new Open and/or On Threshold from the keypad. The Open/Off threshold must be less than the On/Off threshold for accurate input data and diagnostics.

3. Press F3 (enter) to save the new Threshold(s).

4. Pressing F4 (next) displays the Threshold configuration screen for the second group of 8 inputs. These may be changed in the same manner.

5. Press F4 (next) to advance to the next configuration display.

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Report Faults to CPU

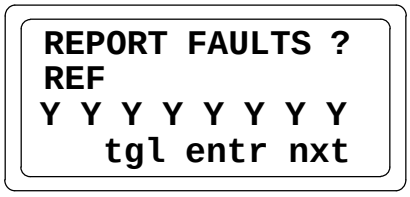
Fault reports to the host can be disabled or enabled for any circuit.

If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit. If fault reporting is disabled, the block does not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block detects faults on the circuit, and takes appropriate action. The Unit OK LED blinks when a fault occurs, and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

The application program can query the block for faults whether or not diagnostics reporting is enabled, using individual Read Diagnostic messages.

HHM Hand-held Monitor Configuration Steps



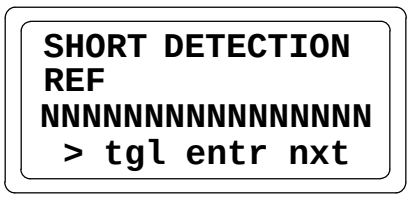
1. The screen shows the current Fault Reports configuration of all circuits on the block.
2. To select a circuit, press F1 (>).
3. To change the Report Faults configuration of the selected circuit, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

Shorted Wire Detection

The Shorted Wire Detection feature causes the block to issue a Short Circuit message if the voltage level on an input reaches 10% (short low) or 90% (short high) of the incoming line voltage.

Shorted Wire Detection can be independently enabled for each of the block's 16 inputs. For a new block, it is not enabled for any input. To detect shorted wire conditions, a series resistor must be located near the input device, as explained on page 6-4.

Hand-held Monitor Configuration Steps



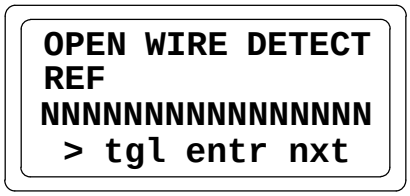
1. The screen shows whether Short Detection is enabled (Y) or not enabled (N) for each input.
2. To change the cursor location, press F1 (>). To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Open Wire Detection

With Open Wire Detection enabled for an input, the block reports an open wire condition if the input's voltage reaches its Open / Off threshold level (see page 6-14). For a new block, this diagnostic is not enabled for any input. Detection of open wire conditions requires a resistor across the terminals of the input device, as shown on page 6-4.

Hand-held Monitor Configuration Steps

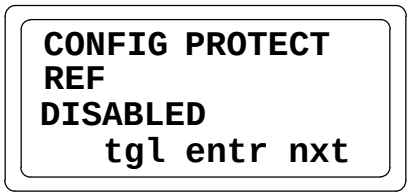


1. The screen shows whether Open Wire Detection is enabled (Y) or not (N) for each input. To change the cursor location, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) when you are ready to advance to the next configuration display.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

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Chapter 7 Relay Output Blocks

Relay Output blocks provide 16 output circuits in four independent groups of four relay–type outputs each. The block power may be either 115V or 230V AC.

There are two types of Relay Output blocks:

- **Relay Output Block** (IC660BBR100), Relays Normally–closed.
- **Relay Output Block** (IC660BBR101), Relays Normally–open.

Features

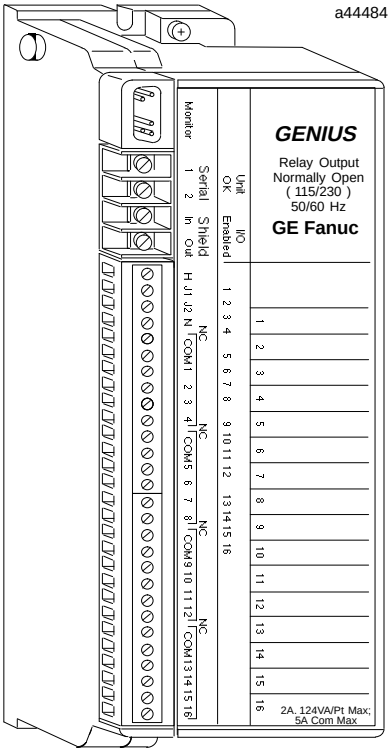
Each group of four outputs on a Relay Block can be powered by a separate AC or DC source. Group to group isolation is 1500 volts.

Relay blocks are compatible with a wide range of low–power control and indicating devices such as relays, contactors, and lamps. Output devices may operate in the range of 5V to 250VAC or 5V to 220VDC, and switch up to 60 Watts or 125 VA.

Configurable features of these blocks include:

- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy type
- Bus Switching Module control

Block LEDs indicate proper block operation and CPU communications. Individual LEDS show the commanded output state of each coil.



Compatibility

These blocks can be used with any type of GE Fanuc Genius bus interface module. They can also be used with any PCIM or QBIM module.

They are compatible with a Hand–held Monitor identified by catalog number IC660HHM501 only.

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Specifications

Block Type:	16 circuit relay outputs in four isolated groups of four
Catalog Numbers:	
Output Block, Normally–Closed Relays	IC660BBR100
Terminal Assembly only	IC660TBR100
Electronics Assembly only	IC660EBR100
Output Block, Normally-Open Relays	IC660BBR101
Terminal Assembly only	IC660TBR101
Electronics Assembly only	IC660EBR101
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)
Weight	4 lbs. (1.8 kg)
LEDs (I/O Block)	Unit OK, I / O Enabled
LEDs (each circuit)	Individual relay coil state
Environmental Specifications:	
Operating temperature	0C to +60C (32F to +140F)
Storage temperature	–40C to +100C (–40F to +212F)
Humidity	5 to 95% (non–condensing)
Vibration	5–10Hz 0.2" (5.08mm) displacement; 10–200Hz at 1G
Block Power Supply:	
Frequency	47–63 Hz
Operating voltage	(115VAC) 93VAC to 132VAC; (230VAC) 185VAC to 265VAC
Power requirement	87mA at 115 VAC
Power supply dropout time	1 cycle
Isolation:	
All outputs to chassis ground	1500 VAC
Between output groups	1500 VAC
Power terminals to chassis ground	1700 VDC
Power terminals to outputs	1500 VAC
Comms terminals to power terminals	1700 VDC
Comms terminals to outputs	1500 VAC
Heat Dissipation	10.1 watts maximum with 16 outputs on
Output Characteristics:	
Maximum Output current	2 amps per circuit
Maximum switching power	60 Watts or 125 VA
Maximum inrush current	2 amps per circuit
Output OFF leakage current	0.1 mA
Maximum switching frequency	20 cycles / minute (inductive loads)
Output turn–on delay (maximum)	5mS
Output voltage range	5V to 250V AC or 5V to 220V DC
Minimum recommended load	10 mA
Relay Type	Fixed coil moving armature
Initial Contact Resistance	100 milliohms, maximum

Typical Life:

Operating Voltage:	Maximum Current for Load Type *			Typical Life
	Resistive	Lamp	Solenoid	(operations)
250VAC	0.5A	—	—	200,000
250VAC	—	0.1A	0.1A	100,000
125VAC	1.0A	0.2A	0.3A	100,000
220VDC	0.3A	—	—	100,000
110VDC	0.6A	—	—	100,000
30VDC	2.0A	—	—	500,000
30VDC	—	0.2A	0.3A	100,000
12VDC	—	0.3A	0.5A	100,000

Effect of Additional Current on Operating Life:

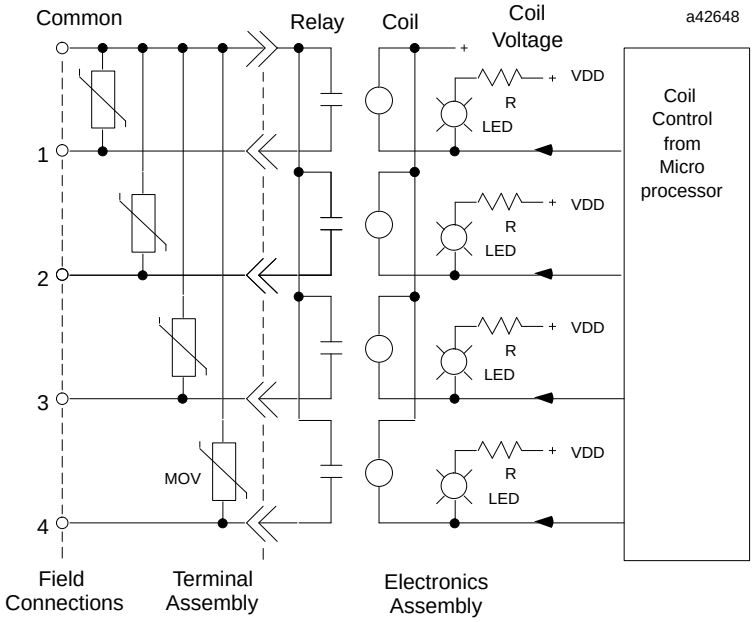
	Current in Load Type			Typical Life
	Resistive	Lamp	Solenoid	(operations)
250VAC	0.1A	—	—	1,500,000
125VAC	0.3A	—	—	1,000,000
30VDC	1.0A	—	—	2,000,000
12VDC	2.0A	—	—	1,000,000

* Lamp loads are defined as a X10 inrush with a power factor (PF) of 1.00; when turned OFF, they represent a PF of 1.00. Solenoids are defined as a X10 inrush with a PF of 0.65; when turned OFF, they represent a PF of 0.35.

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Block Operation

All of a Relay Output block's 16 relay–type outputs are either normally–open or normally–closed (depending on the block version). Outputs are grouped into four groups of four relays. Each group of four shares a common input terminal.



NOTE: Relay Normally-Open version shown. Normally-closed is the same, except for relay type.

Circuit LEDs

Each circuit has its own LED indicator that shows the commanded state of the coil.

Output Data Format

A Relay Output Block receives 2 bytes of output data from the CPU each bus scan. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Byte #	Description
0	Outputs 1 – 8 (output 1 in bit 0)
1	Outputs 9 – 16 (output 9 in bit 0)

The block echos the 2 data bytes each bus scan. PLCs ignore the echoed data. However, it can be displayed on a Hand-held Monitor.

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Relay States

A logical '1' received from the CPU causes a Relay block to energize the corresponding relay coil; a '0' causes the coil to be deenergized. When the coil of a Normally–open relay is energized, the relay contact closes. When the coil of a Normally–closed relay is energized, the relay contact opens.

Coil Type	Coil State	Action of Relays
Normally–open relay	ON (1)	relay closes
	OFF (0)	relay opens
Normally–closed relay	ON (1)	relay opens
	OFF (0)	relay closes

Hand–held Monitor Output Display

The Hand–held Monitor displays the current states of all outputs on line 4 of the Monitor Block screen.

```
REF     1- 16 O
1234567890123456
0000000000000000
00C0C00C0CC000CC
```

Individual circuits are displayed on the Monitor / Control Reference screen (which also shows an output's fault and force status).

Diagnostics

The Relay Output blocks support the EEPROM Failure diagnostic only. There are no diagnostics associated with the individual circuits.

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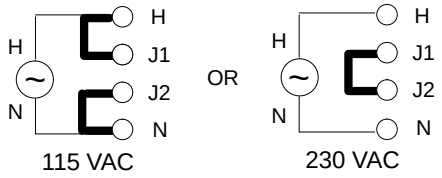
Field Wiring

Field devices are wired to terminals 5–32, which accept AWG #22 through AWG #12 wires. Do not overtorque the terminal screws.

Block Power

Relay Output blocks require a 115 VAC or 230 VAC power source. Voltage selection is made by jumpers on the Terminal Assembly. When shipped from the factory, the power selection jumpers are set for 115 VAC operation. For 230 volt AC power, change the jumpers as shown below. Care must be taken to ensure correct jumper placement. Incorrect jumper placement may result in damage to the block.

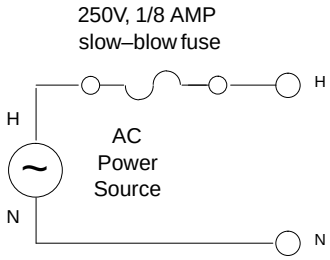
Block Power Options a42511



Connect an appropriate power source to the H and N terminals (5 and 8).

Note

If Class 1 Division 2 conditions must be met for Factory Mutual, install an external 250 volt 1/8 amp slow–blow fuse in series with the Hot AC power connector as shown below.



With the external fuse indicated, this block meets FM Class 1 Division 2 requirements.

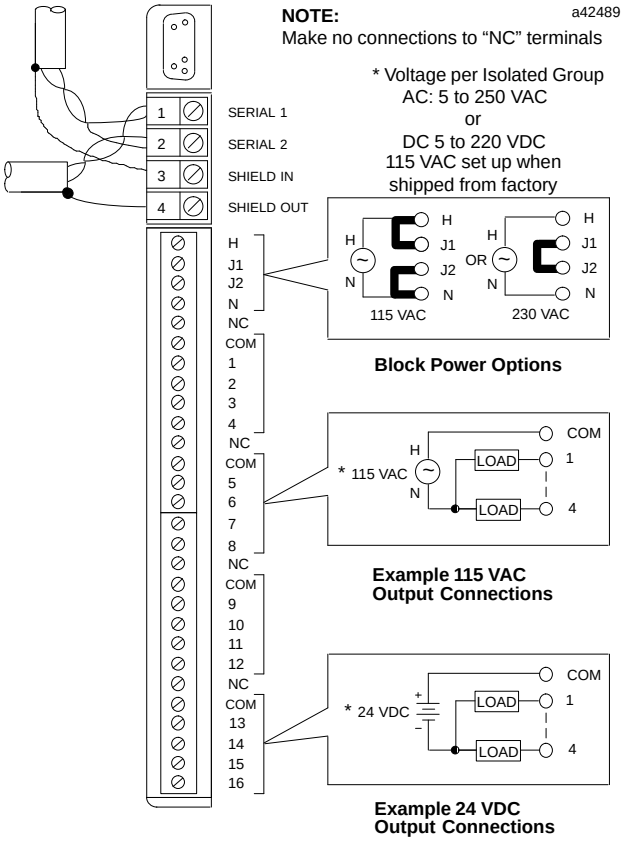
Wiring for Output Devices

Power for AC loads may come from the block AC power supply or other AC source(s). Power for DC loads may come from one or more DC sources. Each group may use a separate AC or DC source.

External Fuses and Snubbers

Relay blocks have no internal fuses. Following normal practices, external fuses of 2 amps or less can be installed in series to protect loads.

External snubbers are not necessary for correct operation of the block. However, the use of snubbers is recommended. Snubbers will protect loads from switching transient pulses and lengthen the contact life of the relays. Use a diode connected in parallel with a DC inductive load or an R–C network across the contacts.



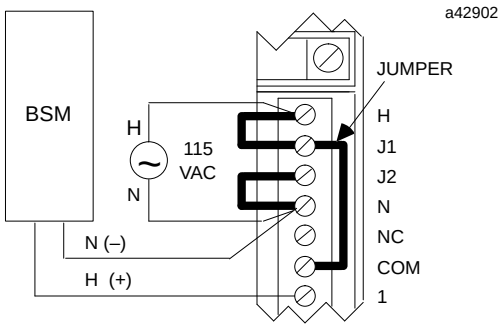
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Using a Relay Block as a BSM Controller

Both types of Relay Block (IC660BBR100 and BBR101) can be used to control a Bus Switching Module. There are two different BSM versions available. It is important to match the BSM to the type of voltage that will power the block's outputs. If this voltage will be 24/48 VDC, BSM version IC660BSM021 is required. If the voltage will be 115 VAC or 125 VDC, IC660BSM120 is needed instead. Connect the BSM to the block as shown below.

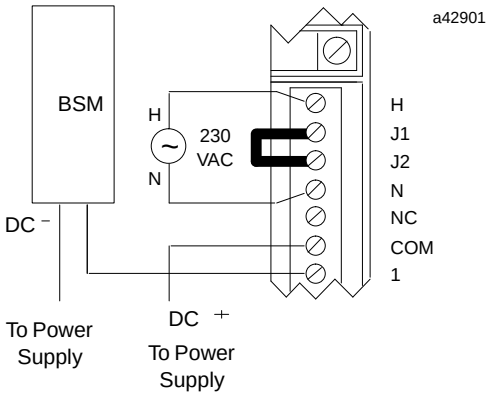
Block and Points Powered by 115 VAC

If the block and points are powered by 115 VAC, connect one wire of BSM version IC660BSM120 to point 1 and connect the other BSM wire to N. Jumpering terminal J1 to COM as shown below allows the points to operate on the same 115 VAC source that powers the block.



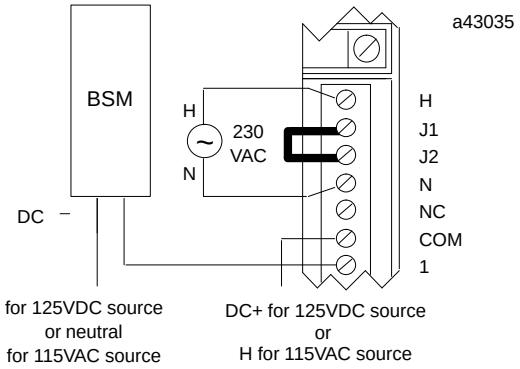
Block Powered by 230 VAC, Points Powered by 24–48 VDC

If the block is powered by 230 VAC and the points are powered by a 24–48 VDC source, connect one wire of BSM version IC660BSM021 to point 1 and the other to DC– (24–48VDC).



Block Powered by 230 VAC, Points Powered by 115 VAC or 125 VDC

If the block is powered by 230 VAC and the points are powered by either a 115 VAC source or a 125 VDC source, use BSM version BSM120. Connect one wire of the BSM to point 1. For a 125 VDC source, connect the other BSM wire to DC–. For a 115 VAC source, connect the other BSM wire to the neutral side of the power supply.



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Block Configuration

The configurable features of a Relay Output Block are listed below. For many, the factory setting will not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Hold Last State	Circuit	no	yes, no
Output Default State	Circuit	coil off	coil on, off
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 or 10 sec
CPU Redundancy	Block	none	none, hot standby, duplex
Duplex Default	Block	off	on, off
Configuration Protection	Block	disabled	enabled,disabled

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

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16 Circuit Relay Output Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Redundancy Features:

Redundancy Mode (None/Standby/Duplex) _____ Duplex Default (on/off) _____

BSM Present (Y/N) BSM Controller (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

	Reference Address	Hold Last State (yes/no)	Default State (ON/OFF)
1			
2			
3			
4			
5			
6			
7			
8			
8			
10			
11			
12			
13			
14			
15			
16			

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Hold Last State

Each output can be independently configured to either hold its last state or default if the block loses CPU communications for at least 3 bus scans.

For a new block, Hold Last State is disabled for each output. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output in its current state instead of setting it to the powerup default.

Outputs remain in their last state or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. The screen displays the current Hold Last State configuration of all circuits. On this screen,

   Y = hold last state.

   N = go to default state (configured on the next HHM screen)

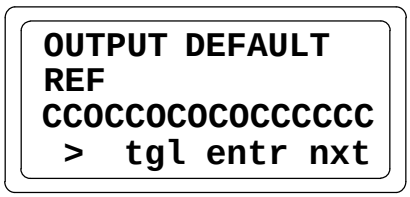
2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl). To save the new selection, press F3 (entr). Press F4 (next) to advance to the next configuration display.

Output Default State

An output goes to its powerup default state when the block is first powered up.

If Hold Last State was NOT enabled, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed. (Additional default time for redundancy is explained on page 7-11.

Hand-held Monitor Configuration Steps



1. The screen displays the Output Default state configuration of all relays. On this screen,

   C = Output Default is closed.

   O = Output Default is open.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl). To save the new selection, press F3 (entr). Press F4 (next) when you are ready to advance to the next configuration display.

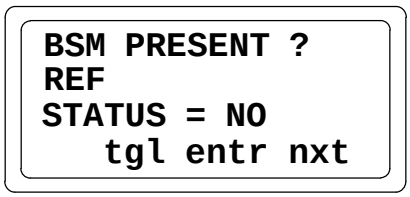
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO (the default).

Change it to YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



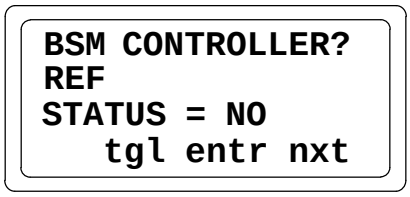
1. To change the BSM Present configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. The default setting for this feature is NO. Change it to YES if the block will be a BSM Controller.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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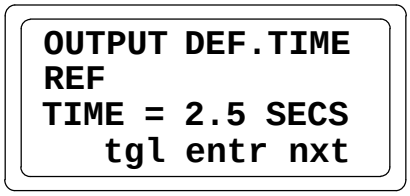
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, outputs will remain in their last state while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any output on a block, and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller Redundancy, Hot Standby or Duplex redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If those outputs are not available, the block will use outputs from the bus interface module with Device Number 30. If no outputs from a CPU are available, outputs will either Hold Last State or go to their defaults.

In Duplex redundancy mode, a block compares outputs received from two CPUs and sets any outputs for which there is disagreement to their Duplex Default state.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

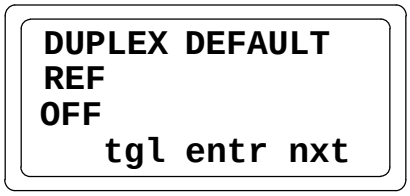
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Duplex Default State

In Duplex Redundancy mode, if the block receives different output states for given points, the block breaks the tie by outputting the Duplex Default State to those points. For new blocks, OFF is selected for all outputs. Change it if outputs should be ON.

Coil Type	Coil State	Action of Relays
Normally–open relay	ON (1)	relay closes
	OFF (0)	relay opens
Normally–closed relay	ON (1)	relay opens
	OFF (0)	relay closes

Hand-held Monitor Configuration Steps



1. To change the Duplex Default state, press F2 (tgl). Press F3 (entr) to save the new selection.
2. Press F4 (next) to advance to the next configuration display.

Note

If the block loses communications with BOTH CPUs, individual outputs go to their configured Hold Last State or Output Default State.

Configuration Protection

This feature can be used to protect the block's configuration, preventing changes from the CPU or Hand–held Monitor. It can only be selected from the Hand–held Monitor. To make subsequent changes, protection must be removed again using the Hand–held Monitor. For a new block, configuration is unprotected. Before a block is used in the system, its configuration should be protected.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection. Press F4 (next) to return to the first configuration display.

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Chapter 8

16 Circuit DC Input/Output Blocks

Four different types of 16–Circuit DC I/O Blocks are available. There are two source blocks, which provide current to field output devices:

- **24 VDC Source block (IC660BBD022)**, for use with 2–wire and 3–wire solid state sensors and electromechanical sensors.
- **24/48 VDC Source block (IC660BBD020)**, for use with 3–wire solid state sensors and electromechanical sensors.

There are also two sink blocks, which receive current from field output devices:

- **24 VDC Sink block (IC660BBD023)**, for use with 2–wire and 3–wire solid state sensors and electromechanical sensors.
- **24/48 VDC Sink block (IC660BBD021)**, for use with 3–wire solid state sensors and electromechanical sensors.

Features

Genius 16 Circuit DC Input/Output blocks have 16 discrete circuits, each easily configured to be an input, tristate input, or output. Output circuits can be connected directly to input circuits without the use of other components or inversion of logic states.

Control power is tapped off the input/output device voltages wired to the terminals. No separate block power supply is needed.

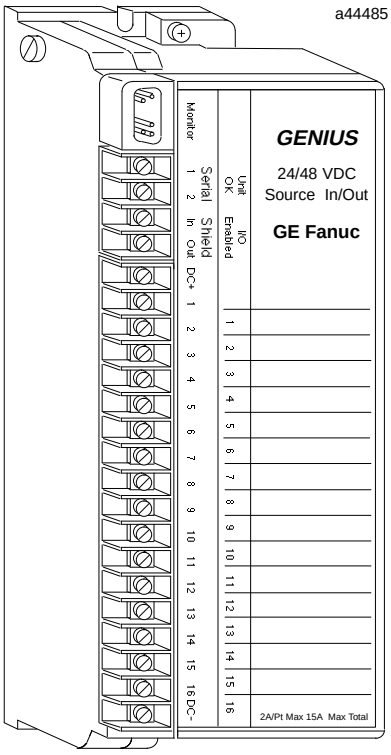
Configurable features include:

- Output Pulse Test capability
- Selectable Input Filter Time from 10mS to 100mS
- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy type
- Bus Switching Module control

The block's advanced diagnostics can pinpoint causes of installation and run–time errors. Each circuit has electronic circuit protection that shuts down an output if inductive surge current exceeds 15 amps for more than 10mS. The output is easily restored by command from a Hand–held Monitor or the CPU.

Additional diagnostics of these blocks are:

- Overtemperature Failed Switch
- Open Wire for Tristate Inputs
- Overload Detection and Shutdown
- No–load Detection



Compatibility

These blocks can be used with any Genius bus controller. They can also be used with a PCIM or QBIM module. They are compatible with all Genius Hand–held Monitors.

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Specifications

Block Type:	16 circuit discrete input and output
Catalog Numbers:	
24 / 48 VDC 16 Circuit Source I / O Block	IC660BBD020
Terminal Assembly only	IC660TSD020
Electronics Assembly only	IC660EBD020 (same as block IC660BBD022)
24VDC Source 16 Circuit Source I / O Block	IC660BBD022
Terminal Assembly only	IC660TBD022
Electronics Assembly only	IC660EBD020 (same as block IC660BBS020)
24 / 48VDC 16 Circuit Sink I / O Block	IC660BBD021
Terminal Assembly only	IC660TSD021
Electronics Assembly only	IC660EBD021 (same as block IC660BBD023)
24VDC 16 Circuit Sink I / O Block	IC660BBD023
Terminal Assembly only	IC660TBD023
Electronics Assembly only	IC660EBD021 (same as block IC660BBD021)
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)
Weight:	4 lbs. (1.8 kg)
LEDS (block):	Unit OK, I / O Enabled
LEDs (each circuit):	Individual load side indicators
Heat Dissipation:	68.8 Watts with 16 outputs on at 2 amps.
Block to Block Isolation:	1500 V
Operating voltage:	18–56 VDC (24 / 48 V), 18–30 VDC (24 V)
Ripple (maximum):	10%
Required DC power:	150mA typical / 300mA maximum
Power supply dropout time:	10mS
Input Characteristics:	
For standard input, voltage relative to (DC–)	**Source Blocks** / **Sink Blocks**
Input ON, 24 VDC supply	16–24 VDC / 0–8 VDC
48 VDC supply*	32–48 VDC * / 0–16 VDC*
Input OFF, 24 VDC supply	0–7 VDC / 17–24 VDC
48 VDC supply*	0–14 VDC* / 34–48 VDC*
Input processing time (typical)	5.6K ohms (24 / 48V), 1.8K ohms (24V)
Input impedance (typical)	1.7mS (plus selectable filter delay)
Selectable input filter times	5–100mS
Input diagnostics	Open wire, Overtemperature, Failed Switch
Output Characteristics:	
Output current (steady state)	2 amps per circuit
Maximum inrush current	10 amps up to 10mS
Block output current	15 amps at 35C
Output OFF leakage current	1.0 mA
Maximum switching frequency	Once per second (high inrush current)
Output turn–on delay (maximum)	1mS
Output voltage drop	2.0 volts maximum at 2 amps inrush
Minimum Recommended Load	50 mA with No Load nabled
Output Diagnostics	Short Circuit, Overload, No Load, Failed Switch, Overtemperature
Environmental:	
Operating temperature	0 to +60C (32 to +140F)
Storage temperature	–40 to +100C (–40 to +212F)
Humidity	5 to 95% (non–condensing)
Vibration	5–10Hz 0.2" (5.08mm) displacement, 10–200Hz at 1G

* for 24 / 48VDC blocks

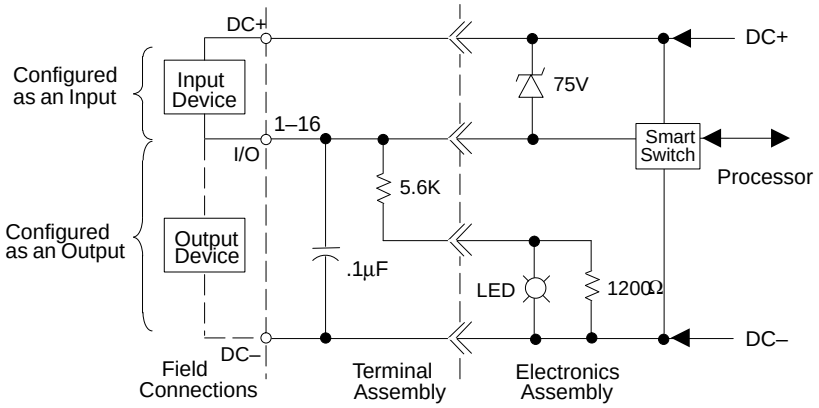
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Block Operation

Each circuit can be configured as an input, a tristate input, or an output. If the block is configured as a combination block, output feedback is provided via the corresponding input references.

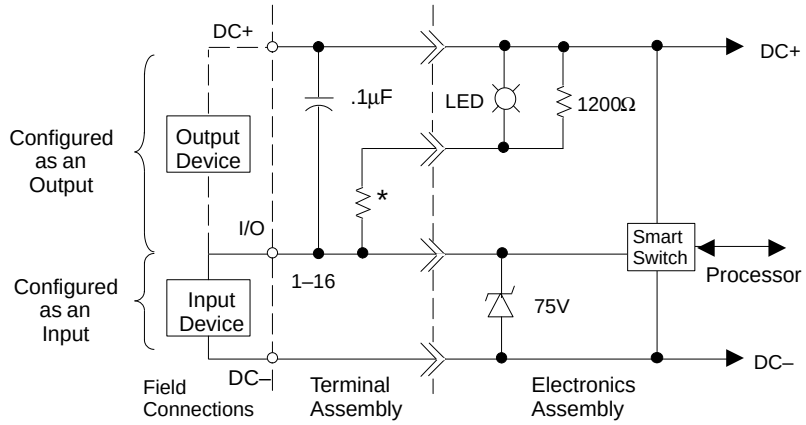
16 Circuit DC Source I/O Blocks

A DC source block has all output devices connected to the negative (–) side of the power supply. Inputs control the positive (+) side.



16 Circuit DC Sink Blocks

A DC sink block has all output devices externally connected to the positive (+) side of the power supply. Inputs control the negative (–) side.



* 5.6K ohms for 24/48 VDC blocks.
1.8K ohms for 24 VDC blocks

For 24/48 Volt DC Blocks, the internal resistor is 5.6K ohms. For 24 Volt DC blocks, the internal resistor is 1.8K ohms.

Circuit LEDs

Each circuit has its own LED. If the circuit is configured as an input, the LED indicates the presence of threshold voltage at the input terminal. If the circuit is configured as an output, the LED indicates the actual state of the load.

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Inputs and Outputs

The block can be configured as an inputs–only, outputs–only, or combination block. Regardless, the block always broadcasts two bytes of data each bus scan, and accepts two bytes of data each bus scan.

If the block is configured as an inputs–only block, all circuits must be regular inputs or tristate inputs. The block will use 16 input references and NO output references.

If the block is configured as an outputs–only block, all circuits must be regular outputs; no feedback analysis will be performed. The block will use 16 output references and NO input references.

If the block is configured as a combination block circuits can be any mix of inputs and / or outputs. The block will use 16 input references and 16 output references. The actual state of each output circuit will be returned to the CPU in the corresponding input references location. The CPU can monitor the feedback state to verify (after an appropriate delay) that the output switching device has operated properly and that the load has the proper voltage and current applied.

Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Input Data Format

A 16 Circuit DC I / O Block broadcasts 2 bytes of input data each bus scan.

Byte #	Description
0	Inputs 1 – 8 (input 1 in bit 0)
1	Inputs 9 – 16 (input 9 in bit 0)

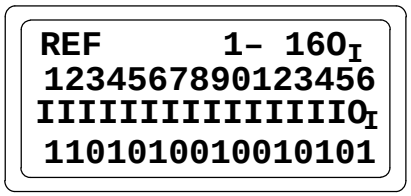
Output Data Format

The block receives 2 bytes of output data from the bus controller each bus scan.

Byte #	Description
0	Outputs 1 – 8 (output 1 in bit 0)
1	Outputs 9 – 16 (output 9 in bit 0)

Hand–held Monitor I/O Display

The Hand–held Monitor displays the I / O types (line 3) and current states (line 4) of all circuits on the Monitor Block screen.



Individual circuits are displayed on the Monitor / Control Reference screen (which also shows a circuit's fault and force status).

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Diagnostics

The block always performs its standard diagnostic checks, plus two optional output diagnostics. The block reports all faults to the Hand–held Monitor, and takes appropriate corrective action.

Individual circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Overtemperature Diagnostic

Each circuit has a built–in thermal sensor. If the block's internal temperature exceeds 100C, the block sends an OVERTEMPERATURE message and turns off the circuit to protect its internal electronics. This diagnostic is always performed for both inputs and outputs.

Short Circuit Diagnostic

Automatic output diagnostic. Output circuits are protected by a short circuit level sensor at the switching device. If the instantaneous current on an output exceeds 10 amps at turn–on, the block turns the output off within microseconds. The block will try to restart the load; if two attempts are unsuccessful, the output circuit is forced off and the block sends a SHORT CIRCUIT message. To restore normal operation to output the cause of the current surge must be removed, then the diagnostic must be cleared from the HHM or the CPU.

This diagnostic detects shorts across the load only. Also, systems with floating power supplies do not detect shorts of I/O points to ground because there is no return current path. Systems with power supplies grounded on the negative side detect grounded output points either as Failed Switch (sink blocks) of Short Circuit (source blocks).

Partial (high resistance) shorts may not draw enough current during a Pulse Test to be detected by the Pulse Test.

Failed Switch Diagnostic

The block automatically monitors all circuits for several types of faults, which may be reported as Failed Switch diagnostics.

For an output, Failed Switch is reported if the circuit's switch state is not the same as its commanded state. The block sends a FAILED SWITCH message identifying the failed circuit. The logic state of the circuit is set to OFF.

When an output fault occurs, the actual condition of the output switch is not known. If the output switch has failed shorted (or closed), current flow is not interrupted when the block forces the output state OFF. Action external to the block must be taken to remedy the problem. The FAILED SWITCH message can alert personnel or cause program logic to be activated, possibly shutting off power to the block, I/O section, or process.

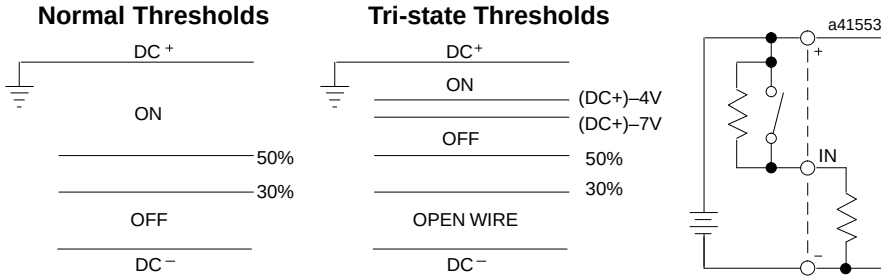
Several additional switch faults independent of the output state are detected and reported as Failed Switch faults on both input and output–configured circuits. Examples include loss of communications with the block's internal microprocessor and some internal power supply faults.

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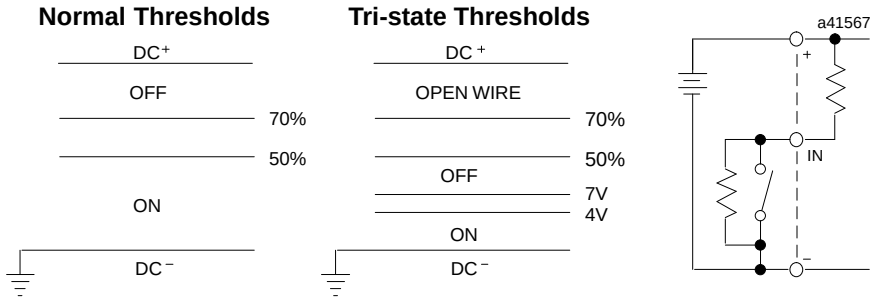
Open Wire Diagnostic

The block automatically performs this diagnostic on any circuit configured as a tristate input. It will detect an electrical (not mechanical) malfunction in a circuit. In addition to being configured as a tristate input, the circuit must have a non–inductive resistor placed as close as practical to the actual dry contacts (such as across the field device terminals). For the 24 / 48 VDC blocks (IC660BBD020 and 021), a 5.1K ohm external resistor should be used. For the 24 VDC blocks (IC660BBD022 and 023), a 1.6K ohm external resistor should be used.

DC Source Block Tristate Input Thresholds



DC Sink Block Tristate Input Thresholds



With the switch closed (ON state), the circuit senses the low source impedance. With the switch open (OFF state), the circuit senses the added resistance. If a wire is broken, cut or removed, impedance becomes very high. The block will transmit 0 as the state of the input, and send an OPEN WIRE message.

Since faulty input circuit monitoring requires specific current flows, devices as photo–sensors, electronic high–speed counters, instrumentation, fiber optic sensors, and similar electronic devices cannot be monitored for Open Wire conditions. Such devices should be set up as standard, not tristate, inputs.

GE offers compatible input devices including a 5.1K ohm monitoring resistor with its line of General Purpose Control sensor devices.

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No Load Diagnostic

The optional No Load diagnostic can be enabled or disabled for individual outputs.

For a new block, outputs are configured to report No–Load conditions. In this configuration, energizing the output activates a no–load current level. If the load does not continuously draw 50mA from the output circuit, the block sends a NO LOAD message. Because this diagnostic monitors both current and voltage, a No Load condition may cause an HHM monitoring the block to display 0 for the circuit although there is voltage at the output and the circuit LED is on.

This diagnostic should be not be used for circuits on which very small loads (small relays, transformers, or indicating lamps) will draw less than 50 mA.

Overload Diagnostic

Like No–Load detection, this diagnostic is optional for individual outputs on the block.

In addition to the protection provided by the block's built–in Short Circuit detection, Overload Shutdown provides further protection for output loads, field wiring, and switching devices. If a load exceeds 2.8 amps DC continuously for 10mS, the block will turn the output off and send an OVERLOAD message if Overload Shutdown is enabled.

For a load that requires more than 2 amps DC, the output can be configured not to shut off at this level or send the OVERLOAD message. These restrictions apply:

1. Maximum load current: 5 amps DC
2. Maximum duty cycle: limit duty cycle so that: (load current) x (% ON) is less than 1.0 amp.
3. Maximum ON time: 1 minute
4. Maximum total current of all outputs ON at the same time is less than 16 amps.

For example, a maximum 5 amp load can be pulsed at a 20% duty cycle, or up to 1 minute ON and 9 minutes OFF. Higher repetition rates can be used if the duty cycle is maintained. The duty cycle derating to an average of 1 amp output current and the ON time limit are needed to avoid overheating due to increased power dissipation in the block at these high currents. Exceeding these limits may cause an overtemperature fault.

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Field Wiring

All field wiring to this block are standard screw, clamp–type terminals which can be operated with a flat or phillips–head screwdriver. Each terminal accepts one AWG #12 or two AWG #14 wires. The minimum recommended wire size is AWG #22. The terminals can accommodate spade or ring terminals up to 0.27 inch (6.85 mm) in width with a minimum opening for a #6 screw, and up to 0.20 inch (5.1 mm) depth from the screw center to the back barrier.

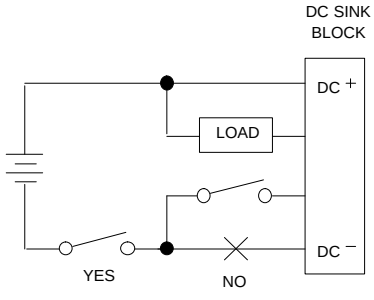
Connect a DC power source to the DC+ terminal (5) and the return to the DC– terminal (22). Depending on the layout and current loads, positive and negative connections can be bussed and made by individual wires back to the block or power source.

Connections for a DC Sink Block

Any circuit can be an input or output. Connect one terminal of the device to the block (terminals 6–21). Connect outputs to DC+ and inputs to DC–.

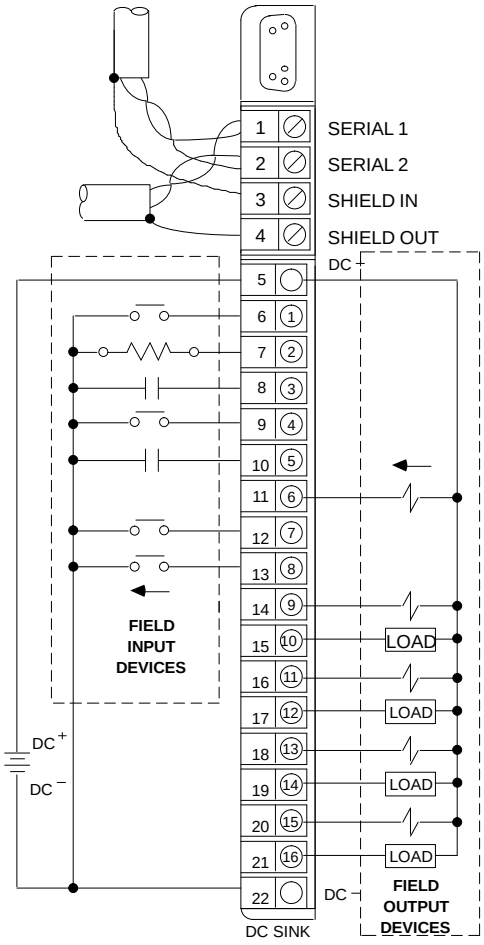
DC Sink Block, Power Disconnects

Since block power is the same as circuit power, it is important to wire block power disconnects so that block power and input power will be removed *at the same time.*



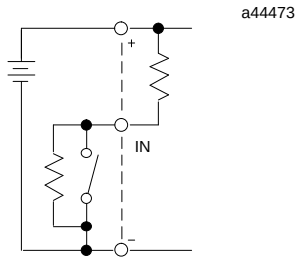
Caution

If circuit power is not removed at the same time as block power, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.



Sink Block, Wiring for Tristate Inputs

If any input is configured as a Tristate Input, install a resistor across the dry contacts of the input device. This added resistance is required to use the Open Wire diagnostic.



For a 24 / 48 VDC block, the resistor should be 5.1K ohms, 1 / 2 Watt or larger. For a 24 VDC block, the resistor should be 1.6K ohms.

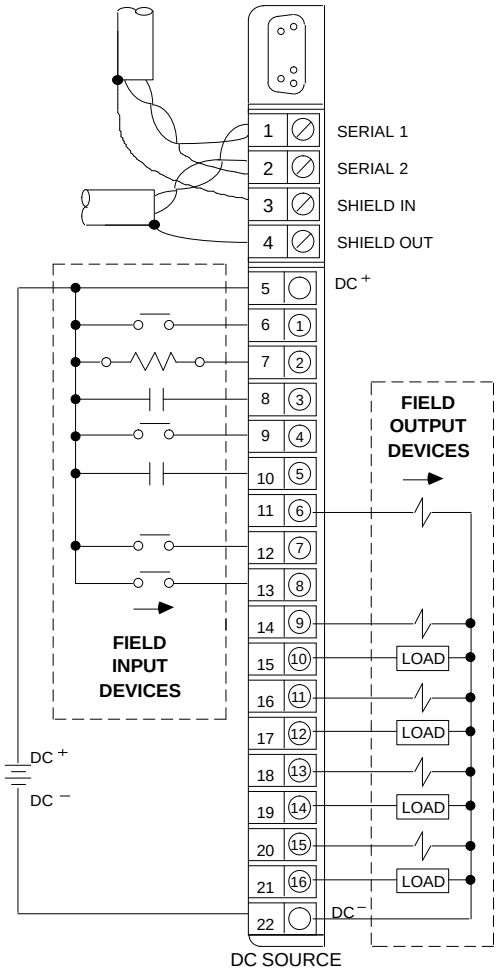
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Connections for a DC Source Block

Any circuit can be an input or output. Connect one terminal of the device to the block (terminals 6–21). Connect outputs to DC– and inputs to DC+.

For a DC source block, connect outputs to the negative side of the power supply and inputs to the positive side. No logic inversion is needed.

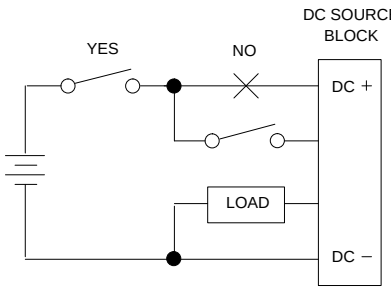
a41552



DC Source Block, Power Disconnects

Since block power is the same as circuit power, it is important to wire block power disconnects so that block power and input power will be removed *at the same time*. Locate the power disconnect as shown at right above.

a44472



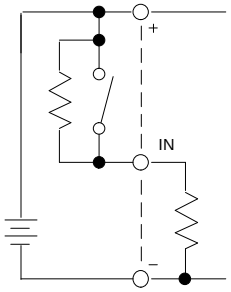
Caution

If circuit power is not removed at the same time as block power, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.

Source Block, Wiring for Tristate Inputs

If any input is configured as a Tristate Input, install a resistor across the dry contacts of the input device. This added resistance is required to use the Open Wire diagnostic.

a44473



For a 24/48 VDC block, the resistor should be 5.1K ohms, 1/2 Watt or larger. For a 24 VDC block, the resistor should be 1.6K ohms.

Wiring for a Bus Switching Module

If the block will be a BSM Controller, attach the BSM like a load to circuit 1. Connect either BSM pigtail wire to terminal 6. For a DC Sink block, connect the other BSM wire to DC+. For a DC Source block, connect the other BSM wire to DC–.

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Block Configuration

The configurable features of a 16 Circuit DC Input / Output Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Selections	Factory Setting
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Block I / O Type*	Block	input	input, output, combination
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Pulse Test for Outputs	Block	enabled	enabled, disabled
Input Filter Time	Block	20mSec	10–100mSec in 10mS steps
Circuit I / O Type	Circuit	input	input, output, tristate input
Report Faults	Circuit	yes	yes, no
Hold Last State	Circuit	no	yes, no
Output Default State	Circuit	off	on, off
Detect No Load	Circuit	yes	yes, no
Overload Shutdown	Circuit	yes	yes, no
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 or 10 sec
Redundancy Mode	Block	none	none, hot standby, duplex, GMR
Duplex Default	Block	off	on, off

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the feature of each 16 Circuit DC Input / Output Block should be decided upon, then recorded on copies of the Configuration Worksheet printed on the next page.

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16 Circuit DC I/O Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____

Block Number (0–31) _____ Block Type (Input/Output/Combination) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Pulse Test (Enabled/Disabled) _____ Input Filter Time (5–100) mS _____

Redundancy Features:

Redundancy Mode (None/Standby/Duplex, GMR) _____ Duplex Default (on/off) _____

BSM Present (Y/N) _____ BSM Controller (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

Ckt #	Reference Number	I/O Type (I/O/I_T*)	Report Faults (yes/no)	(output) Hold Last State (yes/no)	(output) Default State (ON/OFF)	(output) Report No Load (yes/no)	(output) Overload Shutdown (yes/no)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

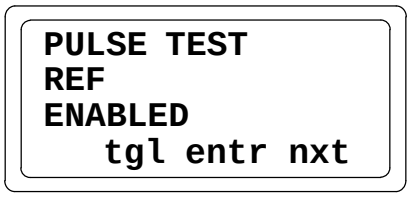
* I_T (Tristate Input) must have 5.1K Ω resistor across dry contacts of input device

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Pulse Test

Pulse Testing verifies the ability of a block's outputs to change state. A new block is configured to enable Pulse Testing. Pulse Testing should remain enabled if the block has loads that hold one state for long periods of time, *unless any load(s) are sensitive to pulses or interruptions of up to 16mS*. It should be disabled if the block's loads will normally change state as the program executes. These will report faults during normal operation, and do not need to be pulsed.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl). Press F3 (enter).
2. Press F4 (next) to advance to the next configuration display.

Pulse Testing Outputs

Outputs can be pulse–tested from a Hand–held Monitor or by sending a command from the CPU. Pulse Testing checks the continuity of each output circuit including the switch device, power source, wiring, interposing devices (fuses, circuit breakers, terminals), and output device. It works whether or not there is minimum current to check for a No–Load condition. Pulse testing will not activate mechanical devices such as motor starters, relays, or solenoid valves.

Pulse Testing should momentarily cause outputs that are OFF to turn ON and outputs that are ON to go OFF. Progressively longer pulses are applied until the desired circuit function is sensed. If the pulse width reaches the maximum of 16mS without detecting valid operation, one of these fault conditions is reported:

Failed Switch: If the output does not change state when pulsed.

Short Circuit: If the load on an output that was OFF exceeds 10 amps when pulsed ON.

No Load: If the load on an output that was OFF draws less than 50 mA when pulsed ON.

If the output was OFF, no current flow when the output is pulsed indicates an open circuit or failed switch. Similarly, continued current flow when ON outputs are pulsed OFF indicates a shorted switch (both malfunctions are reported to the CPU).

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Pulse Test Description

Pulse Testing switches a load to the opposite state then back again. This should occur so quickly that there is no effect on the mechanics or contact outputs of the load device.

Specific Pulse Test operation depends on whether or not No Load detection is enabled.

A. If No Load detection is enabled, the block looks for presence or absence of load current, using the normal No Load threshold. This verifies load continuity.

B. If No Load detection is NOT enabled, Pulse Testing tests only that the block output is switching voltage.

Pulse Testing begins with narrow pulses. If the appropriate condition described above is found on the first try, the test is complete. If the condition is not found, the test is repeated with successively longer pulses (2.5mS increments) until successful. The maximum Pulse Test time is 16 mS. If this time is reached and the result is still not successful, a fault message is generated.

The normal pulse width seen by the load is typically shorter than the maximum 16mS.

A. With No Load detection enabled, the pulses requlred may be longer due to the rise time of the load current and the load inductance.

   Power devices such as contactors and actuators will typically encounter maximum width pulses. Such devices draw moderate currents and are not affected by pulsing.

   Low-power signal relays may have low current draw, high-inductance coils, and fast operation. Such devices may have to be examined closely.

B. With No Load detection NOT enabled, a successful Pulse Test normally occurs in 4mS to 6mS. The time may be slightly longer if there are capacitive loads.

Suitable Loads for Pulse Testing

A resistive and / or inductive load is suitable for Pulse Testing if <u>any</u> of the following is true:

A. If No Load detection is enabled:

   1. The minimum pickup current of the load is less than the No Load threshold of the block. The maximum threshold of the block is 50mA, but typlcal values are 20mA to 35mA.

      When testing on–off–on operation, typical devices with rated currents of 75mA and up are suitable.

      When testing off–on–off operation, certain devices may require the addition of a flyback diode directly across the load coil to increase the dropout time.

   2. The minimum pickup delay is greater than 16mS, and the dropout delay is greater than 5mS. Devices that have slow or delayed operation may be unsuitable because they will ride through the maximum width pulses.

   3. The rise time of current in the load, at normal voltage, allows the peak current to reach the threshold in less time than the device delay, as well as less than the 16mS maximum pulse width. The load current must reach 50mA before the contacts switch. If necessary, the load current can be increased by adding a resistor load across the coil, and the device end of the wiring. This will permit testing of wiring continuity, but it may not detect an open coil.

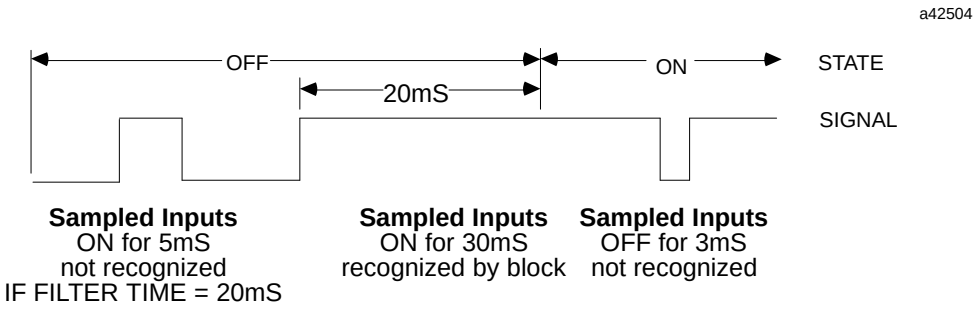
B. If No Load detection is NOT enabled, the minimum pickup or dropout delay is greater than 5mS.

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Input Filter Time

An input filter time of 5mS to 100mS can be selected for the block. The default filter time is 20mS.

The block continuously samples an input for the length of the filter time period. If the input remains either on or off for the length of the Filter Time, the block recognizes its state. For example:



An input filter helps reject spurious noise spikes and multiple inputs generated by the bounce of mechanical devices. In controlled, noise–free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, no additional filter time is needed.

In noisy environments, use a longer filter time to prevent noise from possibly causing erratic or unsafe system operations.

For a block with tristate inputs, the minimum recommended Input Filter Time is 50mS.

Hand-held Monitor Configuration Steps

```
INPUT FILTR TIME
REF
FILTER=   20mS
   tgl entr nxt
```

1. The screen displays the currently–selected filter time. If this time should be changed, press F2 (tgl) to display the other filter times. To save a new selection, press F3 (entr).
2. Press F4 (next) to advance to the next configuration display.

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I/O Circuit Type

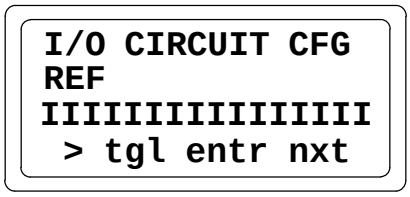
An earlier configuration step selected the Block I/O type (on the Program Block ID screen). That step determined whether the block would be assigned all input references, all output references, or both. The default configuration for each circuit on the block is input. On the screen shown below, the I/O type of each circuit can be changed.

If the Block I/O Type selection was Input, each circuit can be either an regular input (I) or a tristate input (I_T). Select **Tristate Input** for any input circuit that should report the Open Wire diagnostic.

If the Block I/O Type is Output, each circuit must be an output (O).

If the Block I/O Type is Combination, each circuit can be configured as an input (I), an output (O), or a tristate input (I_T). Select **Tristate Input** for any input circuit that should report the Open Wire diagnostic.

Hand-held Monitor Configuration Steps



1. The screen displays the current I/O type of each circuit on the block. On this screen,

   I = the circuit is configured as an input.

   O = the circuit is configured as an output

   I_T = the circuit is configured as a tristate input

2. To select a circuit, press F1 (>). To change a selection, press F2 (tgl).
3. To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit on a block.

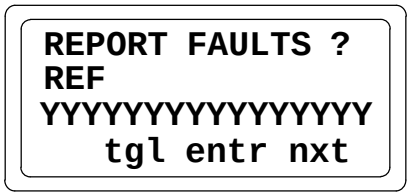
If fault reporting is enabled for a circuit, the block will send a message to the host if any fault occurs on that circuit.

If fault reporting is disabled, the block will not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block will detect faults on the circuit, and take appropriate actions. The Unit OK LED will blink when a fault occurs, and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



1. The screen displays the current Fault Reports selection for all circuits on the block. On this screen,

   Y = report faults that occur on the circuit.

   N = do not report faults

2. To select a circuit, press F1 (>).
3. To change the I/O type of the selected circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. After configuring circuits, press F4 (next) to advance to the next configuration display.

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Hold Last State

Each output can be independently configured to either hold its last state or to go to its powerup default state if the block loses CPU communications for at least 3 bus scans.

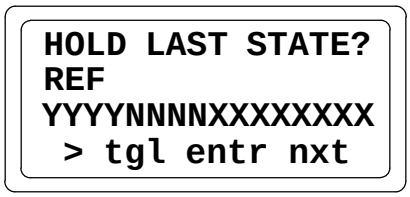
For a new block, Hold Last State is disabled for each output. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output in its current state instead of setting it to the powerup default.

Outputs remain in their last state or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. The screen displays the current Hold Last State configuration of all circuits. On this screen,

   Y = hold last state.

   N = go to default state (configured on the next HHM screen)

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

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Output Default State

An output goes to its powerup default state when the block is first powered up.

If Hold Last State was NOT enabled, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed.

Hand-held Monitor Configuration Steps

```
OUTPUT DEFAULT
REF
000000111XXXXXXX
 > tgl entr nxt
```

1. The screen displays the Output Default state configuration of all circuits. On this screen,

   0 = default is off.

   1 = default is on.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

Report No Load

By default, each output is configured to report No–Load diagnostics. Energizing the output activates a no–load current level. If the load does not continuously draw 50mA from the output circuit, the block sends a NO LOAD message.

Disable this diagnostic for any output where a very small load (small relay, transformer, or indicating lamp) will draw less than 50 mA.

Hand-held Monitor Configuration Steps

```
REPORT NO LOAD?
REF
YYYYYYYNNXXXXXXX
 > tgl entr nxt
```

1. The screen displays the Report No Load configuration of all outputs. On this screen,

   Y = the output will report No Load conditions.

   N = the output will not report No Load conditions.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

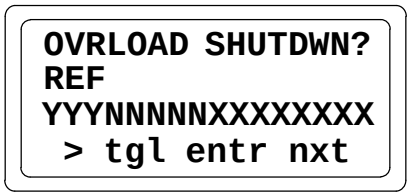
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Overload Shutdown

Overload Shutdown protects output loads, field wiring, and switching devices. If a load exceeds 2.8 amps DC for 100mS and Overload Shutdown is enabled, the block turns the output off and sends an OVERLOAD message.

Under certain conditions (see page 8-7), Overload Shutdown detection and reporting can be disabled for output loads that require more than 2 amps RMS.

Hand-held Monitor Configuration Steps



1. The screen displays the Overload Shutdown configuration of all circuits. On this screen,

   Y = overload will shut down output.

   N = output will remain on.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

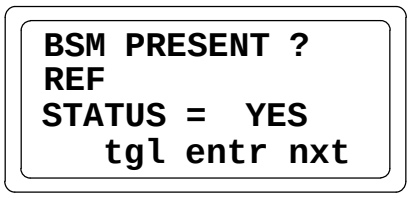
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO.

Select YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



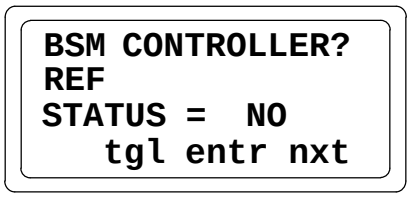
1. To change the BSM Present configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. Selecting a block to be a BSM Controller block has no effect on the block's I/O type – the block can still be configured as an inputs–only block, but circuit #1 cannot be physically used as an input. The first circuit will not be under CPU control.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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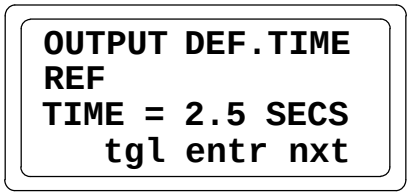
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, outputs will remain in their last state while the BSM Switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any output on a block, and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller redundancy, Hot Standby or Duplex redundancy, or Genius Modular Redundancy (GMR). For new blocks, No Controller Redundancy is selected.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If those outputs are not available, the block will use outputs from the bus interface module with Device Number 30. If no outputs from a CPU are available, outputs will either Hold Last State or go to their defaults.

In Duplex redundancy mode, the block compares outputs received from two CPUs and sets any outputs for which there is disagreement to their Duplex Default state.

Select GMR mode only for blocks that will be part of a Genius Modular Redundancy system as described in the *GMR User's Manual*. **Do not try to configure a block for GMR** mode without referring to the detailed configuration instructions in that book.

Hand-held Monitor Configuration Steps



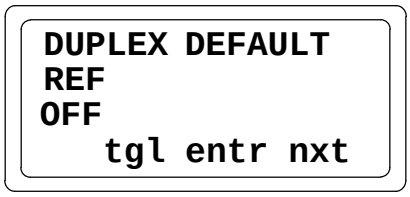
1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

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Duplex Default State

In Duplex Redundancy mode, if the block receives different output states for given points, the block breaks the tie by outputting the Duplex Default State to those points. For new blocks, OFF is selected for all outputs. Change it if outputs should be ON.

Hand-held Monitor Configuration Steps



1. To change the Duplex Default state, press F2 (tgl). Press F3 (entr) to save the new selection.
2. Press F4 (next) to advance to the next configuration display.

Note

If the block loses communications with BOTH CPUs, individual outputs go to their configured Hold Last State or Output Default State.

Configuration Protection

This feature can be used to protect the block's configuration, preventing changes from the CPU or Hand–held Monitor. It can only be selected from the Hand–held Monitor. To make subsequent changes, protection must be removed again using the Hand–held Monitor. For a new block, configuration is unprotected. Before a block is used in the system, its configuration should be protected.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

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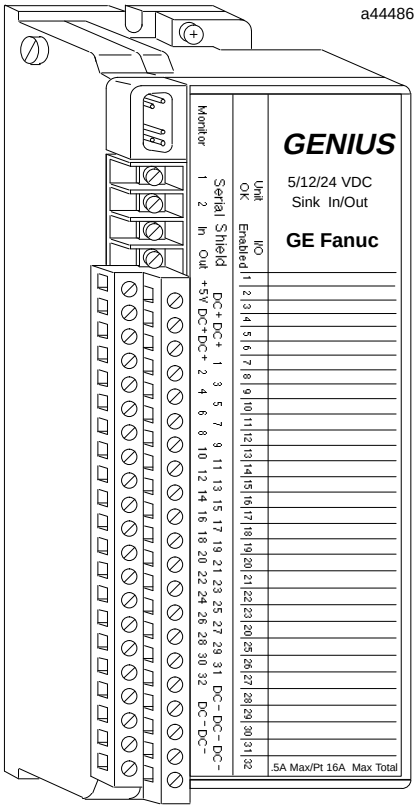
Chapter 9

32 Circuit DC Input/Output Blocks

Two 32–circuit DC blocks are available:

- **32 Circuit 12/24 VDC Source block** (IC660BBD024), which provides current to field output devices.
- **32 Circuit 5/12/24 VDC Sink block** (IC660BBD025), which receives current from field output devices.

Both blocks operate at a nominal 12 to 24 volts DC. The Sink version is also +5 volt TTL–compatible.



Features

32–Circuit DC I/O Blocks interface to a wide range of input devices, including both 2–wire and 3–wire electronic proximity switches. Outputs may be low–power control and indicating devices such as relays, contactors, and lamps.

These blocks have 32 identical discrete I/O circuits, each easily configured to be an input or an output. Output circuits can be directly connected to input circuits without the use of other components or inversion of logic states. This flexibility provides maximum design and application efficiency.

Each circuit contains built–in protection when used as an output, protecting the driver while allowing short–time surges. It also protects against shorted loads caused by wiring errors.

Block LEDs indicate proper block operation and CPU communications.

Fault reporting can be enabled or disabled circuit–by–circuit. Additional configurable features include:

- Output Pulse Test capability
- Selectable Input Filter Time from 1mS to 100mS
- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy type
- Bus Switching Module control*

Compatibility

These blocks are compatible with a phase B Hand–held Monitor (IC660HHM501) only. For the Series Six PLC, a phase B Bus Controller (IC660CBB902 or 903) or a phase A Bus Controller (IC660CBB900 or 901) version 1.3 or later is required. They are compatible with all other GE Fanuc Genius bus controllers, PCIM, and QBIM modules.

* If used to control operation of a Bus Switching Module, BSM IC660BSM021 is required. The block must operate at 18 volts or above.

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Specifications

Block Type:		DC 32-circuit discrete input and output
Catalog Numbers:		
32 Circuit 12 / 24 VDC Source:	I / O Block	IC660BBD024
	Terminal Assembly	IC660TBD024
	Electronics Assembly	IC660EBD024
32 Circuit 5 / 12 / 24 VDC TTL Sink:	I / O Block	IC660BBD025
	Terminal Assembly	IC660TBD025
	Electronics Assembly	IC660EBD025
Size (height x width x depth):		8.83" (22.44cm) x 3.56" (9.05cm) x 4.42" (11.23cm)
Weight		4 lbs. (1.8 kg)
LEDs (I/O Block)		Unit OK, I / O Enabled
LEDs (each circuit)		Individual logic side indicators
Block to Block Isolation		850V
Heat Dissipation		11W minimum with 8 inputs 18W maximum with 32 outputs at .5 amp
Operating voltage (single source)		10 to 30 VDC (12 / 24 V supply) 4.9 to 5.3 VDC (5 V supply) (sink model only) absolute instantaneous limit
Ripple (maximum)		10% (12 / 24 volts), 1% (5 volts)
Required DC power		150 mA typical, 300 mA maximum
Power supply dropout times		4 mS at 12 volts, 20 ms at 24 volts
Input Characteristics:		
Input voltage relative to (DC–)		**Source Blocks** / **Sink Blocks**
Input ON,	5 VDC supply	not applicable / 0–0.8 VDC
	12 VDC supply	8–12 VDC / 0–4 VDC
	24 VDC supply	18–24 VDC / 0–6 VDC
Input OFF	5 VDC supply	not applicable / 2–5 VDC
	12 VDC supply	0–6 VDC / 6–12 VDC
	24 VDC supply	0–12 VDC / 12–24 VDC
Input impedance (typical)		3.3 K ohms
Input processing time (typical)		1.4 mS (plus selectable filter delay)
Selectable input filter times		1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100mS
Output Characteristics:		
Maximum output current (steady state)		0.5 amps per circuit
Maximum inrush current		4 amps up to 10 mS (once every .5 sec. maximum)
Block output current (total)		16 amps
Output OFF leakage current (maximum)		10µA
Output turn–on delay (maximum)		0.5 mS
Output voltage drop		2.0 volts maximum at 4 amps inrush
Output Diagnostics		Switch Fault
Environmental:		
Operating temperature		0 C to +60 C (+32 to +140 F)
Storage temperature		–40 to +100 C (–40 to +212 F)
Humidity		5% to 95% (non–condensing)
Vibration		5–10Hz 0.2" (5.08mm) displacement, 10–200Hz at 1G

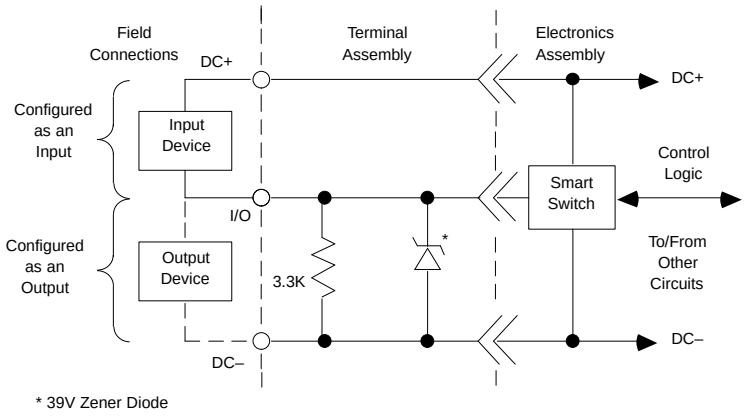
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Block Operation

The block has 32 identical I/O circuits, each of which can be configured as an input or an output. If the block is configured as a combination block, output feedback is provided in the corresponding input references.

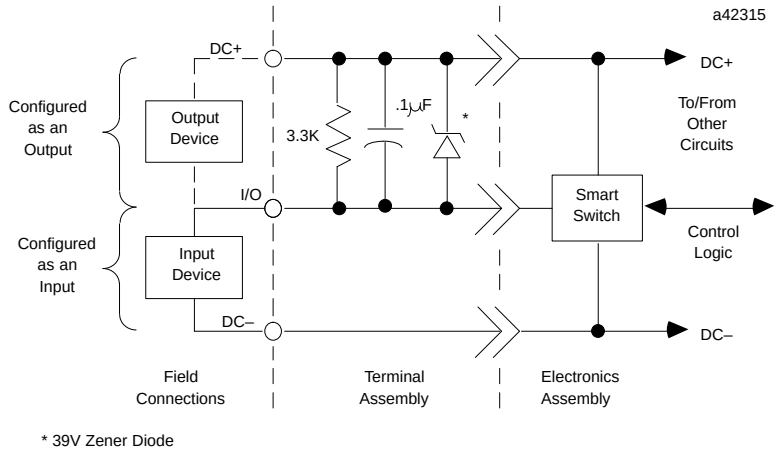
32 Circuit DC Source I/O Block

A 32 Circuit DC Source I/O Block has all output devices connected to the negative (–) side of the power supply. Inputs control the positive (+) side of the power supply. For outputs, an ON condition is logic 1 and an OFF condition is a logic 0.



32 Circuit DC Sink I/O Block

A 32 Circuit DC Sink I/O Block has all output devices externally connected to the positive (+) side of the power supply. Inputs control the negative (–) side of the power supply. For outputs, an ON condition is logic 0 and an OFF condition is a logic 1. When outputs in a sink–type block are connected to inputs in a sink type block, a logic 1 command to the output will turn the output ON and produce a logic 1 to the PLC.



Circuit LEDs

Each circuit has its own LED. If the circuit is configured as an input, the LED indicates the presence of threshold voltage at the input terminal. If the circuit is configured as an output, the LED indicates the actual state of the load.

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Inputs and Outputs

The block can be configured as an inputs–only, outputs–only, or combination block. Regardless, the block always sends 4 bytes of data each bus scan, and accepts 4 bytes of data each bus scan.

If the block is configured as an inputs–only block, all circuits must be inputs. The block will use 32 input references and NO output references.

If the block is configured as an outputs–only block, all circuits must be regular outputs; no feedback analysis can be performed. The block will use 32 output references and NO input references.

If the block is configured as a combination block, it can have any mix of input and / or output circuits. The block will use 32 input references and 32 output references. The actual state of each output circuit will be returned to the CPU in the corresponding input reference location. The CPU can monitor the feedback state to verify (after an appropriate delay) that the output switching device has operated properly and that the load has the proper voltage and current applied.

Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Input Data Format

A 32 Circuit DC I / O Block broadcasts 4 bytes of input data each bus scan.

Byte #	Description
0	Inputs 1 – 8 (input 1 in bit 0)
1	Inputs 9 – 16 (input 9 in bit 0)
2	Inputs 17 – 24 (input 17 in bit 0)
3	Inputs 25 – 32 (input 25 in bit 0)

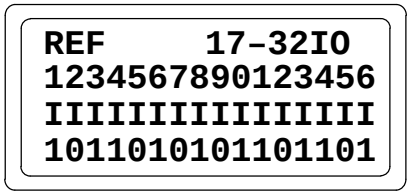
Output Data Format

The block receives 4 bytes of output data from the bus controller each bus scan.

Byte #	Description
0	Outputs 1 – 8 (output 1 in bit 0)
1	Outputs 9 – 16 (output 9 in bit 0)
2	Outputs 17 – 24 (output 17 in bit 0)
3	Outputs 25 – 32 (output 25 in bit 0)

Hand–held Monitor I/O Display

The Hand–held Monitor displays the current states of 16 circuits at a time on line 4 of the Monitor Block screen. Press a function key to see the next 16 circuits.



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Diagnostics

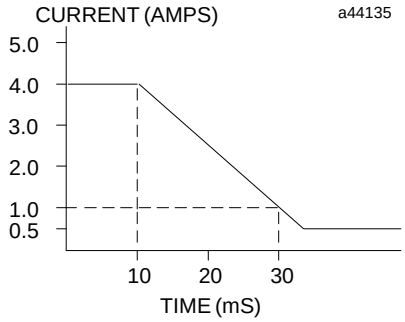
The block monitors outputs for overload conditions, and checks the actual state of each output switch against its commanded state. The block reports all faults to the Hand–held Monitor. Individual circuits can be configured not to report faults to the CPU.

Short Circuit diagnostic

If the output is commanded to go on and current exceeds 5 amps for 1mS, the block automatically turns the circuit off and sends a FAILED SWITCH message. The circuit must be reset by cycling power to the block, or by sending a Clear Faults command from the Hand–held Monitor or the CPU.

Surge Current Protection

These blocks handle steady–state loads of 0.5 amps during normal operation. They will safely switch loads between 0.5 amps and 4 amps, as shown below. To protect the block, surge currents should not exceed these levels. For example, a surge current of 4 amps should not be more than 10mS in duration. A surge current of 1 amp should not exceed 30mS.



Caution

Failure to operate a circuit within these limits may result in thermal overload and damage to the block. The electronic protection will not turn the load off until the current reaches 5 amps.

Overcurrent Protection

If an output is commanded to go on and the load exceeds 5 amps for 1mS, the block automatically turns off the circuit, and sends the FAILED SWITCH message. The circuit must be reset by cycling power to the block, or by sending a Clear Faults command to the block.

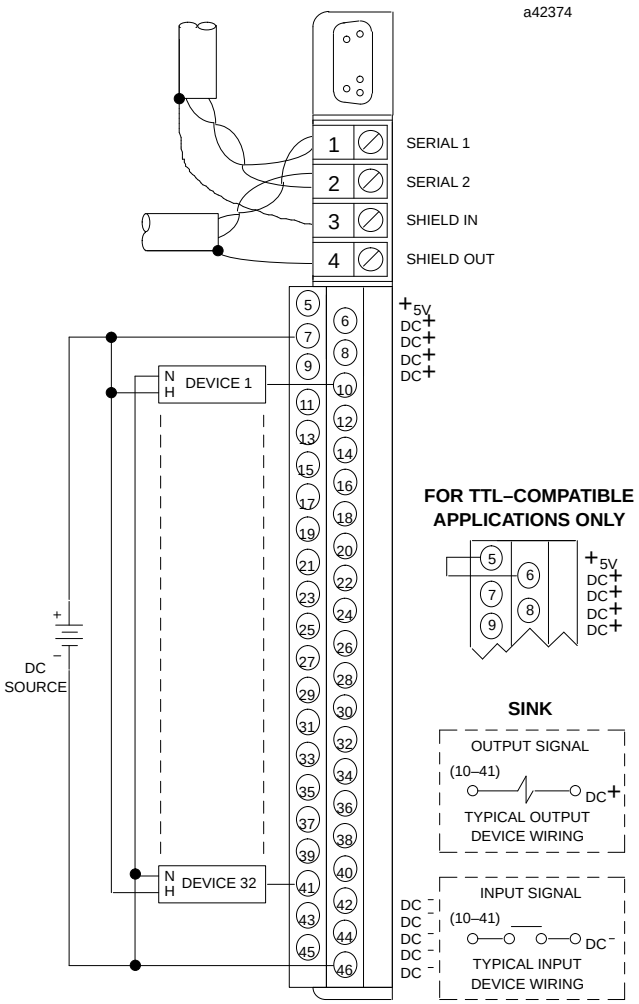
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Field Wiring

Field devices are wired to terminals 5–32, which accept two#14 solid wires, or two #16 stranded wires. Do not overtorque the terminal screws.

Sink Block

Any circuit can be an input or output. Connect one terminal of a field device to DC power and the other to the block (terminals 10–41). All I/O devices must return to the same power circuit. Connect outputs to the positive side of the power supply and inputs to the negative side.



For block power, connect a DC source to the DC+ terminals (6–9) and the return to the DC– terminals (42–46). Depending on layout and current loads, positive and negative connections can be bussed and made by single wires to the block or power source.

Caution

Do not apply more than 5.25 volts to the +5V terminal. Damage to the block might result.

For 5 volt Sink applications only, jumper the +5V terminal to any DC+ terminal.

Caution

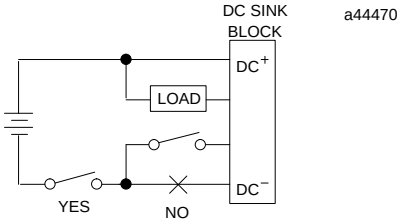
For 12 or 24 volt sink applications, do not jumper the +5V terminal to DC+. It will damage the block. Leave the +5V terminal open.

DC Sink Block, Power Disconnects

Since block power is the same as circuit power, it is important to wire block power disconnects so that block power and input power will be removed at the same time.

Caution

If circuit power is not removed at the same time as block power, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.

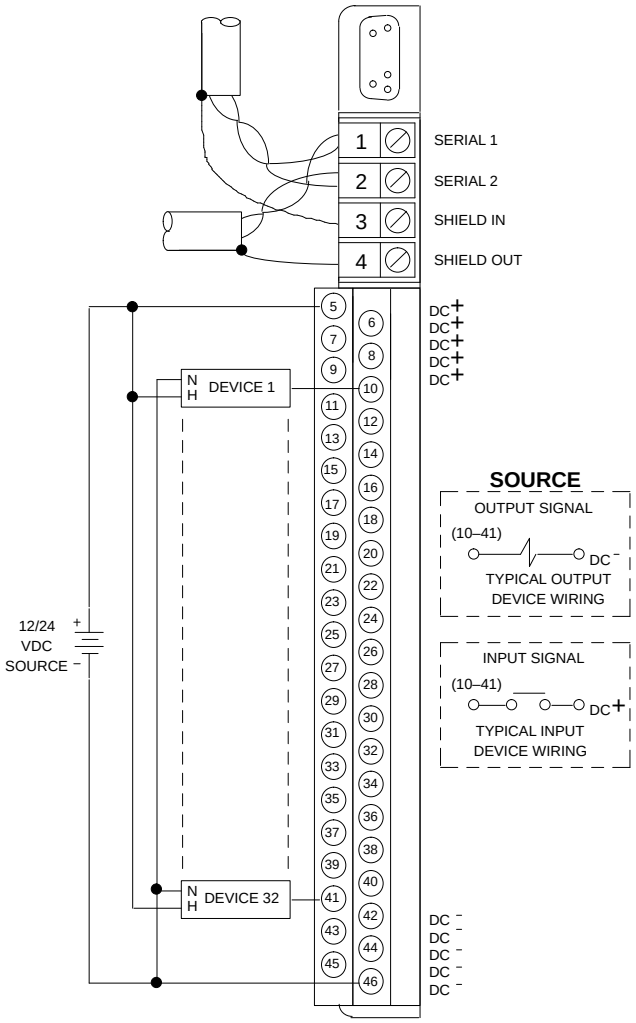


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Field Wiring: Source Block

For a Source block, connect outputs to the negative side of the power supply and inputs to the positive side.

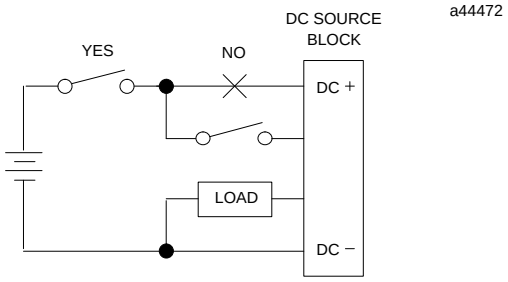
a43020



Block Power Disconnects

Since block power is the same as circuit power, it is important to wire block power disconnects so that block power and input power will be removed *at the same time.*

a44472



Caution

If circuit power is not removed at the same time as block power, the block may power up when multiple inputs are activated, even though one leg of power has been removed from the block.

Wiring for a Bus Switching Module

If the block will be used as a BSM Controller, connect the Bus Switching Module like a load to circuit 1. Connect either of the BSM's pigtail wires to terminal 10. For a DC Sink block, connect the other BSM wire to DC+. For a DC Source block, connect the other BSM wire to DC–.

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Block Configuration

The configurable features of a 32 Circuit DC Input / Output Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Block I / O Type*	Block	input	input, output, combination
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Pulse Test for Outputs	Block	enabled	enabled, disabled
Input Filter Time	Block	20mSec	1, 2, 3, 4, 5, 10 to 100mSec in 10mS steps
Block I / O Type	Block	input	input, output, combination
Circuit I / O Type	Circuit	input	input, output
Report Faults	Circuit	yes	yes, no
Hold Last State	Circuit	no	yes, no
Output Default State	Circuit	off	on, off
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 or 10 sec
CPU Redundancy	Block	none	none, hot standby, duplex, GMR
Duplex Default	Block	off	on, off
Configuration Protection	Block	disabled	enabled, disabled

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the features of each 32 Circuit DC Input / Output block should be decided upon, then recorded on a copy of the Configuration Worksheet printed on the next page.

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32 Circuit DC I/O Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____
Block Number (0–31) _____ Block Type (Input/Output/Combination) _____
Reference Address _____ through _____
Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb)
Pulse Test (Enabled/Disabled) _____ Input Filter Time (1–100) mS _____

Redundancy Features:

Redundancy Mode (None/Standby/Duplex, GMR)_____ Duplex Default (on/off) _____
BSM Present (Y/N)_____ BSM Controller (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

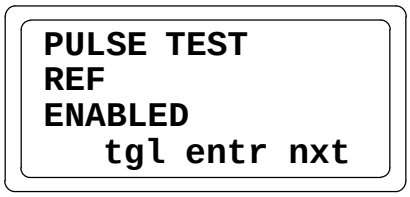
Ckt #	Reference Address	I/O Type (I/O)	Report Faults (yes/no)	(output) Hold Last State (yes/no)	(output) Default State (ON/OFF)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					

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Pulse Test

Pulse Testing verifies the ability of a block's outputs to change state. A new block is configured to enable Pulse Testing. Pulse Testing should remain enabled if the block has loads that hold one state for long periods of time, *unless any load(s) are sensitive to pulses or interruptions.* It should be disabled if the block's loads will normally change state as the program executes. These will report faults during normal operation, and do not need to be pulsed.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl). Press F3 (enter).
2. Press F4 (next) to advance to the next configuration display.

Pulse Testing Outputs

If Pulse Testing is enabled, the block will pulse its outputs on command from either a Hand–held Monitor or the CPU. Pulse Testing checks the continuity of an output circuit including the switch device, power source, wiring, interposing devices (fuses, circuit breakers, terminals), and output device. It can be commanded from the Hand–held Monitor or the CPU. It works whether or not there is minimum current to check for a No–Load condition. Pulse Testing will not activate mechanical devices such as motor starters, relays, or solenoid valves.

Pulse Testing will momentarily cause outputs that are OFF to turn ON for 1mS and outputs that are ON to go OFF for 1mS. Failure of the Pulse Test causes the following message:

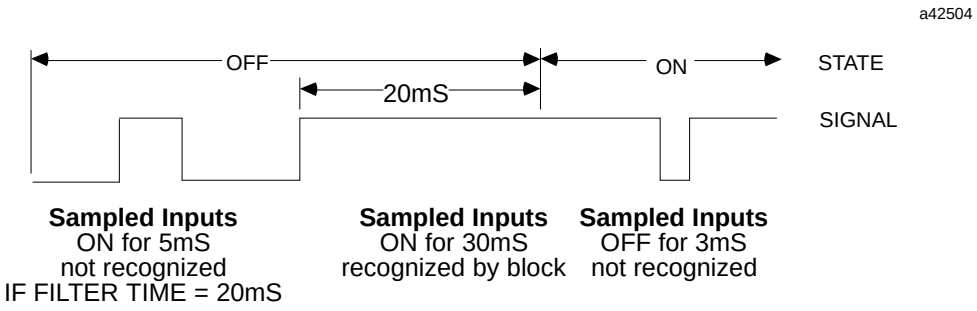
Failed Switch: If the output does not change state when pulsed for up to 1mS, or if current exceeds 5 amps for 1mS.

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Input Filter Time

A filter time can be selected for inputs on the block. (The same filter will apply to all inputs). The default filter time is 20mS.

The block continously samples an input for the length of the filter time period. If the input remains either on or off for the length of the Filter Time, the block recognizes its state. For example:



An input filter helps reject spurious noise spikes and multiple inputs generated by the bounce of mechanical devices. In controlled, noise–free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, no additional filter time is needed.

In noisy environments, select a longer filter time to prevent noise from possibly causing erratic or unsafe system operations. The filter time can be 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100mS.

Hand-held Monitor Configuration Steps

```
INPUT FILTR TIME
REF
FILTER=   10mS
   tgl entr nxt
```

1. The screen displays the currently–selected filter time. If this time should be changed, press F2 (tgl) to display the other filter times.
2. To save a new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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I/O Circuit Type

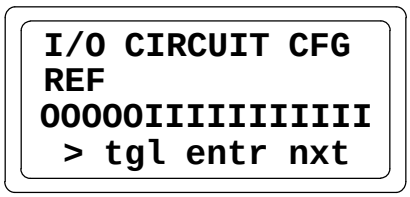
An earlier configuration step selected the Block I/O type (on the Program Block ID screen). That step determined whether the block would be assigned all input references, all output references, or both. On the screen shown below, the I/O type of each circuit can be specified.

The default Block I/O Type and I/O Circuit Type is Input. When the Block I/O Type is **Input**, all circuits must be inputs.

If the Block I/O Type is **Output**, each circuit must be an output (O).

If the Block I/O Type is **Combination**, each circuit can be configured as an input (I) or an output (O).

Hand-held Monitor Configuration Steps



1. Line 3 shows the I/O type of circuits 1 to 16. To select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to display the I/O circuit type of circuits 17–32.
4. Press F4 (next) from the second screen I/O circuit type screen when you are ready to advance to the next configuration screen.

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit on a block.

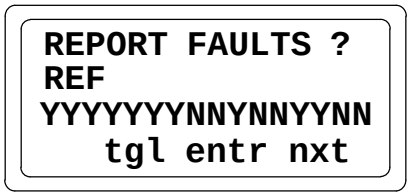
If fault reporting is enabled for a circuit, the block will send a message to the host if any fault occurs on that circuit.

If Fault reporting is disabled, the block will not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block will detect faults on the circuit, and take appropriate actions. The Unit OK LED will blink when a fault occurs, and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Fault Reports selections for the first 16 circuits. On this screen,

   Y = report faults.

   N = do not report faults.

2. To select a circuit, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) to display the Report Faults screen for circuits 17–32.
5. From the second Report Faults screen, press F4 (next) when you are ready to advance to the next configuration display.

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Hold Last State

Each output can be independently configured to either hold its last state or to go to its powerup default state if the block loses CPU communications for at least 3 bus scans.

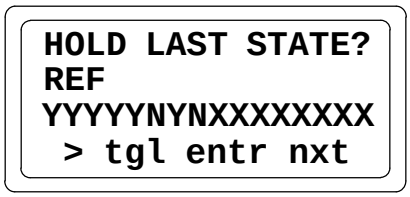
For a new block, Hold Last State is disabled for each output. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output in its current state instead of setting it to the powerup default.

Outputs remain in their last state or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. Line 3 displays the current Hold Last State configuration of circuits 1–16. On this screen,

   Y = hold last state.

   N = go to default state (configured on the next HHM screen)

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) to display the Hold Last State screen for outputs 17–32.
6. Press F4 (next) from the second Hold Last State screen when you are ready to advance to the next configuration display.

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Output Default State

An output goes to its powerup default state when the block is first powered up.

If Hold Last State was NOT enabled, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed. (Additional default time for redundancy is explained on page 9-17).

Hand-held Monitor Configuration Steps

```
OUTPUT DEFAULT
REF
X1X1X1X0X0X0X0X0
 > tgl entr nxt
```

1. Line 3 shows the Output Default state configuration of circuits 1–16. On this screen,

   0 = the output default state is off.

   1 = the output default state is on.

   X = the circuit has been configured as an input.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 to display the Output Default screen for circuits 17–32.
6. From the second Output Default screen, press F4 (next) when you are ready to advance to the next configuration display.

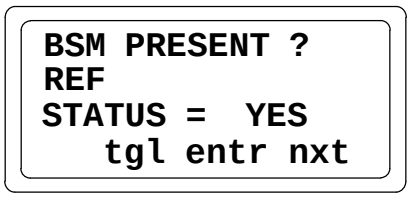
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO.

Select YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



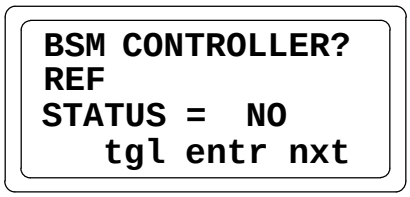
1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. Selecting a block to be a BSM Controller block has no effect on the block's I/O type – the block can still be configured as an inputs–only block, but circuit #1 cannot be physically used as an input. The first circuit will not be under CPU control.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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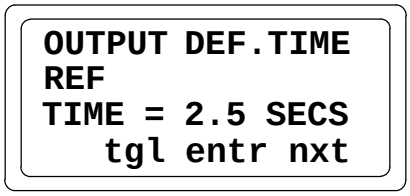
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, outputs will remain in their last state, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any output on a block, and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller redundancy, Hot Standby or Duplex redundancy, or Genius Modular Redundancy (GMR). For new blocks, No Controller Redundancy is selected.

In Hot Standby mode, a block receives output data from two CPUs but uses the data from only one to drive its outputs. The block prefers outputs sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If those outputs are not available, the block will use outputs from the bus interface module with Device Number 30. If no outputs from either are available, the block's outputs will either Hold Last State or go to their defaults.

In Duplex redundancy mode, a block compares outputs received from two CPUs and sets any outputs for which there is disagreement to their Duplex Default state (explained next).

Select GMR mode only for blocks that will be part of a Genius Modular Redundancy system as described in the *GMR User's Manual*. **Do not try to configure a block for GMR** mode without referring to the detailed configuration instructions in that book.

Hand-held Monitor Configuration Steps



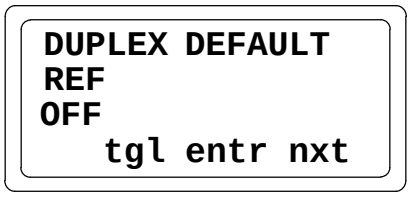
1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

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Duplex Default State

In Duplex Redundancy mode, if the block receives different output states for given points, the block breaks the tie by outputting the Duplex Default State to those points. For new blocks, OFF is selected for all outputs. Change it if outputs should be ON.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

Note

If the block loses communications with BOTH CPUs, individual outputs go to their configured Hold Last State or Output Default State.

Configuration Protection

This feature can be used to protect the block's configuration, preventing changes from the CPU or Hand–held Monitor. It can only be selected from the Hand–held Monitor. To make subsequent changes, protection must be removed again using the Hand–held Monitor. For a new block, configuration is unprotected. Before a block is used in the system, its configuration should be protected.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

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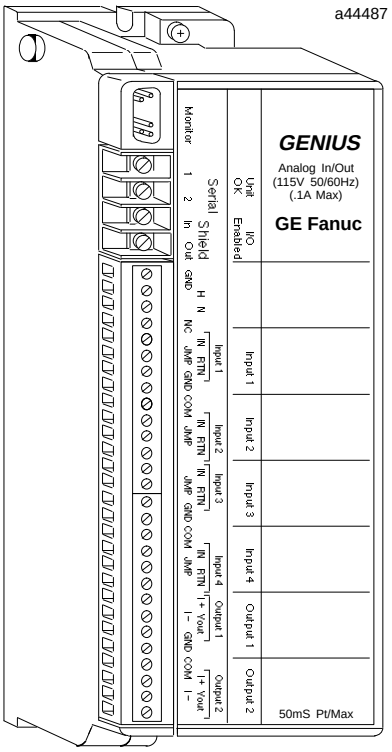
Chapter 10

Voltage/Current Analog Input/Output Blocks

Voltage / Current 4 Input / 2 Output Analog Input / Output Blocks have four independent input circuits and two independent output circuits. Two block versions are available:

- **115 VAC Analog I/O Block** (IC660BBA100)
- **24/48 VDC Analog I/O Block** (IC660BBA020)

They are identical except for the power supply.



Features

Each circuit on a Voltage / Current Analog I / O Block can accept or provide signals in one of five analog ranges: 0 to 10 volts DC, –10 volts DC to +10 volts DC, –5 volts DC to +5 volts DC, 0 to 5 volts DC, or 4 to 20 mA (1 to 5 volts DC). External resistance can be used to interface these blocks to current–loop devices with other signal ranges.

The block converts the input and output signal levels to / from digital count values and translates them into engineering units values that relate to the application.

The block's internal power supply drives current mode output loads up to 300 ohms each. For loads up to 2K ohms, an external 24 or 48 VDC power supply can be used. For current-loop applications, Current-source Analog blocks may be more suitable. See chapters 11 through 13.

Individual inputs can be set up to operate in Alarm Input Mode. In this mode, the input's analog value is not sent to the HHM or the CPU. Instead, the block will report values that indicate whether the input signal exceeds either of its alarm levels.

Additional configurable features include:

- Selectable Input Filter Time up to 1024mS
- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy

Block diagnostics are performed automatically:

- Input Low Alarm and High Alarm detection
- Open Wire detection
- Input Underrange or Overrange
- Output Underrange or Overrange

Compatibility

These blocks are compatible with all Genius bus controllers, PCIM and QBIM modules. Any Genius Hand–held Monitor can be used.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus, rev. 110 or later is required. The programming software must be Logicmaster™ Six rel. 4.02 or later.

For a Series Five™ PLC, the CPU must be rev. 3.0 or later. The Logicmaster Five programming software must be rel. 2.01 or later.

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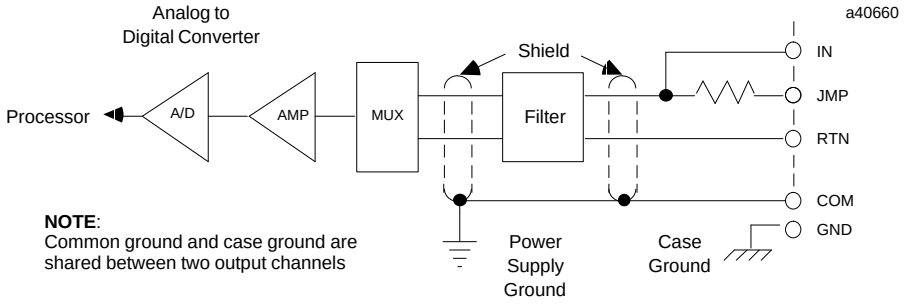
Specifications

Block Type:	4 input / 2 output circuits	
Catalog Numbers:		
115 VAC Analog I / O Block	IC660BBA100	
Terminal Assembly only	IC660TSA100	
Electronics Assembly only	IC660EBA100	
24 / 48 VDC Analog I / O Block	IC660BBA020	
Terminal Assembly only	IC660TSA020	
Electronics Assembly only	IC660EBA020	
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)	
Weight:	4 lbs. (1.8 kg)	
LEDs (block):	Unit OK, I / O Enabled	
Block to Block Isolation:	1500 V	
Heat Dissipation:	6 Watts	
Block Power (nominal):	**115 VAC**	**24/48 VDC**
Operating range	98–132 VAC	18–56
Maximum power	10 VA	8W
Frequency / ripple	47–63 Hz	10% max. ripple
Power supply dropout time	1 cycle	10mS
Common mode rejection:	60 dB (0–1 KHz)	
Common mode voltage:	" 170 volts, maximum	
Absolute accuracy (at 25C):	Typical: " 0.2% of full scale; Maximum: " 0.5% of full scale: within 50mV on the 10 volt range, 25mV on the 5 volt range, and 100mA on the 4 to 20 mA range.	
Thermal drift (from 25C):	Typical: 10 PPM per C; Maximum: 40 PPM per C	
Circuit range selections:	0–10 VDC, " 10 VDC, " 5 VDC, 0–5 VDC, 4–20 mA (or 1–5 VDC)	
Input Characteristics:		
Input resolution	12 bit + sign	
Input update frequency	Once every 4mS	
Input filter ranges	none, 8, 16, 32, 64, 128, 256, 512, 1024mS	
Input diagnostics	Underrange, Overrange, High Alarm, Low Alarm, Open Wire	
Output Characteristics:		
Output resolution	12 bit + sign	
Output update frequency	Once every 4mS	
Output diagnostics	Underrange, Overrange.	
Output load	Voltage mode: 2000Ω or greater; Current mode: 0 to 300Ω	
Environmental:		
Operating temperature	0 to 60C (+32 to 140F)	
Storage temperature	–40 to +100C (–40 to +212F)	
Humidity	5% to 95% (non–condensing)	
Vibration	5–10 Hz 0.2" (5.08mm) displacement; 10–200 Hz at 1G	

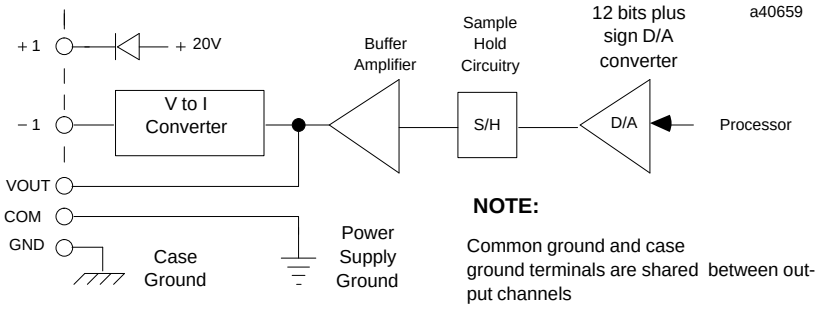
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Block Operation

The first four circuits on a Voltage / Current Analog I / O block are inputs. One 12–bit analog to digital (A / D) converter is time–shared between the input circuits. The block converts each input signal voltage or current to a digital count value. It then scales the count value to an integer that represents the engineering units for that input.



Circuits 5 and 6 are outputs. A 12–bit digital to analog (D / A) converter serves the output circuits. The block scales the engineering units output received from the CPU to a digital count value. It then converts the count value to an output signal voltage or current.



Accuracy is within " 0.5% maximum, " .2% typical over the entire span of the reading at 25C. This means accuracy is within 50mV on the 10 volt range, 5mV on the 5 volt range, and 100µA on the 4 to 20 mA range. The blocks automatically calibrate all internal A / D and D / A circuits periodically during normal operation.

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Inputs and Outputs

Each engineering units input and output is a 16–bit twos complement number. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Input Data Format

A Voltage / Current 4 Input / 2 Output Analog block broadcasts 8 bytes of input data each bus scan.

Byte #	Description
0	Input channel 1, bits 0 – 7
1	Input channel 1, bits 8 – 15
2	Input channel 2, bits 0 – 7
3	Input channel 2, bits 8 – 15
4	Input channel 3, bits 0 – 7
5	Input channel 3, bits 8 – 15
6	Input channel 4, bits 0 – 7
7	Input channel 4, bits 8 – 15

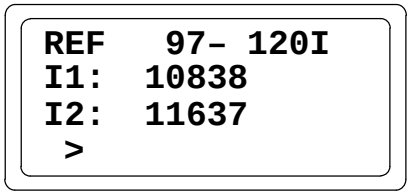
Output Data Format

Each bus scan, the bus controller sends an Analog I / O block 4 bytes of output data.

Byte #	Description
0	Output channel 1, bits 0 – 7
1	Output channel 1, bits 8 – 15
2	Output channel 2, bits 0 – 7
3	Output channel 2, bits 8 – 15

Hand–held Monitor I/O Display

The Hand–held Monitor displays each input or output as a whole integer value. The Monitor Block screen shows the current value of two circuits at a time.



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Circuit Scaling

The block automatically scales each input or output to / from a value in engineering units. This whole integer number can represent any type or increment of units meaningful to the application. For example, if the current value of a temperature input was 116.37F, it might be reported as:

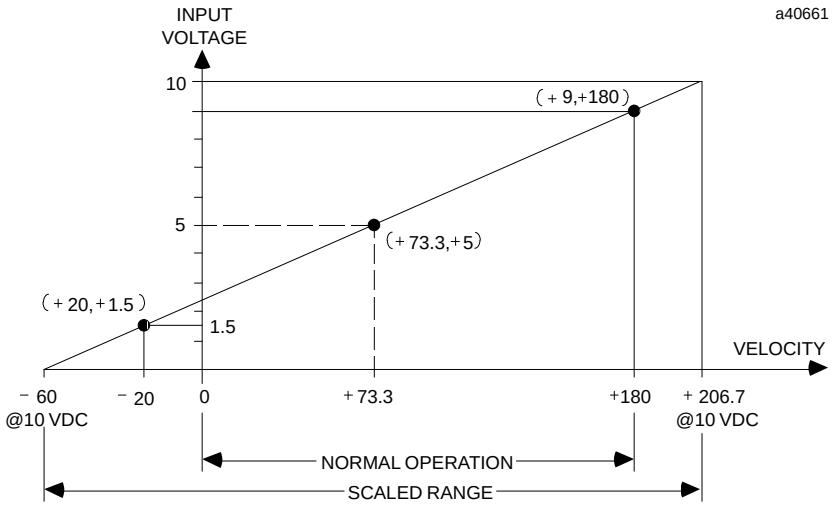
116	degrees, or
1163	tenths of degrees, or
11637	hundredths of degrees

All circuits can be scaled independently, as explained later in this chapter.

Example of Scaling an Analog Circuit

A circuit is configured in the 0 to 10 volts DC range. It measures a velocity input. Electronic sensors and mechanical linkage external to the block have determined that an input level of +1.5 volts DC is equal to –20 feet / second (–6 meters / second), and that +9 volts DC is equal to +180 feet / second (+50 meters / second).

Plotting these values on a graph shows that a signal of 5 volts DC corresponds to a speed of 73.3 feet / second.



Because engineering units values are whole integers, this would be rounded to +00073.

For better resolution, the circuit is reconfigured to units of hundredths of feet / second. New scaling values are configured which are 100 times the original values. The low engineering units value of –20 is reconfigured as –2000. The high engineering units value +180 is changed to +18000. Now, the 5 volt DC signal represents +07333 (hundredths of feet / second).

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Diagnostics

If a fault occurs, the block reports it to the Hand–held Monitor and takes appropriate corrective action.

Individual circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Open Wire Diagnostic

The OPEN WIRE diagnostic detects an open wire at an input terminal. The diagnostic is only available for circuits set to operate from 4 to 20 mA. If the circuit current drops below 2 mA, the block sends an OPEN WIRE message. Nothing is done to alter the actual input data.

Input Low Alarm and High Alarm Diagnostics

Individual low alarm thresholds and high alarm thresholds can be configured for each input.

If an input is over its high alarm limit, the block sends a HIGH ALARM message. If an input is under its low Alarm Threshold, the block sends a LOW ALARM message. The alarm message identifies the input circuit which is in alarm. Only one message is sent upon reaching the limit. Since the input value is supplied as part of the normal input status update, the CPU can determine how much over the limit it is.

Input Underrange and Overrange Diagnostics

The block sends an UNDERRANGE or OVERRANGE message if:

A. The input voltage or current is outside the circuit's configured range. Therefore, when the block converts the signal level to digital counts, the result is lower than –4095 or higher than +4095. To prevent this, the input signal should be clamped appropriately.

B. The channel scaling is incorrect. When the block converts the digital counts value to engineering units, the result is lower than –32,767 or higher than +32,767. This should be corrected by adjusting channel scaling.

Output Underrange and Overrange Diagnostics

The block sends an UNDERRANGE or OVERRANGE message if conversion of the engineering units output it receives from the CPU results in a counts value that corresponds to a signal outside the circuit's configured range. For example, if the output is configured for 0 to +5V and the conversion from engineering units to counts results in a value of –2V at the output, the block sends an UNDERRANGE diagnostic.

If an underrange or overrange condition occurs, the block clamps the output to the selected range limit to protect external hardware.

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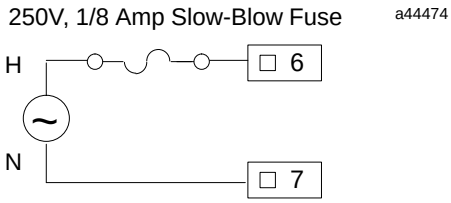
Field Wiring

Field devices are wired to terminals 5–32, which accept AWG #22 through AWG #14 wires. Do not overtorque the terminal screws.

Power Source Wiring

For block power, connect the power source to terminals 6 and 7. For a 24/48 VDC block, connect the source to the DC+ terminal and the return to the DC– terminal. For a 115 VAC block, connect the source to the H terminal and neutral to N.

For the 115 VAC block (IC660BBA100) only, if Class 1 Division 2 conditions must be met for Factory Mutual, install a 250 volt 1/8 amp slow–blow fuse in series with the Hot AC power connector:



Wiring for I/O Devices

The ground (GND) terminal (5) is for block safety. It is connected internally to the block chassis, and to terminals 12, 20, and 28, which are marked GND. Each pair of signals has one ground terminal and one common terminal, for shield termination if desired. The three common terminals are connected together internally to the source.

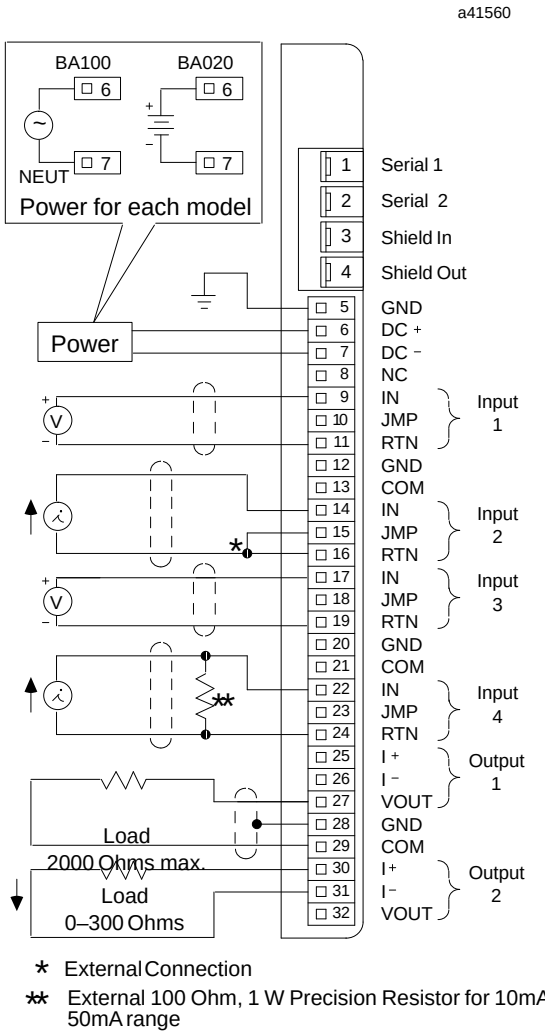
For a voltage input device, connect the device in series between V+ and the terminal marked IN for that input. Connect V– to RTN.

For a voltage output device, connect the load to the terminals marked VOUT and COM for that output.

If current mode (4–20mA) is used for an input circuit without an external resistor, connect a jumper from the terminal marked JMP to the terminal marked RTN for that circuit.

If an input current device operates outside the 4–20mA range, connect a resistor across the voltage inputs. For example, to measure 10mA to 50mA current loop signals, install a 100 ohm resistor.

If current mode is used for an output circuit, use the terminals marked I+ and I–. For outputs set up in current mode, the block's internal power supply can be used to drive loads up to 300 ohms per output. For loads up to 2K ohms, use an external power supply. Connect the positive lead of the external supply to one side of the load, and the negative lead of the external supply to block common on terminal 29. If the external supply is between 24V and 50V, you can use terminal 25 or 30 as a tie point for the positive connection. This point will be disconnected from the external supply by a reverse biased diode.



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Block Configuration

The configurable features of an Analog Input / Output Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Input Filter Time	Circuit	128mS	none, or 8–1024mS
Current / Voltage	Circuit	10VDC	0–10VDC, ± 10VDC, 0–5VDC, ± 5VDC, 4–20mA (1–5VDC)
Report Faults	Circuit	yes	yes, no
Hold Last Value	Circuit	no	yes, no
Output Default Value	Circuit	0	± 32,767
Scaling Points	Circuit	(± 10,000 eng. units, ± 4095 counts)	(± 32,767 engineering units, ± 4095 counts)
Low / High Alarms	Circuit	± 10,000	± 32,767
Alarm Input Mode	Circuit	no	yes, no
BSM Present	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 or 10 seconds
Redundancy Mode	Block	none	none, standby

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

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Voltage/Current 4 Input/2 Output Analog Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Redundancy Features:

Redundancy Mode (None/Standby) _____

BSM Present (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

	Input Circuits				Output Circuits	
	1	2	3	4	5	6
References: From						
To						
Report Faults? (Y/N)						
Range Selection:						
–10 to +10 volts						
0 to +10 volts						
0 to +5 volts						
4mA to 20mA						
–5 to +5 volts						
Scaling Points:						
Low Pt (eng units)						
Low Pt (A/D or D/A units)						
High Pt (eng units)						
High Pt (A/D or D/A units)						
Alarm Input Mode (Y/N)						
Input Filter Time (mS)						
Alarm Thresholds:						
Low (eng units)						
High (eng units)						
Outputs:						
Hold Last State (Y/N)						
Default Values (eng units)						

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit.

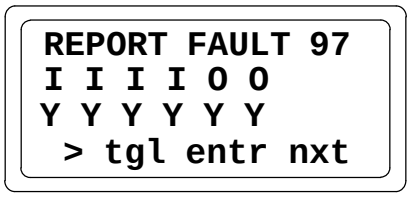
If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit. If fault reporting is disabled, the block does not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block will detect faults on the circuit, and take appropriate actions. The Unit OK LED will blink when a fault occurs, and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps

Line 3 shows the current Report Faults configuration of each circuit (circuits are shown on line 2 for reference).



1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Range Select

For each circuit, select the voltage or current range that corresponds to the signal level of the input or output device:

0 to 10 volts DC
–10 volts DC to +10 volts DC
–5 volts DC to +5 volts DC
0 to 5 volts DC
4 to 20 mA / 1 to 5 volts DC

This matches an input voltage range to the block's internal range of 4095 digital counts. It also sets the limits at which outputs are clamped by the software.

For all current–loop input or output devices, select the 4mA to 20 mA range. Current loop scaling can be changed by installing an external resistor across the voltage inputs. For example, a 100 ohm resistor would be connected across the inputs to measure 10mA to 50mA current loop signals.

The 4mA to 20 mA range can also be selected to improve noise immunity on long input leads. However, it is better to use longer communication cables and voltage sensing where practical than to use long input leads.

Note

Range Selection is a setup parameter; it is not ordinarily changed while the block is operational. If the block sends an UNDERRANGE or OVERRANGE message, adjust the circuit scaling, not the selected range. See page 10-12 for information about circuit scaling.

Hand-held Monitor Configuration Steps

Line 3 shows the range presently selected for the circuit identified on line 2.

```
RANGE SELECT
IN 1  97– 120 I
RANGE: –10V,+10V
  > tgl entr nxt
```

1. To select another circuit for configuration, press F1 (>).
2. To change the range selection for the circuit, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) when you are ready to advance to the next configuration display.

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Circuit Scaling

Each circuit can be configured for a different type or increment of engineering units values. The default configuration for each circuit is to operate in the range of " 10VDC and to report engineering units of millivolts. If those selections are appropriate, the default configuration can be used.

If units of millivolts are not appropriate, or a circuit has been reconfigured to another voltage / current range, it should be rescaled. All that is needed to scale a circuit is two pairs of associated digital count values and engineering units values. These can be taken from the following table or from actual process measurements, or they can be estimates of expected values.

Scaling Values for 1mV or 1µA Engineering Units

If a circuit should use 1mV or 1µA engineering units, configure its scaling by entering values from the table below. (It is not necessary to re–enter the default values).

RANGE Selected	To measure this voltage/ current	Enter the following engineering units value		Enter the following digital count value	
0 to +10V	0 volts	(Low)	0	(Low)	0
	+10 volts	(High)	+10,000	(High)	+4,095
–10V to +10V	–10 volts	(Low)	–10,000	(Low)	–4,095
(default)	+10 volts	(High)	+10,000	(High)	+4,095
–5V to +5V	–5 volts	(Low)	–5,000	(Low)	–4,095
	+5 volts	(High)	+5,000	(High)	+4,095
0V to +5V	0 volts	(Low)	0	(Low)	0
	+5 volts	(High)	+5,000	(High)	+4,095
4 to 20mA	0 mA	(Low)	0	(Low)	0
	20 mA	(High)	20,000	(High)	+4,095
	4 mA	(Low)	4,000	(Low)	+819
	20 mA	(High)	20,000	(High)	+4,095
(+1V to +5V)	0 volts	(Low)	0	(Low)	0
	+5 volts	(High)	+5,000	(High)	+4,095
	+1 volt	(Low)	+1,000	(Low)	+819
	+5 volts	(High)	+5,000	(High)	+4,095

Measuring Scaling Values

If the circuit will not use mV / µA units, the most accurate scaling values can be found by taking actual measurements of the process. The process must be set to two distinctly different conditions, so two engineering units measurements can be taken. If the block is online to the process, it will automatically provide the digital count value associated with each engineering units measurement. If the block is not online to the process, the input or output voltage or current associated with each engineering units value must also be measured external to the block.

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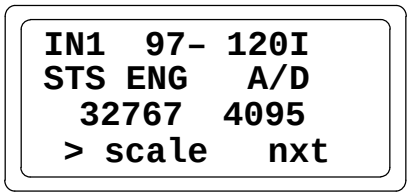
Scaling Guidelines

1. Pick two different digital count values from –4095 to +4095, depending upon the range of the circuit. These count values must differ by at least 2.
2. Pick two different engineering units values from –32767 to +32767. These values must also differ by at least 2.
3. Check the values by drawing a graph with engineering units as the horizontal axis and counts as the vertical axis. Locate both pairs of values on the graph, and draw a connecting line between them. The line must cross the engineering units axis between –32767 and +32767. That is, zero (0) counts must correspond to a number of engineering units in this range. The slope of the resulting line should be between 1/200 and 200 (for a positive slope) or between –1/200 and –200 (for a negative slope). Values outside this range will be accepted by the block (provided other requirements are met), but may not yield satisfactory accuracy during internal calculations.
4. The values selected should provide the greatest range of engineering units values without exceeding " 32767.

Entering Scaling Values

If you are NOT measuring the process while scaling the circuit, have the two pairs of scaling values ready. If you ARE measuring the process to scale the circuit, set the process to one of the two conditions being measured.

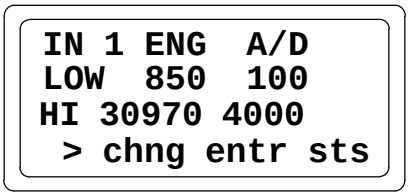
Hand-held Monitor Configuration Steps



1. The next configuration screen after the Range Select screen is this status screen. Line 1 shows which circuit is selected for configuration. If you want to scale a different circuit, press F1 (>).
2. If you are NOT measuring the process with the block online, go to step 4.

   If you are measuring the process with the block online, continue at step 3.
3. Line 3 shows an engineering units value and count value for the circuit. The block has calculated the engineering units value, on the left, based on the present scaling. If the scaling is wrong, the engineering units value is wrong too. With the block online, the digital count value on the right is the numerical equivalent of the actual circuit circuit voltage or current being measured. Make a note of this value; you will need it to complete the next screen.

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4. Press F2 (scale) to scale the circuit.
5. Line 2 of the HHM screen shows the circuit's low pair of engineering unit and digital count values. Line 3 shows a higher pair. All values on this screen are configured (not measured) values. Pressing F1 (>) moves the cursor.
6. Enter the engineering units value(s). After each entry, press F3 (entr).
7. Enter the associated count value(s).
   A. If you are measuring the process online, enter the digital count value from the HHM's status screen.
   B. If you are measuring the process with the block offline, find the voltage or current level of the signal. Convert the voltage or current to a count value by multiplying it by the number below that corresponds to the circuit's configured range, or by looking up the count value in the table on the next page.

Range Selected for Circuit	Multiply Measured Volts or mA by this Number
0 to +5V or –5V to +5V	819
0 to +10V or –10V to +10V	409.5
4mA to 20mA	204.75

8. To save the new entries for a circuit, press F3 (entr) again.
9. If you are using measured values, set the process to a distinctly different condition. Repeat the necessary steps above.
10. Press F4 (nxt) to return to the status screen. From the status screen, select F1 (>) to select another circuit for scaling.
11. When you are finished scaling circuits, press F4 (nxt) to configure additional block features.

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Equivalent Analog Voltages, Currents, and Digital Counts

Note

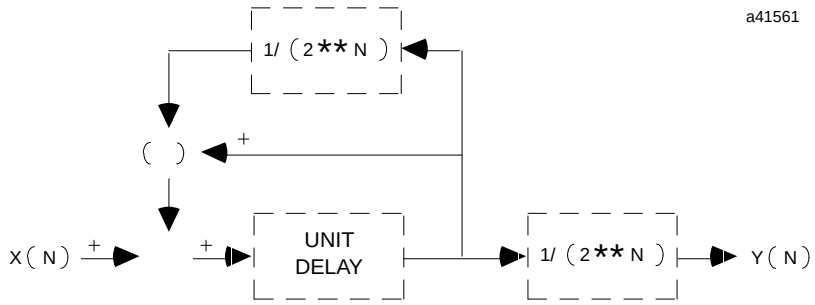
The following table shows the digital counts value associated with selected voltage/current levels. If the measured voltage or current lies between these values, use the multiplier on the previous page to find its associated counts value.

Range			COUNTS	Range			COUNTS
to " 5V	to " 10V	mA		to " 5V	to " 10V	mA	
0.000	0.00	0.00	0	2.625	5.25	10.50	2149
0.125	0.25	0.50	102	2.750	5.50	11.00	2252
0.250	0.50	1.00	204	2.875	5.75	11.50	2354
0.375	0.75	1.50	307	3.000	6.00	12.00	2457
0.500	1.00	2.00	409	3.125	6.25	12.50	2559
0.625	1.25	2.50	511	3.250	6.50	13.00	2661
0.750	1.50	3.00	614	3.375	6.75	13.50	2764
0.875	1.75	3.50	716	3.500	7.00	14.00	2866
1.000	2.00	4.00	819	3.625	7.25	14.50	2968
1.125	2.25	4.50	921	3.750	7.50	15.00	3071
1.250	2.50	5.00	1023	3.875	7.75	15.50	3173
1.375	2.75	5.50	1126	4.000	8.00	16.00	3276
1.500	3.00	6.00	1228	4.125	8.25	16.50	3378
1.625	3.25	6.50	1330	4.250	8.50	17.00	3480
1.750	3.50	7.00	1433	4.375	8.75	17.50	3583
1.875	3.75	7.50	1535	4.500	9.00	18.00	3685
2.000	4.00	8.00	1638	4.625	9.25	18.50	3787
2.125	4.25	8.50	1740	4.750	9.50	19.00	3890
2.250	4.50	9.00	1842	4.875	9.75	19.50	3992
2.375	4.75	9.50	1945	5.000	10.00	20.00	4095
2.500	5.00	10.00	2047	5.000	10.00	20.00	4095

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Input Filter Time

Each analog input can have its own filter time. The filter integrates the value of the input signal over time to reject noise. Operation of the filter is shown below.



In controlled, noise–free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, a longer filter time is not needed.

Selections are: none, 8, 16, 32, 64, 128, 256, 512, or 1024mS. For a new block, this is set to 128mS. To remove the filter, specify the unfiltered value (code 0, filter time = none).

Hand-held Monitor Configuration Steps

```
INPUT FILTR TIME
IN1          97
FILTER=   128mS
   tgl entr nxt
```

1. Line 3 shows the selected filter time. If this is not appropriate, press F2 (tgl) to change it.
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Alarm Input Mode

Ordinarily, the block sends the current value of each input circuit, in engineering units, to the CPU. This is referred to as the analog block's normal mode of operation. For a new block, all inputs are set to operate in Normal Mode.

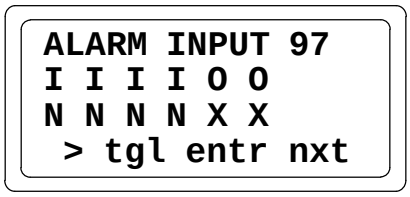
For some applications, it may be preferred to send an alarm status indication instead of the actual analog input value for one or more circuits. This is referred to as Alarm Input mode. In this mode, the analog value normally sent to the CPU is replaced by the value 0, 1, or 2 (decimal):

0 if the signal lies between the block's two alarm thresholds.

1 if the signal lies at or below the low alarm threshold.

2 if the signal lies at or above the high alarm threshold.

Hand-held Monitor Configuration Steps



1. The screen displays the present input mode of all circuits. On this screen,

   N = normal input mode (analog value is reported).

   Y = Alarm Input mode (only alarm status is reported)

   X = the circuit is an output.

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) to advance to the next configuration display.

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Alarm Thresholds

Each input circuit can have two unique Alarm Thresholds, one for a low engineering units value and one for a high value. Maximum values are " 32,767. The high threshold should be greater than the low threshold. Threshold limits are based on circuit scaling. If scaling is changed, review and readjust the Alarm Thresholds if necessary.

Alarm Thresholds may be used for either normal–mode or alarm–mode inputs (see above). In normal mode, if an input reaches one of the thresholds, the block sends the actual value and a LOW ALARM or HIGH ALARM message. The message identifies the circuit in alarm. Only one message is sent upon reaching the limit. Alarms do not stop the process or change the value of the input.

Alarm Thresholds can be set anywhere over the dynamic range of the signal. Typically, they are set at levels beyond which the input should not operate or levels beyond which alternate processing is required. They can also be set beyond the dynamic range of the signal, ensuring that they will never be activated.

Example 1:

A circuit is expected to report engineering unit values of –20 ft / sec (–6 m / sec) to +180 ft / sec (+50 m / sec). The high alarm is set at 150 ft / sec (+40 m / sec) and the low alarm at –25 ft / sec (–7.5m / sec).

If an input reached its high alarm, a new threshold could be set. This could generate a high–high alarm or an alarm–cleared threshold.

Example 2:

An Alarm Threshold is set at 150 ft / sec. Upon receiving an alarm message, the CPU changes the Alarm Threshold to 165 ft / sec by using a Write Configuration command and sends the appropriate Clear Circuit Fault command. No alarm message is sent upon changing the threshold unless the speed is greater than 165 ft / sec. If the speed is only 157 ft / sec but increasing, a second message would be sent at 165 ft / sec. Since these two diagnostic messages are the same, it would be necessary for the program to keep track of the level of the Alarm Thresholds and recognize this as a higher alarm than that received initially. At the same time, it could move the low alarm to 140 ft / sec and use this level to detect the end of the high alarm conditions.

Hand-held Monitor Configuration Steps

Line 3 first displays the low and high Alarm Thresholds for the block's first input.

```
ALARM INPUT 97
I1 LOW I1 HI
-10000  10000
 > chg     nxt
```

1. To select the next circuit, press F1 (>) to move the cursor from LOW to HI, then press F1 (>) again.
2. To change the threshold shown at the cursor location, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Hold Last State

Each output can be configured to either hold its last value or go to its powerup default value if the block loses CPU communications for at least 3 bus scans.

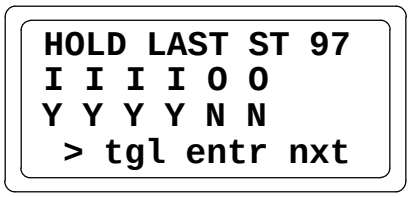
For a new block, Hold Last State is disabled for both outputs. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output at its current value instead of setting it to the powerup default.

Outputs remain in their last value or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. The screen displays the current Hold Last State configuration of all outputs. On this screen,

   X = the circuit is an input.

   Y = the circuit is configured to hold last its value.

   N = the circuit is configured to go to its default value (configured on the next HHM screen)

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) to advance to the next configuration display.

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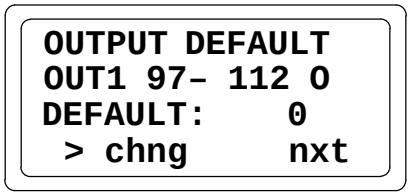
Output Default Value

An output goes to its powerup default value when the block is first powered up. For a new block, the output default value for each output is 0.

If Hold Last State is NOT enabled, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed. . (Additional default time for redundancy is explained on page 10-21).

Hand-held Monitor Configuration Steps

Line 3 shows the default value of the block's first output.



1. To select the other output, press F1 (>).
2. To change a default, press F2 (chng) then enter the new value.
3. To save the new value, press F3 (entr).
4. When you are ready to advance to the next configuration screen, press F4 (next).

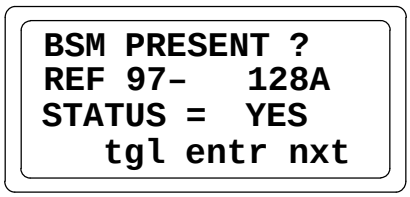
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO.

Select YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

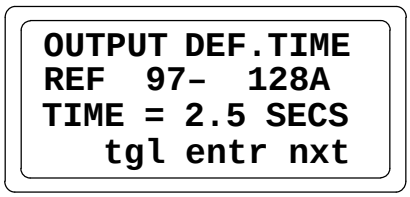
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, outputs will remain in their last value while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any output on a block, and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

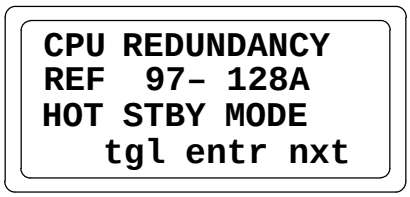
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CPU Redundancy

The block can be configured for No Controller redundancy or Hot Standby redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If those outputs are not available, the block will use outputs from the bus interface module with Device Number 30. If no outputs from a CPU are available, a Genius I/O block's outputs will either Hold Last State or go to their predefined Output Default state.

Hand-held Monitor Configuration Steps

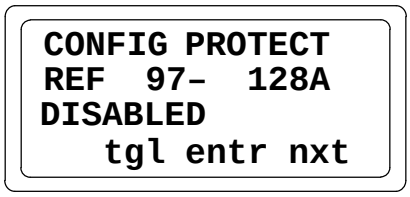


1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

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Chapter 11 Current-source Analog Input/Output Blocks

Current–source Input / Output Blocks have 4 input and 2 output circuits for 4–20mA devices.

Two Current–source Analog Blocks Input / Output Blocks are available:

- **115 VAC/125 VDC Current–source Analog 4 Input/2 Output Block** (IC660BBA104)
- **24/48 VDC Current–source Analog 4 Input/2 Output Block** (IC660BBA024)

Two similar blocks, described in the next chapter, provide 6 outputs for devices that accept 4 to 20mA signals. Two outputs on those blocks can also be used for 0V to 5V signals.

Features

These blocks provide isolated power to all circuits; no separate power is required for 4–20mA signals.

All circuits on the block support independent selection of linear scaling values. These values can be used to convert the internal values into engineering units suitable for the application.

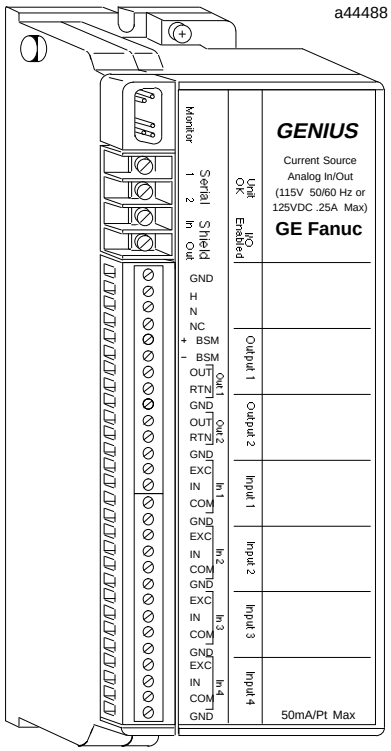
A dedicated digital output is provided to drive a Bus Switching Module when a Current Source Analog block is installed in a redundant bus cable system. The 24 / 48 VDC Bus Switching Module (version IC660BSM021) is required for this.

Additional configurable features include:

- Input alarm detection
- Output Hold Last State or default
- Selectable input conversion time up to 400mS
- CPU Redundancy
- Output feedback checking

These blocks automatically perform the following diagnostic checks:

- Input Open Wire detection
- Input high and low alarms
- Input Overrange and Underrange
- Output Overrange and Underrange
- Output Feedback Error



Compatibility

These blocks are compatible with all Genius bus controllers, PCIM and QBIM modules. Hand–held Monitor IC660HHM501E (version 3.7) or later is required for configuration.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus PLC, rev. 110 or later is required. The programming software must be Logicmaster™ 6 rel. 4.02 or later.

For a Series Five PLC, the CPU must be rev. 3.0 or later. The Logicmaster 5 programming software must be rel. 2.01 or later.

A Bus Switching Module must be the 24 / 48 VDC version (IC660BSM021) only.

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Specifications

Block Type:	Four input / 2 output circuits	
Catalog Numbers:		
115 VAC / 125 VDC Current Source Analog block	IC660BBA104	
Terminal Assembly Only	IC660TBA104	
Electronics Assembly Only	IC660EBA104	
24 / 48 VDC Current Source Analog block	IC660BBA024	
Terminal Assembly Only	IC660TBA024	
Electronics Assembly Only	IC660EBA024	
Size (height x width x depth)	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)	
Weight:	4 lbs. (1.8 kg)	
LED's (I/O Block):	Unit OK, I / O Enabled	
Heat Dissipation:	12 Watts maximum	
BSM Control:	Switches one 24 / 48 VDC BSM (IC660BSM021)	
Block to Block Isolation:	1500 V for one minute	
Group to Group Isolation:	300 V rms	
115 VAC / 125 VDC block power:	**115 VAC**	**125 VDC**
Power supply voltage	93–132 VAC	105–145 VDC
Maximum current	250 mA	140 mA
Frequency / ripple	47–63 Hz	10% max. ripple
Power supply dropout time	1 cycle	10 mS min.
24/48 VDC block power:		
Power supply voltage	18–56 VDC	
Maximum current	600 mA	
Ripple	10% max.	
Power supply dropout time	10 mS min.	
Input Signal Characteristics:		
Input accuracy (at 25 C)	0.1% of full scale reading	
Input resolution	1µA	
Input conversion time	16.6mS to 400mS (user selectable)	
Range	4mA to 20mA	
Overrange capacity	0mA to 25mA	
Input diagnostics	Underrange, Overrange, High Alarm, Low Alarm, Open Wire	
Channel to channel isolation	300 volts RMS	
Thermal drift (from 25 C)	70 PPM per degree C typical	
Input Impedance:	100 ohms $ 5%	
Normal Mode Rejection:	–45 dB at 50, 60 Hz	
Input Excitation Characteristics:		
Open circuit voltage	24 VDC	
Short circuit current	< 75mA	
Loop impedance	1000 ohms max. (0mA to 20mA) 800 ohms max. (20mA to 25mA)	
Output Signal Characteristics:		
Output accuracy at 25 C	0.15% of full scale reading	
Output resolution	6µA	
Output update frequency	6mS to 8mS typical	
Range	4mA to 20mA	
Overrange capacity	0mA to 24mA	
Output diagnostics:	Underrange, Overrange, Feedback error	
Load:	0 ohms to 850 ohms	
Thermal drift (from 25C):	35 PPM per degree C typical	
Environmental:		
Operating Temperature	0C to +60C (+32F to +140F)	
Storage Temperature	–40C to +100C (–40F to +212F)	
Humidity	5% to 95% (non–condensing)	
Vibration	5 – 10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G	

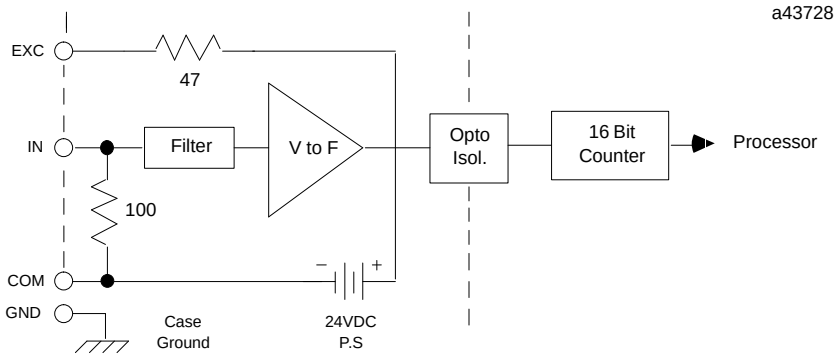
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Block Operation

These blocks have four independent inputs and two independent outputs.

Input Circuits

Input channels use voltage to frequency converters and counters to translate analog currents to a digital value. This value is converted by the block to engineering units before it is sent to the CPU.



Each input has a 24 volt current loop power supply, capable of providing 25mA of current. Each input is isolated from all other circuits within the block. Input accuracy is 0.1%. Input conversion time can be selected to provide the appropriate combination of noise rejection and input resolution. Conversion times are programmable from 16mS to 400mS. Resolution increases as the conversion time is lengthened. Input resolution is 1µA for 200mS conversion time.

Input Data Format

Each bus scan, a Current–source Analog I/O Block broadcasts 8 bytes of input data. Each input consists of 2 bytes of scaled engineering units data. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

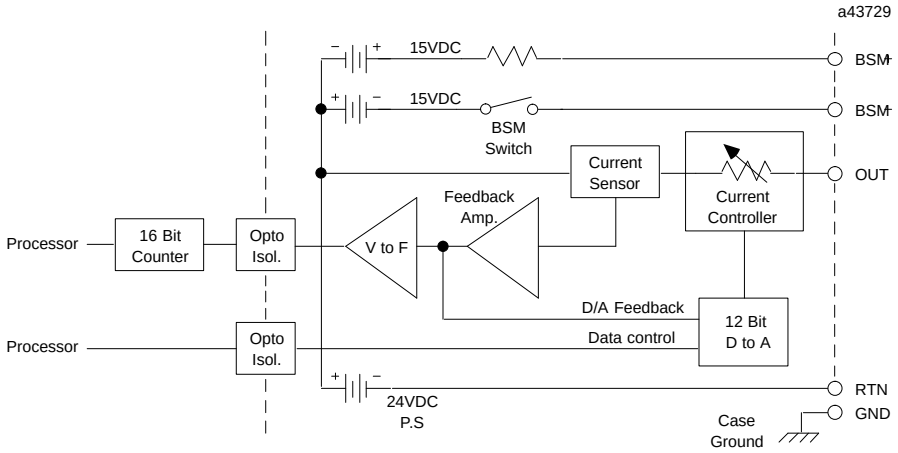
Byte #	Description
0	Input channel 1, bits 0 – 7
1	Input channel 1, bits 8 – 15
2	Input channel 2, bits 0 – 7
3	Input channel 2, bits 8 – 15
4	Input channel 3, bits 0 – 7
5	Input channel 3, bits 8 – 15
6	Input channel 4, bits 0 – 7
7	Input channel 4, bits 8 – 15

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Output Circuits

The two independent output circuits are electrically common to each other and the Bus Switching Module outputs, but isolated from all other circuits on the block. Power for the outputs' current loops is provided by the block.

Output channels use a dual 12–bit digital to analog converter, and can independently control currents from 0mA to 24mA. Output accuracy is 0.15% at 25 C. Output resolution is 6µA.



Two additional A–to–D channels are used to check the two output channels after a programmable settling time. The block will indicate a fault if the feedback from these channels does not match the commanded value to within 250µA.

Output Data Format

Each bus scan, the CPU sends a Current–source Analog I/O block 4 bytes of output data. Each analog output consists of 2 bytes of engineering units data.

Byte #	Description
0	Output channel 1, bits 0 – 7
1	Output channel 1, bits 8 – 15
2	Output channel 2, bits 0 – 7
3	Output channel 2, bits 8 – 15

The block automatically translates this engineering units value into the analog output signal used by the output device.

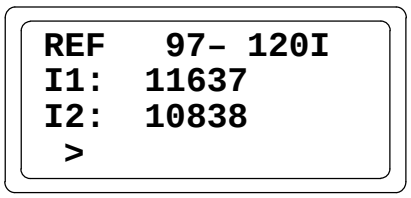
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Hand–held Monitor I/O Display

Inputs and outputs are always reported and received as whole integers. For example, if the current value of a temperature input was 116.37F, it could be reported as:

116	degrees, or
1163	tenths of degrees, or
11637	hundredths of degrees

Here, the example input, configured as hundredths of degrees, is input 1 on the Monitor Block screen.



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Diagnostics

Current–source Analog I/O Blocks perform the diagnostics described below. If a fault occurs, the block will report it to the Hand–held Monitor, and take appropriate corrective action.

Individual circuits can be configured not to send a diagnostic message to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using a Read Diagnostic datagram, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Input Open Wire Diagnostic

The block monitors input current levels. If input current is below 2mA, the block sends an Open Wire message.

Alarm Thresholds

An individual low alarm and high alarm threshold can be configured for each input. If an input reaches one of its configured limits, the block sends a High Alarm or Low Alarm message. Since the circuit's current value is also available, it is possible to determine how much beyond the limit the input is. Only one diagnostic message is sent upon reaching the limit.

Input Underrange and Overrange Diagnostics

The block sends an UNDERRANGE message if current is negative, or 0mA. It sends an OVERRANGE message if the input signal exceeds 25mA.

Output Underrange and Overrange Diagnostics

The block sends an UNDERRANGE message if conversion of the engineering units output it receives from the CPU results in a commanded output less than 0mA.

It sends an OVERRANGE message if conversion of the engineering units output it receives from the CPU results in an output signal level that exceeds 24mA. The block clamps the output to the selected range limit to protect external hardware.

Output Feedback Error

This diagnostic is used to detect wiring errors or other hardware faults on output circuits. After waiting for a configurable period of time, the block compares each output's current to its last commanded output value. If the difference is greater than 250µA, the block reports a Feedback Error. The block continues sending new values from the CPU to the output.

Nuisance diagnostics may be reported if the Output Feedback Time selected for the circuit is too brief. If this happens, increase the feedback time or disable output feedback testing.

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Field Wiring

Terminals 5 through 32 are used for input power, Bus Switching Module control, and field wiring devices. These terminals accept AWG #22 to AWG #14 wires. Do not overtorque the terminal screws.

The ground (GND) terminal (5) is for block safety. It is connected to the block chassis, and to terminals 13, 16, 20, 24, 28, and 32 which are marked GND. Each channel has one ground terminal for shield termination, if desired.

Power Source Wiring

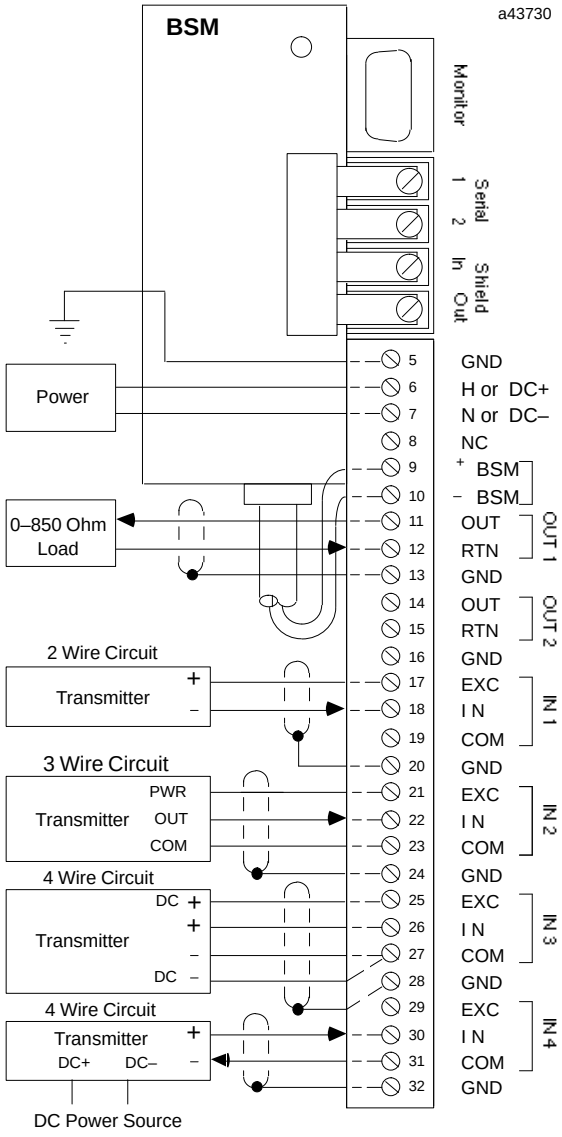
Connect an appropriate power source to terminals 6 and 7. For AC block power, connect the source to the H terminal and neutral to the N terminal. For DC block power, connect the source to the DC+ terminal and the return to the DC– terminal.

Wiring for I/O Devices

Typical wiring for various configurations is shown at right. Self–powered or externally–powered transmitters are wired differently from those powered by the block.

External Resistors for Grounded Output Loads

If both of the block's output loads are grounded, and the loads are widely separated by distance, an external resistor should be installed in each load's return line to the block. This will prevent possible damage to the block caused by the significant voltage differences that may occur between the two ground points. 10–ohm resistors are suggested.



Wiring a Bus Switching Module to a CSA Block

When a Bus Switching Module is installed, connect the BSM control wires to terminals 9 and 10. The polarity from the block is as marked; the BSM is insensitive to polarity.

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Block Configuration

The configurable features of a Current–source Analog 4 input / 2 Output Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6Kb std	153.6 st, 153.6 ext, 76.8, 38.4 Kb
Configuration Protected	Block	disabled	enabled / disabled
Report Faults	Circuit	yes	yes, no
Channel active	Circuit	active	active,inactive
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Redundancy Mode	Block	none	none, standby
Outputs timeout	Block	3 bus scans	(for bus redundancy) 2.5 or 10 sec.
Input conversion time	Block	400mS	16mS to 400mS
Input Scaling	Circuit	1µA / eu	" 32767 eng units 0 to +25000µA
Output Scaling	Circuit	1µA / eu	" 32767 eng units 0 to +24000µA
Low Alarm	Circuit	0	" 32767 eng. units
High Alarm	Circuit	+25000	" 32767 eng. units
Hold Last State	Circuit	no	yes, no
Output Default	Circuit	4000	" 32767 eng. units
Output Feedback Enabled	Circuit	yes	yes, no
Output Feedback time	Circuit	0mS	0mS to 255ms

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

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Current–source Analog 4 Input/2 Output Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Input Conversion Time (16mS to 400mS) _____

Redundancy Features:

Redundancy Mode (None/Standby) _____ Outputs Default (2.5/10 sec) _____

BSM Present (Y/N) _____ BSM Controller (Y/N) _____

Circuit Features:

	Input Circuits				Output Circuits	
	1	2	3	4	5	6
References: From						
To						
Report Faults? (Y/N)						
Channel Active? (Y/N)						
Scaling Points:						
Low Pt (eng units)						
Low Pt (µA)						
High Pt (eng units)						
High Pt (µA)						
Alarm Thresholds:						
Low (eng units)						
High (eng units)						
Outputs:						
Hold Last State (Y/N)						
Default Values (eng units)						
Output Feedback Enabled? (Y/N)						
Output Feedback Time (0 to 255mS)						

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit.

If fault reporting is enabled, the block sends a message to the host if any fault occurs.

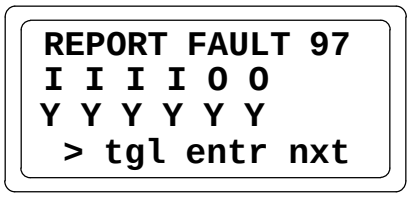
If Fault reporting is disabled, the block does not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block detects faults on the circuit, and takes appropriate action. If a fault occurs, the block's Unit OK LED blinks and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps

Line 3 shows the current Report Faults configuration of each circuit. Line 2 shows the I / O type of each circuit.



1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) when you are ready to advance to the next configuration display.

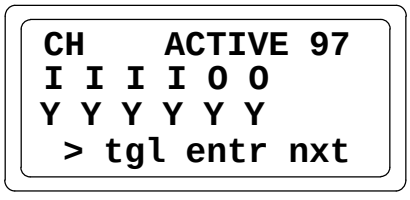
Channel Active

If a channel is not wired, or if a channel is wired but should not report diagnostics, it should be configured as an inactive channel.

The block processes input data from an inactive channel, but it does not perform fault detection on it. The Unit OK LED does not indicate faults for inactive channels.

Hand-held Monitor Configuration Steps

Line 3 shows the current Channel Active configuration of each circuit. Line 2 shows the I / O type of each circuit.



1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Circuit Scaling

All circuits on the block can be scaled independently. To scale a circuit, two pairs of values are entered: two engineering units values and their associated signal levels. Based on these two pairs of values, the block will be able to calculate engineering units for all other input or output levels.

The block uses the scaling values to convert the input and output signal levels (0 to " 25000µA for inputs, 0 to " 24000 µA for outputs) into engineering units values. Each engineering units value is an integer to " 32767. The converted number is still a numerical value, and will appear as such on the Hand–held Monitor or at the CPU with its programming device. The applicable units of measure should be recorded separately on a meter or display.

When scaling a circuit, it is important to select units that will produce adequate resolution in the final integer value. Engineering units scaling values can be increased by a convenient multiple, such as 10 or 100, as long as the resulting engineering units values calculated by the block will not exceed the limit of " 32,767.

On a new block, circuit scaling is set to 1µA per engineering unit. If this is appropriate, it will not need to be changed. Or each input can be independently scaled. The scaling values selected should provide the maximum range for the application's engineering units.

Scaling can also be used to compensate for field device inaccuracies.

Entering Scaling Values

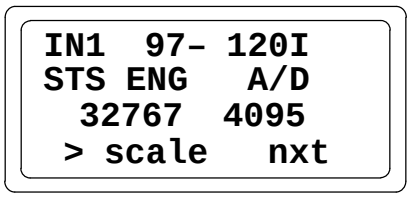
The most accurate scaling comes from actual measurements. The process must be set to two distinctly different conditions, so two engineering units measurements can be taken.

If the block is online to the process, it automatically provides the signal level for each engineering units measurement. If the block is not online to the process, the signal level associated with each engineering units value must also be measured external to the block.

If the process cannot be measured, you can estimate scaling values. Estimated values will not be as accurate as measured values.

If you are NOT measuring the process while scaling the circuit, have the two pairs of scaling values ready. If you ARE measuring the process to scale the circuit, set the process to one of the two conditions being measured.

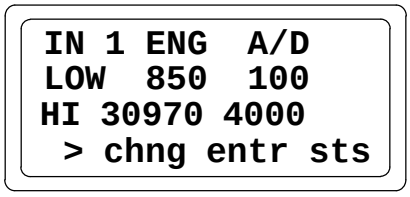
Hand-held Monitor Configuration Steps



1. The next configuration screen after the Channel Active screen is this status screen. Line 1 shows which circuit is selected. If you want to scale a different circuit, press F1 (>).
2. If you are NOT measuring the process with the block online, go to step 4.

   If you are measuring the process with the block online, continue at step 3.

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3. Line 3 on the status screen shows an engineering units value and the equivalent µA signal level for the selected circuit. The engineering units value, on the left, is a calculated value. If the scaling is wrong, the engineering units value is too. The µA value, on the right, is a measured value. Make a note of the µA value; you will need it to complete the next screen.

4. Press F2 (scale) to scale the circuit.

   Line 2 shows the circuit's lower pair of engineering units and µA values. All values on this screen are configured values, not measured values. Pressing F1 (>) moves the cursor.

5. Enter the engineering units value(s). This must be an integer. For greater resolution, increase the configured values by a convenient multiple, such as 10 or 100. That is, to measure tenths of degrees, you would configure low and high engineering units values of 10x the actual measured temperature. Or to measure hundredths of feet per second, you would configure engineering units values of 100x the measured velocity.

6. After each entry, press F3 (entr).

7. Enter the associated µA value(s). If you are measuring the process online, enter the value read from the HHM's status screen. If you are measuring the process with the block offline, enter the signal level obtained with an external measuring device.

8. **To save the new entries for a circuit, press F3 (entr) again.**

9. Press F4 (next) to return to the status screen.

10. If you are using measured values, set the process to a different condition. Repeat the necessary steps above.

11. Press F4 (nxt) to return to the status screen. From the status screen, select F1 (>) to select another circuit for scaling.

12. When you are finished scaling circuits, press F4 (nxt) to configure additional block features.

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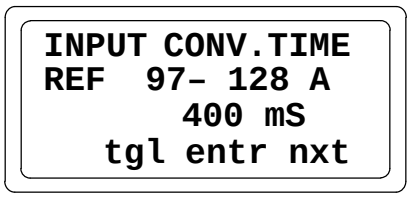
Input Conversion Time

Input conversion time determines the length of time required to make one analog to digital conversion on each input channel. The table below shows the available conversion times and their associated resolution and line rejection capabilities. For a new block, 400mS is the default. This conversion time, which provides the maximum resolution and noise rejection, is suitable for most applications.

Change it only if faster update times are required. The following table shows the available conversion times, and the resolution and noise rejection for each.

Conversion Time (mS)	Resolution		Rejected Frequencies (Hertz)
	(μA)	(bits)	
17	12	11+	60
20	10	11+	50, 400
33	6	12+	60
40	5	12+	50, 400
67	3	13+	60
80	2.5	13+	50, 400
100	2	14	50, 60, 400
200	1	15	50, 60, 400
400	0.5	16	50, 60, 400

Hand-held Monitor Configuration Steps



1. The screen displays the selected conversion time. If this is not appropriate, press F2 (tgl) to change it. To save the new selection, press F3 (entr).
2. Press F4 (next) to advance to the next configuration display.

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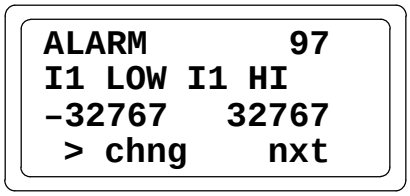
Alarm Thresholds

Each input circuit can have two unique alarms, one for a low value and one for a high value. The high value should be greater than the low value. If an input reaches one of the limits, the block sends the actual value and a LOW ALARM or HIGH ALARM message. The message identifies the circuit in alarm. Only one message is sent upon reaching the threshold. Alarms do not stop the process or change the value of the input.

Alarm Thresholds are scaled values between +/–32,767 engineering units. For a new Current–source Analog block, the default Alarm Thresholds are 0 (low) and +25000 (high). Typically, Alarm Thresholds are set at levels beyond which the input should not operate or levels beyond which alternate processing is required.

Because Alarm Thresholds are engineering units values, if scaling is changed, Alarm Thresholds should be reviewed and adjusted if necessary. Alarm Thresholds can also be changed by the ladder logic program in the CPU. If an input reached its high alarm, a new limit could be set. This could generate a high–high alarm or an alarm–cleared threshold. Two examples are described on page 10-18.

Hand-held Monitor Configuration Steps



1. The screen displays the low and high Alarm Thresholds for the block's first input.
2. To select the next circuit, press F1 (>) to move the cursor from L O W to H I, then press F1 (>) again.
3. To change the threshold shown at the cursor location, press F2 (chng).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

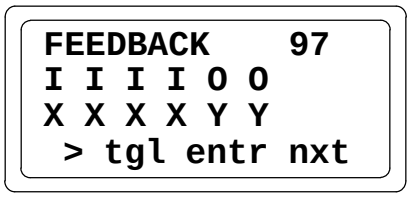
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Output Feedback Testing

After the Feedback Time (see below) period has elapsed, the block compares feedback from each output to its output value received from the CPU. If these values differ by more than 250µA, the block reports a Feedback Error for the circuit. For a new block, feedback testing is enabled for each output. It can be disabled or enabled individually.

Hand-held Monitor Configuration Steps

Line 3 shows the current Output Feedback configuration of the outputs. Line 2 shows the I/O type of each circuit.



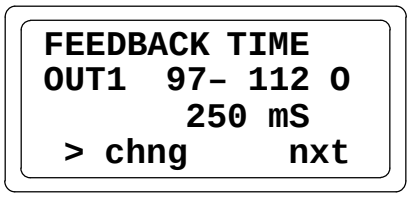
1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl).
3. To save the new selection, press F3 (entr).Press F4 (next) when you are ready to advance to the next configuration display.

Feedback Time

Feedback Time is the interval between the time the block receives an output value from the CPU, and the time the output channel is expected to attain the commanded value. This interval is used in conjunction with Feedback Testing, enabled or disabled above. A suitable interval should be selected so that the output current will reach its commanded value before the comparison is made. This prevents false Feedback Error diagnostics for the output. A longer feedback interval should be specified for outputs that respond slowly to changes in output signal levels. The Feedback Time may be in the range 0mS to 255mS. For a new block, Feedback Time of 0mS is used for each output.

Hand-held Monitor Configuration Steps

Line 3 shows the Feedback Time configured for the output circuit indicated on line 2.



1. To select the other output, press F1 (>).
2. To change the Feedback Time for the output, press F2 (chng), then enter a new time. To save the new time, press F3 (entr).
3. Press F4 (next) when you are ready to advance to the next configuration display.

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Hold Last State

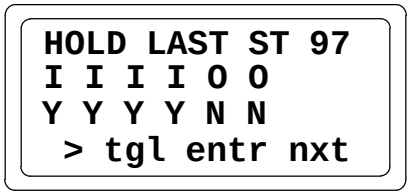
Each output can be independently configured to either hold its last value or go to its powerup default value if the block loses CPU communications for at least 3 bus scans.

For a new block, Hold Last State is disabled for each output. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost. If Hold Last State is enabled, the block continues to hold the output at its current value instead of setting it to the powerup default.

Outputs remain in their last value or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. The screen displays the current Hold Last State configuration of all outputs. On this screen,

   X = the circuit is an input.
   Y = hold last state.
   N = go to default state (configured on the next HHM screen)

2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

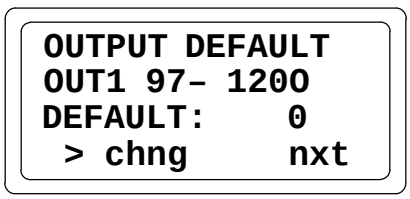
Output Default Value

Outputs always go to their default values when the block is first powered up. For a new block, the output default value is 4000.

If Hold Last State was NOT enabled, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, additional time is needed to accommodate switching of the BSM (see “Output Default Time” on page 11-18).

Hand-held Monitor Configuration Steps

The screen first displays the default value of the block’s first output.



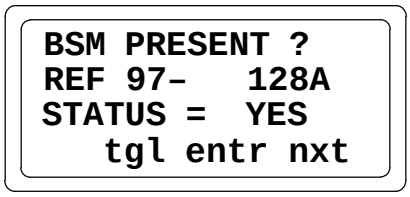
1. To select an output, press F1 (>).
2. To change a default value, press F2 (chng), then enter the new value.
3. To save the new default, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO. Select YES of the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



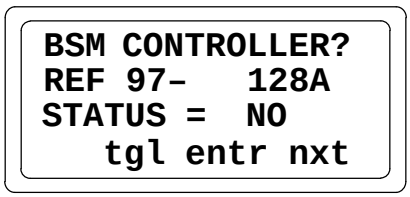
1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. For a new block, the default is NO. Change it only if the block will be used as a BSM Controller.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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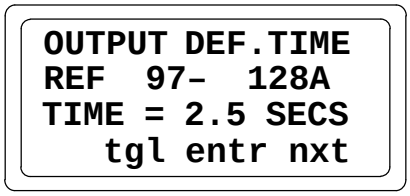
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, the block will hold outputs at their last value while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for either output and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



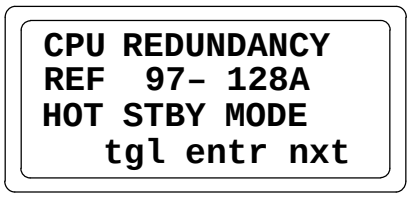
1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller redundancy or Hot Standby redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If those outputs are not available, the block will use outputs from the bus interface module with Device Number 30. If no outputs from a CPU are available, a Genius I/O block's outputs will either Hold Last State or go to their predefined Output Default state.

Hand-held Monitor Configuration Steps



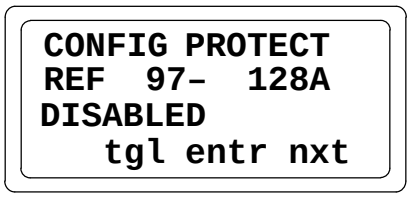
1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

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Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

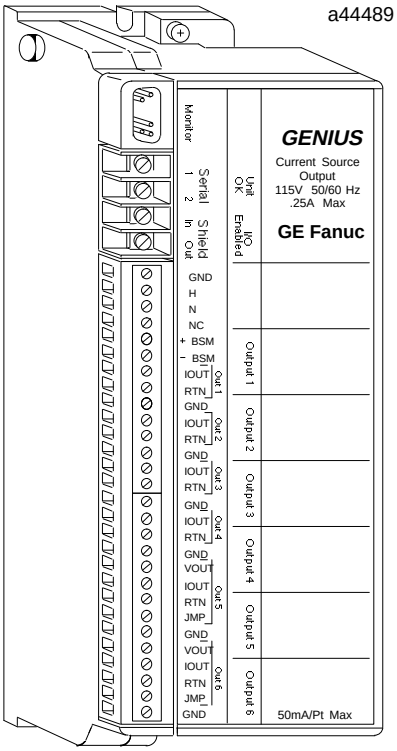
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Chapter 12

Current–source Analog 6 Output Blocks

Current–source Analog Output Blocks have 6 output circuits for devices that accept 4 to 20mA signals. Outputs 5 and 6 can also be used for voltage applications. Two Current–source Analog Output Blocks are available:

- **115 VAC/125 VDC Current–sour ce Analog 6 Output Block**(IC660BBA105)
- **24/48 VDC Current–sour ce Analog 6 Output Block** (IC660BBA025)



Features

These blocks provide power to all circuits; no separate power is required for 4–20mA signals. Each output provides power and control of a 4–to–20mA current loop. This power is isolated from the rest of the block. The outputs and BSM circuitry are electrically common. Output accuracy is 0.15% at 25C. Output resolution is 6µA.

A dedicated digital output is provided to drive a Bus Switching Module when a Current Source Analog block is installed in a redundant bus cable system.

Additional configurable features include:

- Output Hold Last State or default
- Circuit scaling to engineering units values.
- Output feedback checking and feedback time
- CPU Redundancy

Fault reporting can be enabled or disabled circuit–by–circuit. These blocks automatically perform the following diagnostic checks:

- Output Overrange and Underrange
- Output Feedback less than 1.5mA

Compatibility

These blocks are compatible with all Genius bus controllers, PCIM and QBIM modules. Hand–held Monitor IC660HHM501E, version 3.7 (or later) is required for configuration.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus PLC, rev. 110 or later is required. The programming software must be Logicmaster™ 6 rel. 4.02 or later.

For a Series Five PLC, the CPU must be rev. 3.0 or later. The Logicmaster 5 programming software must be rel. 2.01 or later.

A Bus Switching Module must be the 24 / 48 VDC version (IC660BSM021) only.

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Specifications

Block Type:	6 Current–source Outputs
Catalog Numbers:	
115 VAC / 125 VDC Current-source Analog Output block	IC660BBA105
Terminal Assembly Only	IC660TBA105
Electronics Assembly Only	IC660EBA105
24 / 48 VDC Current-source Analog Output block	IC660BBA025
Terminal Assembly Only	IC666TBA025
Electronics Assembly Only	IC666EBA025
Size, Height x Width x Depth:	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)
Weight:	4 lbs. (1.8 kg)
LED's (I/O Block):	Unit OK, I / O Enabled
BSM Control:	Switches one 24 / 48 VDC BSM (IC660BSM021)
Block to Block Isolation:	1500 V for one minute
Heat Dissipation:	12 Watts maximum
115 VAC block power:	
Power supply voltage	93–132 VAC
Maximum current	250 mA
Frequency / ripple	47–63 Hz
Power supply dropout time	1 cycle
125 VDC block power:	
Power supply voltage	105–145 VDC
Maximum current	140 mA
Frequency / ripple	10% max. ripple
Power supply dropout time	10mS min.
24/48 VDC block power:	
Power supply voltage	18–56 VDC
Maximum current	600 mA
Ripple	10% max.
Power supply dropout time	10mS min.
Output Signal Characteristics:	
Accuracy at 25 C	0.15% of full–scale reading
Resolution	6µA
Update frequency	25mS
Range	< 4mA to 20mA
Overrange capacity	0mA to 24mA
Diagnostics	Underrange, Overrange, Feedback error
Load	0 ohms to 850 ohms (current application) 0 to 10mA: 0 to 5–volt application 0 to 10mA: 0 to 20–volt (maximum) voltage application
Thermal drift (from 25 C)	35 PPM per C typical
Environmental:	
Operating Temperature	0C to +60C (+32F to +140F)
Storage Temperature	–40C to +100C (–40F to +212F)
Humidity	5% to 95% (non–condensing)
Vibration	5 – 10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G

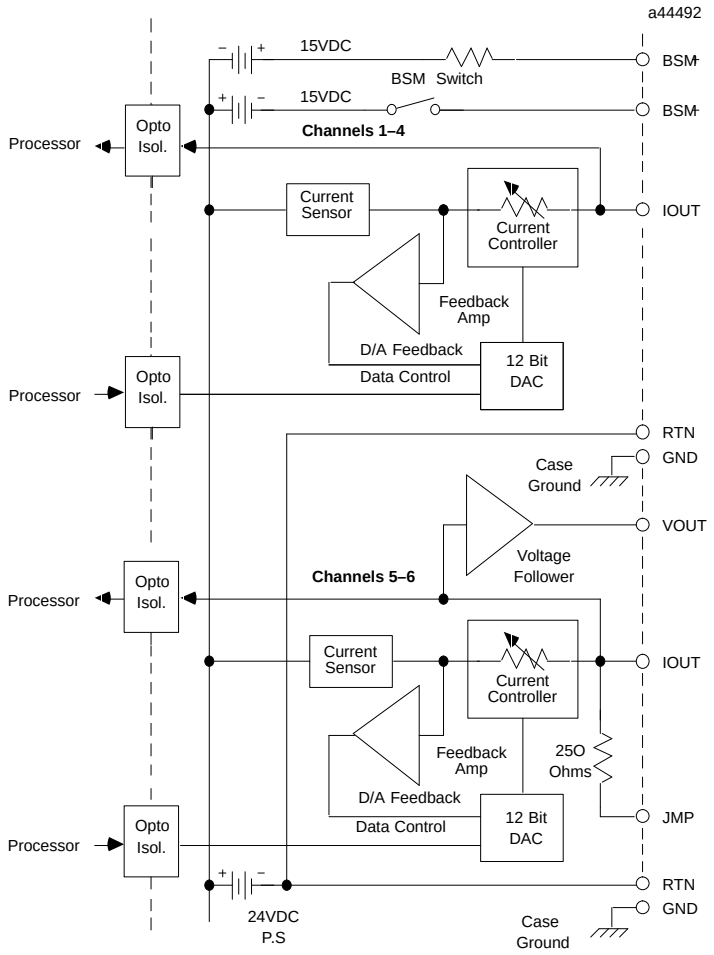
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Block Operation

The block has six independent output circuits which are electrically common to each other and the Bus Switching Module outputs, but isolated from all other circuits on the block. Power for the outputs' current loops is provided by the block.

Output Circuits

Output channels use a dual 12–bit digital to analog converter, and can independently control currents from 0mA to 24mA. A diagram of the output circuits is shown below.



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Output Data Format

A Current–source Output Block receives 12 bytes of output data each bus scan. Each analog output consists of 2 bytes of engineering units data. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Byte #	Description
0	Output channel 1, bits 0 – 7
1	Output channel 1, bits 8 – 15
2	Output channel 2, bits 0 – 7
3	Output channel 2, bits 8 – 15
4	Output channel 3, bits 0 – 7
5	Output channel 3, bits 8 – 15
6	Output channel 4, bits 0 – 7
7	Output channel 4, bits 8 – 15
8	Output channel 5, bits 0 – 7
9	Output channel 5, bits 8 – 15
10	Output channel 6, bits 0 – 7
11	Output channel 6, bits 8 – 15

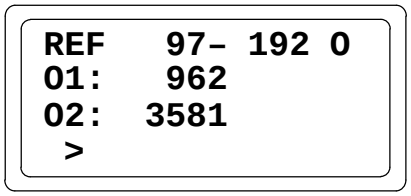
The block automatically translates this engineering units value into the analog output signal used by the output device.

Hand–held Monitor Output Display

Outputs are whole integers. For example, if the current value of an output was 35.81, it could be reported as:

35	engineering units, or
358	tenths of units, or
3581	hundredths of units

Output values are displayed on the Monitor Block screen.



Individual outputs are also displayed in the Monitor / Control Reference screens.

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Diagnostics

Current–source Analog Output Blocks perform the diagnostics described below. If a fault occurs, the block will report it to the Hand–held Monitor, and take appropriate corrective action.

Individual circuits can be configured not to send a diagnostic message to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using a Read Diagnostic datagram, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Output Underrange and Overrange Diagnostics

The block sends an UNDERRANGE message if conversion of the engineering units output it receives from the CPU results in a commanded output less than 0mA.

It sends an OVERRANGE message if conversion of the engineering units output it receives from the CPU results in an output signal level that exceeds 24mA. The block clamps the output to the selected range limit to protect external hardware.

Output Feedback Error

This diagnostic is used to detect wiring errors or other hardware faults on output circuits. After waiting for a configurable period of time, the block checks the current level of the output. If it is less than approximately 1.5mA, the block reports a Feedback Error. The block continues sending new values from the CPU to the output.

Feedback fault reporting should be disabled if a channel is configured for a voltage application.

Nuisance diagnostics may be reported if the Output Feedback Time selected for the circuit is too brief. If this happens, increase the feedback time or disable output feedback testing.

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Field Wiring

Terminals 5 through 32 are used for input power, Bus Switching Module control, and field wiring devices. These terminals accept AWG #22 to AWG #14 wires. Do not overtorque the terminal screws.

The ground (GND) terminal (5) is for block safety. It is connected to the block chassis, and to terminals 13, 16, 19, 22, 27, and 32 which are marked GND. Each channel has one ground terminal for shield termination, if desired.

Power Source Wiring

Connect an appropriate power source to terminals 6 and 7. For AC block power, connect the source to the H terminal and neutral to the N terminal. For DC block power, connect the source to the DC+ terminal and the return to the DC– terminal.

Wiring for I/O Devices

Typical wiring for various configurations is shown.

Wiring for Voltage Outputs: If the load requires 0 to 5 volts power, connect the load across the VOUT and RTN terminals (circuits 5 and 6 only). Attach a jumper across the RTN and JMP terminals.

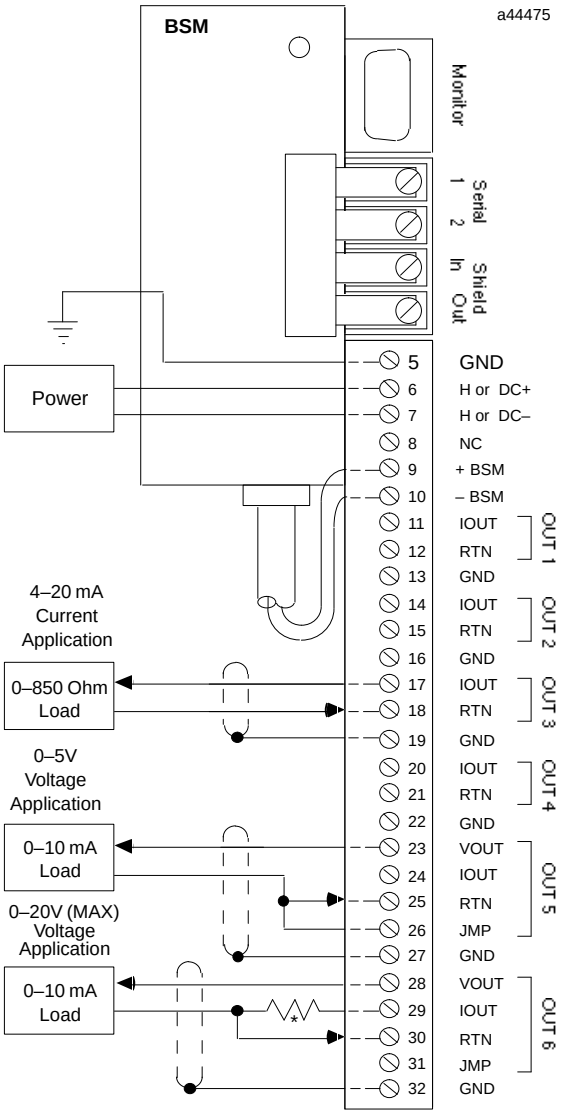
If the load requires a different voltage range, connect it across the VOUT and RTN terminals. Do not jumper the RTN and JMP terminals. Install an appropriate resistor across the OUT and JMP terminals. For example, the maximum voltage obtainable if a 500 ohm resistor is used is:

$$V_{MAX} = 20mA / 500\Omega = 10V$$

Wiring for Current Outputs: If the load requires current in the 4 to 20mA range, connect it between the OUT and RTN terminals (for circuits 1 through 6).

Connecting a Bus Switching Module to a CSO Block

If an optional Bus Switching Module is installed, connect the BSM control wires to terminals 9 and 10. The polarity from the block is as marked; the BSM is insensitive to polarity.



* User-Specified Resistor: 1K Ω Maximum

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Block Configuration

The configurable features of a Current–source Analog Output Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6Kbstd	153.6 st, 153.6 ext, 76.8, 38.4 Kb
Configuration Protected	Block	disabled	enabled / disabled
Report Faults	Circuit	yes	yes, no
Channel active	Circuit	active	active,inactive
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Redundancy Mode	Block	none	none, standby
Outputs timeout	Block	3 bus scans	(for bus redundancy) 2.5 seconds or 10 seconds
Output Scaling	Circuit	1µA / eu	" 32767 eng units 0 to +24000µA
Hold Last State	Circuit	no	yes, no
Output Default	Circuit	4000	" 32767 eng. units
Output Feedback Enabled	Circuit	yes	yes, no
Output Feedback time	Circuit	0mS	0mS to 255ms

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the features of each Current–source Analog Output Block should be decided upon, then recorded on a copy of the Configuration Worksheet printed on the next page.

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Current–source Analog Output Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Redundancy Features:

Redundancy Mode (None/Standby) _____ Outputs Default (2.5/10 sec) _____

BSM Present (Y/N) _____ BSM Controller (Y/N) _____

Circuit Features:

	Outputs					
	1	2	3	4	5	6
References: From						
To						
Report Faults? (Y/N)						
Channel Active? (Y/N)						
Scaling Points:						
Low Pt (eng units)						
Low Pt (µA)						
High Pt (eng units)						
High Pt (µA)						
Hold Last State (Y/N)						
Default Values (eng units)						
Output Feedback Enabled? (Y/N)						
Output Feedback Time (0 to 255mS)						

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit.

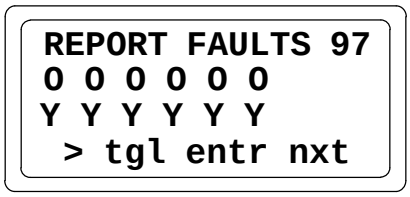
If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit.

If Fault reporting is disabled, the block does not send fault reports to the CPU.

Regardless of whether fault *reporting* is enabled, the block detects faults on the circuit, and takes appropriate action. If a fault occurs, the block's Unit OK LED blinks and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including those with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Report Faults configuration of each circuit (circuits are shown on line 2 for reference).
2. To move the cursor and select a circuit for configuration, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

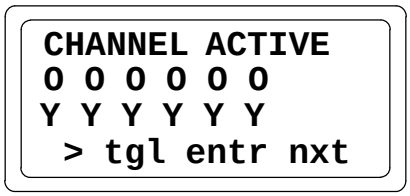
Channel Active

If a channel is not wired, or if a channel is wired but should not report diagnostics, that channel should be configured as inactive.

The block processes input data from an inactive channel, but does not perform fault detection. The block's Unit OK LED does not indicate faults for inactive channels.

Hand-held Monitor Configuration Steps

Line 3 shows the current Channel Active configuration of each circuit (circuits are shown on line 2 for reference).



1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Circuit Scaling

All circuits on the block can be scaled independently. To scale a circuit, two sets of values are entered: two engineering units values and their associated signal levels. Based on these two pairs of values, the block will be able to calculate engineering units for all other input or output levels.

The block will use the configured scaling values to convert the output signal levels (0 to " 24000 µA) into engineering units values. Each engineering units value is an integer to " 32767. The converted number is still a numerical value, and will appear as such on the Hand–held Monitor or at the CPU with its programming device. The applicable units of measure should be recorded separately on a meter or display. Scaling can also be used to compensate for field device inaccuracies.

On a new block, the scaling is set to 1µA per engineering unit. If this is appropriate, it will not need to be changed.

The most accurate scaling comes from actual measurements. The process must be set to two distinctly different conditions, so two engineering units measurements can be taken. If the block is online to the process, it will automatically provide the signal level for each engineering units measurement. If the block is not online to the process, the signal level associated with each engineering units value must also be measured external to the block.

Entering Scaling Values

If you are NOT measuring the process while scaling the circuit, have the two pairs of scaling values ready. If you ARE measuring the process to scale the circuit, set the process to one of the two conditions being measured.

The next configuration screen after the Channel Active screen is this status screen.

Hand-held Monitor Configuration Steps

Line 1 shows which circuit is selected.

```
OUT 1 97– 120I
STS ENG   uA
  30636  3957
 > scale   nxt
```

1. If you want to scale another circuit, press F1 (>).
2. continue at step 3.
3. Line 3 on the status screen shows an engineering units value and the equivalent µA signal level for the selected circuit.The engineering units value, on the left, is calculated from on the current scaling. If the scaling is wrong, the engineering units value is too. Make a note of the µA value shown on this screen; you will need this information to complete the next screen.

```
OUT1 ENG    uA
LOW  850   100
HI 30970  4000
 > chng entr nxt
```

4. Press F2 (scale) to scale the circuit.
5. Line 2 shows the circuit's low pair of engineering units and µA values. All values on this screen are configured values, not measured values. Pressing F1 (>) moves the cursor between lines.
6. Enter the engineering units value(s). This must be an integer. For greater resolution, increase the configured values by a

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convenient multiple, such as 10 or 100. That is, to measure tenths of degrees, you would configure low and high engineering units values of 10x the actual measured temperature. Or to measure hundredths of feet per second, you would configure engineering units values of 100x the measured velocity.

7. After each entry, press F3 (entr).
8. Enter the associated µA value(s). If you are measuring the process online, enter the value read from the HHM's status screen. If you are measuring the process with the block offline, enter the signal level obtained with an external measuring device.
9. To save the new entries for a circuit, press F3 (entr) again.
10. Press F4 (next) to return to the status screen.
11. If you are using measured values, set the process to a different condition. Repeat the necessary steps above.
12. Press F4 (nxt) to return to the status screen. From the status screen, select F2 (scale) to select another circuit for scaling.
13. When you are finished scaling circuits, press F4 (nxt) to configure additional block features.

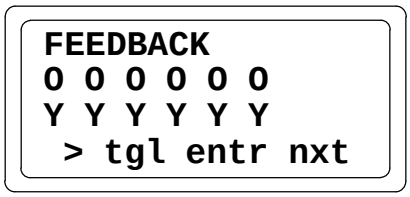
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Output Feedback Testing

After the Feedback Time (see below) period has elapsed, the block compares feedback from each output to its output value received from the CPU. If the feedback is less than 1.5mA, the block reports a Feedback Error for the circuit. For a new block, feedback testing is enabled for all outputs. It can be disabled for any or all.

Hand-held Monitor Configuration Steps

Line 3 shows the current Output Feedback configuration of the outputs (circuit types are shown on line 2 for reference).



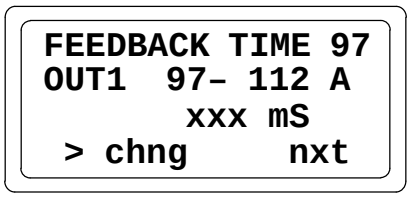
1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl).
3. To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

Feedback Time

Feedback Time is the interval between the time the block receives an output value from the CPU, and the time the output channel is expected to attain the commanded value. This interval is used in conjunction with Feedback Testing, enabled or disabled above. A suitable interval should be selected so that the output current will reach its commanded value before the comparison is made. This prevents false Feedback Error diagnostics for the output. A longer feedback interval should be specified for outputs that respond slowly to changes in output signal levels.

Hand-held Monitor Configuration Steps

Line 3 shows the Feedback Time configured for the output circuit indicated on line 2.



1. To select the other output, press F1 (>).
2. To change the Feedback Time for the output, press F2 (chng), then enter a new time.
3. To save the new time, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

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Hold Last State

Each output can be independently configured to either hold its last value or go to its powerup default value if the block loses CPU communications for at least 3 bus scans.

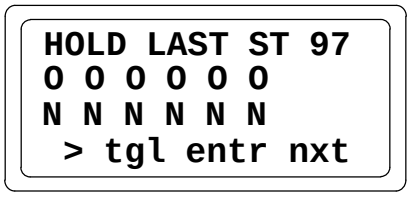
For a new block, Hold Last State is disabled for all outputs. With Hold Last State disabled, the block sets an the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output at its current value instead of setting it to the powerup default.

Outputs remain in their last value or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand–held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps



1. The screen displays the current Hold Last State configuration of all outputs. On this screen,

   Y = hold last state.

   N = go to default state (configured on the next HHM screen)

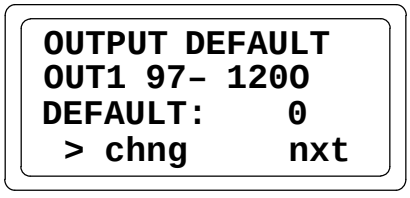
2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl). To save the new selection, press F3 (entr). Press F4 (next) to advance to the next configuration display.

Output Default Value

Outputs always go to their default values when the block is first powered up. For a new block, the output default value is 4000.

If Hold Last State was NOT enabled, the block will also default the output if CPU communications are lost. On a non–redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, additional time is needed to accommodate switching of the BSM (see “Output Default Time” on page 12-15).

Hand-held Monitor Configuration Steps



1. The screen first displays the default value of the block’s first output. To select an output, press F1 (>).
2. To change a default value, press F2 (chng), then enter the new value.
3. To save the new default, press F3 (entr). Press F4 (next) when you are ready to advance to the next configuration display.

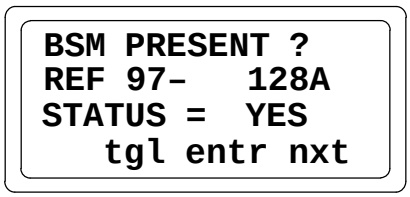
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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO.

Select YES of the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



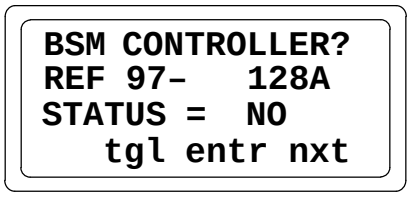
1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. For a new block, the default is NO. Change it only if the block will be used as a BSM Controller.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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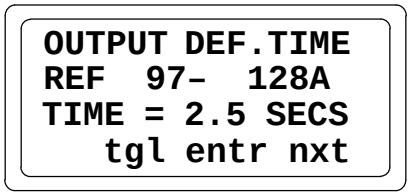
Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, the block will hold outputs at their last value while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any of the outputs and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps



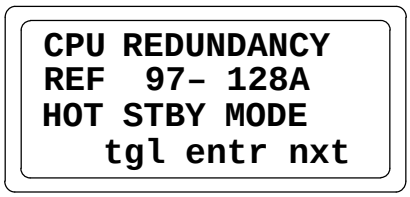
1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller redundancy or Hot Standby redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus controller with Device Number 31. If those outputs are not available, the block will use outputs from the bus controller with Device Number 30. If no outputs from a CPU are available, the outputs either Hold Last State or go to their predefined Output Default state.

Hand-held Monitor Configuration Steps



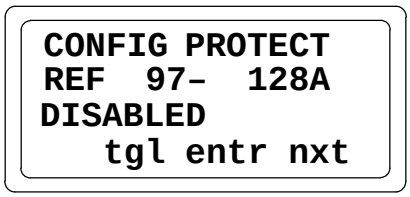
1. To change the current selection, press F2 (tgl).
2. F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

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Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

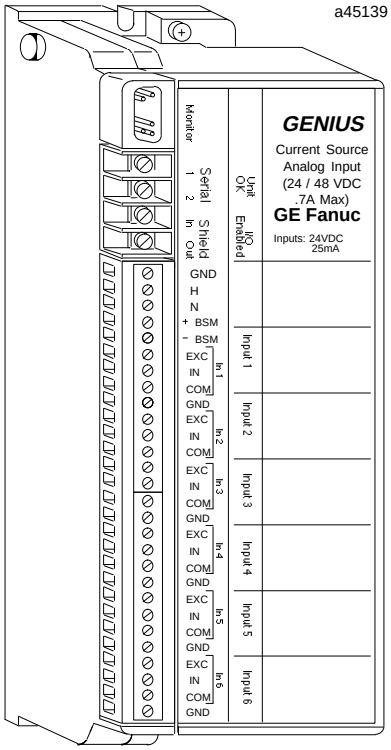
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Chapter 13 Current-source Analog 6 Input Blocks

Current-source Analog Input Blocks are used to interface a controller to devices that provide 4mA to 20mA analog signal. Current-source Analog Input Blocks are available with two types of block power supply:

- **115VAC/125VDC Current-source Analog Input block** (IC660BBA106)
- **24/48VDC Current-source Analog Input block** (IC660BBA026).

The two blocks are the same in all other respects.



Features

A Current-source Analog Input block has six 4–to–20mA current inputs. Each input provides a 24 volt current loop power supply and is isolated from all other circuits within the block. The BSM circuitry is electrically common to Input 1, but isolated from the other inputs.

A dedicated digital output is provided to drive a Bus Switching Module when a Current-source Analog Input block is installed in a redundant bus cable system.

Additional configurable features include:

- Circuit scaling to engineering units values.
- CPU redundancy.
- Input conversion time.

Fault reporting can be enabled or disabled circuit by circuit. These blocks automatically perform the following diagnostic checks:

- Input low and high alarms
- Input overrange and underrange
- Input current below 2mA

Compatibility

Current-source Analog Input blocks require a phase B Hand–held Monitor (IC660HHM501H, version 4.5 or later) for configuration.

For a Series 90–70 PLC, the programming software must be version 3.0 or later. Genius bus controller IC697BEM731C or later is required.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus PLC, rev. 110 or later is required. The programming software must be Logicmaster™ 6 rel. 4.02 or later. These blocks are compatible with bus controllers identified by catalog numbers IC660CCBB902 and 903. They are not compatible with bus controllers IC660CBB900 and 901.

For a Series Five PLC, the CPU must be rev. 3.0 or later. The Logicmaster 5 programming software must be rel. 2.01 or later.

A Bus Switching Module must be the 24 / 48 VDC version (IC660BSM021) only.

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Specifications

Block Type:	Six analog input circuits	
Catalog Numbers:		
115 VAC / 125VDC Current Source Input block	IC660BBA106	
Terminal Assembly Only	IC660TBA106	
Electronics Assembly Only	IC660EBA106	
24 / 48 VDC Current Source Input block	IC660BBA026	
Terminal Assembly Only	IC660TBA026	
Electronics Assembly Only	IC660EBA026	
Size (height x width x depth)	.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)	
Weight:	4 lbs. (1.8 kg)	
LED's (I/O Block):	Unit OK, I / O Enabled	
BSM Control:	8 Switches one 24 / 48 VDC BSM (IC660BSM021)	
Heat Dissipation:	12 Watts, maximum	
Block to Block Isolation:	1500 V for one minute	
Group to Group Isolation:	1500 V rms	
115 VAC/125 VDC block power:	**115 VAC**	**125 VDC**
Power supply voltage	93–132 VAC	105–145 VDC
Maximum current	250mA	140mA
Frequency / ripple	47–63 Hz	10% max. ripple
Power supply dropout time	1 cycle	10 mS min.
24/48 VDC block power:		
Power supply voltage	18–56 VDC	
Maximum current	700mA	
Ripple	10% max.	
Power supply dropout time	10 mS min.	
Input Signal Characteristics:		
Input accuracy (at 25° C)	0.1% of full scale reading	
Input resolution	1µA	
Input conversion time	16.6mS to 400mS (user selectable)	
Range	4mA to 20mA	
Overrange capacity	0mA to 25mA	
Input diagnostics	Underrange, Overrange, High Alarm, Low Alarm, Open Wire	
Channel to channel isolation	1500 volts RMS	
Thermal drift (from 25° C)	70 PPM per ° C typical	
Input Impedance:	100 ohms $ 5%	
Normal Mode Rejection:	–45 dB at 50, 60 Hz	
Input Excitation Characteristics:		
Open circuit voltage	24 VDC	
Short circuit current	<75mA	
Loop impedance	1000Ω maximum (0mA to 20mA), 800Ω maximum (20mA to 25mA)	
Environmental:		
Operating Temperature	0°C to +60°C (+32°F to +140°F)	
Storage Temperature	–40 °C to +100°C (–40°F to +212°F)	
Humidity	5% to 95% (non–condensing)	
Vibration	5 – 10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G	

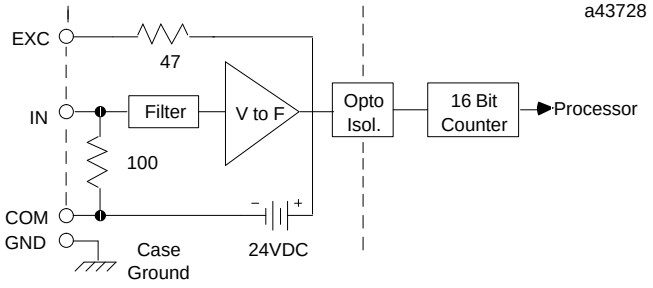
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Block Operation

These blocks have six independent inputs.

Input Circuits

Input channels use voltage to frequency converters and counters to translate analog currents to a digital value. This value is converted by the block to engineering units before it is sent to the CPU. A diagram of an input circuit is shown below.

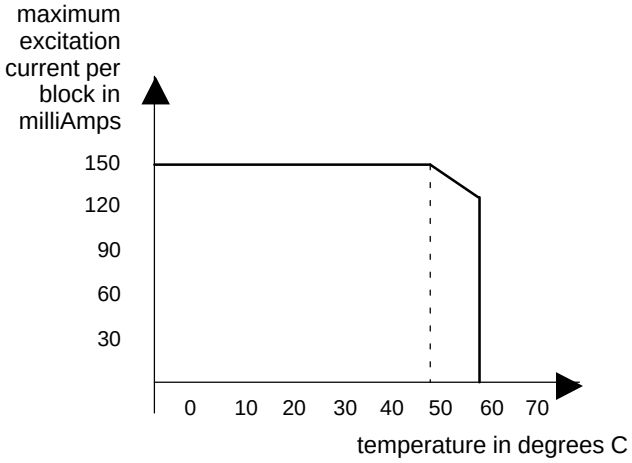


Each input circuit has a 24 volt current loop power supply, capable of providing 25mA of current. Each input is isolated from all other circuits on the block. Input accuracy is 0.1%. Input conversion time can be selected to provide the appropriate combination of noise rejection and input resolution. Conversion times are programmable from 16mS to 400mS. Resolution increases as the conversion time is lengthened. Input resolution is 1µA for 200mS conversion time.

Upper and lower alarm limits can be programmed for each input circuit. If either limit is exceeded, the block indicates a fault and sends a message to the Hand–held Monitor and CPU.

Input Excitation Current

The following illustration shows the input excitation current derating versus temperature. The maximum excitation current per channel is 25mA.



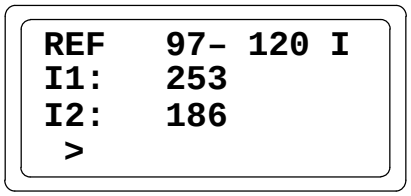
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Input Data Format

Each bus scan, a Current-source Input block broadcasts 12 bytes of input data. Each input consists of 2 bytes of data in the configured units. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Byte #	Description
0	Input channel 1, bits 0 – 7
1	Input channel 1, bits 8 – 15
2	Input channel 2, bits 0 – 7
3	Input channel 2, bits 8 – 15
4	Input channel 3, bits 0 – 7
5	Input channel 3, bits 8 – 15
6	Input channel 4, bits 0 – 7
7	Input channel 4, bits 8 – 15
8	Input channel 5, bits 0 – 7
9	Input channel 5, bits 8 – 15
10	Input channel 6, bits 0 – 7
11	Input channel 6, bits 8 – 15

Hand–held Monitor Input Display



Inputs are reported as whole integers. For example, if the current value of an input was 25.36, it could be reported as:

25	engineering units, or
253	tenths of units, or
2536	hundredths of units

Input values are displayed on the Monitor Block screen as shown at left. Individual inputs are also displayed in the Monitor / Control Reference screens.

Diagnostics

The block's advanced diagnostics provide the messages listed below. Fault messages can be cleared from the Hand–held Monitor or the CPU.

Input Open Wire: Input current is below 2mA.

Input High Alarm: Input above high alarm level.

Input Low Alarm: Input below low alarm level.

Input Overrange: Signal exceeds 25mA.

Input Underrange: Current is negative, or 0mA.

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Field Wiring

Terminals 5 through 32 are used for input power, Bus Switching Module control, and field wiring devices. These terminals accept AWG #22 to AWG #14 wires. Do not overtorque the terminal screws.

The ground (GND) terminal (5) is for block safety. It is connected to the block chassis, and to terminals 13, 20, 24, 28, and 32. These terminals, which are marked GND, are for shield termination, if desired.

Power Source Wiring

For block power, connect an appropriate power source to terminals 6 and 7. For AC block power, connect the source to the H terminal and neutral to the N terminal. For DC block power, connect the source to the DC+ terminal and the return to the DC– terminal.

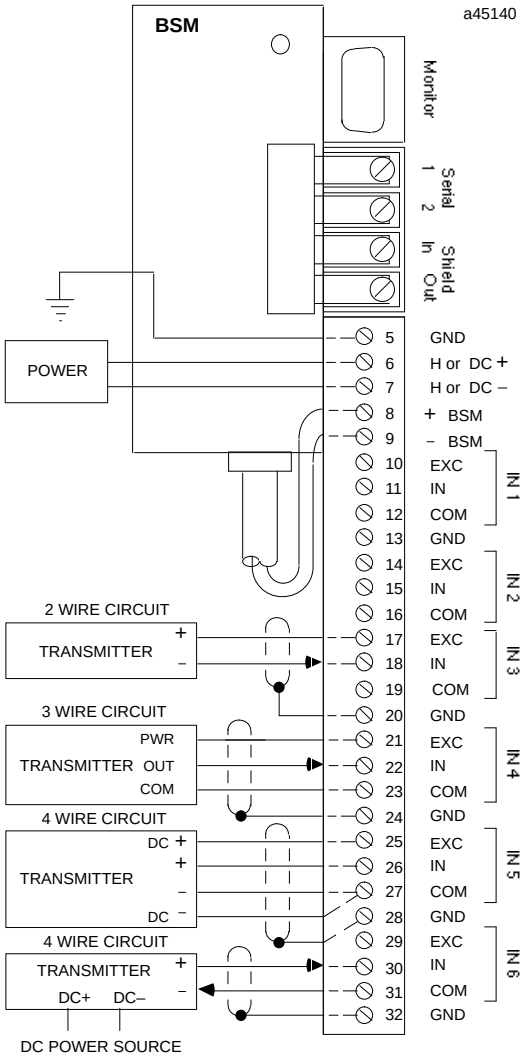
Self–powered or externally–powered transmitters are wired differently from those powered by the block.

Wiring for I/O Devices

Typical wiring for various configurations is shown at right. Connection of an optional Bus Switching Module is also shown.

Connecting a Bus Switching Module to a CSI Block

When a Bus Switching Module is installed, connect the BSM control wires to terminals 8 and 9. The polarity from the block is as marked; the BSM is insensitive to polarity.



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Block Configuration

The configurable features of a Current–source Analog Input Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6Kbstd	153.6 st, 153.6 ext, 76.8, 38.4 Kb
Configuration Protected	Block	disabled	enabled / disabled
Report Faults	Circuit	yes	yes, no
Channel active	Circuit	active	active,inactive
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no
Redundancy Mode	Block	none	none, standby
Input conversion time	Block	400mS	16mS to 400mS
Input Scaling	Circuit	1µA / eu	" 32767 eng units 0 to +25000µA
Low Alarm	Circuit	0	" 32767 eng. units
High Alarm	Circuit	+25000	" 32767 eng. units

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the features of each Current–source Analog Input Block should be decided upon, then recorded on a copy of the Configuration Worksheet printed on the next page.

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Current–source Analog Input Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____ Input Conversion Time _____ (mS)

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Redundancy Features:

BSM Present (Y/N) _____ BSM Controller (Y/N) _____

Redundancy Mode (none, standby) _____

Circuit Features:

		Inputs					
		1	2	3	4	5	6
References:	From						
	To						
Report Faults? (Y/N)							
Channel Active? (Y/N)							
Scaling Points:							
Low Pt (eng units)							
Low Pt (µA)							
High Pt (eng units)							
High Pt (µA)							
Low Alarm							
High Alarm							

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Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit.

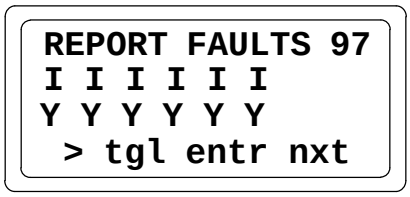
If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit.

If Fault reporting is disabled, the block does not send fault reports to the CPU.

Regardless of whether fault *reporting* is enabled, the block detects faults on the circuit, and takes appropriate action. If a fault occurs, the block's Unit OK LED blinks and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including those with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Report Faults configuration of each circuit (circuits are shown on line 2 for reference).
2. To move the cursor and select a circuit for configuration, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

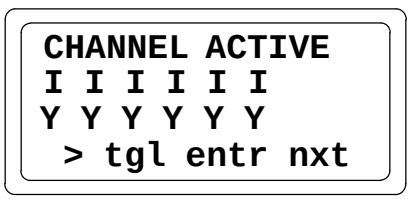
Channel Active

If a channel is not wired, or if a channel is wired but should not report diagnostics, that channel should be configured as inactive.

The block processes input data from an inactive channel, but does not perform fault detection. The block's Unit OK LED does not indicate faults for inactive channels.

Hand-held Monitor Configuration Steps

Line 3 shows the current Channel Active configuration of each circuit (circuits are shown on line 2 for reference).



1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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Circuit Scaling

All circuits on the block can be scaled independently. To scale a circuit, two sets of values are entered: two engineering units values and their associated signal levels. Based on these two pairs of values, the block will be able to calculate engineering units for all other input or output levels.

The block will use the configured scaling values to convert the input signal levels (0 to ± 24000 µA) into engineering units values. Each engineering units value is an integer to ± 32767. The converted number is still a numerical value, and will appear as such on the Hand–held Monitor or at the CPU with its programming device. The applicable units of measure should be recorded separately on a meter or display. Scaling can also be used to compensate for field device inaccuracies.

On a new block, the scaling is set to 1µA per engineering unit. If this is appropriate, it will not need to be changed.

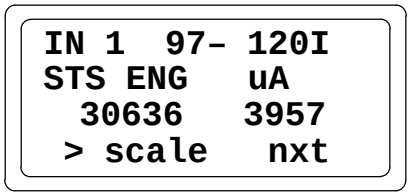
The most accurate scaling comes from actual measurements. The process must be set to two distinctly different conditions, so two engineering units measurements can be taken. If the block is online to the process, it will automatically provide the signal level for each engineering units measurement. If the block is not online to the process, the signal level associated with each engineering units value must also be measured external to the block.

Entering Scaling Values

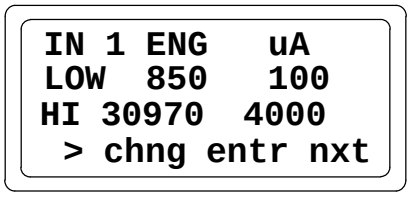
If you are NOT measuring the process while scaling the circuit, have the two pairs of scaling values ready. If you ARE measuring the process to scale the circuit, set the process to one of the two conditions being measured.

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Hand-held Monitor Configuration Steps



1. Line 1 shows which circuit is selected. If you want to scale another circuit, press F1 (>).
2. If you are NOT measuring the process with the block online, go to step 4. If you are measuring the process with the block online, continue at step 3.
3. Line 3 on the status screen shows an engineering units value and the equivalent µA signal level for the selected circuit.The engineering units value, on the left, is calculated from on the current scaling. If the scaling is wrong, the engineering units value is too. Make a note of the µA value shown on this screen; you will need this information to complete the next screen.



4. Press F2 (scale) to scale the circuit.
5. Line 2 shows the circuit's low pair of engineering units and µA values. All values on this screen are configured values, not measured values. Pressing F1 (>) moves the cursor between lines.
6. Enter the engineering units value(s). This must be an integer. For greater resolution, increase the configured values by a convenient multiple, such as 10 or 100. That is, to measure tenths of degrees, you would configure low and high engineering units values of 10x the actual measured temperature. Or to measure hundredths of feet per second, you would configure engineering units values of 100x the measured velocity.
7. After each entry, press F3 (entr).
8. Enter the associated µA value(s). If you are measuring the process online, enter the value read from the HHM's status screen. If you are measuring the process with the block offline, enter the signal level obtained with an external measuring device.
9. **To save the new entries for a circuit, press F3 (entr) again.**
10. Press F4 (next) to return to the status screen.
11. If you are using measured values, set the process to a different condition. Repeat the necessary steps above.
12. Press F4 (nxt) to return to the status screen. From the status screen, select F (>) to select another circuit for scaling.
13. When you are finished scaling circuits, press F4 (nxt) to configure additional block features.

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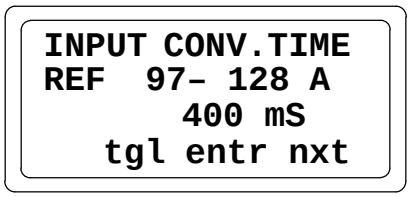
Input Conversion Time

Input conversion time determines the length of time required to make one analog to digital conversion on each input channel. The table below shows the available conversion times and their associated resolution and line rejection capabilities. For a new block, 400mS is the default. This conversion time, which provides the maximum resolution and noise rejection, is suitable for most applications.

Change it only if faster update times are required. The following table shows the available conversion times, and the resolution and noise rejection for each.

Conversion Time (mS)	Resolution		Rejected Frequencies (Hertz)
	(μA)	(bits)	
17	12	11+	60
20	10	11+	50, 400
33	6	12+	60
40	5	12+	50, 400
67	3	13+	60
80	2.5	13+	50, 400
100	2	14	50, 60, 400
200	1	15	50, 60, 400
400	0.5	16	50, 60, 400

Hand-held Monitor Configuration Steps



1. The screen displays the selected conversion time. If this is not appropriate, press F2 (tgl) to change it. To save the new selection, press F3 (entr).
2. Press F4 (next) to advance to the next configuration display.

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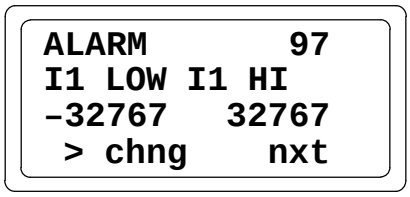
Alarm Thresholds

Each input circuit can have two unique alarms, one for a low value and one for a high value. The high value should be greater than the low value. If an input reaches one of the limits, the block sends the actual value and a LOW ALARM or HIGH ALARM message. The message identifies the circuit in alarm. Only one message is sent upon reaching the threshold. Alarms do not stop the process or change the value of the input.

Alarm Thresholds are scaled values between +/–32,767 engineering units. For a new Current–source Analog Input block, the default Alarm Thresholds are 0 (low) and +25000 (high). Typically, Alarm Thresholds are set at levels beyond which the input should not operate or levels beyond which alternate processing is required.

Because Alarm Thresholds are engineering units values, if scaling is changed, Alarm Thresholds should be reviewed and adjusted if necessary. Alarm Thresholds can also be changed by the ladder logic program in the CPU. If an input reached its high alarm, a new limit could be set. This could generate a high–high alarm or an alarm–cleared threshold. Two examples are described on page 10-18.

Hand-held Monitor Configuration Steps



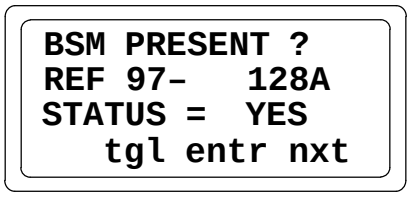
1. The screen displays the low and high Alarm Thresholds for the block's first input.
2. To select the next circuit, press F1 (>) to move the cursor from L O W to H I, then press F1 (>) again.
3. To change the threshold shown at the cursor location, press F2 (chng).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) when you are ready to advance to the next configuration display.

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BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO. Select YES of the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps



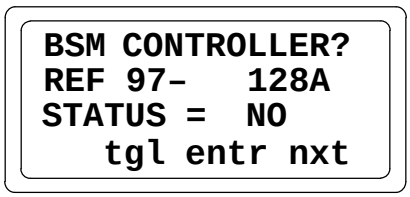
1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. For a new block, the default is NO. Change it only if the block will be used as a BSM Controller.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps



1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

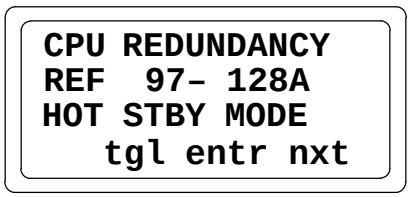
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CPU Redundancy

The block can be configured for No Controller redundancy or Hot Standby redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives communications from both CPUs. The block prefers communications sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If communications from that controller are not available, the block will accept communications from Device Number 30.

Hand-held Monitor Configuration Steps

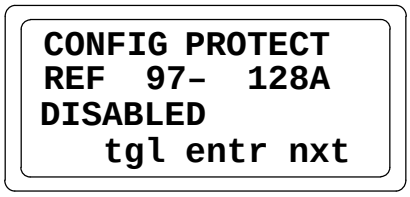


1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

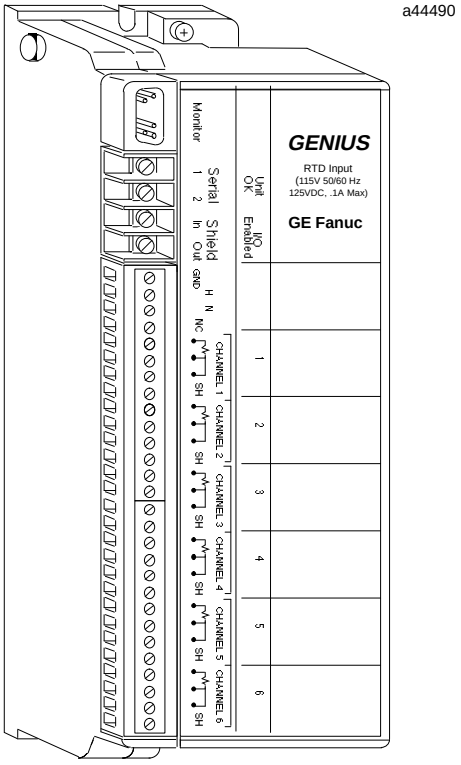
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Chapter 14 RTD 6 Input Blocks

RTD Input blocks monitor temperature inputs from Resistive Temperature Detectors (RTDs). Two RTD blocks are available:

- **115 VAC/125 VDC RTD Block** (IC660BBA101)
- **24/48 VDC RTD Block** (IC660BBA021)

They are identical except for the power supply.



Features

An RTD Input block has six input circuits, in three groups of two circuits each. Group to group isolation is 300 volts. Each input can be used with platinum, nickel, or copper RTDs. Input data for each circuit is linearized according to the type of RTD selected. Input data is reported to the CPU in engineering units of tenths of degrees Celsius, tenths of degrees Fahrenheit, tenths of ohms, or counts. Additional configurable features include:

- Alarm thresholds
- RTD resistance
- Alpha type
- Linearization
- Input filter time

RTD blocks are factory–calibrated; there is no need for subsequent re–calibration.

In addition, the block's automatic diagnostics can pinpoint the cause of installation and run–time errors:

- Input Short detection
- Internal Fault detection
- Wiring Error detection
- Open Wire detection
- Overrange and Underrange input indication
- High and Low input alarms

Fault reporting can be enabled or disabled circuit–by–circuit.

Compatibility

These blocks are compatible with PCIM and QBIM modules. Hand–held Monitor IC660HHM501D, version 3.5 (or later) is required.

For a Series 90™–70 PLC, the CPU may be rel. 1 (IC697CPU731 or 771) or later. The bus controller may be rel. 1 (IC697BEM731) or later.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus PLC, rev. 110 or later is required. The programming software must be Logicmaster™ 6 rel. 4.02 or later.

For a Series Five PLC, the CPU must be rev. 3.0 or later. The Logicmaster 5 programming software must be rel. 2.01 or later.

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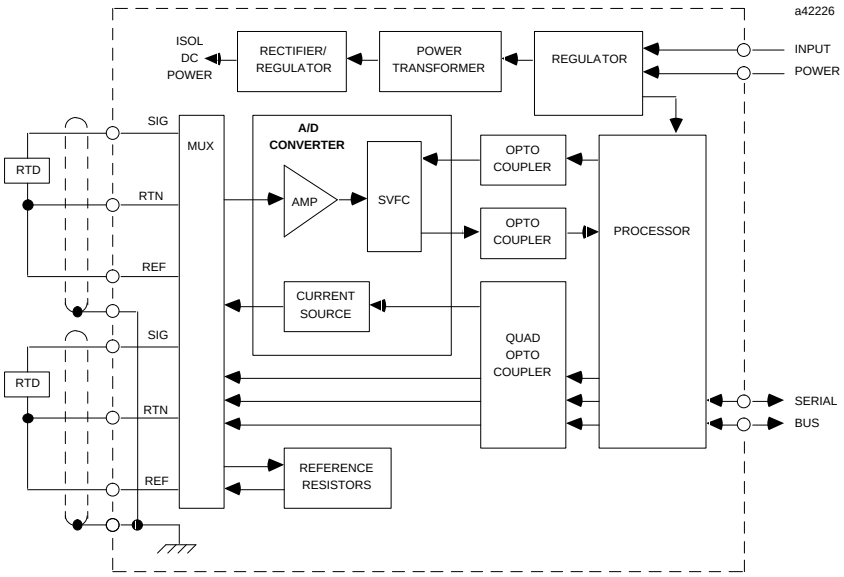
Specifications

Block Type:	6 RTD–compatible inputs, 3 isolated groups of 2	
Catalog Numbers:		
115 VAC / 125 VDC RTD Block	IC660BBA101	
Terminal Assembly Only	IC660TBA101	
Electronics Assembly Only	IC660EBA101	
24 / 48 VDC RTD Block	IC660BBA021	
Terminal Assembly Only	IC660TBA021	
Electronics Assembly Only	IC660EBA021	
LEDs (I/O Block):	Unit OK, I / O Enabled	
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)	
Weight:	4 lbs. (1.8 kg)	
Heat Dissipation:	7W maximum	
Block to Block Isolation:	1500 V	
Group to Group Isolation:	300 V	
115 VAC/125 VDC block power:	**115 VAC**	**125 VDC**
Power supply voltage:	93–132 VAC @ 7W 47–63 Hz	105–145 VDC @ 7W 10% max. ripple
Power supply dropout time:	1 cycle	10mS
24/48 VDC block power:		
Power supply voltage:	18–56 VDC @ 7W, 10% max. ripple	
Power supply dropout time:	10mS	
Input Characteristics:		
Input resolution	0.1 C	
Absolute accuracy (at 25C)		
Platinum or Nickel:	" 0.5 C typical, " 1.0C maximum	
10Ω Copper:	" 5C typical, "10C maximum	
Input update frequency	Once every 400 ms, 800 ms, or 1600 ms	
Input filter ranges (per block)	400 ms, 800 ms, 1600 ms	
RTD linearization	Platinum (DIN 43760), Nickel (DIN 43760), Copper, Linear	
Resistance measurement range	0 to 5000Ω	
Diagnostics	Input shorted, Internal fault, Wiring error, Open wire, Overrange, Underrange, High Alarm, Low Alarm	
Environmental:		
Operating temperature	0C to +60C (32F to +140F)	
Storage temperature	–40C to +100C (–40F to 212F)	
Humidity	5% to 95% (non–condensing)	
Vibration	5 – 10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G	

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Block Operation

For each pair of inputs, a multiplexer switches the A / D converter between the RTD inputs and internal reference resistors that are used for self–calibration. The following diagram shows one pair of inputs.



Opto–couplers isolate the control and clock signals; a small transformer isolates the circuit power. A synchronous voltage–to–frequency converter changes the measured signals to the proportional frequency sent via an opto–coupler to the processor. The processor's frequency counter converts this synchronous frequency to a 16–bit binary number.

The processor corrects each input measurement for lead resistance and for internal offset and gain drifts as it converts the input to an ohmic value. This value is either reported as is, or linearized according to the RTD type selected and converted to a value in degrees. The per channel update rate (input filter time) is preset. It may be 400, 800, or 1600 milliseconds. These selections provide 14, 15, or 16 bit resolution of the measurement.

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Input Data Format

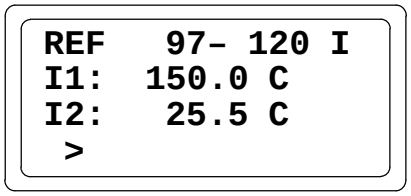
Each bus scan, an RTD block broadcasts 12 bytes of input data. Each input consists of 2 bytes of data in the configured units (C, F, ohms, or counts). Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Byte #	Description
0	Input channel 1, bits 0 – 7
1	Input channel 1, bits 8 – 15
2	Input channel 2, bits 0 – 7
3	Input channel 2, bits 8 – 15
4	Input channel 3, bits 0 – 7
5	Input channel 3, bits 8 – 15
6	Input channel 4, bits 0 – 7
7	Input channel 4, bits 8 – 15
8	Input channel 5, bits 0 – 7
9	Input channel 5, bits 8 – 15
10	Input channel 6, bits 0 – 7
11	Input channel 6, bits 8 – 15

Except as noted on the next page, temperature data from an RTD block is never overwritten due to the presence of a fault condition. The data continues to change after a fault condition has been detected.

Hand–held Monitor Input Display

The Hand–held Monitor displays the configured unit values. The following example shows the Monitor Block screen with configured units of tenths of degrees C.



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Diagnostics

Circuit diagnostics for RTD Input blocks are listed below. Active circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. However, such circuits still respond to faults and report them to the Hand–held Monitor.

If the CPU requests diagnostic information from the block using a Read Diagnostic datagram, the block returns current diagnostics for all active circuits, including any with CPU fault reporting disabled. It will not return diagnostics from inactive circuits.

It is necesssary to clear any fault that occurs to re-enable detection of that particular fault. For example, after a high alarm is reported the temperature may drop back to an acceptable level. The block continues to supply the actual temperature data. However, to re-enable high alarm detection, it is necessary to clear the existing High Alarm fault report.

Input Shorted This diagnostic indicates an input circuit measurement below the minimum expected for RTD type. It may indicate a fault in the wiring or in the RTD. Instead of reporting the actual input value, the block uses the appropriate Underrange value (see below).

Internal Fault An internal fault occurs if one or more of the internal auto–calibration readings for a pair of channels is out of tolerance. When this fault occurs, the block reports a value of zero for each channel of the faulty pair. The block's Electronics Assembly should be replaced.

Wiring Error A wiring error fault occurs if connections between the RTD and the block's Terminal Assembly are incorrect. The incorrect connections may cause faulty input data to be reported. Field wiring should be changed to match the wiring diagram indicated on the block's faceplate.

Open Wire The block reports an Open Wire diagnostic if there is less current than expected for the input type on that circuit. An Open Wire diagnostic may also mean that the input circuit excitation current is not present. The RTD may be missing or faulty, or the RTD is not connected to the block.

Overrange The block sends an Overrange message if the Celsius or Fahrenheit input value exceeds expected maximum positive value (limits are 850C or 1562F for platinum, 250C or 482F for nickel, +3276.7C or +3276.7F otherwise). This only occurs when converting to units of temperature.

Underrange The block sends an Underrange message if the Celsius or Fahrenheit value exceeds expected maximum negative value (limits are –200C or –328F for platinum, –60C or –76F for nickel, –3276.7C or –3276.7F otherwise).

Low Alarm/ High Alarm Individual low and high alarm thresholds can be configured for each input. If an input reaches one of its alarm thresholds, the block reports a Low Alarm or High Alarm diagnostic. The diagnostic is triggered upon reaching the limit and will not be repeated until circuit faults are cleared.

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Field Wiring

Terminals 5 through 32 are for wiring field devices. They accept AWG #22 to AWG #14 wires.

Power Source Wiring

For block power, connect an appropriate power source to terminals 6 and 7. For an AC block, connect the AC source to the HOT terminal and neutral to the NEUT terminal. For a DC block, connect the DC source to the DC+ terminal and the return to the DC– terminal.

The ground (GND) terminal (5) is for block safety. It is connected to the block chassis.

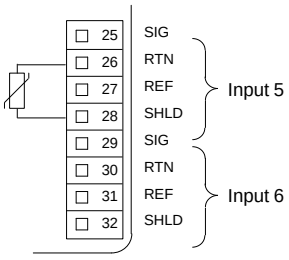
Noise Suppression

If noise spikes exceeding 4000 volts will be present in the system, additional noise suppression is needed to protect the block. This can be provided by physically separating and shielding the RTD input leads from any noise source.

Each circuit also has a SHLD terminal for shield termination, if desired. This terminal is internally connected to the block chassis and to the input power safety ground terminal.

Additional suppression can be provided by connecting three MOVs to the block; one for each pair of input points (inputs 1&2, 3&4, and 5&6 are pairs). For one point *of each input pair*, connect the MOV between the RTN and SHLD terminals. For example, connect:

terminals 10 and 12 for input 1
terminals 18 and 20 for input 3
terminals 26 and 28 for input 5, shown below.

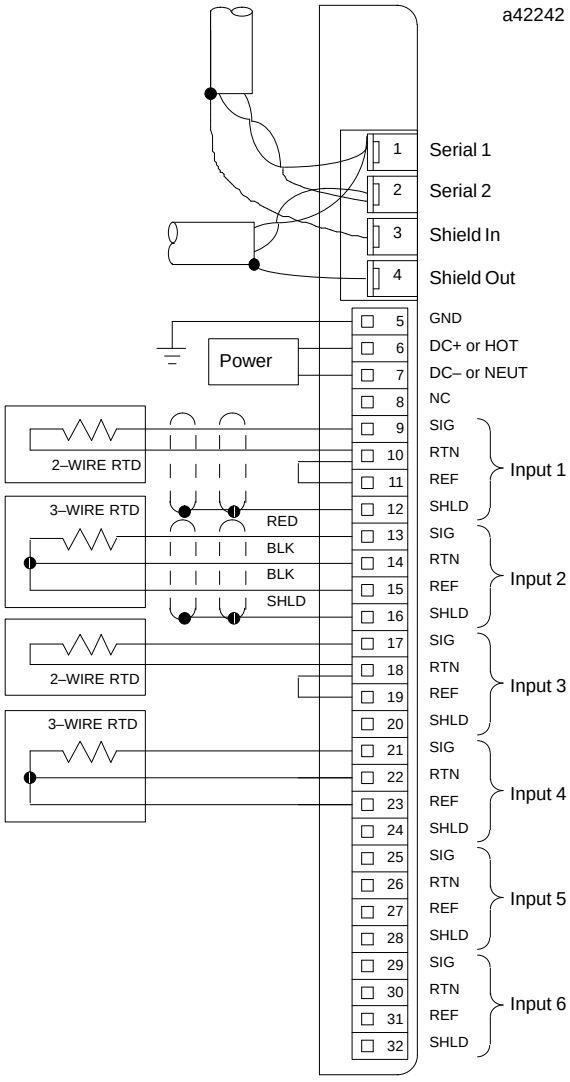


Be sure the MOV leads do not cause shorts between any other wires.

Wiring for Input Devices

There are 4 terminals available for each input device: a SIG, RTN, REF, and SHLD input. Connect RTDs between the SIG and RTN terminals.

The REF input is used for lead wire compensation of a 3–wire RTD. For a 3–wire RTD, connect the third wire to the REF terminal. For 2–wire RTDs, short the REF terminal to the RTN terminal.



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Block Configuration

The configurable features of an RTD Block are listed below. For many, the factory setting will not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Channel Active	Circuit	yes	yes, no
Report Faults	Circuit	yes	yes, no
Linearization	Circuit	Platinum	Platinum, Nickel, Copper, Linear
RTD Resistance	Circuit	100.0 ohms	5.0–2000.0 ohms
Alpha Type	Circuit	0.003850	0.001000–0.007000
Low Alarm	Circuit	–200C	–32,767 to +32,767 or 0 to +65,535
High Alarm	Circuit	+800C	–32,767 to +32,767 or 0 to +65,535
Input Filter Time	Block	1600mS	400, 800, 1600mS
Units	Block	Celsius	Celsius, Fahrenheit, ohms, counts

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

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RTD Input Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Input Filter Time (1600/800/400mS) _____

Units (tenths of degrees Celsius/tenths of degrees Fahrenheit/tenths of Ohms/counts) _____

Circuit Features:

	1	2	3	4	5	6
References: From						
To						
Report Faults? (Y/N)						
Channel Active? (Y/N)						
Linearization (PT/NI/CU/Linear)						
RTD Resistance (5.0 –2000.0Ω)						
Alpha (0.001000–0.07000)						
Alarm Thresholds:						
Low (eng units)						
High (eng units)						

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Report Faults to CPU

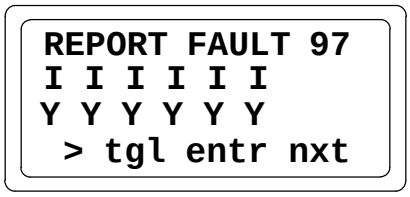
Fault reports to the host can be disabled or enabled for any circuit.

If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit.

Regardless of whether fault *reporting* is enabled, the block will detect faults on the circuit, and take appropriate actions. The block's Unit OK LED will blink when a fault occurs, and a fault report will be sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps



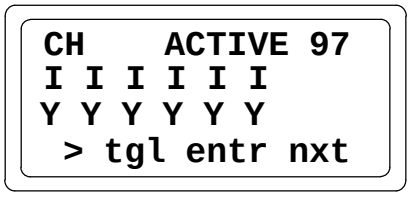
1. Line 3 shows the current Report Faults configuration of each circuit (circuits are shown on line 2 for reference).
2. To move the cursor and select a circuit for configuration, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

Channel Active

If a channel is not wired, or if a channel is wired but should not report diagnostics, that channel should be configured as inactive.

The block processes input data from the channel, but does not perform fault detection on it. The block's Unit OK LED does not indicate faults for inactive channels.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Channel Active configuration of each circuit (circuits are shown on line 2 for reference).
2. To move the cursor and select a circuit for configuration, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

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Units

The block can be configured to report data as engineering units or as unconverted counts.

If units of Celsius, Fahrenheit, or ohms are selected, the block will automatically calibrate and convert input data into engineering units of:

- tenths of a degree Celsius
- tenths of a degree Fahrenheit
- tenths of ohms

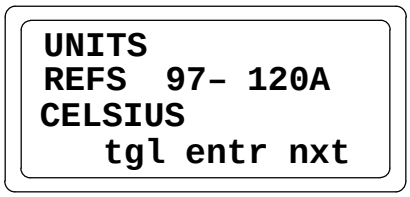
Values are reported to the CPU as tenths of units. For example, 300.2 ohms is reported to the CPU as 3002. This provides greater resolution than simply reporting integer values.

The Hand–held Monitor accurately displays the engineering units value to one decimal place. The same 300.2 ohms appears on the HHM as:

300.2 Ω

If counts are selected, values are reported as they are received from the hardware, with no auto calibration performed.

Hand-held Monitor Configuration Steps



1. Line 3 shows the currently–selected units.
2. To change the units, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

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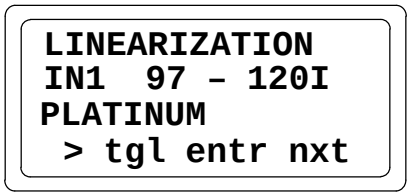
Linearization

The block converts the resistance from an RTD into degrees according to the type of Linearization selected for the circuit. The default Linearization type is platinum. Copper, nickel, or linear (configured for RTDs that do not conform to the DIN 43760 standard) may also be selected.

If platinum or nickel is configured, the block linearizes the input according to the DIN 43760 standard. If copper or linear is configured, the block linearizes the input using a straight line approximation based on the RTD resistance and Alpha type. If copper or linear is selected, the block converts resistance to temperature based on the entries made for RTD Resistance and Alpha, using this equation:

$$\text{Measured Temp (TC)} = \frac{\text{(RTD Resistance at TC)}–\text{(R TD Resistance at 0C)}}{\text{(RTD Resistance at 0C x Alpha)}}$$

Hand-held Monitor Configuration Steps



1. Line 3 shows the current selection for the first RTD. To change the Linearization type for the RTD currently displayed, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. To select another circuit, press F1 (>).
4. Press F4 (next) to advance to the next configuration display.

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RTD Resistance

This entry specifies the nominal resistance (at 0C) in tenths of ohms of the RTD connected to each input. The default RTD Resistance depends on which type of Linearization is configured for that circuit.

Linearization Selection	Default RTD Resistance
Platinum	100.0 Ω
Nickel	100.0 Ω
Copper	10.0 Ω

RTD Resistance can be reconfigured to a value between 5.0Ω and 2000.0Ω. RTD Resistance specifications are available from the RTD manufacturer, or may be determined by actual measurement. RTD Resistance can also be calculated as explained on the next page. RTD Resistance must be calculated if the selection for Linearization is Linear.

Hand-held Monitor Configuration Steps

Line 3 shows the RTD Resistance for the first RTD.

```
RTD RESISTANCE
IN1  97 - 120A
OHMS=    100.0
 > chng    nxt
```

1. To change the RTD Resistance type for the RTD currently displayed, press F2 (chng). From the Hand–held Monitor, RTD Resistance is entered as ohms and tenths of ohms:

   92.0Ω

   When configuring the block from the CPU, RTD Resistance is entered in tenths of ohms (for this example, 920).

2. To save the new selection, press F3 (entr).
3. To select another RTD, press F1 (>).
4. Press F4 (next) when you are ready to advance to the next configuration display.

Adjusting RTD Resistance

For greater measurement accuracy, you can adjust the RTD Resistance value to produce a temperature reading that matches a known measurement point. At 100C, changing the RTD Resistance value by 0.1 ohm changes the temperature measurement by 0.37C. At 850C, changing the RTD Resistance value by 0.1 ohm changes the temperature measurement by 1.34C.

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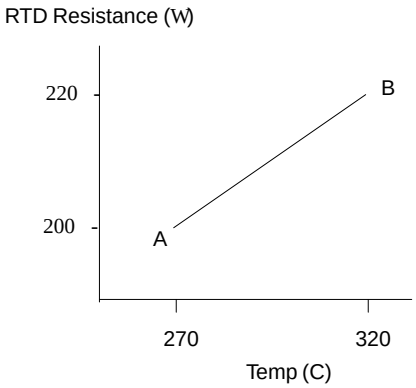
Calculating RTD Resistance

If it is necessary to calculate RTD Resistance, follow these steps.

1. Select high and low resistance values for the RTD. They should represent the span over which the RTD is expected to operate. Appropriate values should be provided in the manufacturer's documentation. If not, measure two resistance values:

Measure lower RTD resistance. In this example, resistance is 200.0Wat 270C.

Measure upper RTD resistance. In this example, resistance is 220.0Wat 320C.



2. Calculate the slope of a straight line between the two chosen points:

$$\text{Slope} = \frac{\text{Change in Resistance}}{\text{Change in Temperature}} = \frac{220\Omega - 200\Omega}{320C - 270C} = 0.4\Omega / C$$

3. Calculate the RTD Resistance at 0C:

$$\text{RTD Resistance @ } 0^{o} = \text{Lower Resistance} - (\text{Slope} \times \text{Lower Temperature})$$
$$= 200.0\Omega - (0.4\ \Omega /{}^{o}C \times 270^{o}C) = 92.0\Omega$$

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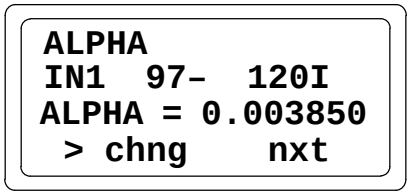
Alpha

This entry specifies the Alpha value of an RTD in micro–ohms / ohm–degree C. The default Alpha value depends on which type of Linearization is configured for that circuit.

Linearization Selection	Alpha Default Ω/ΩC
Platinum	0.003850
Nickel	0.006180
Copper	0.004200

The Alpha value can be reconfigured within the range of 0.0010000 to 0.007000. Alpha information is available from the RTD manufacturer. If the Alpha value is not available or if Linear was selected for Linearization, calculate Alpha as shown below.

Hand-held Monitor Configuration Steps



1. Line 3 shows the Alpha value for the first RTD. The value illustrated above would be equal to 3850µ Ω/Ω C from CPU
2. To change the value currently displayed, press F2 (chng). From the Hand–held Monitor, Alpha is entered as Ω/ΩC:

   0.004348

   (When configuring the block from the CPU, Alpha entered in µΩ/ΩC (for this example, 4348µΩ/ΩC
3. To save the new selection, press F3 (entr). To select another RTD, press F1 (>).
4. Press F4 (next) when you are ready to advance to the next configuration display.

Calculating Alpha

Use this equation to calculate Alpha. If necessary, turn back to "RTD Resistance" to calculate slope.

$$\text{Alpha} = \frac{\text{Slope}}{\text{RTD Resistance at 0C}} = \frac{0.4\Omega / \text{C}}{92.0\Omega} = 0.004348\Omega/\Omega\text{C} = 4348\mu\Omega/\Omega\text{C}$$

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Alarm Thresholds

Each RTD input is associated with a low alarm threshold and a high alarm threshold. If an input reaches one of its thresholds, the block sends the actual value and a LOW ALARM or HIGH ALARM message. The message identifies the circuit in alarm. Only one message is sent upon reaching the limit. Alarms do not stop the process or change the value of the input.

The default Alarm Thresholds depend on the type of Units selected:

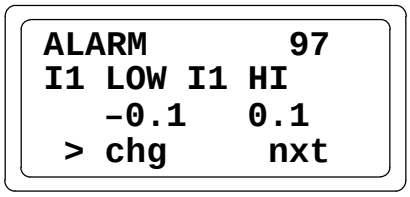
UNITS	LOW Alarm Threshold	HIGH Alarm Threshold
Counts	0	+65,535
Ohms	0	+65,535
Celsius	–32,767	+32,767
Fahrenheit	–32,767	+32,767

Alarm thresholds can be set anywhere over the dynamic range of the signal. If alarm reporting is not wanted, the circuit's alarm thresholds can be set beyond the dynamic range of the signal so they will never be activated.

Because alarm thresholds are engineering units values, if units are changed, alarm thresholds should be reviewed and adjusted if necessary. The block will automatically switch to the default alarm thresholds when the engineering units are changed. The previous alarm limits will be saved and restored if the units selection is changed back to its previous value. If power is removed from the block, the thresholds for the currently–selected engineering units will be saved and restored when power is restored to the block.

Alarm thresholds can also be changed by the application program in the CPU. If an input reached its high alarm, a new limit could be set. This could generate a high alarm, or an alarm–cleared threshold. Two examples are described on page 10-18.

Hand-held Monitor Configuration Steps



1. The screen displays the low and high alarm thresholds for the first RTD input. To select the next circuit, press F1 (>) to move the cursor from LOW to HI, then press F1 (>) again.
2. To change the threshold shown at the cursor location, press F2 (tgl).
3. To save the new selection, press F3 (entr). Press F4 (next) to advance to the next configuration display.

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Input Filter Time

The Filter Time determines how frequently the block will sample new values for each input.

Filter time may be: 400mS (14–bit resolution), 800mS (15–bit resolution), or 1600mS (16–bit resolution). Longer filter times integrate input values over time to reject noise and improve resolution. The default filter time is 1600mS, which is suitable for most applications. Change it only if faster sampling is needed.

Hand-held Monitor Configuration Steps

The screen displays the selected filter time.

```
INPUT FILTR TIME
REF  97- 120A
FILTER=  400mS
   tgl entr nxt
```

1. If this is not appropriate, press F2 (tgl) to change it. To save the new selection, press F3 (entr).
2. Press F4 (next) to advance to the next configuration display.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps

```
CONFIG PROTECT
REF  97-  120A
DISABLED
   tgl entr nxt
```

1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.

   Press F4 (next) to return to the first configuration display.

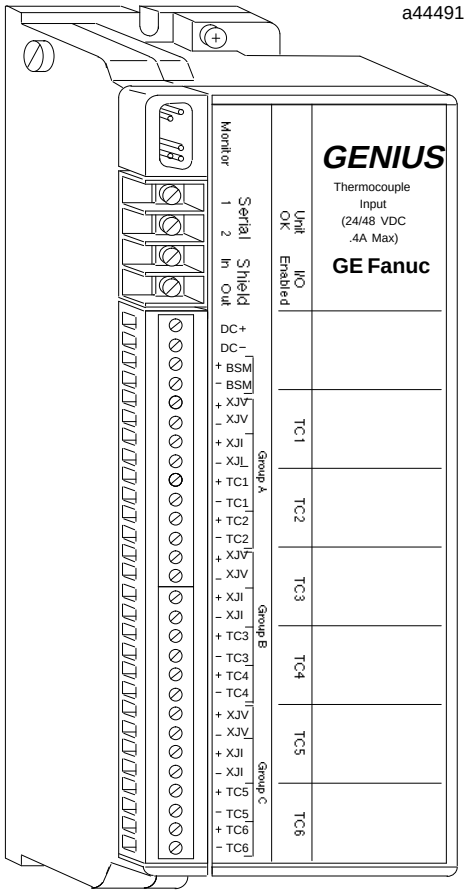
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Chapter 15 Thermocouple 6 Input Blocks

Thermocouple Input Blocks are primarily used to monitor temperature inputs from standard thermocouples. They can also be used to measure low–level voltage input signals. Two blocks are available:

- **115 VAC/125 VDC Thermocouple Block** (IC660BBA103)
- **24/48 VDC Thermocouple Block** (IC660BBA023)

They are the same except for the power supply.



Features

A Thermocouple block has six input circuits, in three isolated groups. ± 10 V common mode voltage (maximum) allowed between 2 points in a group. Each group has two thermocouple input circuits and two remote cold junction compensation inputs. Group to group isolation is 300 volts.

Each input can interface to type J, K, T, E, B, R, S, and N (#14 AWG Nicrosil vs. Nisil) thermocouples. The block provides cold junction compensation for all thermocouple input measurements. Each channel can be configured to use an internal sensor, an external sensor, or a user–defined value for cold–junction compensation. An external signal from a remote junction can be either a voltage (XJV) or a current (XJI) analog of temperature. The XJV input is scaled for 1.0mV per degree Celsius and the XJI input is scaled for 1.0uA per degree Kelvin. After compensation, the block linearizes each thermocouple input measurement according to the NBS monograph for the type in use.

Each input measurement can be adjusted up to ± 100.0C or ± 100.0F for greatest accuracy.

The blocks perform the following diagnostics:

- Internal fault detection
- Open Wire detection
- Overrange and Underrange input indication
- High and low input alarms

An output is provided to drive a Bus Switching Module (version IC660BSM021 only).

Compatibility

These blocks are compatible with PCIM and QBIM modules. Hand–held Monitor IC660HHM501D, version 3.5 (or later) is required.

For a Series 90™–70 PLC, the CPU must be rel. 2 (IC697CPU731 or 771) or later. The bus controller must be rel. 2 (IC697BEM731) or later. The programming software must be Logicmaster™ 90–70 rel. 2.02 or later.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus PLC, rev. 110 or later is required. The programming software must be Logicmaster™ 6 rel. 4.02 or later.

For a Series Five PLC, the CPU must be rev. 3.0 or later. The Logicmaster 5 programming software must be rel. 2.01 or later.

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Specifications

Block Type:	Six thermocouple–compatible inputs, three isolated groups of two.	
Catalog Numbers: 115 VAC / 125 VDC Thermocouple Block Terminal Assembly Only Electronics Assembly Only 24 / 48 VDC Thermocouple Block Terminal Assembly Only Electronics Assembly Only	 IC660BBA103 IC660TBA103 IC660EBA103 IC660BBA023 IC660TBA023 IC660EBA023	
Size (Height x width x depth): **Weight:** **LEDs (I/O Block)**: **Heat Dissipation:**	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm) 4 lbs. (1.8 kg) Unit OK, I / O Enabled 9W maximum	
Block to Block Isolation: **Group to Group Isolation**:	1500 V for one minute 300 V	
115 VAC/125 VDC block power: Power supply voltage Power supply dropout time:	**115 VAC** 93–132 VAC @ 9W 47–63 Hz 1 cycle	**125 VDC** 105–145 VDC @ 9W 10% max. ripple 10 mS
24/48 VDC block power: Power supply voltage Power supply dropout time	 18–56 VDC @ 9W, 10% max. ripple 10mS minimum	
Input Characteristics: Voltage measurement: Range Resolution Accuracy (at 25C) Bandwidth of input amplifier filter Temperature coefficient	 –25.0mV to +150mV Less than $ 4 µV Less than $ 10µV error typ, $ 20µV max. 8 Hz $ 2µV / C typical	
Internal Cold Junction Measurement: Range Offset at 25C Linearity Resolution Temperature coefficient	 0 to 60C $ 2 C typ. User adjustable to zero at any temperature. $ 0.15C Less than $ 0.01C $ 0.05 per C	
External Cold Junction Measurement: Range Scale factors Resolution Accuracy	 –25.0C to +150.0 C 1.0C per millivolt, 1.0K per microampere Less than $ 0.01 C $ 0.1C	
Input update time (all channels):	2.0 sec (typ), 3.0 sec (max)	
Open wire detection response:	less than 5.0 seconds	
Diagnostics:	Open Wire, Overrange, Underrange, High Alarm, Low Alarm, Internal Fault	
Environmental: Operating Temperature Storage Temperature Humidity Vibration:	 0C to +60C (+32F to +140F) –40C to +100 C (–40F to +212F) 5% to 95% (non–condensing) 5–10 Hz 0.2" (5.08mm) displacement, 10–200 Hz at 1G	

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Block Operation

A Thermocouple Input Block has three isolated pairs of inputs. Transformers isolate power and optical couplers provide signal isolation.

For each pair of inputs:

1. After filtering, each signal input is sequentially switched into a common amplifier whose output is applied to a voltage–to–frequency converter. The output signal frequency of the VFC is applied to a frequency counter via an optical coupler. The output frequency is counted for a 400 millisecond gate time, which is a common multiple of all the common line frequency periods. This provides considerable rejection of line frequency pickups.
2. The multiplexer intersperses other inputs between the two main thermocouple input times. The other inputs come from the cold junction sensors and from internal references. The cold junction inputs are measured and stored for later compensation of the normal thermocouple input measurement errors.
3. To detect and correct for any gain or offset drift in the amplifier or VFC, the block takes new readings of factory–calibrated internal reference levels during operation. These new measurements are compared to reference values stored by the block.
4. The processor converts the cold junction temperature value to a voltage as specified by the NBS monograph for the thermocouple type in use. This voltage is then added to the thermocouple measurement before converting to thermal units. Since there may be some small differences between the cold junction temperature measurement and the actual cold junction temperature, an offset adjustment can be entered using a Hand–held Monitor. These offsets are due to variances in the terminal strip assembly and the correction factors are therefore stored in the Terminal Assembly EEPROM.

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Block Measurement Accuracy

The overall accuracy of the block in a given application depends on both:

1. Accurate measurement of the thermocouple millivolt signal.
2. Accurate compensation of the cold junction connections.

The block can measure the input millivolt signal to an accuracy of " 10µV (typical) or " 20µV (maximum). Depending on the thermocouple type used and the temperatures being measured, measurement accuracy in C or F can be determined.

The output from a thermocouple varies in a non–linear manner as the temperature being measured changes. Furthermore, each thermocouple type has a unique characteristic.

The following table may be used as a guide to estimate accuracy in units of degrees. It lists optimal accuracy for each thermocouple type, without allowing for conditions that might be encountered in the application, or for the accuracy of the specific thermocouple being used. For a more accurate estimate, consult the NBS monograph published for the thermocouple type used in the application, referencing the temperature range to be measured.

Thermocouple Type	Average Sensitivity: µV/C	Optimal Accuracy in C
J	52.6	0.19
K	38.8	0.26
T	40.5	0.25
E	67.9	0.15
B	7.6	1.32
R	12.0	0.84
S	10.6	0.95
N	38.5	0.26

Cold junction compensation can be performed internally by the block itself, or remotely. The block has a cold junction sensor which is set at the factory to compensate the cold junction to within " 2C typically. If a more accurate setting is required, this compensation can be adjusted using a Hand–held Monitor, after the block is installed (see page 15-14).

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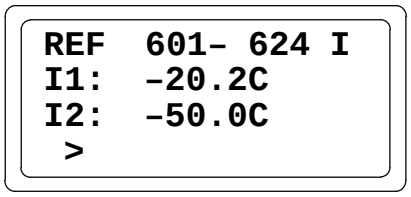
Input Data Format

Each bus scan, a Thermocouple block broadcasts 12 bytes of input data. Each input consists of 2 bytes of data in the configured units (C, F, mV, or counts). Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Byte #	Description
0	Input channel 1, bits 0 – 7
1	Input channel 1, bits 8 – 15
2	Input channel 2, bits 0 – 7
3	Input channel 2, bits 8 – 15
4	Input channel 3, bits 0 – 7
5	Input channel 3, bits 8 – 15
6	Input channel 4, bits 0 – 7
7	Input channel 4, bits 8 – 15
8	Input channel 5, bits 0 – 7
9	Input channel 5, bits 8 – 15
10	Input channel 6, bits 0 – 7
11	Input channel 6, bits 8 – 15

Hand–held Monitor Input Display

The Hand–held Monitor displays the values in the configured units. The following example shows the Monitor Block screen with configured units of tenths of degrees C.



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Diagnostics

Circuit diagnostics for Thermocouple Input Blocks are listed below. These diagnostics are automatically performed by the block for any active circuit. Active circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. However, such circuits still respond to faults and report them to the Hand–held Monitor. If a circuit is configured as "inactive", it will not *detect faults* or report diagnostics.

If the CPU requests diagnostic information from the block using a Read Diagnostic datagram, the block returns current diagnostics for all active circuits, including any with CPU fault reporting disabled. It will not return diagnostics from inactive circuits.

Internal Fault

An internal fault occurs if one or more of the internal references is faulty. While this fault is present, the block reports a value of zero for each channel using the faulty reference(s). The block's Electronics Assembly should be replaced.

Open Wire

The block reports an Open Wire diagnostic if there is a missing or faulty connection to the thermocouple input, XJV input, or XJI input for the channel.

Overrange/Underrange

This diagnostic is reported only if engineering units of Celsius or Fahrenheit are selected. It indicates either that:

1. The input temperature exceeds the expected range for the thermocouple type in use. The expected range for each thermocouple type, derived from the corresponding NBS monograph, is:

Thermocouple Type	Range		
J	–210.0C	to	+1200.0C
K	–270.0C	to	+1370.0C
T	–270.0C	to	+400.0C
E	–270.0C	to	+1000.0C
B	+20.0C	to	+1820.0C
R	–50.0C	to	+1770.0C
S	–50.0C	to	+1770.0C
N	0.0C	to	+1300.0C
L	–3276.7C	to	+3276.7C

2. **(**If **Overrange)**: the cold junction sensor reading is above +150C. It may be caused by an open wire if an XJV sensor is in use. **(**If **Underrange)**: the cold junction sensor reading is below –50C. It may be caused by an open wire if an XJI sensor is in use.

Low Alarm/High Alarm

Individual low and high alarm thresholds can be configured for each input. If an input reaches one of its alarm thresholds, the block reports a Low Alarm or High Alarm diagnostic. The diagnostic is triggered upon reaching the limit and will not be repeated until circuit faults are cleared.

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Field Wiring

Terminals 5 through 32 are used for input power, Bus Switching Module control, and field wiring devices. These terminals accept AWG #22 to AWG #14 wires. For the smaller gauge thermocouple wires, connector–type crimp pins of the same alloy are recommended to make installation easier.

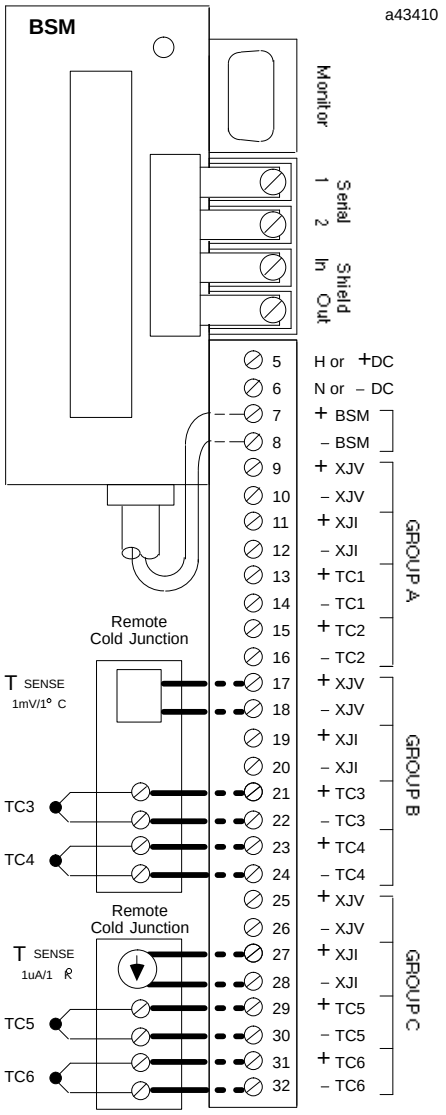
For block power, connect an appropriate power source to terminals 5 and 6. For the 115 VAC / 125 VDC block version, connection can be of either polarity. For the 24 / 48 VDC version, the polarity should be observed as marked, although protection is provided against accidental reversed input polarity.

When a Bus Switching Module is installed, connect the BSM control wires, which are not polarized, to terminals 7 and 8.

Wiring for Thermocouples

Thermocouple wires should be connected to the six channels observing the proper polarity. For American color coding, connect the red wire to the (–) terminal.

Typical connections for both types of remote cold junction sensing are shown in the following illustration.



NOTE:
Heavy lines (▬) represent copper wires.

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Block Configuration

The configurable features of a Thermocouple Block are listed below. For most, the factory setting is suitable for many applications and will not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6 std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Report Faults	Circuit	yes	yes, no
Channel inactive	Circuit	active	active, inactive
Units	Block	C	C, F, millivolts, counts
Thermocouple type	Circuit	Type J	Type J, K, T, E, B, R, S, N or (L)inear
Compensation method	Circuit	Internal	Internal, external voltage, external current, or user–supplied compensation value
Compensation value (for user–supplied method)	Circuit	0.00mV	range is " 326.67mV
Offset value	Circuit	0.00	" 100.0C or " 100.0F
Low Alarm	Circuit	–250C	range is –32767 to +32767
High Alarm	Circuit	+1400C	range is –32767 to +32767
BSM Present	Block	no	yes, no
BSM Controller	Block	no	yes, no

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand–held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand–held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

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Thermocouple Input Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Units (tenths of degrees Celsius/tenths of degrees Fahrenheit/millivolts/counts) _____

Circuit Features:

	1	2	3	4	5	6
References: From						
To						
Report Faults? (Y/N)						
Channel Active? (Y/N)						
Thermocouple Type (J, K, T, E, B, R, S, N, L)						
Compensation Method (I, XJV, XJI. U)						
Compensation Value (" 327.67mV)						
Input Offset Value (" 100.0º)						
Alarm Thresholds:						
Low (eng units)						
High (eng units)						

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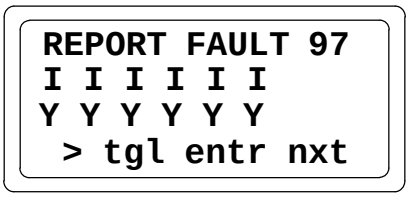
Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit on a block. If fault reporting is enabled for a circuit, the block will send a message to the host if any fault occurs on that circuit. If Fault reporting is disabled, the block will not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block will detect faults on the circuit, and take appropriate actions. The Unit OK LED will blink when a fault occurs, and a fault report is sent to a Hand–held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps

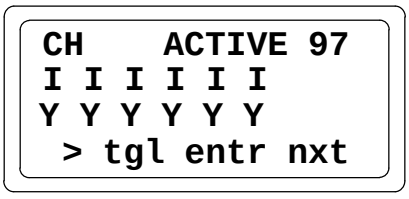


1. Line 3 shows the current Report Faults configuration of each circuit (circuits are shown on line 2 for reference).
2. To move the cursor and select a circuit for configuration, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) when you are ready to advance to the next configuration display.

Channel Active

Used to disable fault detection for a channel that is not wired, or from which no diagnostics should be reported. If enabled, the block will continue to report input data, but will perform no fault detection on the input channels. The Unit OK LED will not indicate faults for inactive channels.

Hand-held Monitor Configuration Steps



1. Line 3 shows the current Channel Active configuration of each circuit (circuits are shown on line 2 for reference).
2. To move the cursor and select a circuit for configuration, press F1 (>).
3. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

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Units

The block can be configured to report data as engineering units or as unconverted counts.

If units of Celsius, Fahrenheit, or millivolts are selected, the block will automatically calibrate and convert input data into engineering units of:

- tenths of a degree Celsius
- tenths of a degree Fahrenheit
- hundredths of millivolts

Temperature values are reported to the CPU as tenths of units. For example, 300.2 degrees Celsius is reported to the CPU as 3002. This provides greater resolution than simply reporting integer values.

The Hand–held Monitor accurately displays the temperature value to one decimal place. The same 300.2 degrees Celsius appears on the HHM as:

300.2C

Millivolt values are reported to the CPU as hundredths of millivolts. For example, 300.25mV is reported to the CPU as:

30025

The Hand-held Monitor accurately displays the millivolt value to two decimal places. The same 300.25mV appears on the Hand-held Monitor as:

300.25

If counts are selected, values are reported as they are received from the hardware, with no auto calibration performed.

Hand-held Monitor Configuration Steps

```
UNITS
REFS  97– 120A
CELSIUS
   tgl entr nxt
```

1. Line 3 shows the currently–selected units.
2. To change the units, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

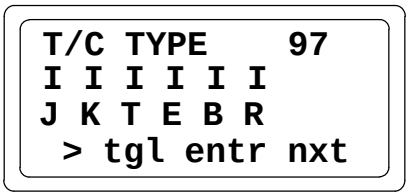
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Thermocouple Type

Each channel can receive inputs from a type **J, K, T, E, B, R, S,** or **N** thermocouple. If one of these thermocouple types is configured, the block will convert input values to engineering units using an internal linearization table for that thermocouple type.

If **L**inear is selected, the block will convert input values to appropriate engineering units, using a fixed scaling factor of 10C / mV.

Hand-held Monitor Configuration Steps



1. Line 3 shows the type of thermocouple currently selected for each input. To change the thermocouple type for input indicated by the cursor, press F2 (tgl). To save the new selection, press F3 (entr).
2. To select another circuit, press F1 (>).
3. Press F4 (next) to advance to the next configuration display.

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Compensation Method

The source of cold junction compensation for each input is configured separately. The block uses this compensation when converting input readings to temperature values.

- **I** Internal sensor selects input from the sensor in the block's Terminal Assembly.
- **X_V** External voltage compensation selects input from an XJV sensor.
- **X_I** External current compensation selects input from an XJI sensor.
- **U** Selects the User–supplied Compensation Value (see next page).

Hand-held Monitor Configuration Steps

```
COMP METHOD  97
I I I I I I
I XV U XI I I
 > tgl entr nxt
```

1. Line 3 shows the type of compensation currently selected for each thermocouple input. To change the compensation method for input indicated by the cursor, press F2 (tgl).
2. To save the new selection, press F3 (entr). To select another circuit, press F1 (>).
3. Press F4 (next) to advance to the next configuration display.

User–supplied Compensation Value

This value is entered only if user–supplied compensation was selected for a channel, and the units are C or F. The range for the compensation value is " 327.67mV.

The compensation value is a mV value, not an engineering units value. During operation, the block will automatically add this value to the measured input voltage BEFORE calibrating and converting voltage to tenths of degrees.

Hand-held Monitor Configuration Steps

```
USER COMP VALUE
IN3   97– 120I
      0.00mV
 > chng     nxt
```

1. This screen appears once for each input configured as U on the Compensation Method screen. The first of these is indicated on line 2. If a compensation value has already been entered for the input indicated on line 2, that value appears on line 3. To enter a new compensation value for the input, press F2 (chng).
2. To save the new selection, press F3 (entr).
3. If U has been selected as the compensation method for more than one input, press F1 (>) to select the next input. Enter additional compensation values as needed.
4. Press F4 (next) to advance to the next configuration display.

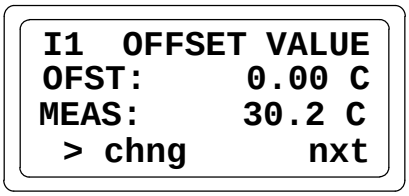
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Input Offset Value

For each channel, an offset value can be specified to correct for observed measurement inaccuracy. The range for this offset value is " 100.00C or " 100.00F .

The following screen appears when the selection for Units is either Celsius or Fahrenheit. Offset adjustments should be made following the procedure explained below.

Hand-held Monitor Configuration Steps



1. Line 1 indicates the input being configured. Line 3 shows the actual measured value from that input. To enter an offset, press F2 (chng).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Field Offset Adjustment

After the block is installed, follow the steps below when making offset adjustments to temperature input values. Repeat these steps for each channel being adjusted.

1. Operate the block at its normal ambient operating temperature for at least two hours to allow for thermal stabilization.
2. Using a Hand–held Monitor, configure the block for units of Fahrenheit to obtain more resolution.
3. Connect a thermocouple simulator set for 32.0F to the input being adjusted.
4. Subtract the average measured value from 32.0 to find the amount of offset.
5. On the Hand–held Monitor, display the Offset Value configuration screen. Enter the number found in step 4.
6. Repeat steps 3, 4, and 5 until HHM displays an average measured value of 32.0F .
7. Reconfigure the block to the desired units.

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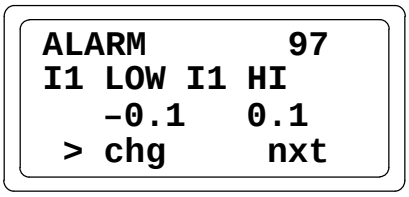
Alarm Thresholds

For each input, these configured values determine the values at which low alarm and high alarm conditions will be reported. The selectable range is –32767 to +32767 engineering units, if the configuration for Units was Celsius, Fahrenheit, or millivolts. If counts were configured as the units for the block, the range is 0 to 65535 counts.

Because alarm thresholds are engineering units values, if units are changed, alarm thresholds should be reviewed and adjusted if necessary. The block will automatically switch to the default alarm thresholds when the engineering units are changed. The previous alarm limits will be saved and restored if the units selection is changed back to its previous value. If power is removed from the block, the thresholds for the currently–selected engineering units will be saved and restored when power is restored to the block.

Alarm thresholds can also be changed by the application program in the CPU. If an input reached its high alarm, a new limit could be set. This could generate a high–high alarm or an alarm–cleared threshold. Two examples are described on page 10-18.

Hand-held Monitor Configuration Steps



1. The screen first displays the low and high alarm thresholds for the first input. To select the next circuit, press F1 (>) to move the cursor from L O W to H I, then press F1 (>) again.
2. To change the Alarm threshold shown at the cursor location, press F2 (chng), then enter the new value.
3. To save the new selection, press F3 (entr).
4. Press F4 (next) to advance to the next configuration display.

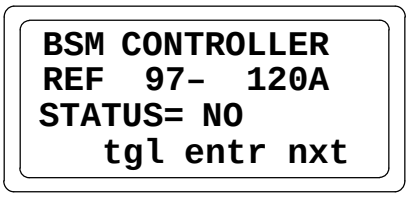
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BSM Controller

A BSM Controller is a block to which a Bus Switching Module is directly attached, which controls the BSM's switching action. For a new block, the default is NO. Change it only if the block will be used as a BSM Controller.

To change this configuration with a Hand–held Monitor, the block must first be configured for BSM PRESENT. The BSM CONTROLLER menu will not appear if BSM PRESENT is set to NO.

Hand-held Monitor Configuration Steps

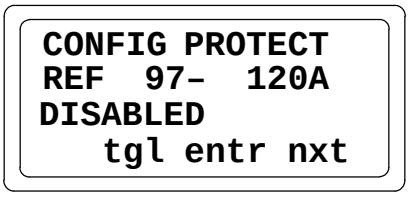


1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand–held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand–held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps



1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.

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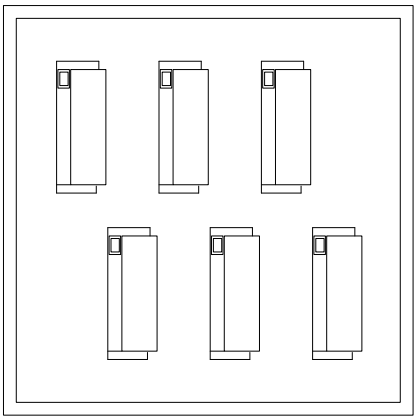
Chapter 16 Sizing Enclosures

This chapter explains how to decide what size enclosure to use, based upon the sizes of the blocks it will contain, and upon the amount of heat they will generate during operation.

Space Needed for Blocks

When mounting I/O blocks in an enclosure, space must be provided around each block for wiring and airflow. Allow 3 inches to 6 inches (about 8 cm to 15 cm) of empty space at the top of an enclosure. Also, allow at least 1.5 inches (3.8 cm) between the sides of adjacent blocks, and 3 inches (7.6 cm) above and below blocks. As a rough guide, each block will require a space approximately 12 inches (30 cm) high, 5 inches (13 cm) wide, and 6 inches (15.2 cm) deep.

If blocks will be installed vertically one above the other (minimum 3 inches / 7.6 cm), allow space for blocks to be staggered. This permits hot air generated by lower blocks to pass between upper blocks. Place blocks that generate more heat toward the top. The following illustration shows how six blocks could be mounted in an enclosure 24 inches (61 cm) high and 20 inches (50.5 cm) wide.



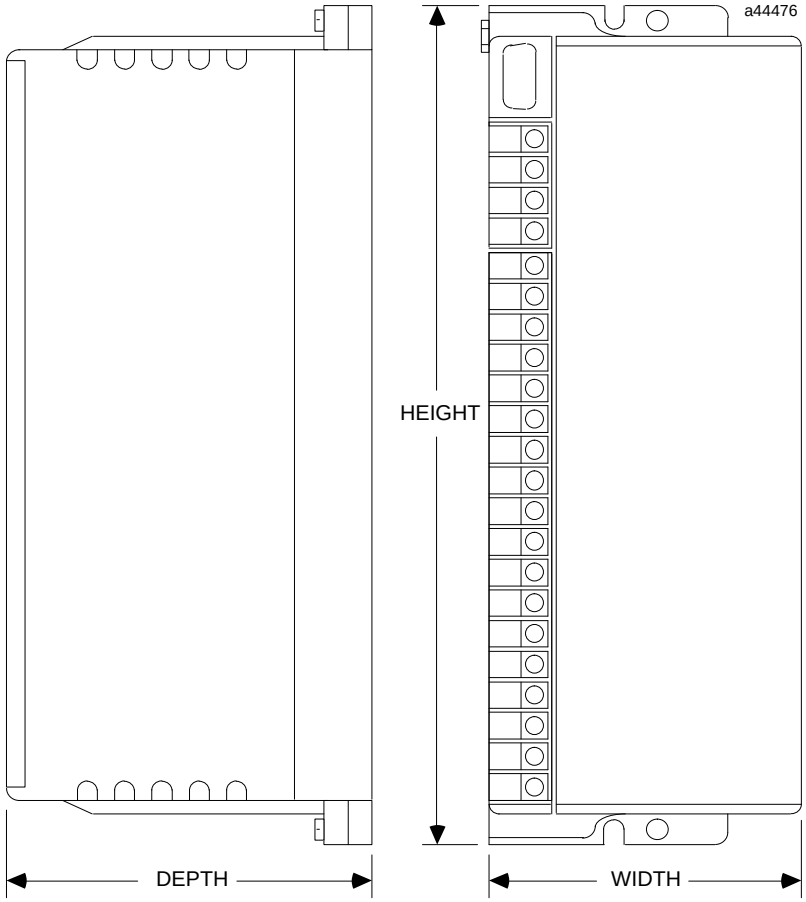
There must be space for free flow of air along each block's Electronics Assembly (the side opposite the Terminal Assembly). Wiring conduits, shelves, and other components (including projections on the cover or door) should not inhibit cooling airflow around the blocks.

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Dimensions of Genius I/O Blocks

The table below shows the dimensions of different types of blocks.

Block Types	Height	Width	Depth
32 Circuit DC Input / Output Blocks	8.83”(22.44cm)	3.56”(9.05cm)	4.42”(11.23cm)
All other I / O blocks	8.83”(22.44cm)	3.50”(8.89cm)	3.94”(10.00cm)
PowerTRAC Module	11.00”(27.94cm)	5.21”13.23cm)	8.06”(20.47cm)
Bus Switching Module (when installed)	3.65”(9.3cm)	1.7”(4.3cm)	2.8”(7.1cm)



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Heat Dissipation

Particularly when using discrete blocks, it is important to be sure that the size of an enclosure is adequate for amount of heat that will be generated within it. You should calculate the heat generation as described below.

1. Identify the types of I/O blocks within the enclosure.
2. Estimate the I/O mix and duty cycle of each block; unused circuits should be considered inputs with 0% duty cycle.

   As an example, if there were two outputs driving a solenoid valve open and closed, one of which must be energized at all times, both might be on for one or two AC cycles while the system switched from one state to another. An insignificant amount of heat would be generated while both were on. For temperature estimating, they should be thought of as one output on for 100% of the time; however, for AC power loads and circuit breaker selection, they could be thought of as two loads that would draw a larger than normal current during switchover.
3. Use the table on the next page to estimate heat dissipation for each block. Begin with the Watts per block. Multiply the number of outputs by the additional number of Watts for each output circuit. Multiply the number of inputs by the additional number of Watts per input circuit. Add the total number of Watts for the block, for outputs, and for inputs. This number represents the number of Watts of dissipated heat when outputs conduct full current at 100% duty cycle.
4. Add the estimated heat from each block to that generated by other electronics in the enclosure. Remember that most of the heat will be generated by field devices connected to the I/O blocks, not by the I/O blocks themselves.

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Watts of Heat Generation for Genius I/O Blocks

BLOCKTYPE	Watts per Block	Additional Number of Watts for each Input Circuit, Full Current at 100% Duty Cycle	Additional Number of Watts for each Output Circuit at 100% Duty Cycle
115 VAC 8 Ckt Grouped I/O Block (IC660BBD101)	6	4.7W at 2 amps	1.1
115 VAC / 125VDC Isolated I/O blocks (IC660BBS100, 101 102, and 103)	8	4.7W at 2 amps	1.1
115 VAC 16 Ckt AC Input Block (IC660BBD110)	8	n/a	1.25
Relay Output Blocks (IC660BBR100 and BBR101)	4.75	0.33W	n/a
24/48VDC 16 Ckt Source/Sink (IC660BBD020 and BBD021)	4.8	4W at 2 amps	0.1W at 24V 0.4W at 48V
24 VDC 16 Ckt Source/Sink (IC660BBD022 and BBD023)	4.8	4W at 2 amps	0.3W
32 Ckt DC Source/Sink Blocks (IC660BBD024 and BBD025)	2	0.5W at 1/2 amp	0.28W
Analog Input/Output Blocks (IC660BBA020 and BBA100)	6	n/a	n/a
Current–source Analog I/O Blocks (IC660BBA024 and BBA104)	12	n/a	n/a
Current–source Analog Output Blocks (IC660BBA025 and BBA105)	12	n/a	n/a
Current–source Analog Input Blocks (IC660BBA026 and BBA106)		n/a	n/a
RTD Input Blocks (IC660BBA101 and BBA021)	7	n/a	n/a
Thermocouple Input Blocks (IC660BBA023 and BBA103)	7	n/a	n/a

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Heat Dissipation of NEMA–Type Enclosures

The table on the next page shows the heat dissipation, surface area, and dimensions standard NEMA–type enclosures.

Calculating Available Surface Area: To use an enclosure size not listed in the table, find the amount of available surface area (in square inches) needed for heat transfer by multiplying the total number of Watts by one of the numbers below:

for 25C ambient temperature: Watts x 7.8

for 35C ambient temperature: Watts x 12.6

for 45C ambient temperature: Watts x 33

For example, if the total amount of heat generated is 400 Watts, the minimum enclosure surface area at 35C ambient necessary to prevent the enclosure interior temperature from exceeding 55C would be:

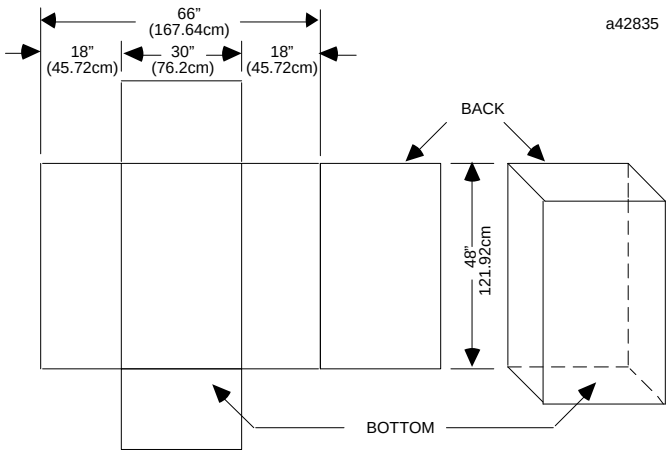
400 x 12.6 = 5040 sq in

To transfer heat, this surface area must be exposed to free space. For example, in a wall–mounted enclosure the back is not exposed so it is not available for heat transfer. For a floor–mounted enclosure, the bottom is not generally available for heat transfer and the sides or back may also not be exposed.

Calculating Power Dissipation for an Enclosure

To estimate heat dissipation for enclosures of different sizes, you can use a factor of 6 Watts per square meter of exposed surface area (.004 Watts per square inch) per C of temperature difference between the inside and outside ambient temperatures of an enclosure. This is relatively accurate for a 20C temperature difference. However, it is less accurate for other temperature differences.

As an example of calculating power dissipation, an enclosure is 48 inches (121.92 cm) high, 30 inches (76.2 cm) wide, and 18 inches (45.72 cm) deep. It is floor–mounted and its bottom and back are not exposed for heat transfer.



Total available surface area is 3708 square inches (23923 cm^2). For 35C ambient temperature, the table on the next page shows that a surface area of 3780 square inches (24387cm^2) will dissipate 300 Watts. For the slightly smaller size of the example enclosure, you could estimate heat dissipation of approximately 295 Watts.

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Heat Transfer Capabilities of Standard NEMA Enclosures

This table shows the smallest non–vented NEMA–type enclosures to use at various levels of heat generation at ambient temperatures of 25C, 35C, and 45C, with the internal temperature of the enclosure not exceeding 55C. The table lists both wall–mount and floor–mount type enclosures. The size of the enclosure back is given by the first two dimensions (H x W). Floor–mount enclosures are indicated by asterisks.

Watts Generated Internally	AMBIENT TEMPERATURE SURROUNDING ENCLOSURE											
	25C (77F)				35C (95F)				45C (113F)			
	Surface Area	Enclosure Dimensions			Surface Area	Enclosure Dimensions			Surface Area	Enclosure Dimensions		
		H x	W x	D		H x	W x	D		H x	W x	D
150w	1170in^2 7548cm^2	20 in 51 cm	16 in 41 cm	12 in 31 cm	1890in^2 12194cm^2	24 in 61 cm	20 in 51 cm	16 in 41 cm	4950in^2 31935cm^2	48 in 122 cm	36 in 92 cm	20 in 51 cm
		20 in 51 cm	24 in 61 cm	8 in 20 cm								
200w	1560in^2 10065cm^2	36 in 92 cm	24 in 61 cm	6 in 15 cm	2520in^2 16258cm^2	36 in 92 cm	30 in 76 cm	12 in 31 cm	6600in^2 42581cm^2	*72 in 183 cm	24 in 61 cm	30 in 76 cm
		30 in 76 cm	24 in 61 cm	8 in 20 cm						*72 in 183 cm	60 in 152 cm	12 in 31 cm
250w	1950in^2 12581cm^2	30 in 76 cm	24 in 61 cm	12 in 31 cm	3150in^2 20323cm^2	36 in 92 cm	30 in 76 cm	16 in 41 cm	8250in^2 53226cm^2	*72 in 183 cm	60 in 152 cm	20 in 51 cm
300w	2340in^2 15097cm^2	30 in 76 cm	30 in 76 cm	12 in 31 cm	3780in^2 24387cm^2	42 in 107 cm	36 in 92 cm	16 in 41 cm	9900in^2 63871cm^2	*72 in 183 cm	72 in 183 cm	24 in 61 cm
350w	2730in^2 17613cm^2	42 in 107 cm	36 in 92 cm	8 in 20 cm	4410in^2 28452cm^2	48 in 122 cm	36 in 92 cm	16 in 41 cm	11550in^2 74516cm^2	*72 in 183 cm	60 in 152 cm	36 in 92 cm
400w	3120in^2 20129cm^2	36 in 92 cm	30 in 76 cm	16 in 41 cm	5040in^2 32516cm^2	48 in 122 cm	36 in 92 cm	20 in 51 cm	13200in^2 85161cm^2	*86 in 219 cm	112 in 285 cm	14 in 36 cm
450w	3510in^2 22645cm^2	60 in 152 cm	36 in 92 cm	8 in 20 cm	5670in^2 36581cm^2	*60 in 152 cm	60 in 152 cm	12 in 31 cm	14850in^2 95806cm^2	*90 in 229 cm	72 in 183 cm	36 in 92 cm
500w	3900in^2 25161cm^2	42 in 107 cm	36 in 92 cm	16 in 41 cm	6300in^2 40645cm^2	*72 in 183 cm	60 in 152 cm	10 in 25 cm	16500in^2 106451cm^2	*84 in 213 cm	117 in 297 cm	24 in 61 cm
550w	4290in^2 27677cm^2	48 in 122 cm	36 in 92 cm	16 in 41 cm	6930in^2 44710cm^2	72 in 183 cm	30 in 76 cm	24 in 61 cm	18150in^2 117097cm^2	84 in 213 cm	154 in 391 cm	18 in 46 cm
600w	4680in^2 30193cm^2	*60 in 152 cm	48 in 122 cm	12 in 21 cm	7560in^2 48774cm^2	*90 in 229 cm	36 in 92 cm	20 in 51 cm	19800in^2 127742cm^2	*84 in 213 cm	154 in 391 cm	24 in 61 cm
						*72 in 183 cm	60 in 152 cm	16 in 41 cm				
650w	5070in^2 32710cm^2	48 in 122 cm	36 in 92 cm	20 in 51 cm	8190in^2 52839cm^2	*72 in 183 cm	60 in 152 cm	20 in 51 cm	21450in^2 138387cm^2	*84 in 213 cm	194 in 493 cm	18 in 46 cm
700w	5460in^2 35226cm^2	*60 in 152 cm	48 in 122 cm	16 in 41 cm	8820in^2 56903cm^2	*72 in 183 cm	72 in 152 cm	18 in 46 cm	23100in^2 149032cm^2	*84 in 213 cm	194 in 493 cm	24 in 61 cm
						72 in 183 cm	36 in 92 cm	36 in 92 cm				
750	5850in^2 37742cm^2	*60 in 152 cm	36 in 92 cm	20 in 51 cm	9450in^2 60968cm^2	*72 in 183 cm	72 in 183 cm	20 in 51 cm	24750in^2 159677cm^2	*84 in 213 cm	194 in 493 cm	24 in 61 cm
800w	6240in^2 40258cm^2	72 in 183 cm	30 in 76 cm	20 in 51 cm	10080in^2 65032cm^2	*72 in 183 cm	72 in 183 cm	24 in 61 cm	26400in^2 170322cm^2	84 in 213 cm	231 in 587 cm	18 in 46 cm
850w	6630in^2 42774cm^2	*72 in 183 cm	60 in 152 cm	12 in 31 cm	10710in^2 69097cm^2	*90 in 229 cm	36 in 92 cm	36 in 92 cm	28050in^2 180967cm^2	84 in 213 cm	231 in 587 cm	24 in 61 cm
900w	7020in^2 45290cm^2	72 in 183 cm	30 in 76 cm	24 in 61 cm	11340in^2 73161cm^2	*90 in 229 cm	72 in 183 cm	20 in 51 cm	29700in^2 191613cm^2	84 in 213 cm	271 in 688 cm	18 in 46 cm

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Chapter 17 I/O Point Redundancy

This chapter explains how Genius I/O blocks can be used to back up critical I/O points for failsafe operation. The type of blocks needed will depend on installation requirements.

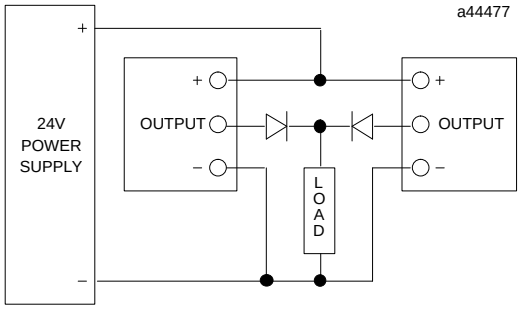
There may be:

1. Two points tied together to the same load. This requires two source or sink discrete DC blocks.
2. Two points going through relay contacts to the same load. Two discrete DC blocks and a Relay block are needed for this.
3. Parallel/series I/O points tied to the same load. This can be done using two AC or DC discrete blocks.

Two DC Blocks Tied to the Same Load

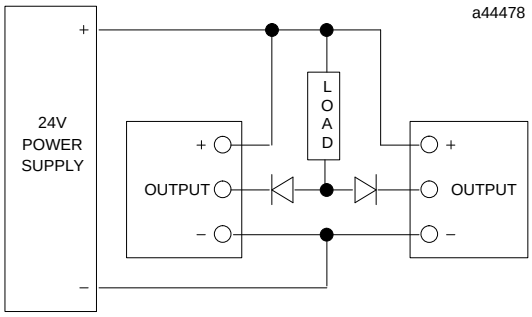
With Genius I/O blocks, tying two points together directly will cause error messages. With intervening diodes, however, two source or sink DC blocks can be used to protect against failed off (open) conditions. This method does NOT protect against failed on (short) conditions.

Two DC Source Blocks Tied to the Same Load



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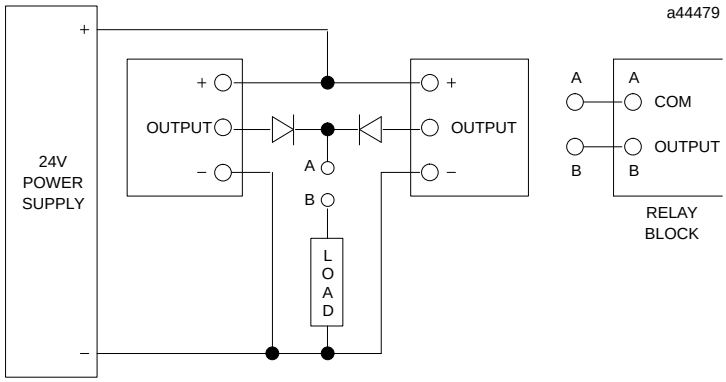
Two DC Sink Blocks Tied to the Same Load



Two DC Blocks and a Relay Block Tied to the Same Load

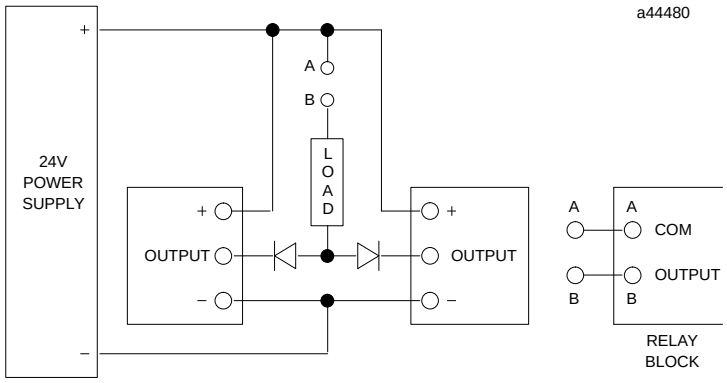
To protect against both failed off (open) and failed on (short) conditions, a Relay block is needed in addition to the two DC source or sink blocks. The same Relay block could also be used to back up other points. Operation of the relay would be controlled by the application program in response to diagnostics received from the other two blocks.

Two DC Source Blocks and a Relay Block Tied to the Same Load



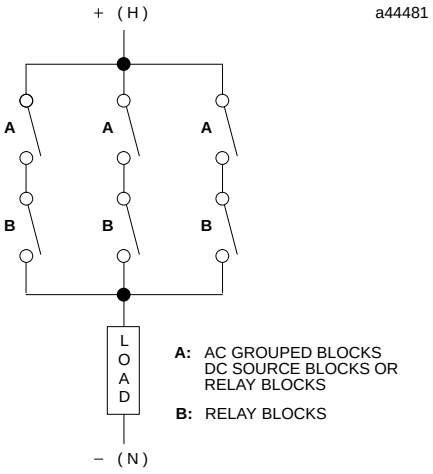
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Two DC Sink Blocks and a Relay Block Tied to the Same Load



Parallel/Series Points Tied to the Same Load

Either AC or DC blocks can be backed up with two (or more) parallel branches can be tied to the same load. In each branch, a relay controls operation of the redundant points. The application program, in turn, controls relay operation based on diagnostics received from the redundant points.



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Chapter 18 I/O Block Troubleshooting

This chapter:

- Lists LED indications
- Describes error indications and corrective actions.

Most problems can be found by observing block LEDs and by using a Hand–held Monitor to identify faults.

Block LEDs

A block's 2 status LEDs indicate its current operating condition. After startup, both of these LEDs are normally on.

UNIT OK	I/O ENABLED	Meaning
ON	ON	Block functioning, CPU communicating
ON	OFF	Block functioning, No CPU communications for 3 bus scans
ON	Blinking	Block functioning, Circuit forced
Blinking	ON	Circuit fault, CPU communicating
Blinking	OFF	Circuit fault, No CPU communications for 3 bus scans
Alternate blinking		Circuit fault, Circuit forced
Double Alternate blinking (each LED blinks twice)		Block experiencing communications problems. (This diagnostic is not available on some blocks).
Synchronous blinking		No CPU Communications; block number conflict
OFF	don't care, or OFF	No power to block, or block faulty. (For RTD, Thermocouple, and Current–source Analog blocks, I/O Enabled LED is off.
OFF	blinking	For RTD, Thermocouple, and Current–source Analog blocks only, this indicates an Electronics Assembly / Terminal Assembly mismatch.

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Problems and Corrective Actions

Most problems fall into one of the categories listed below.

- **When you power up a block, its UNIT OK and I/O Enabled LEDs blink in unison.**
  - Duplicate Device Number. Use the Hand–held Monitor to assign an unused Device Number.
- **When power is first applied to an Isolated I/O Block, its LEDs flash.**
  - This is normal for an Isolated I/O Block.
- **Power up was attempted but a block's UNIT OK LED remains OFF.**
  - See if the Electronics Assembly is attached to the Terminal Assembly properly.
  - Check to see if block power wires are connected to proper terminals.
  - Check for an EEPROM failure.
  - If this problem also occurs with other blocks, the bus may not be properly terminated.

    If the above conditions are met, replace Electronics Assembly.
- **None of the circuits on one block are working.**
  - Check Terminal Assembly wiring.
  - Ensure Terminal Assembly voltage is proper for your block.
  - The block may be offline due to a Device Number conflict. The Unit OK and I/O Enabled LEDs will blink together. Reprogram the Device Number to one that is unassigned.

    If the problem persists, replace the block's Electronics Assembly.
- **One circuit on a operating block is not working at all.**
  - Try another circuit on the same block to verify operation of sensor or actuator.
  - Check wiring for that circuit.
  - Reseat the Electronics Assembly carefully.
  - See if the circuit will switch when forced with the HHM.

    If the problem persists, replace the block's Electronics Assembly.
- **One circuit on an operating block is not being recognized by the CPU.**
  - Ensure that the correct voltage level is being supplied to the Terminal Assembly.
  - Check for a faulty sensor.
  - If the circuit's LED is OFF, check wiring connections.
  - Reseat the Electronics Assembly.

    If the problem persists, replace the block's Electronics Assembly.

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- **No input data from block at CPU.**
  - □ Confirm block reference address and Block Number with HHM
  - □ For Series Six Plus PLC, confirm correct channel number selected on Bus Controller DIP switches.
  - □ Verify that the block is not an outputs–only block.
- **No output data from the CPU at one or more blocks.**
  - □ Verify bus connections at BSM
  - □ Check block's Redundancy mode with HHM.
  - □ Determine whether outputs to the block(s) are currently disabled. Information on disabled outputs is in your bus controller manual.
- **The CPU is not receiving all inputs, or the blocks are not receiving all outputs.**

  CPU program execution time and bus scan time may not be compatible, resulting in lost inputs or lost outputs. The Genius I/O System User's Manual explains program execution time and bus scan time.
- **In a Series Six Plus PLC system, one or more operating blocks seem to have incorrect inputs and/or outputs.**

  Check for duplicate or overlapping I/O addresses on another bus or with another I/O module.
- **A block's UNIT OK blinks, indicating a circuit fault**.
  - □ Check the fault using a Hand–held Monitor, or at the CPU.
  - □ If there appears not to be an actual circuit fault, see if an EEPROM has failed in the Terminal Assembly by:

    a. Poweringdown/up

    b. Changingconfiguration/retry

    c. If a block indicates a Terminal Assembly EEPROM fault, issuing the Clear All Circuit Faults command (from the HHM or CPU) causes the block to attempt to rewrite the EEPROM. If successful, the fault caused by the failure of the EEPROM is removed; otherwise, a fault type 0 is reported to the CPU.

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- **False I/O point faults on a block occur at random times.** The faults do not recur immediately when cleared, and cannot be explained by known load conditions.
  - Check the load and power supply conditions during machine operation and at rest. If nothing is wrong, replace the block's Electronics Assembly. If this does not clear up the problem, replace the block.
- **Several I/O points and/or blocks report faults almost simultaneously,** usually during one part of a machine cycle or mode of operation.
  - Check for sources of electro–magnetic interference. Watch for problems that occur immediately after the operation of a particular input or load device. If observation fails to reveal the problem, the application program can be used to monitor for circuits that repeatedly change state just before faults are reported.
  - Look for inadequate level separation of wiring and poor suppression. In particular, look for wiring that carries current between an unsuppressed contact and load which is mixed with Genius wiring. This can cause problems even with high inductance / low current loads that generate high dV / dT. While these are most commonly found on higher voltage (120 or 480 volt) supplies, other high energy loads are also suspect.
  - Look at higher energy loads and at coil voltages of contactors driven by interposing contacts. Switch the load using the contacts to check for noise on the contacts. Any devices that produce voltage spikes reaching 400 volts or more in less than 1 microsecond (400 volts per microsecond) may cause problems. The load should be suppressed. The type and amount of suppression needed to reduce dV / dT can be significantly lower than would be needed to suppress arcing. Generally, lowering the dV / dT to less than 20 volts per microsecond is sufficient. The values determined by the 1mfd per amp rule result in 1 volt per microsecond. Lower values can be tried experimentally.
  - If a Genius block is running on a floating power source, common mode switching to the supply voltage and not recovering to zero generally indicates a grounded load. High amplitude fast transients which give common mode voltages greater than twice the supply, followed by a slow recovery back to zero, indicate significant noise energy coupled back into the system. Such systems are sometimes improved by adding bypass capacitors to ground or hard grounding one side of the supply. The bypass or ground should be located close to the injection point of the noise. If this is not known, distribute bypasses over the entire system.

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Appendix A Ordering Information

The following tables lists catalog numbers of Genius I/O blocks, terminal assemblies, electronics assemblies, and related products.

Module	Catalog Number
115 VAC Grouped Low–leakage I/O Block Terminal Assembly only Electronics Assembly only	IC660BBD101 IC660TSD100 IC660EBD101
115VAC / 125VDC Isolated I/O Block Terminal Assembly only Electronics Assembly only	IC660BBS100 IC660TSS100 IC660EBS100
115VAC / 125VDC Isolated I/O Block w / o Failed Switch Terminal Assembly only Electronics Assembly only	IC660BBS101 IC660TSS100 IC660EBS101
115VAC 16 Circuit Input Block Terminal Assembly only Electronics Assembly only	IC660BBD110 IC660TBD100 IC660EBD110
Relay Outputs Block, Normally–closed relays Terminal Assembly Electronics Assembly	IC660BBR100 IC660TBR100 IC660EBR100
Relay Outputs Block, normally–open relays Terminal Assembly Electronics Assembly	IC660BBR101 IC660TBR101 IC660EBR101
24 / 48 VDC 16 Circuit Source I/O Block Terminal Assembly only	IC660BBD020 IC660TSD020
24 VDC 16 Circuit Source I/O Block Terminal Assembly only Electronics Assembly for 24 VDC and 24 / 48 VDC Source I/O blocks	IC660BBD022 IC660TBD022 IC660EBD020
24 / 48 VDC 16 Circuit Sink I/O Block Terminal Assembly only	IC660BBD021 IC660TSD021
24 VDC 16 Circuit Sink I/O Block Terminal Assembly only Electronics Assembly for 24 VDC and 24 / 48 VDC Sink I/O blocks	IC660BBD023 IC660TBD023 IC660EBD021
32 Circuit 12 / 24 VDC Source I/O Block Terminal Assembly Electronics Assembly	IC660BBD024 IC660TBD024 IC660EBD024
32 Circuit 5 / 12 / 24 VDC Sink I/O Block Terminal Assembly Electronics Assembly	IC660BBD025 IC660TBD025 IC660EBD025
115 VAC Analog I/O Block Terminal Assembly only Electronics Assembly only	IC660BBA100 IC660TSA100 IC660EBA100

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Module	Catalog Number
24 / 48VDC Analog I / O Block Terminal Assembly only Electronics Assembly only	IC660BBA020 IC660TSA020 IC660EBA020
115 VAC / 125VDC Current Source Analog I / O block Terminal Assembly only Electronics Assembly only	IC660BBA104 IC660TBA104 IC660EBA104
24 / 48VDC Current Source Analog I / O block Terminal Assembly only Electronics Assembly only	IC660BBA024 IC660TBA024 IC660EBA024
115 VAC / 125VDC Current Source Analog Output Block Terminal Assembly only Electronics Assembly only	IC660BBA105 IC660TBA105 IC660EBA105
24 / 48VDC Current Source Analog Output block Terminal Assembly only Electronics Assembly only	IC660BBA025 IC660TBA025 IC660EBA025
115 VAC / 125VDC Current Source Analog Input Block Terminal Assembly only Electronics Assembly only	IC660BBA106 IC660TBA106 IC660EBA106
24 / 48VDC Current Source Analog Input block Terminal Assembly only Electronics Assembly only	IC660BBA026 IC660TBA026 IC660EBA026
115 VAC / 125VDC RTD Input Block Terminal Assembly only Electronics Assembly only	IC660BBA101 IC660TBA101 IC660EBA101
24 / 48VDC RTD Input Block Terminal Assembly only Electronics Assembly only	IC660BBA021 IC660TBA021 IC660EBA021
115 VAC / 125VDC Thermocouple Input Block Terminal Assembly only Electronics Assembly only	IC660BBA103 IC660TBA103 IC660EBA103
24 / 48VDC Thermocouple Input Block Terminal Assembly only Electronics Assembly only	IC660BBA023 IC660TBA023 IC660EBA023
High–speed Counter Block Terminal Assembly only Electronics Assembly only	IC660BBD120 IC660TBD120 IC660EBD120
PowerTRAC Block	IC660BPM100
Hand–held Monitor Battery Pack for Hand–held Monitor Battery Charger HHM Cable	IC660HHM501 IC660BPM500 IC660BCM501 IC660HHC005
Block Puller	IC660BLM507
Terminating Resistor Plugs, 150Ω Terminating Resistor Plugs, 75Ω	IC660BLM506 IC660BLM508
3’ Belden type 9182 cable with connectors 15” Belden type 9182 cable with connectors	IC660BLC003 IC660BLC001

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Appendix B

Genius Blocks I/O Reference Usage

Catalog No.	Description	Series 90	Series 6~	Series 5
IC660BBA020 IC660BBA100 IC660BBA024 IC660BBA104	24/48 Vdc Analog 4I/2O 115 Vac Analog 4I/2O 24/48 Vdc CS Analog 4I/2O 115 Vac/125 Vdc CS Analog 4I/2O	$\%AI_n$ to $\%AI_{n+3}$ and $\%AQ_n$ to $\%AQ_{n+3}$ † (use %AQI)	I_n to I_{n+23}# and O_n to O_{n+31} R_n to R_{n+5}*	I_n to I_{n+63} and O_n to O_{n+31} R_n to R_{n+5}*
IC660BBA021 IC660BBA101 IC660BBA023 IC660BBA103 IC660BBA026 IC660BBA106	24/48 Vdc RTD 6 Input 115 Vac/125 Vdc RTD 6 Input 24/48 Vdc T/C 6 Input 115 Vac/125 Vdc T/C 6 Input 24/48 VDC CS Analog 6 Input 115 Vac/125 Vdc CS Analog 6 Input	$\%AI_n$ to $\%AI_{n+5}$	I_n to I_{n+23}# R_n to R_{n+5}	I_n to I_{n+95} R_n to R_{n+5}
IC660BBA025 IC660BBA105	24/48 Vdc CS Analog 6–Output 115 Vac/125 Vdc CS Analog 6–Output	$\%AQ_n$ to $\%AQ_{n+5}$	O_n to O_{n+95} R_n to R_{n+5}	O_n to O_{n+95} R_n to R_{n+5}
IC660BBR100 IC660BBR101	115/230 Vac Relay N.C. 16 Output 115/230 Vac Relay N.O. 16 Output	$\%Q_n$ to $\%Q_{n+15}$	O_n to O_{n+15} R_n	O_n to O_{n+15} R_n
IC660BBD020 IC660BBD021 IC660BBD022 IC660BBD023	24/48 Vdc Source 16I/O 24/48 Vdc Sink 16I/O 24 Vdc Source 16I/O 24 Vdc Sink 16I/O	$\%QI_n$ to $\%QI_{n+15}$ or $\%I_n$ to $\%I_{n+15}$ or $\%Q_n$ to $\%Q_{n+15}$	I_n to I_{n+15} and/or O_n to O_{n+15} R_n* or R_n to R_{n+1}* (combo)	I_n to I_{n+15} and O_n to O_{n+15} R_n* or R_n to R_{n+1}* (combo)
IC660BBD024 IC660BBD025	12/24 Vdc Source 32I/O 5/12/24 Vdc Sink 32I/O	$\%QI_n$ to $\%QI_{n+31}$ or $\%I_n$ to $\%I_{n+31}$ or $\%Q_n$ to $\%Q_{n+31}$	I_n to I_{n+31} and/or O_n to O_{n+31} R_n to R_{n+1}* or R_n to R_{n+3}* (combo)	I_n to I_{n+31} and O_n to O_{n+31} R_n to R_{n+1}* or R_n to R_{n+3}* (combo)
IC660BBD100 IC660BBD101 IC660BBS100 IC660BBS101	115 Vac 8 I/O 115 Vac 8 I/O Low Leakage 115 Vac/125 Vdc 8I/O Isolated	$\%QI_n$ to $\%QI_{n+7}$ or $\%I_n$ to $\%I_{n+7}$ or $\%Q_n$ to $\%Q_{n+7}$	I_n to I_{n+7} and/or O_n to O_{n+7} R_n* or R_n to R_{n+1}* (combo)	I_n to I_{n+7} and O_n to O_{n+7} R_n* or R_n to R_{n+1}* (combo)
IC660BBD110	115 Vac 16 Input	$\%I_n$ to $\%I_{n+15}$	I_n to I_{n+15} R_n	I_n to I_{n+15} R_n
IC660BBD120	115 Vac/10–30 Vdc Hi–Speed Counter	$\%I_n$ to $\%I_{n+15}$ and $\%Q_n$ to $\%Q_{n+15}$ and $\%AI_n$ to $\%AI_{n+14}$	I_n to I_{n+255} and O_n to O_{n+15} R_{n-n+15}*	I_n to I_{n+255} and O_n to O_{n+15} R_{n-n+15}*
IC660BPM100	115–230 Vac/125 Vdc PowerTRAC	$\%I_n$ to $\%I_{n+15}$ and $\%Q_n$ to $\%Q_{n+15}$ and $\%AI_{n-n+17}$	I_n to I_{n+23}# and O_n to O_{n+15} R_n to R_{n+19}*	I_n to I_{n+303} and O_n to O_{n+15} R_n to R_{n+19}*

~ Use of Register assignments for most I/O blocks is discouraged in Series Six applications, since a DPREQ/WINDOW command must be used to update the data, which is not updated automatically as when assigned to the I/O tables. Furthermore, all diagnostics from the block are lost when the block is assigned to Register space.

* In Series Six and Series Five, assignments to Register space result in inputs being located in lower–order registers, starting at the designated register, followed by outputs in higher–order registers. Inputs and outputs are always placed in separate registers. Discrete circuits are located in the low–order bits first (Circuit #1 in bit 1 of Register n, etc.). Analog circuits are located in the low–order registers first (Circuit #1 in Register n, etc.).

\# Analog Inputs are multiplexed into the Series Six Input Table, updated at the rate of one channel per PLC sweep. The channel reading is located in I n–n+15 and the channel number in the next byte up (I n+16–n+18). The Read Analog Inputs DPREQ/WINDOW command may be used to move all input data simultaneously into registers designated by the command.

† AQ data located in $\%AQ_n$ and $\%AQ_{n+1}$. References $\%AQ_{n+2}$ and $\%AQ_{n+3}$ are not used.

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Appendix C

Non-Incendive Field Wiring

This appendix consists of two drawings illustrating non-incendive field wiring for the following Genius blocks:

- 24 / 48 VDC Thermocouple Inputs Block (IC660BBA023)
- 115 VAC / 125 VDC VDC Thermocouple Inputs Block (IC660BBA103)
- 24 / 48 VDC Current-source Analog 4 Input / 2 Output Block (IC660BBA024)
- 115 VAC / 125 VDC Current-source Analog 4 Input / 2 Output Block (IC660BBA104)

This wiring meets Factory Mutual requirements for use in Class 1 Division 2, Group A, B, C, and D hazardous locations.

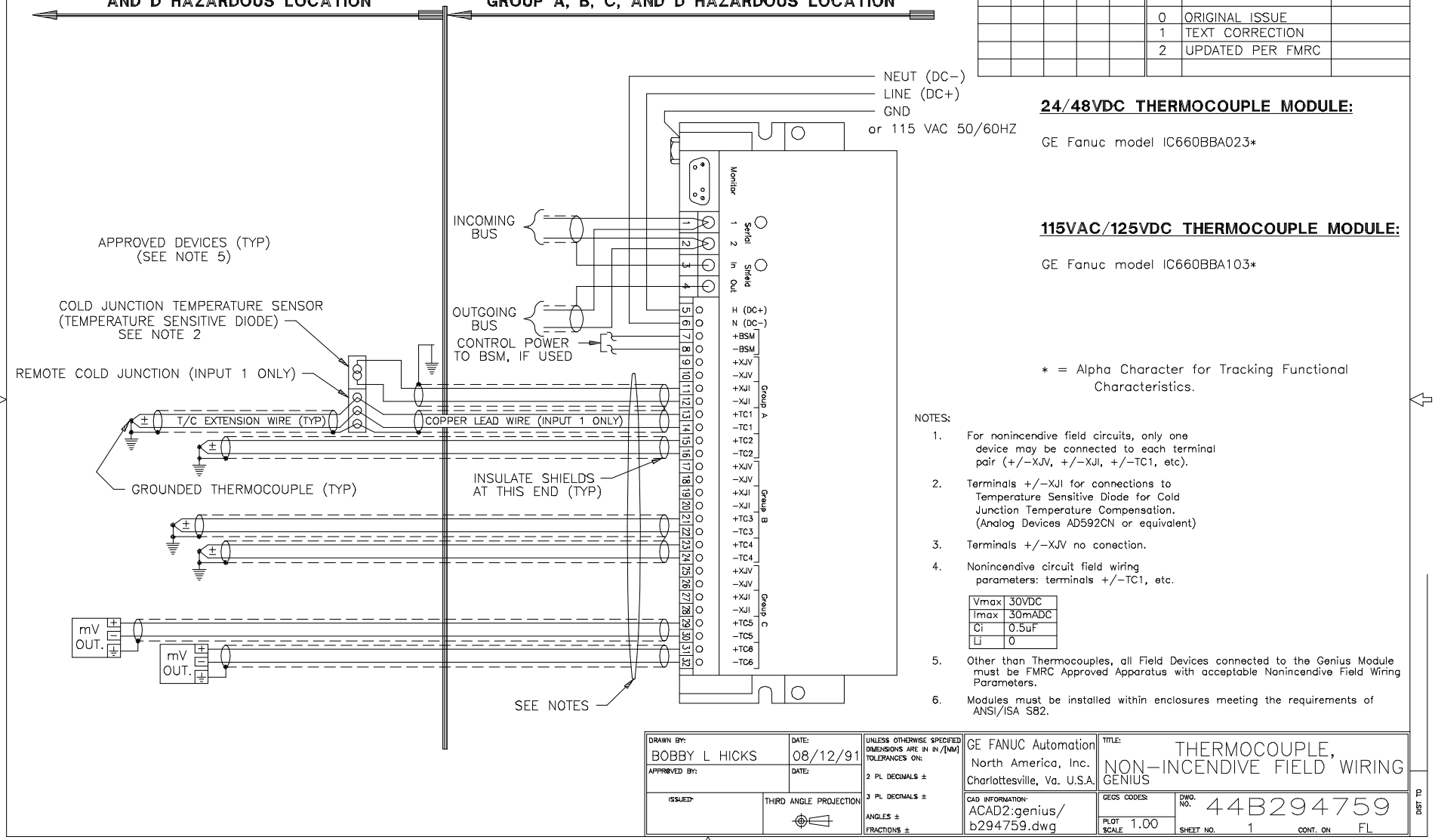
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SIZE	DWG NO	SH	REV
B	44B294759	1	1

FIGURE NUMBER VERSION STATUS					

DRAWING REVISIONS		
REV	DESCRIPTION	APPROVED
0	ORIGINAL ISSUE	
1	TEXT CORRECTION	
2	UPDATED PER FMRC	



24/48VDC THERMOCOUPLE MODULE:

GE Fanuc model IC660BBA023*

115VAC/125VDC THERMOCOUPLE MODULE:

GE Fanuc model IC660BBA103*

* = Alpha Character for Tracking Functional Characteristics.

NOTES:

1. For nonincendive field circuits, only one device may be connected to each terminal pair (+/–XJV, +/–XJI, +/–TC1, etc).
2. Terminals +/–XJI for connections to Temperature Sensitive Diode for Cold Junction Temperature Compensation. (Analog Devices AD592CN or equivalent)
3. Terminals +/–XJV no conection.
4. Nonincendive circuit field wiring parameters: terminals +/–TC1, etc.

Vmax	30VDC
Imax	30mADC
Ci	0.5uF
Li	0

5. Other than Thermocouples, all Field Devices connected to the Genius Module must be FMRC Approved Apparatus with acceptable Nonincendive Field Wiring Parameters.
6. Modules must be installed within enclosures meeting the requirements of ANSI/ISA S82.

DRAWN BY: BOBBY L HICKS	DATE: 08/12/91	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN IN /[MM] TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± ANGLES ± FRACTIONS ±	GE FANUC Automation North America, Inc. Charlottesville, Va. U.S.A.	TITLE: THERMOCOUPLE, NON–INCENDIVE FIELD WIRING GENIUS
APPROVED BY:	DATE:			
ISSUED:	THIRD ANGLE PROJECTION		CAD INFORMATION: ACAD2:genius/ b294759.dwg	GEGS CODES: PLOT SCALE 1.00 DWG. NO. 44B294759 SHEET NO. 1 CONT. ON FL

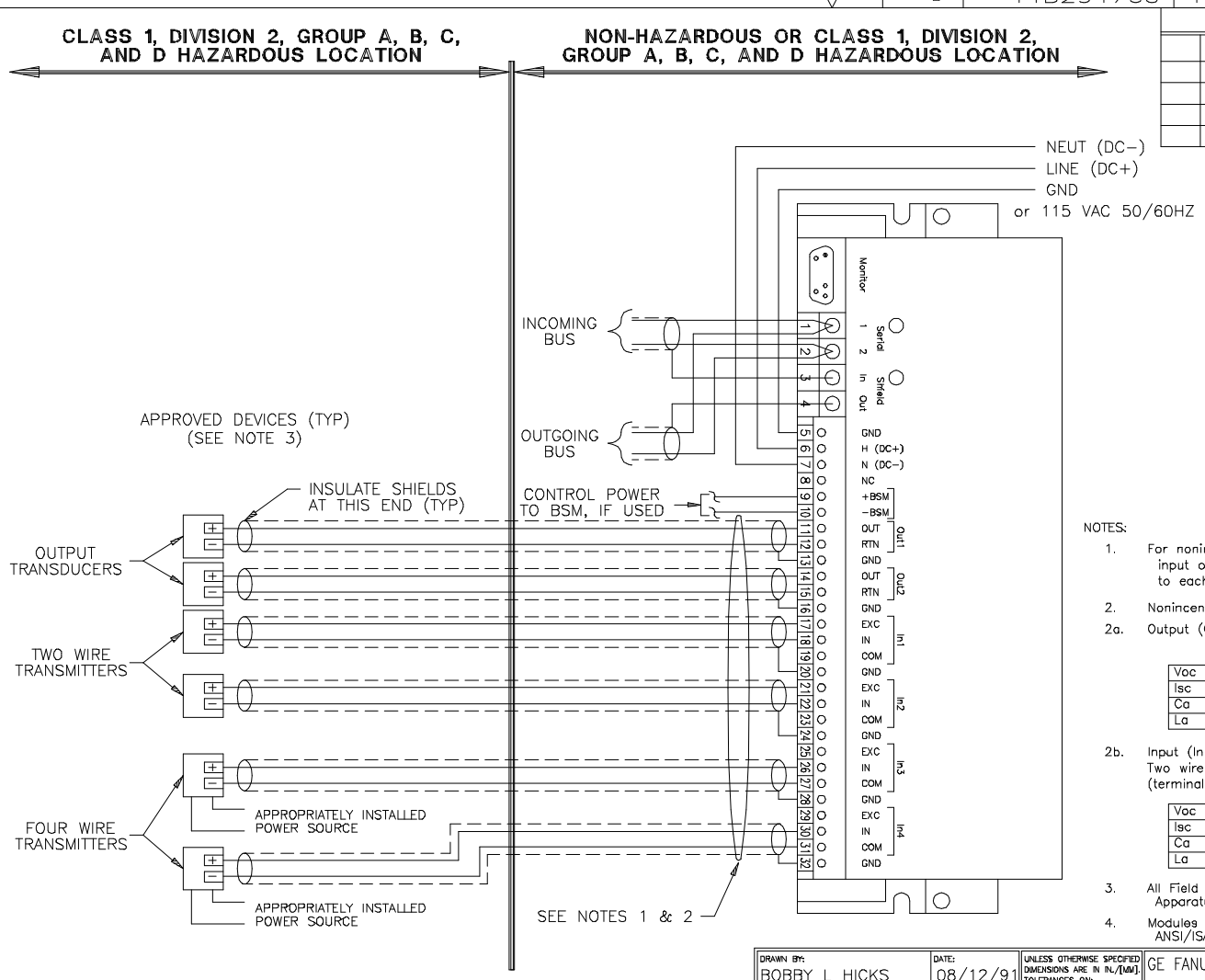
DIST TO

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SIZE	DWG NO	SH	REV
B	44B294760	1	2

FIGURE NUMBER VERSION STATUS					

DRAWING REVISIONS		
REV	DESCRIPTION	APPROVED
0	ORIGINAL ISSUE	
1	TEXT CORRECTION	
2	UPDATED PER FMRC	



24/48VDC CURRENT SOURCE MODULE:

GE Fanuc model IC660BBA024*

115VAC/125VDC CURRENT SOURCE MODULE:

GE Fanuc model IC660BBA104*

* = Alpha Character for Tracking Functional Characteristics.

NOTES:

1. For nonincendive field circuits, only one input or output device may be connected to each circuit (Out 1, In 1, etc).
2. Nonincendive circuit field wiring parameters.

2a. Output (Out 1, Out 2)

Voc	25.2Vdc
Isc	50mA
Ca	0.26uF
La	18mH

2b. Input (In 1, etc) Two wire transmitter (terminals EXC and IN)

Voc	25.2Vdc
Isc	75mA
Ca	0.36uF
La	11.5mH

2c. Input (In 1, etc) Four wire transmitter (terminals IN and COM)

Vmax	30Vdc
Imax	30mA
Ci	2400pf
Li	23.1uH

3. All Field Devices connected to the Genius Module must be FMRC Approved Apparatus with acceptable Nonincendive Field Wiring Parameters.
4. Modules must be installed within an enclosure meeting the requirements of ANSI/ISA S82.

DRAWN BY: BOBBY L HICKS	DATE: 08/12/91	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN IN./[MM]. TOLERANCES ON:	GE FANUC Automation North America, Inc. Charlottesville, Va. U.S.A.
APPROVED BY: BOBBY L HICKS	DATE: 09/07/93	2 PL DECIMALS ±	TITLE: CURRENT SOURCE, NON–INCENDIVE FIELD WIRING GENIUS
ISSUED:	THIRD ANGLE PROJECTION	3 PL DECIMALS ± ANGLES ± FRACTIONS ±	CAD INFORMATION: ACAD2:GENIUS/ B294760.DWG
			GEOS CODES: PLOT SCALE 1.00
			DWG. NO. 44B294760 SHEET NO. 1 CONT. ON FL

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