

800xA for TRIO/Genius

Getting Started

System Version 6.0

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Release: August 2014
Document number: 3BUR002459-600

TABLE OF CONTENTS

About This Manual

| | |
|---|----|
| General | 13 |
| Document Conventions | 14 |
| Use of Warning, Caution, Information, and Tip | 15 |
| Terminology..... | 15 |
| Related Documentation | 16 |

Safety Summary

Section 1 - Introduction

| | |
|--------------------------------------|----|
| Product Overview | 19 |
| Prerequisites and Requirements | 19 |
| Capabilities | 21 |
| Implemented Functionality | 21 |
| Functionality Not Implemented | 22 |
| TRIO Block Types..... | 23 |
| CI862 TRIO Interface Module | 25 |
| CI862 Features | 27 |
| CI862 Functions | 27 |
| µGenie Network Interface Module..... | 28 |
| Redundancy Handling | 28 |
| CEX-Bus | 29 |
| Configuration Tools | 30 |
| Control Builder M..... | 30 |
| Hand-Held Monitor | 30 |
| Basic Planning Considerations | 32 |

| | |
|--------------------------------|----|
| AC800M Integration | 32 |
| Field Bus | 33 |
| Redundant Field Bus | 33 |
| Field Bus Considerations | 33 |

Section 2 - Installation

| | |
|--|----|
| Overview | 37 |
| Installing CI862 TRIO Interface Module | 37 |
| Mounting CI862 | 39 |
| Removing CI862 | 40 |
| Unit to Baseplate Alpha Code Lock | 41 |
| I/O Installation Guidelines | 41 |
| Determine Locations of Blocks and Assign I/O Points | 41 |
| Software Factors | 42 |
| Hardware Factors | 42 |
| Mounting I/O Blocks | 43 |
| AC Power Considerations | 44 |
| Power Disconnects | 47 |
| Block Grounding | 48 |
| Connecting Devices to the Field Bus | 49 |
| Connecting Field Bus to a CI862 TRIO Interface Module | 50 |
| Connecting the Field Bus to TRIO I/O Blocks | 50 |
| Prefabricated Cables | 52 |
| Terminating Resistor Plug | 52 |
| Connecting the Field Bus to a BSM Cluster | 53 |
| Terminating a Field Bus | 56 |
| CI862 Field Bus Termination | 57 |
| Disabling a Block | 58 |
| Procedures to Add and Remove an I/O Block | 58 |
| Procedures to Remove and Replace an Electronics Assembly | 58 |
| Procedure to Add a Block to a Field Bus | 59 |
| Procedure to Replace a Terminal Assembly | 60 |

Section 3 - Discrete I/O Block Characteristics

| | |
|--|-----|
| Overview..... | 63 |
| Discrete I/O Blocks..... | 63 |
| Flow Chart for Choosing Discrete Blocks..... | 63 |
| Quick Facts About the Discrete Blocks..... | 68 |
| 6248B Relay Output Blocks do not Participate in Warmstart..... | 68 |
| Isolation Characteristics of the 6246B Isolated Digital I/O Block..... | 68 |
| External Resistors for I/O Channels..... | 68 |
| Source versus Sink..... | 69 |
| Current Loads..... | 71 |
| Discrete Block Diagnostics..... | 71 |
| 6240B 16 Circuit dc Source and Sink I/O Blocks..... | 73 |
| Field Bus and Block Power Wiring..... | 73 |
| I/O Channel Wiring for the Source I/O Block..... | 73 |
| I/O Channel Wiring for the Sink I/O Block..... | 76 |
| 6240B 16 Circuit dc Source and Sink I/O Block Specifications..... | 79 |
| 6241B 32 Circuit dc Source and Sink I/O Blocks..... | 81 |
| Field Bus and Block Power Wiring..... | 81 |
| I/O Channel Wiring for the Source I/O Block..... | 82 |
| I/O Channel Wiring for the Sink I/O Block..... | 85 |
| 6241B 32 Circuit dc Source and Sink I/O Block Specifications..... | 89 |
| 6244B 115 V ac 8 Circuit Grouped and 6245B 115 V ac Low Leakage 8 Circuit Grouped I/O Blocks..... | 91 |
| Field Bus and Block Power Wiring..... | 91 |
| I/O Channel Wiring..... | 91 |
| 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Block Specifications..... | 94 |
| 6246B 115 V ac/125 V dc Isolated I/O Block..... | 97 |
| Field and Block Power Wiring..... | 97 |
| I/O Channel Wiring..... | 97 |
| 6246B 115 V ac/125 V dc Isolated I/O Block Specifications..... | 100 |
| 6247B 115 V ac 16 Circuit Input Block..... | 103 |
| Field Bus and Block Power Wiring..... | 103 |

| | |
|---|-----|
| Input Channel Wiring..... | 103 |
| 6247B 115 V ac 16 Circuit Input Block Specifications..... | 105 |
| 6248B Relay Output Blocks..... | 107 |
| Field Bus and Block Power Wiring | 107 |
| I/O Channel Wiring..... | 110 |
| 6248B Relay Output Block Specifications | 113 |
| Interfacing Small Loads to Discrete Blocks..... | 116 |
| Interaction Between Leakage Currents and Load Characteristics | 116 |
| External Load Resistance for Coils and Lamps..... | 116 |

Section 4 - Analog I/O Block Characteristics

| | |
|--|-----|
| Overview | 119 |
| Analog I/O Blocks | 119 |
| Quick Facts About the Analog Blocks..... | 119 |
| 6230B 4 In/2 Out Analog I/O Block Support..... | 120 |
| 6231B 4 In/2 Out Current Source Analog I/O Block Support..... | 120 |
| 6232B 6 Circuit Thermocouple Input Block Support..... | 121 |
| 6233B 6 Circuit RTD Input Block Support | 121 |
| Isolation Characteristics of the 6232B and 6233B Blocks | 121 |
| 6235B 6 Circuit Current Source Analog Input Block Support..... | 121 |
| 6236B 6 Circuit Current Source Analog Output Block Support | 122 |
| Analog Block Diagnostics | 122 |
| Scaling Analog Blocks..... | 123 |
| 6230B 4 In/2 Out Analog Input/Output Block..... | 124 |
| Field Bus and Block Power Wiring | 124 |
| Inputs to the 6230B 4 In/2 Out Analog I/O Block..... | 124 |
| Inputs from a 4 to 20 mA Transmitter | 126 |
| Inputs from a 10 to 50 mA Transmitter | 128 |
| Inputs from a Voltage Source..... | 128 |
| Outputs from the 6230B 4 In/2 Out Analog I/O Block | 129 |
| Voltage Outputs..... | 130 |
| Current Outputs..... | 130 |
| Accuracy | 131 |

| | |
|--|-----|
| Calibration | 132 |
| 6230B 4 In/2 Out Analog I/O Block Specifications | 132 |
| 6231B 4 In/2 Out Current Source Analog Input/Output Block..... | 134 |
| Field Bus and Block Power Wiring..... | 134 |
| I/O Channel Wiring..... | 136 |
| 6231B 4 In/2 Out Current Source Analog I/O Block Specifications | 138 |
| 6235B 6 Circuit Current Source Analog Input Block | 140 |
| Field Bus and Block Power Wiring..... | 140 |
| I/O Channel Wiring..... | 142 |
| 6235B 6 Circuit Current Source Analog Input Block Specifications | 143 |
| 6236B 6 Circuit Current Source Analog Output Block..... | 145 |
| Field Bus and Block Power Wiring..... | 145 |
| I/O Channel Wiring..... | 145 |
| Wiring for Current Outputs | 148 |
| Wiring for Voltage Outputs | 148 |
| 6236B 6 Circuit Current Source Analog Output Block Specifications..... | 149 |
| 6232B 6 Circuit Thermocouple Input Block | 151 |
| Field Bus and Block Power Wiring..... | 152 |
| I/O Channel Wiring..... | 152 |
| Using Internal Sensor for Cold Junction Compensation..... | 154 |
| Using Remote Sensor for Cold Junction Compensation..... | 154 |
| Using Fixed Configurable Value for Cold Junction Compensation .. | 156 |
| Millivolt Inputs..... | 157 |
| 6232B 6 Circuit Thermocouple Input Block Specifications | 158 |
| 6233B 6 Circuit RTD Input Block..... | 160 |
| Field Bus and Block Power Wiring..... | 160 |
| Inputs to the 6233B 6 Circuit RTD Input Block | 160 |
| 6233B 6 Circuit RTD Input Block Specifications..... | 163 |
| Section 5 - High Speed Counter Block Characteristics | |
| Overview..... | 165 |
| Field Bus and Block Power Wiring..... | 167 |
| Block Power, No Outputs..... | 168 |

| | |
|---|-----|
| Block Power When Outputs Used | 169 |
| Backup Block Power..... | 170 |
| DC Block Power | 171 |
| +5 V dc Output | 172 |
| Terminal Connections | 172 |
| Terminal Connections for a Type A Block | 172 |
| Terminal Connections for a Type B Block..... | 175 |
| Wiring for TTL Open Collector Input Devices..... | 179 |
| 6234B High Speed Counter Block Specifications | 181 |

Section 6 - Field Bus

| | |
|---|-----|
| Field Bus Guidelines | 185 |
| Devices on the Field Bus | 185 |
| Device Numbers..... | 186 |
| Cable Parameters | 186 |
| Length of Bus, Baud Rates | 187 |
| Redundant Field Bus Guidelines | 189 |
| Bus Scan Time..... | 194 |
| Controller Scans and Field Bus Scans | 194 |
| Field Bus Scan Calculations | 194 |
| Noise Rejection and Immunity | 196 |
| Routing Guidelines | 196 |
| Running the Bus Cable Outdoors or Between Buildings | 197 |
| Device Placement on the Bus | 198 |
| Planning for the Hand-held Monitors (HHMs)..... | 198 |

Section 7 - Mounting and Power Planning

| | |
|-----------------------------------|-----|
| Overview | 201 |
| Environmental Specifications..... | 201 |
| Vibration | 201 |
| Noise | 201 |
| Heat | 202 |
| Cold | 202 |

| | |
|--|-----|
| Mounting Blocks in Cabinets | 202 |
| Connecting Blocks to Field Bus Within a Cabinet..... | 203 |
| Bus Grounding | 203 |
| Blocks Not Mounted in Enclosures..... | 204 |
| Calculating the Power Required for a Cabinet | 205 |
| Calculating the Power Required for a Block..... | 206 |
| Calculating Heat Generation for an Enclosure..... | 208 |
| Selecting an Enclosure When You Know the Total Heat Generation | 210 |
| Calculating Required Surface Area for Non Standard Enclosures | 213 |
| Calculating Power Dissipation for an Enclosure..... | 213 |

Appendix A - Hand-Held Monitor

| | |
|--|-----|
| Initial Setup for Blocks..... | 215 |
| Setting Up an HHM | 215 |
| Powering the HHM | 216 |
| Changing the HHM Configuration..... | 217 |
| Setting Baud Rate and Device Number on Blocks | 221 |
| Setting Up a Block | 221 |
| Starting HHM..... | 223 |
| Setting Block Baud Rate and Device Number | 224 |
| Adding a HHM Connector to a Field Bus | 227 |
| Installing a Hand-held Monitor as a Permanent Workstation..... | 228 |

INDEX

About This Manual

General



Any security measures described in this User Manual, for example, for user access, password security, network security, firewalls, virus protection, etc., represent possible steps that a user of an 800xA System may want to consider based on a risk assessment for a particular application and installation. This risk assessment, as well as the proper implementation, configuration, installation, operation, administration, and maintenance of all relevant security related equipment, software, and procedures, are the responsibility of the user of the 800xA System.

Taylor™ Remote I/O (TRIO) is used to collect a large number of Genius I/O points located remotely on the plant floor or in the field. The heart of the system is a variety of multi-channel analog and discrete I/O blocks. These blocks communicate with the 800xA System through Field Buses with as many as 30 blocks being connected to a bus. This user manual covers procedures for:

- Installing the CI862 TRIO/Genius Interface.
- Connecting TRIO/Genius I/O modules.
- Considerations when migrating from the MOD 300 control system.

This user manual is intended for engineers who install controller and I/O hardware. This user manual is not intended as the sole source of instruction. Users should understand distributed automated process control and the 800xA System. See [Related Documentation](#) on page 16.

Document Conventions

Microsoft Windows conventions are normally used for the standard presentation of material when entering text, key sequences, prompts, messages, menu items, screen elements, etc.

Use of Warning, Caution, Information, and Tip

This publication includes **Warning**, **Caution**, and **Information** where appropriate to point out safety related or other important information. It also includes **Tip** to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:



Electrical warning icon indicates the presence of a hazard which could result in *electrical shock*.



Warning icon indicates the presence of a hazard which could result in *personal injury*.



Caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in *corruption of software or damage to equipment/property*.



Information icon alerts the reader to pertinent facts and conditions.



Tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Terminology

A complete and comprehensive list of Terms is included in the *System 800xA, System Guide, Functional Description (3BSE038018*)*. The listing includes terms and definitions as they apply to the 800xA system where the usage is different from commonly accepted industry standard definitions and definitions given in standard dictionaries such as *Webster's Dictionary of Computer Terms*.

You should also be familiar with the following list of terms used in this instruction:

| Term | Description |
|-------------|---------------------------------|
| BSM | Bus Switch Module |
| CEM | Communication Expansion Module |
| CEX-Bus | Communication Expansion Bus |
| HHM | Hand Held Monitor |
| HSC | High Speed Counter |
| LAN | Local Area Network |
| TRIO | Taylor Remote I/O or Genius I/O |
| TRL | TRIO Redundant Link |

Related Documentation

A complete list of all documents applicable to the 800xA System is provided in Released User Documents, 3BUA000263*. This document lists applicable Release Notes and User Instructions. It is provided in PDF format and is included on the Release Notes/Documentation media provided with your system. Released User Documents are updated with each release and a new file is provided that contains all user documents applicable for that release with their applicable document number. Whenever a reference to a specific instruction is made, the instruction number is included in the reference.

Safety Summary



Electrostatic Sensitive Device

Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

The CI862 baseplate has no locking device. Insert only the CI862 unit into this baseplate. Insertion of other unit types may cause damage to the equipment. Page 41.

If the block is not properly grounded, hazardous voltages may exist. Death or injury can result. Page 209.

DO NOT TOUCH the connectors or wiring after powering up the block. Hazardous voltages exist, and death or injury may result. Page 209.

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. Page 47.

SPECIFIC CAUTIONS

No Caution text appears in the instruction.



Section 1 Introduction

Product Overview

Taylor Remote I/O (TRIO) represent a family of multi-channel analog and discrete I/O blocks from the Genius™ I/O line of intelligent, self-contained, configurable I/O modules. A TRIO Field Bus connects the modules to the controller AC800M using the CI862 TRIO Interface, a Communication Expansion (CEX) module. This capability to connect to the 800xA System provides an evolutionary path from MOD 300 to Industrial IT by allowing reuse of the TRIO I/O installation with a field bus connection to the AC800M controller.

Information is provided on how to physically switch an existing TRIO LAN. Also included is the TRIO block wiring information. After disconnecting the TRIO LAN from the MOD 300 Controller (Multibus, SC or AC460) and connecting it to an AC800M Controller using the CI862 TRIO Interface, TRIO block configuration is then performed through Control Builder M using ABB's implementation of the IEC 61131 standard for application configuration as described in the *800xA for TRIO/Genius (3BUR002460*)* user manual.

Prerequisites and Requirements

TRIO I/O is used in the 800xA System along with Control Builder M professional. A CI862 TRIO Interface module provides the field bus connection of TRIO blocks.



The CI862 can be used in a redundant processor module configuration under the following conditions:

a. If the CI862 is used with redundant PM866, only the TK850 CEX-bus extension cable shall be used for interconnection between the PM866 modules. The BC810 shall not be used.

b. If the CI862 is used with other redundant processor modules (PM861A/PM864A/PM865), either BC810 or TK850 CEX-bus extension cable can be used for interconnection between the two processor modules.



The CI862 is not supported with the PM891 processor module.

Capabilities

Certain functionality existing in the MOD TRIO is implemented in the 800xA System while other functionality is not included as described below.

Implemented Functionality

| | |
|------------------------------|--|
| Scaling | Scaling of I/O values performed by TRIO blocks. |
| OSP | Output states are pre-determined when the controller cannot drive outputs. The output state, either hold last value or accepts a defined value. |
| Latched bad status | If a fault condition occurs on a channel, the channel is latched at bad status until the user sends a clear fault command and the condition has cleared. This capability is configurable on a per channel basis. |
| Configurable channel type | Certain TRIO blocks have configurable channel types (i.e., input or output). |
| Second bus active redundancy | During normal operation of a redundant Field Bus, both buses are active and communication occurs on both Bus A and Bus B with some blocks communicating on Bus A and some communicating on Bus B. However, a block can only be communicating on one bus at a time. If communications on one bus fails, the BSMs on that bus switch communications to the other bus. For example, if Bus A fails, all BSMs on Bus A switch communications to Bus B. |

Functionality Not Implemented

| | |
|-----------------------------------|--|
| Second bus passive redundancy | During normal operation of a redundant Field Bus connected to a controller, only one bus is active at a time and communication occurs only on the active bus. Communications normally take place on Bus A. If communication on Bus A fails, the BSMS switch the blocks in the cluster to Bus B." |
| Single bus, redundant bus masters | A primary/backup controller allows a single bus with redundant bus masters. The primary bus master would be part of the primary controller's I/O card. The backup bus master would be part of the backup controller's I/O card. A controller fail over would cause the backup controller's I/O card to assume mastership of the bus. |
| Warmstart | Upon controller startup, the control application is synchronized with field outputs. |
| Upload | TRIO provides the capability of configuring blocks using a hand held monitor. The block configuration could be uploaded into the configuration database. |
| User initiated bus switch | A user could switch a block from one bus to another via an operator display. |

TRIO Block Types

TRIO blocks, [Figure 1](#), are self-contained, configurable I/O blocks used to interface field devices to the communications bus. These blocks can be individually installed on machines, in junction boxes, or grouped in racks or panels. A TRIO block is made of cast aluminum, and weighs approximately 4 pounds (1.8 Kg). It measures approximately 9 x 4 x 3 inches. Each block has its own communications capability and microprocessor, and provides from 6 to 32 circuits for connecting input and output devices. You can place blocks on the bus in any combination or sequence. You can use a mix of blocks on the same bus. Various types of blocks are available as listed in [Table 1](#).

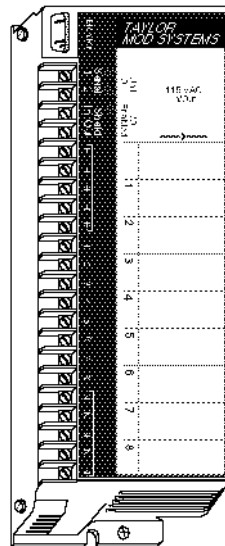


Figure 1. TRIO Block

Table 1. TRIO Block Types

| Number | Name | Type | Description | Can be BSM |
|--------|-----------------------|---------|--|------------|
| 6230B | 4 In 2 Out | Analog | 4 Input, 2 Output | No |
| 6231B | Current Source I/O | Analog | 4 Input, 2 Output | Yes |
| 6232B | Thermocouple | Analog | 6 Input | Yes |
| 6233B | RTD | Analog | 6 Input | No |
| 6235B | Current Source Input | Analog | 6 Input | Yes |
| 6236B | Current Source Output | Analog | 6 Output | Yes |
| 6240B | 16 Circuit I/O | Digital | 16 Input or Output (configurable) | Yes |
| 6241B | 32 Circuit I/O | Digital | 32 Input or Output (configurable) | Yes |
| 6244B | 8 Circuit Grouped | Digital | 8 Input or Output (configurable) | Yes |
| 6245B | 8 Circuit Grouped | Digital | 8 Input or Output (configurable) | Yes |
| 6246B | 8 Circuit Isolated | Digital | 8 Input or Output (configurable) | Yes |
| 6247B | 16 Circuit Input | Digital | 16 Input | No |
| 6248B | 16 Circuit Output | Digital | 16 Output | Yes |
| 6234B | High Speed Counter A | Counter | 4 16 bit Up/Down Counters | No |
| 6234B | High Speed Counter B | Counter | 2 Bi-directional 24 bit Up/Down Counters | No |

CI862 TRIO Interface Module

The CI862 TRIO Interface module, [Figure 2](#), connects a TRIO Field Bus to the controller AC800M. The connection between CI862 and AC800M is done via the CEX-Bus. The CI862 also supports TRIO slave and master redundancy through the TRIO Redundancy Link (TRL). Both are managed via software.

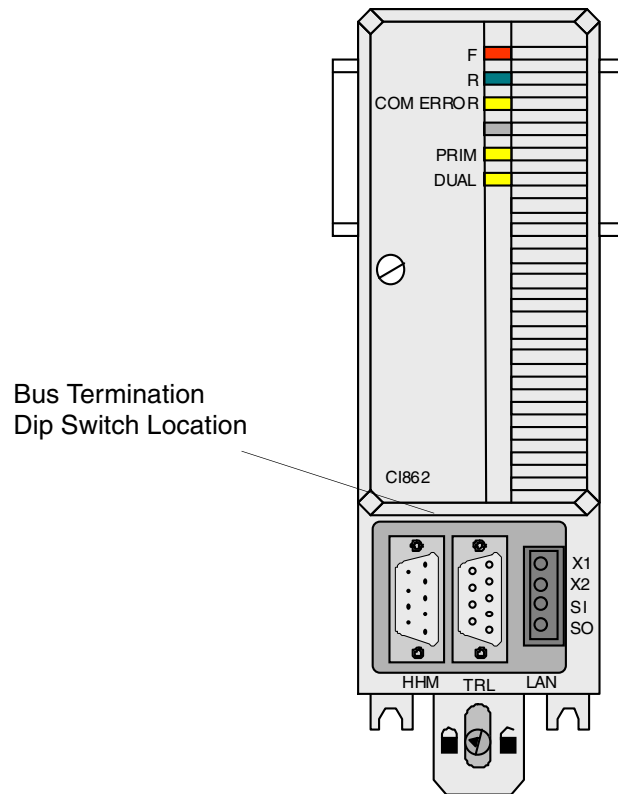


Figure 2. CI862 TRIO Interface Module

A complete CI862K01 unit consists of a Communication Expansion Baseplate (CEB) board (TP862), a CEM board (CI862), and their mechanics, [Figure 3](#). All electronic devices and all functions are located on the board which also includes the μ Genie slave module. Baseplate and CEM are connected via an 80-pin edge connector. Connections to the outside world are made on the baseplate.

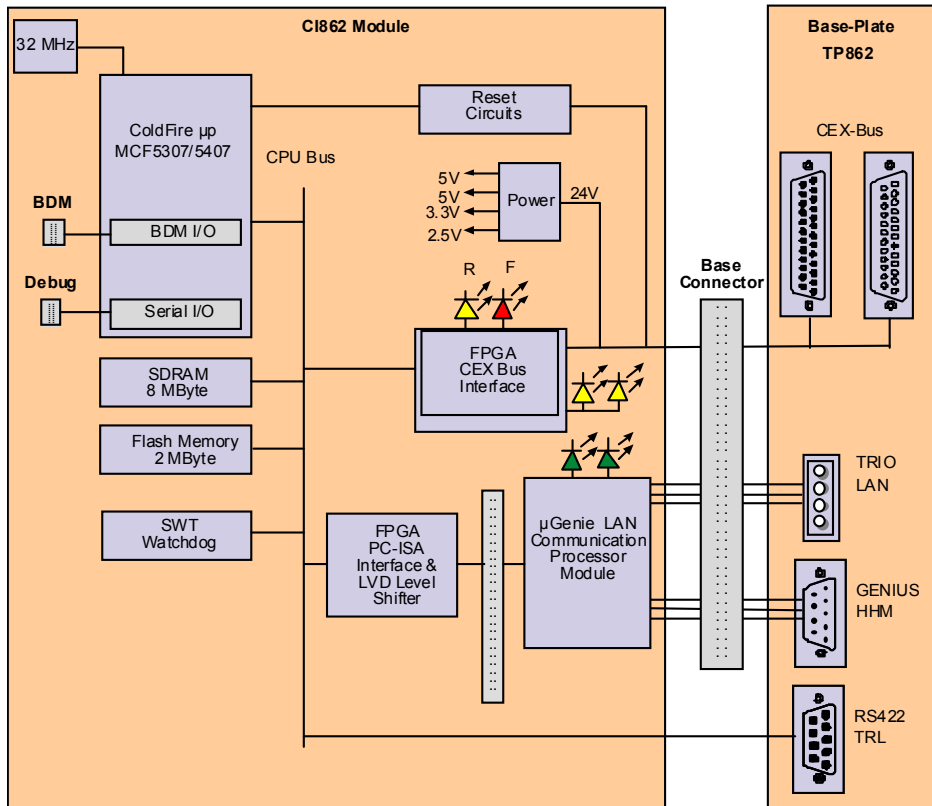


Figure 3. CI862 TRIO Interface Functional Diagram

The baseplate contains only passive elements. It holds the input and output connectors for the CEX-Bus, a slot for the CEM, a port used for the Genius Bus Hand Held Monitor, a high speed serial port used for module redundancy link communications and a port for the TRIO Field Bus connection.

The CEM contains the Coldfire MCF5307 Microcontroller with Flash memory, RAM, LED indicators, power supply, and CEX-Bus interface with dual port memory, bridged to a GE/Fanuc μ Genie Communication Module. The μ Genie handles all data transfer between the CI862 Carrier module and the TRIO FIELD BUS, allowing the Carrier CPU to control the remote I/O.

CI862 Features

- CEX-Bus interface for communication to AC800M.
- LED indicators for R(un), F(ault), Communication Error, Primary (Bus Master), and Dual (redundancy).
- Motorola MCF5307 Microcontroller running at 32 MHz.
- 2 MByte Flash memory for code.
- 8 MByte SDRAM for configuration and dynamic data, also used as Dual Port Memory between CI862 and AC800M.
- Power supply from the CEX-Bus +24V supply with DC/DC converters to +5V, +3.3V, and +2.5V.
- TRL (TRIO Redundancy Link) port for Redundancy.
- Hand Held Monitor Port used for reading Local I/O Block.
- Field bus termination switch.

CI862 Functions

The CI862 module can be removed from the Baseplate without disturbing the communication to other modules on the CEX-Bus.

The CI862 handles data traffic between the CEX-Bus, (on which the AC800M controller is the bus master), and the TRIO FIELD BUS.

The data traffic between the μ Genie CEX Dual Port RAM and the μ Genie module is handled by the MPU on CI862.

The CEX and the μ Genie logical interfaces are implemented in two FPGAs, one of which also handles the arbitration of the internal bus. Furthermore, the larger FPGA contains the CEM Communication and Status Register, CSR. The smaller FPGA handles the logic control signals to the μ Genie interface and also acts as a voltage

level shifter for common logic +3.3V signals on the CI862 and the common logic +5V signals of the μGenie module.

μGenie Network Interface Module

The μGenie (Genius micro Network Interface) Board is a single printed circuit daughter board in the CI862. The μGenie allows the host CEM to read and write μGenie's general-purpose Shared RAM. The μGenie handles all data transfer between the host and a TRIO Field Bus.

The μGenie operates as a general-purpose controller, performing the housekeeping tasks of initialization and fault management for up to 31 other bus devices (30 TRIO blocks and 1 Hand-held Monitor for example). It keeps up-to-date images of the I/O controlled by each device, and can communicate with other controllers using datagrams, Global Data, and Directed Control Data messages. μGenie handles all protocol, and provides a non-time critical method of tapping into the TRIO Field Bus.

The bus may serve any mix of I/O blocks and bus controllers; its primary purpose may be I/O control, or communications between hosts, or any combination of the two. In addition to TRIO blocks and bus controllers, a bus may serve one or more Genius Hand-held Monitors. The Hand-held Monitor is a versatile, portable operator interface device used for diagnostics and configuration.

Redundancy Handling

Redundant CI862 modules are actually active and running at the same time. They are more accurately called 'primary' and 'secondary'. The primary module maintains an "image" of the channel data for itself and for the secondary (backup) module. This image provides a single copy point for applications to read/write channel data for both modules. A dedicated RS 422 line is used to communicate between the primary and backup modules (RCL).

The AC800M writes outputs to both CI862 modules. It reads inputs from the designated 'primary'. Both CI862 modules are actively controlling their respective bus. The designated primary reads the 'image' of the backup and updates its local image.

CEX-Bus

The connection between CI862 and AC800M is done via the CEX-Bus which is located on the left-hand side of the processor unit baseplate (TP830). A bus termination is required when the CI862 is present on the CEX-Bus with the processor PM864. The bus terminations get placed into the communication units at the point farthest away from the processor unit.

A TB850 male CEX-Bus termination unit is supplied with PM864K01 for the PM864 processor unit. If the TK850 extension cable is used, then a TB851 female CEX-Bus termination unit is used and must be fitted to the last baseplate in the sequence. A TB851 female CEX-Bus termination unit is supplied with each TK850 extension cable. See the *AC 800M Controller Hardware (3BSE036351*)* for details on these connections.

Configuration Tools

TRIO blocks are configured using Control Builder M which is an 800xA control system based engineering tool for the AC800M controller. Each block is supplied with default configuration options which can be changed to suit the application. Block configuration must updated, modified and downloaded from Control Builder M.

Control Builder M

Control Builder M is used to configure the TRIO Interface module and the TRIO blocks. Project Explorer is used to add and remove hardware units. Hardware Editor is used to edit the settings for a hardware unit and associate variables to I/O channels.

The Control Builder contains a set of templates to set up (configure) the databases of the blocks. The templates specify the basic parameters for the blocks and determine the startup characteristics of the system. Startup items that can be specified include:

- If the database defined by the templates is automatically downloaded to the blocks upon startup. If not, you can download it to the blocks later.
- whether to resume communication with a block, or upon download of a loop.
- coldstart - if calculated output values are sent at startup.
- warmstart - output values are synchronized with the output values in the TRIO blocks' memories.

The configuration templates are described in *800xA for TRIO/Genius (3BUR002460*)*.

Hand-Held Monitor

The Hand-held Monitor (HHM), [Figure 4](#), is a portable interface device used to monitor the operation of TRIO blocks and the Field Bus. The HHM plugs directly into any block, Field Bus Interface Module, CI862 TRIO Interface module, or connector on the bus. You can permanently mount the HHM to create an operator workstation. A mounting kit is provided with each HHM for this purpose.

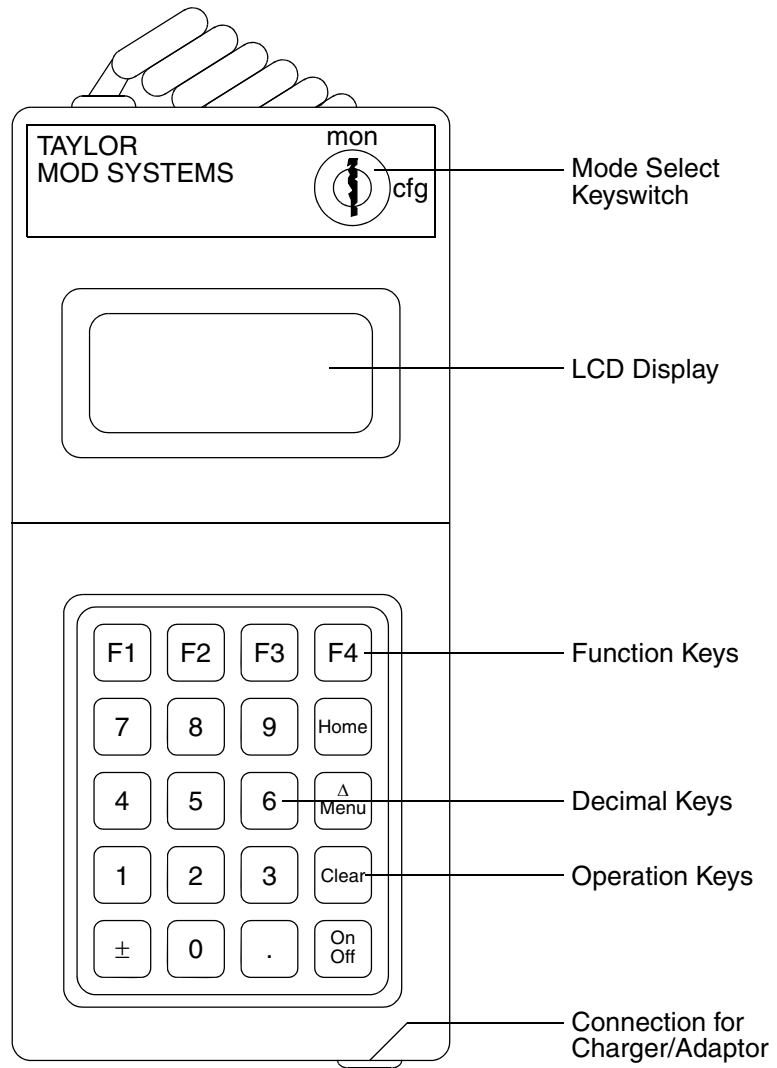


Figure 4. Hand-Held Monitor

Basic Planning Considerations

Basic planning considerations for a TRIO I/O installation include:

- Analyzing field device characteristics.
- Selecting discrete and analog blocks based on field device characteristics.
- Determining point and block breakdown by geographic area.
- Considering special requirements for redundant buses.
- Planning bus route.
- Planning power distribution.

Start by analyzing all I/O that interface to TRIO blocks. For each field device determine:

- Physical location.
- Load and lead wire impedance.
- Isolation.
- Duty cycle.
- Effects of leakage current.
- Interaction with other parts of the system.
- Analog device type and range:
 - Measurement.
 - Electrical.

AC800M Integration

Moving the MOD 300 TRIO installation (Advant OCS or MOD 300) into a AC800M with TRIO installation requires moving field busses and not rewiring field devices. The main task to integrating the TRIO blocks into the 800xA system is completing the configuration work as described in *800xA for TRIO/Genius (3BUR002460*)*.

All TRIO blocks are supported. However, there is a limited set of functionality supported as described in [Capabilities](#) on page 21. While switching the field bus to the CI862 TRIO Interface module helps preserve your I/O wiring, a certain amount of configuration work will have to be done in Control Builder M.

A single CI862 can connect 30 blocks to a single LAN. The AC800M can have up to four single LANs (PM864) or four redundant LANs (PM864A). The maximum I/O with TRIO in an AC800M is 1000 IO points.

Field Bus

A Field Bus carries serial communications among the devices of the TRIO I/O system. Groups of up to 30 TRIO blocks can be interconnected. This can eliminate the need to have multiple field wires connecting individual input and output devices directly to the control system. The wide range of available block types allows close matching between the I/O requirements of the process and the actual I/O complement of the control system.

Typically the inputs and outputs can be configured on a single block in any combination. There is no need for separate input and output modules. Also the unique “smart switch” technology used in TRIO discrete blocks can verify operation of the switched load, often eliminating the need for a separate feedback input.

Redundant Field Bus

A redundant bus can eliminate downtime caused by cable breaks during normal operation. A cluster of from 1 to 8 blocks can interface to both buses through a Bus Switching Module (BSM). The first block in the cluster must be a block to which you can physically attach and electrically control the BSM. This block is then called a BSM Controller.

The first bus of a redundant Field Bus pair is called Bus A and the other bus of the pair is called Bus B.

During normal operation of a redundant Field Bus, both buses are active and communication occurs on both Bus A and Bus B with some blocks communicating on Bus A and some communicating on Bus B. However, a block can only be communicating on one bus at a time. If communications on one bus fails, the BSMs on that bus switch communications to the other bus. For example, if Bus A fails, all BSMs on Bus A switch communications to Bus B.

Field Bus Considerations

The AC800M supports a total of four CI862 modules. Providing the maximum of 1000 I/O points is not exceeded for a controller, the existing field busses can be moved over to one AC800M. In a Multibus Subsystem scenario, the additional field buses must be added to a second AC800M.

Remember, a SC Controller or an Advant Controller 410 can have one or two Field Buses, an Advant Controller 460 can have up to four Field Buses, and a Multibus Subsystem can have as many as six.

Field Bus communications that were brought into the Advant OCS via either:

- a SC Controller Field Bus Interface Module,
- a CI560 TRIO MIB submodule, or
- a Multibus Field Bus Interface Module.

can be moved to the CI862 TRIO Interface module. Non-redundant Field Buses consist of a single cable as shown in Figure [Figure 5](#). Redundant field busses could be made non-redundant. In this scenario, a redundant Field Bus of a SC Controller or Multibus Subsystem consists of two cables where each cable would attend a CI862. A redundant Field Bus of an Advant Controller 460 consists of two cables, each cable is connected to a separate CI560 TRIO MIB submodule. These busses would also be switched to the CI862.

You can connect up to 30 TRIO blocks to the bus. You can also attach Hand-held Monitors (HHMs) to the bus at either the CI862 module, at the I/O blocks, or, as an option, at special HHM connectors on the bus.

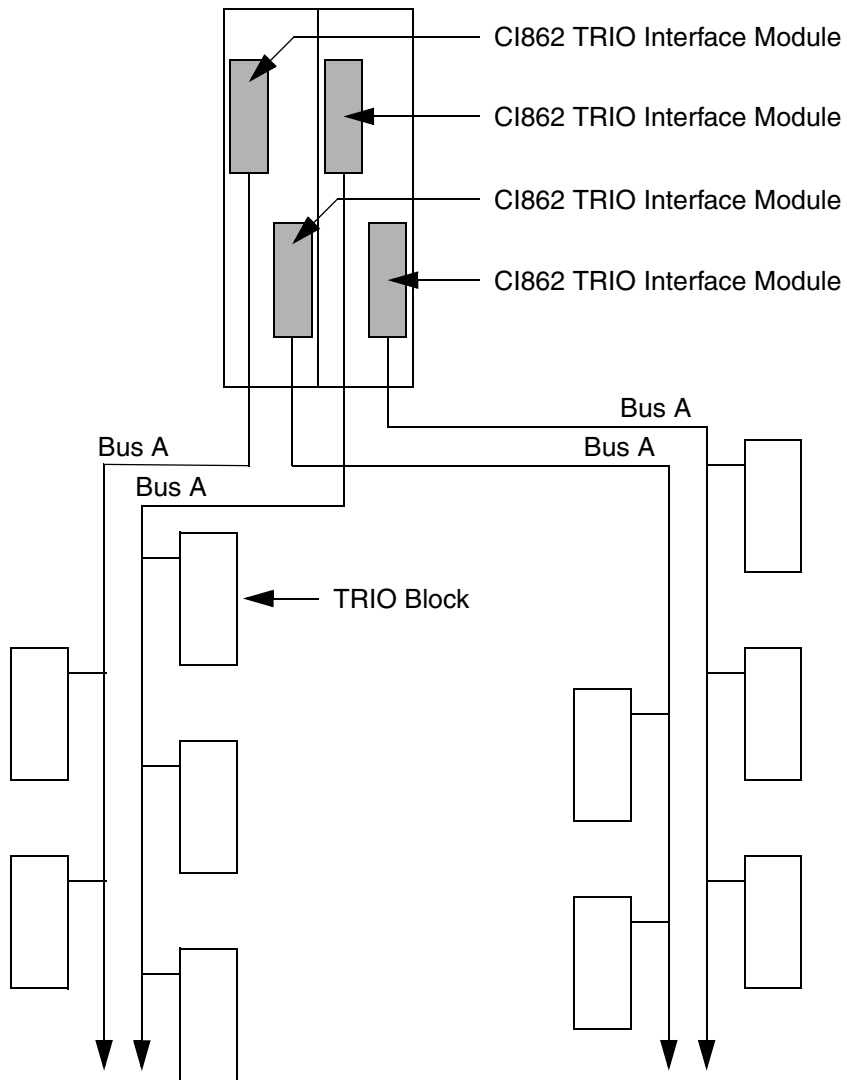


Figure 5. Non-Redundant TRIO LANs with Up To 30 Blocks

Section 2 Installation

Overview

This chapter contains information for installing the CI862 TRIO Interface module, mounting the blocks, and attaching devices to the Field Bus.

Installing CI862 TRIO Interface Module

The CI862 is powered from the processor unit via the CEX-Bus, [Figure 6](#), and requires no additional external power source. No field device is powered from the CI862.

Use the following procedure to install the CI862 TRIO Interface module with redundancy cable:

1. Mount the unit onto the DIN-rail, see [Mounting CI862](#) on page 39.
2. If the CI862 is installed in a redundant configuration connect the TK862 Redundancy Cable (maximum 1000 cm (39.37 inches)) between the TRL (TRIO Redundancy Link) connectors (left most connector).
3. Connect the field bus cable to the LAN connector (right most connector). See [Field Bus Guidelines](#) on page 185 for cable types and length. See [Connecting Devices to the Field Bus](#) on page 49 for connection details.
4. A bus termination unit must always be fitted to the last unit on the CEX-Bus, as described in the *AC 800M, Controller Hardware (3BSE036351*)* user manual.

The Hand-Held Monitor, if used, is connected to the HHM connector. See [Appendix A, Hand-Held Monitor](#) for information on the Hand-Held Monitor.

The mounting and installation of the TRIO I/O-related components is covered later in this section.

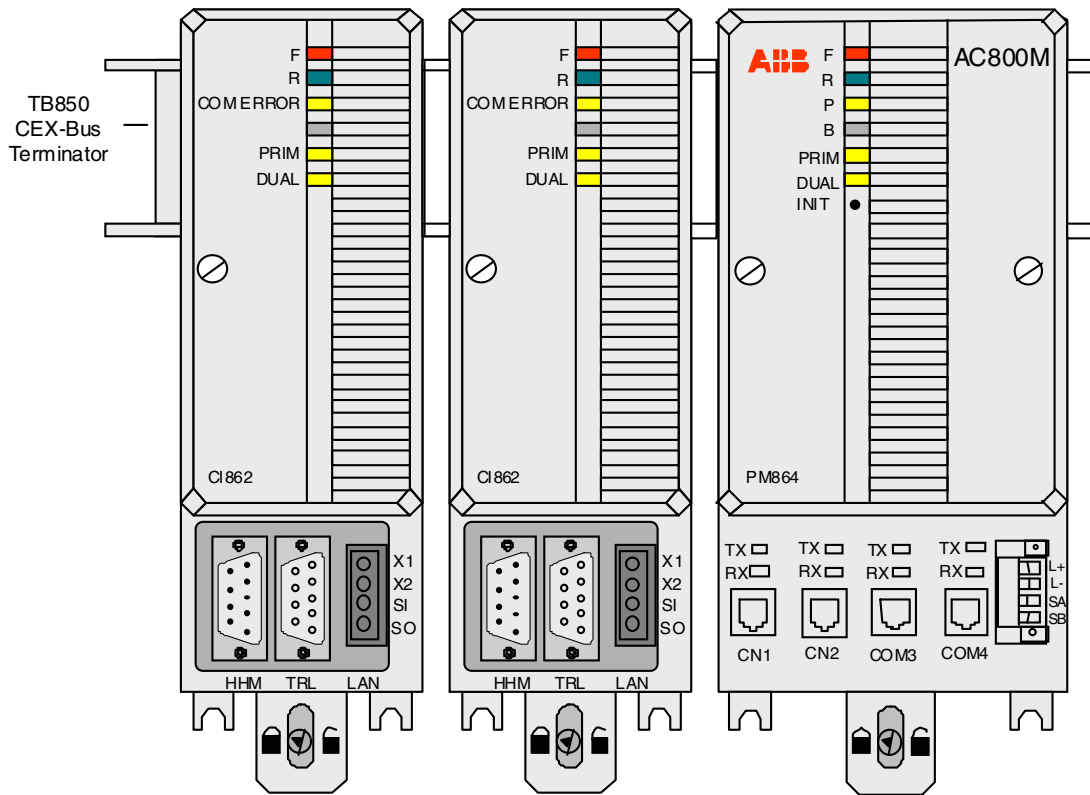


Figure 6. Terminating CEX-Bus

Mounting CI862

Before mounting the communication interface onto the DIN-rail, read carefully the installation instructions provided below. Since the electronic unit and baseplate are supplied as a single unit, there is no requirement to separate them during the mounting procedure.

Since the communication interface is cooled by self convection, it is important that it only be mounted onto a horizontal DIN- rail.

Each baseplate has a locking mechanism that contacts the metal backplate to the DIN-rail, providing an effective ground connection. The DIN-rail functions as a very effective ground for the system.

The additional screw lugs, located in the lower part of the baseplate, serve no electrical function. They are provided for use should extra fastening be required within environments subject to excessive vibration.

The DIN-rail must be firmly attached to a suitable conductive mounting surface, by means of suitable screws positioned at exact intervals of 100 mm (4 in) along the full length of the rail.

Mounting the units onto the DIN-rail only requires a blade screwdriver that fits securely into the baseplate locking screw (1 mm slot). For further details on mounting procedure, see [Figure 7](#).

Use the procedure below to mount the baseplates, complete with units:

1. Rotate the locking device to the OPEN position (1), hook the upper lip at the rear of the unit baseplate securely over the upper edge of the DIN-rail and gently snap the baseplate fully into the mounting position.
2. Rotate the locking device to the SLIDE position (2), gently slide the unit along the DIN-rail to the desired mounting position and using the connector plugs and sockets gently attach it to the adjacent unit baseplate.



To prevent damage to the pins, be sure the baseplate plugs and sockets are fully aligned as the units interconnect. Under no circumstances use excessive force!

- When interconnection is complete, rotate the locking device clockwise to the LOCKED position (3). The baseplate is now fully locked into position and has a good ground connection to the DIN-rail.



It is essential that the locking device be placed in the LOCKED position to avoid possible problems caused by vibration and/or intermittent grounding.

- The bottom of the baseplate includes lugs for extra screws. These can provide secure mounting in locations subject to vibration.

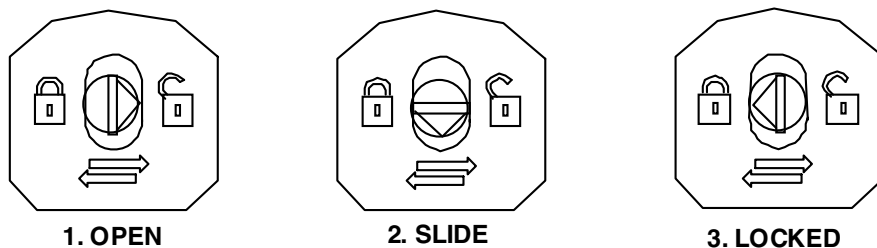


Figure 7. Baseplate Locking Device

Removing CI862

- Remove any detachable cables from the appropriate unit baseplate.
- Rotate the locking device to the SLIDE position (2) on the unit baseplate, [Figure 7](#).



In order to provide adequate access and removal space, note that the SLIDE sequence must be carried out on the unit baseplates adjacent to the unit that is to be removed.

- Gently ease the unit/baseplates sideways in order to release the contacts of the unit baseplate being removed.
- Turn the locking device anti-clockwise to the OPEN position (1) and ease the unit baseplate outward and upward at the base. Lift the unit to remove it from the DIN-rail. The AC 800M units must be disconnected from the power source before removing them from the DIN-rail.



The unit baseplates are easily disconnected from each other by gently prying them apart with a blade screwdriver.

Unit to Baseplate Alpha Code Lock

Baseplates are typically given a two-part, pre-set Alpha code locking device that prevents the installation of an incompatible type of unit onto the baseplate should the Alpha codes not agree. Identical unit types have the same factory pre-set, two-letter Alpha code installed prior to delivery.

The CI862 unit and baseplate have the locking device removed because of the placement of the electronics inside the unit. The electronics will not allow the CI862 unit to be installed in any baseplate with a locking device. However, other units could be inserted into the CI862 baseplate.



The CI862 baseplate has no locking device. Insert only the CI862 unit into this baseplate. Insertion of other unit types may cause damage to the equipment.

I/O Installation Guidelines

Consider the information given here when planning I/O assignments.

Determine Locations of Blocks and Assign I/O Points

Use diagrams of your plant site to plan the geographic distribution of the blocks. Determine which blocks to mount in cabinets and which to mount in other manners, that is, attached to machines, in junction boxes, and so on.

[Section 3, Discrete I/O Block Characteristics](#) and [Section 4, Analog I/O Block Characteristics](#) contain detailed descriptions of the individual blocks. This information includes diagrams that show the individual channels. Use these diagrams to make lists of the connections for each channel on the blocks. These lists are used by the people who install the field wiring. If you plan to use a redundant bus, there are constraints on some channels and blocks. See the information about BSMs in [Redundant Field Bus Guidelines](#) before finalizing the channel assignments.

Software Factors

Assignment of the I/O channels requires working closely with the people who are planning the applications using Control Builder M. The following is a quick summary of I/O requirements:

- All inputs to the application for a process device such as a fan or pump must be on the same block at contiguous channels. The same rule applies for device outputs. Output and inputs for a device can be on the same block or outputs can be on one block while inputs are on another.
- Digital inputs can read from 1 to 16 consecutive discrete channels on a block.
- Digital outputs can write to 1 to 16 consecutive discrete channels on a block.
- The digital input and output to be manipulated must be local to the controller in which the program is running.

Hardware Factors

No more than 30 blocks can be attached to a Field Bus Controller.

A controller can have four Field Buses (four non-redundant or or two redundant).

Depending upon your application, the controller may be limited to handling 1000 I/O points.

Mounting I/O Blocks

If blocks are to be located close together, it may be easier to complete field wiring before mounting the blocks. This is particularly true for analog, 32-circuit discrete, relay, and high speed counter blocks because field wiring for those blocks enters their terminal strips from the side.

For each block, drill two screw or bolt holes for 8-32 hardware as shown in [Figure 8](#). 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.

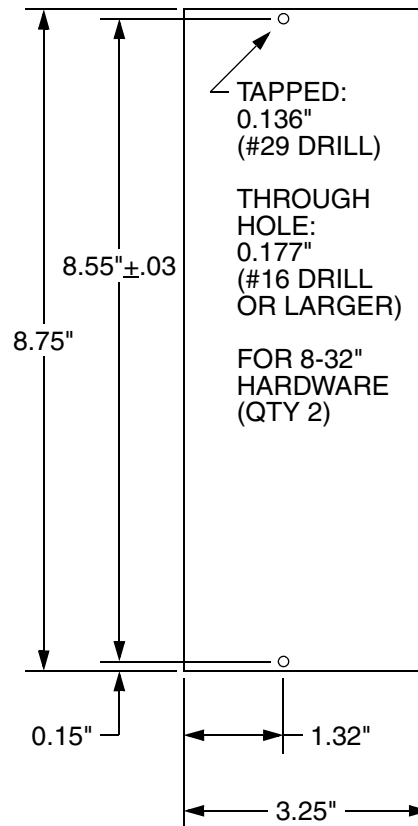


Figure 8. Mounting Guide for TRIO Blocks

AC Power Considerations

For all ac powered blocks except the 6246B 115 V ac/125 V dc 8 Circuit Isolated I/O Block and 6248B 16 Circuit Relay Output Block, all power and I/O connections on a block must be wired to the same ac phase. In general, the 6244B 115 V ac 8 Circuit Grouped I/O Block, the 6247B 115 V ac 16 Circuit Input Block, and the 6248B 16 Circuit Relay Output Block should serve as the power source for the field devices. However, different blocks can have different phases. See [Figure 9](#).

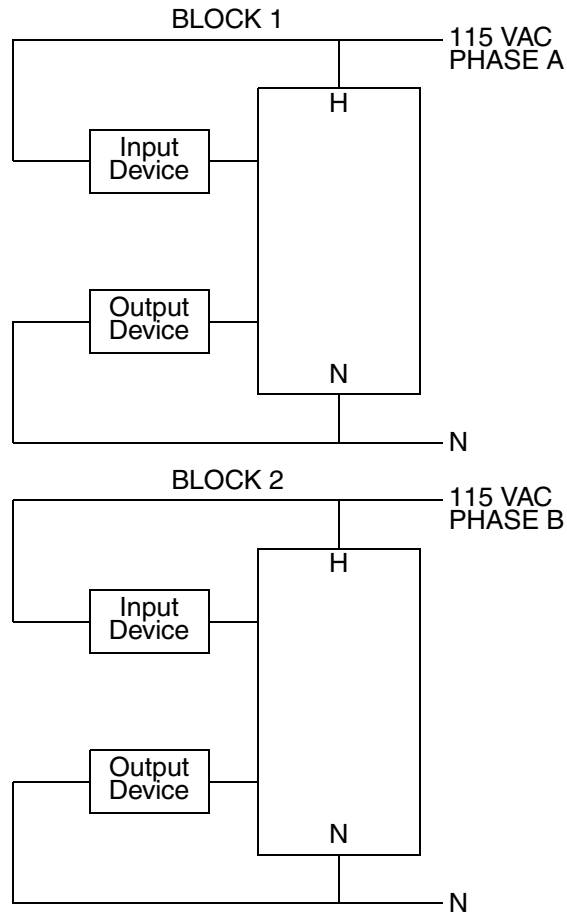


Figure 9. AC Power Phases for TRIO I/O Block Power

On 6246B 115 V ac/125 V dc 8 Circuit Isolated I/O Blocks, each pair of I/O channels can have its own power supply. All channels on the block must use either ac or dc power. Channel power and block power do not have to be the same type. Block power can be dc while channel power is ac, and so on. If channel power is ac, both channels of a pair must be wired to the same ac phase. However, different pairs of channels on an Isolated I/O Block can be wired to different ac phases as shown by [Figure 10](#). The separate I/O channel groups can be combined, if desired, by

jumpering I/O power H and N terminals on the Terminal Assembly.

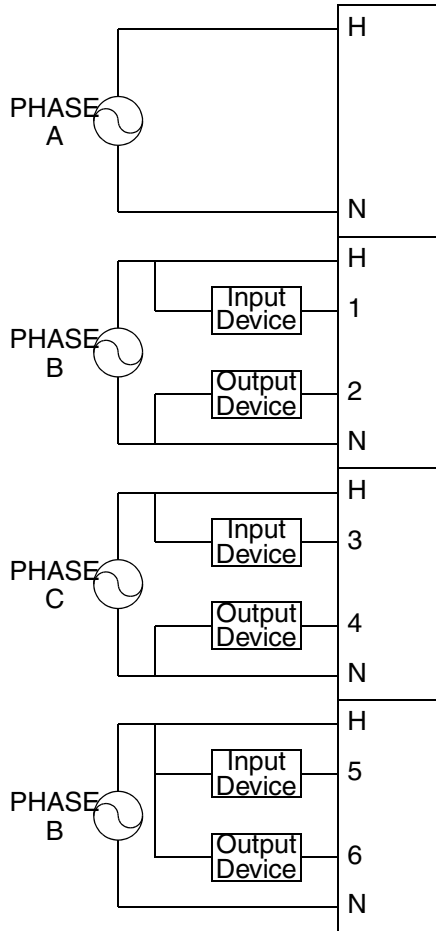


Figure 10. AC Power Phases for the 6246B 115 V ac/125 V dc 8 Circuit Isolated I/O

Power Disconnects

When power for a block comes from the same source that supplies its field I/O, care must be taken when designing a block power disconnect. Block power and input power should be removed at the same time. Figure 11 shows the correct (YES) and incorrect (NO) position for switches. If these techniques are not followed, the block may power up when multiple inputs are activated even though one leg of the power has been disconnected from the block. With dc blocks, either the positive or negative line can be switched. Normal practice is to switch the ungrounded line.

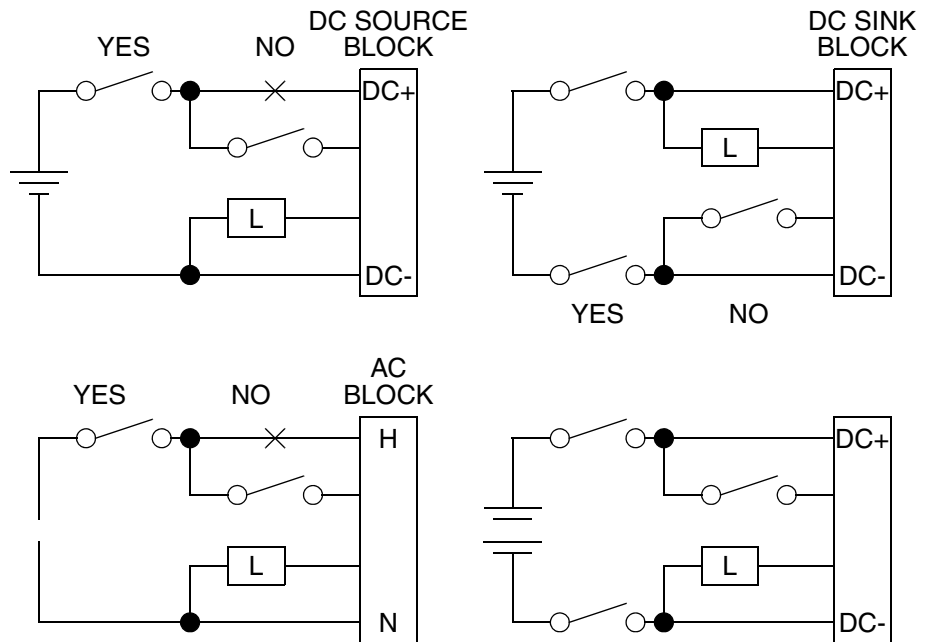


Figure 11. Block Power Disconnects

Block Grounding

Cabinets should be grounded according to local codes. You should insure that a proper ground is made. If a block is installed in an ungrounded cabinet, or if the mounting screws of the block do not make a good electrical ground connection, the grounding screw on the side of the block must be connected to a reliable ground system. See [Figure 12](#).

The techniques described in the previous paragraph ground the Terminal Assembly. The Electronics Assembly is grounded by its physical contact with the Terminal Assembly. Make sure these two assemblies make good contact.

You should consider the effect of the Field Bus on block grounds. The Bus Shield Out termination of the block is connected internally to its chassis ground. The Shield Out termination is capacitively coupled to Shield In. The purpose of this configuration is to break up any differences in ground voltages which may be present at different blocks on the bus (up to 50 V of continuous difference of ground potential).



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.

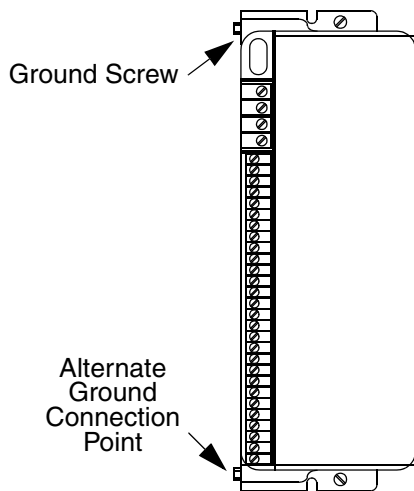


Figure 12. Location of TRIO Block Grounding Screws

Connecting Devices to the Field Bus

This section describes how to connect the control system, TRIO blocks and Bus Switching Modules (BSMs) to the Field Bus. When you make these connections, you should clearly and accurately label each Field Bus. This will aid hardware maintenance and the person configuring the TRIO part of the database.

Figure 13 shows the general bus configuration. Shield In can be left unconnected for the first device. Shield Out can be left unconnected for the last device. The CI862 module is often at the beginning or end of the bus, but it is possible to attach it at other bus positions and has a bus termination switch (see [CI862 Field Bus Termination](#) on page 57). The appropriate terminating resistor must be attached at both the beginning and end of the bus.

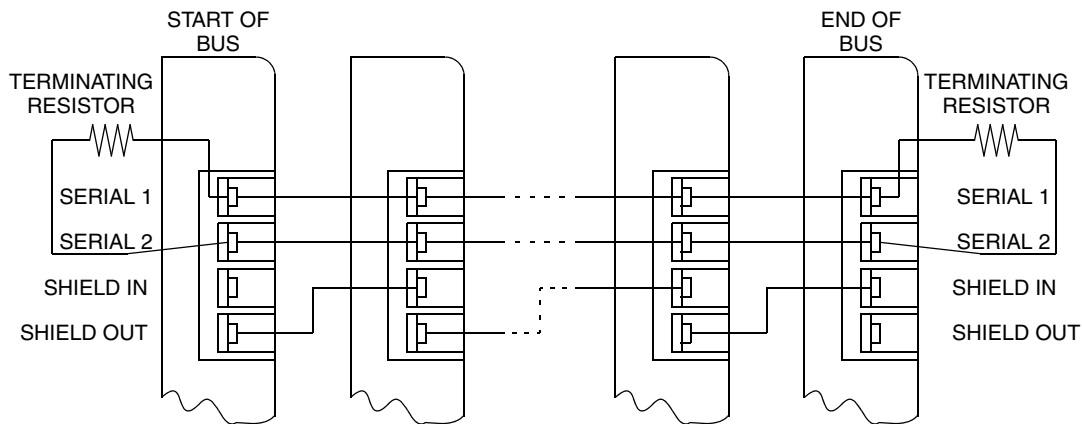


Figure 13. Items on a Field Bus

The following sections provides detailed descriptions of the methods to connect the different items:

- [Connecting Field Bus to a CI862 TRIO Interface Module](#) on page 50
- [Connecting the Field Bus to TRIO I/O Blocks](#) on page 50
- [Connecting the Field Bus to a BSM Cluster](#) on page 53
- [Terminating a Field Bus](#) on page 56

[CI862 Field Bus Termination](#) on page 57

Connecting Field Bus to a CI862 TRIO Interface Module

Each CI862 TRIO Interface module is individually connected to a separate field bus cable without a relay, maintaining a constant connection to the TRIO LAN (Field Bus). A redundant TRIO LAN requires two CI862 TRIO CEX modules; one for each bus (Bus A and Bus B) of the redundant LAN. Therefore, each CI862 module can support either a single bus architecture or one half of a redundant bus architecture.

The front panel of each CI862 module, [Figure 2](#), contains a connector for the Field Bus cable which consists of twisted pair (X1 and X2) connections and Shield In and Out (SI and SO) connections.

The X1 terminal of the CI862 module must be daisy chained to the X1 terminals of the TRIO blocks on the TRIO LAN. Likewise, the X2 terminal of the CI862 module must be daisy chained to the X2 terminals of the TRIO blocks on the TRIO LAN. If the controller is the first device on the TRIO LAN, leave Shield In (SI) unconnected. If the controller is not the first device on the TRIO LAN, connect the Shield In (SI) terminal of the CI862 module to the Shield Out (SO) terminal of the previous device on the TRIO LAN. Connect the Shield Out (SO) terminal of the CI862 module to the Shield In (SI) terminal of the next device on the TRIO LAN. If the controller is the last device on the TRIO LAN, leave Shield Out (SO) unconnected.

Connecting the Field Bus to TRIO I/O Blocks

Terminals 1 to 4 on a TRIO block are used to connect the bus to the block. As [Figure 14](#) shows, the Serial 1 terminals of all devices on the bus are daisy chained together, as are the Serial 2 terminal. The Shield In terminal must be connected to the outgoing shield (Shield Out) of the preceding device. Shield In can be left unconnected on the first device on the bus. For the last device on the bus, Shield Out can be left unconnected.

Terminals 1 to 4 accept one AWG #12 or two AWG #14 wires. The minimum recommended wire size is AWG #22. Terminals 1 to 4 also accept spade or ring terminals up to 0.27 inch (6.8 mm) wide with an opening for a #6 screw and up to 0.20 inch (5.1 mm) depth from the screw center to the back barrier.

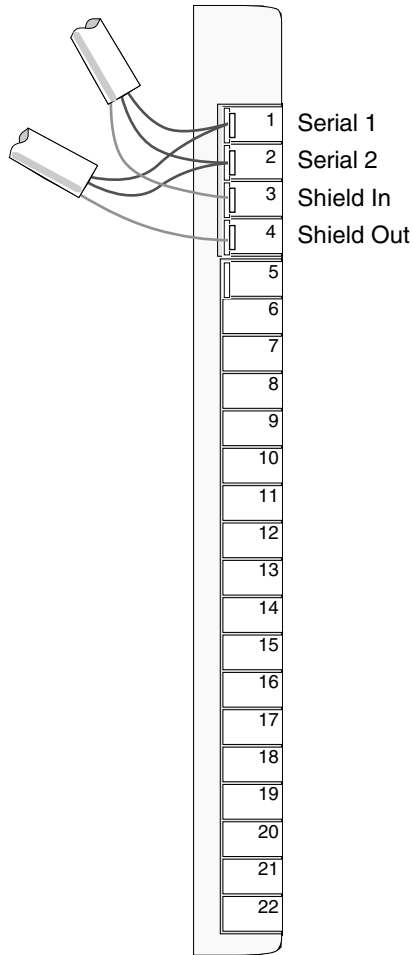


Figure 14. Field Bus Connections for a Block

Prefabricated Cables

For applications using Taylor Field Bus Cable, prefabricated cables, [Figure 15](#), in 15 inch (6200CP0015A) and 36 inch (6200CP0036A) lengths are available and are often used for connecting blocks within a cabinet. These cables terminate in mating connectors that simplify wiring between I/O blocks. The cables have a characteristic impedance of 150 ohms.

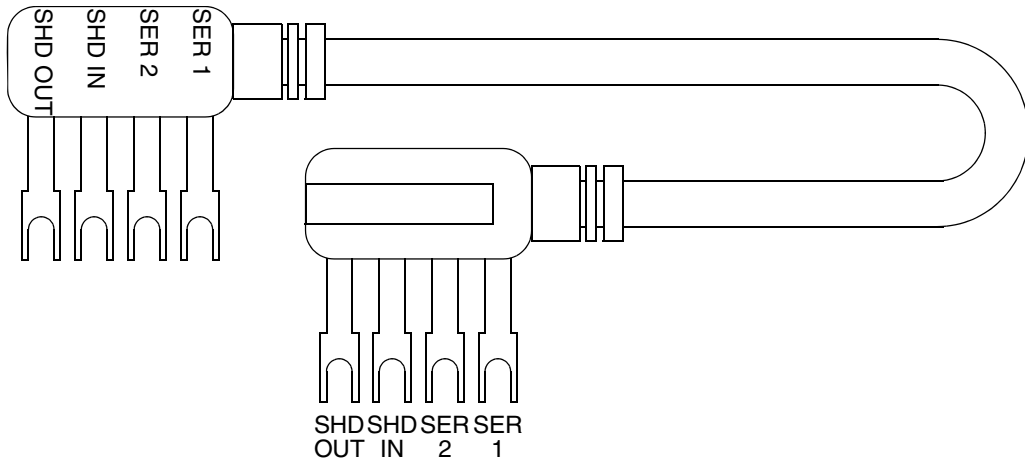


Figure 15. Prefabricated Connecting Cables

Terminating Resistor Plug

If the block is on either end of the bus, install the appropriate terminating resistor across the Serial 1 and Serial 2 terminals. 150 ohm (6202FP00150) and 75 ohm (6202FP00075) resistor plugs, [Figure 16](#), can also be used.

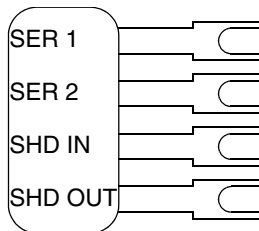


Figure 16. Terminating Resistor Plug for the First or Last Block

Connecting the Field Bus to a BSM Cluster

This section explains how to make a BSM cluster and how to attach it to the bus trunk. The Bus Switching Module (BSM), [Figure 17](#), is a small module that connects directly to a TRIO I/O block. There are two types of BSMs, a 24/48 V dc version and a 115 V ac/125 V dc version. The information about the modules in [Section 3, Discrete I/O Block Characteristics](#), and [Section 4, Analog I/O Block Characteristics](#), indicate the type of BSM needed for each type of block.

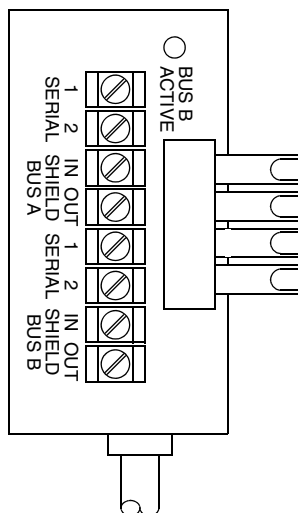


Figure 17. A BSM

To install a BSM onto a block,

1. Remove the grounding screw from the upper grounding position of the block.
2. Loosen the Serial 1, Serial 2, Shield In and Shield Out terminal screws of the block.
3. Insert the BSM connectors under the terminals, [Figure 18](#). Do not tighten the terminal screws until the bus stub wiring is complete.
4. Bolt the BSM to the upper grounding hole.
5. Connect the BSM wires to the proper terminals. For the 6232B 6 Circuit Thermocouple Input Block and the 6231B 4 In/2 Out Current Source Analog

I/O Block, use the BSM+ and BSM- terminals. For a discrete block, wire the BSM to channel 1 in the same manner that you would attach any load to channel 1 of that block. [Section 3, Discrete I/O Block Characteristics](#), has information on attaching BSMs. Be sure to check the Relay Block information if the BSM is being attached to a 6248B 16 Circuit Relay Output Block.

6. Connect Bus A to the terminals on the BSM labeled BUS A. Connect Bus B to the terminals labeled BUS B.

If the BSM is the last device on the Field Bus, terminate each cable with its characteristic resistance. Do this by installing its terminating resistor across the Serial 1 and Serial 2 terminals where the cable attaches to the BSM.

7. Complete wiring the other blocks to the stub. Connections must be made with the Taylor Field Bus Cable. Prefabricated cables in 15 inch (6200CP0015A) and 36 inch (6200CP0036A) lengths simplify wiring a stub.
 - a. Attach one end of the bus stub over the BSM connectors on the controller block. Tighten the Serial 1, Serial 2, Shield In and Shield Out terminal screws.
 - b. Connect the other blocks to the stub, keeping the stub length as short as possible.
 - c. At each block on the stub, connect the Serial 1, Serial 2, Shield In and Shield Out terminals.

DO NOT terminate the stub with a resistor.

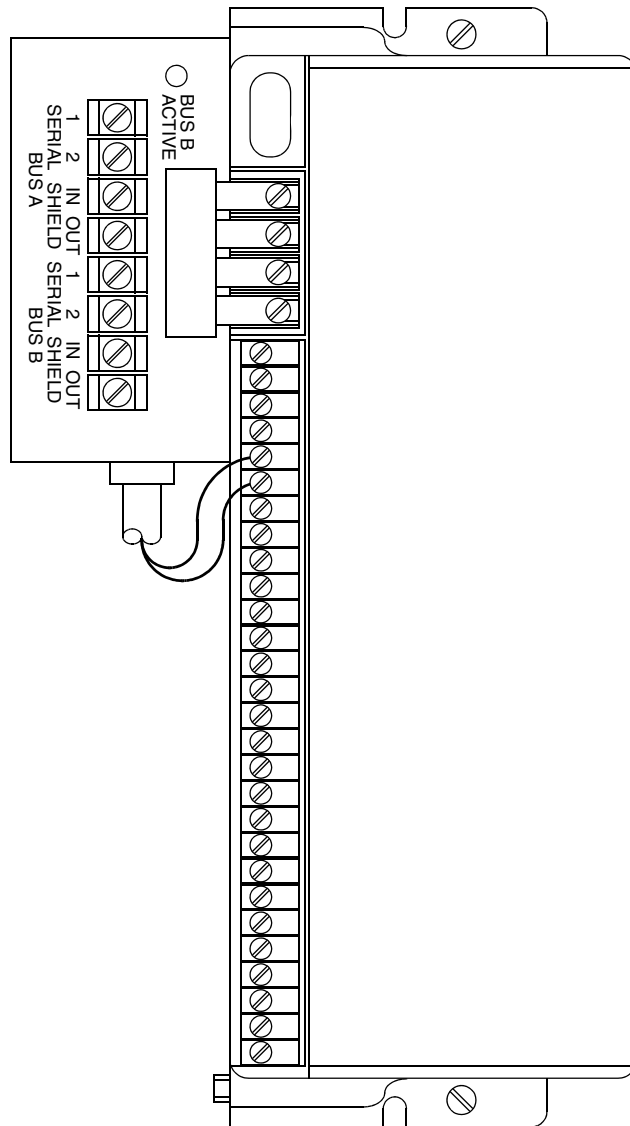


Figure 18. BSM Attached to a TRIO Block

Terminating a Field Bus

Be sure that you have terminated both ends of the main Field Bus trunk line with the characteristic impedance of its cables, [Figure 19](#). The characteristic impedance for each type of cable is listed in [Table 19](#). One end of the trunk is usually, but not always, located at the Field Bus Controller. If a TRIO module is at the beginning or end of the bus, the bus can be terminated with a resistor or a terminating resistance plug, 6202FP00150 for 150 Ω or 6202FP00075 for 75 Ω . BSM stubs should not be terminated. Note that both cables of a redundant bus must be terminated, [Figure 20](#). The stubs of a redundant bus should not be terminated.

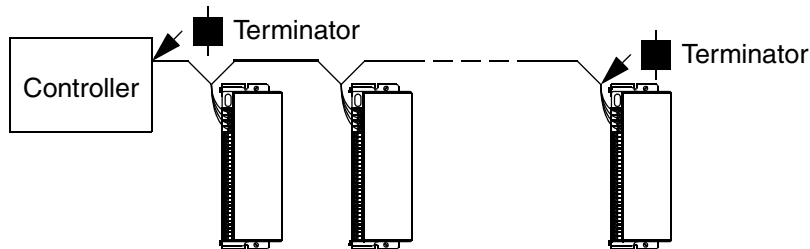


Figure 19. Terminating a Non-Redundant Field Bus

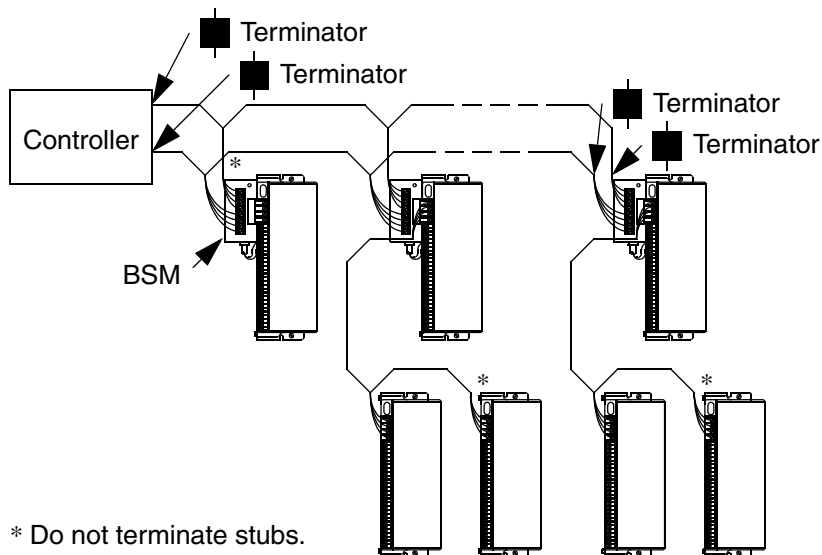


Figure 20. Terminating a Redundant Field Bus

CI862 Field Bus Termination

If the CI862 is at either end of the bus, the characteristic resistance is set by a switch, [Figure 2](#), on the Field Bus Interface Module, [Table 2](#).

Table 2. Field Bus Termination Switch Settings of the CI862

| Dip Switch ⁽¹⁾ | Setting |
|---------------------------|-------------------------|
| 1 | 75 ohms |
| 2 | 110 ohms ⁽²⁾ |
| 3 | 150 ohms |
| 4 | No Termination |

- (1) The dip switch must be closed to make the termination connection. The default is open, (no internal termination).
- (2) The 110 ohm option may be used to terminate cables with an impedance in the range of 100 to 120 ohms.

Disabling a Block

To disable an I/O block without removing power from the input devices, unplug the Electronics Assembly using a 6201F Block Puller. See [Procedures to Add and Remove an I/O Block](#) on page 58.

Procedures to Add and Remove an I/O Block

All field wiring connections to a TRIO I/O block are made to its Terminal Assembly, which is ordinarily permanently installed. This means the Electronics Assembly can be removed and replaced without disturbing field wiring, entering new addresses, 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 and so on).

Procedures to Remove and Replace an Electronics Assembly

To remove an Electronics Assembly, [Figure 21](#),

Open the swing away door of the block and unscrew the retaining screws.

Engage the tabs on the Block Puller in the upper vent slots of the block. Move the tool to the center of the block and squeeze the handle. Pull the Electronics Assembly upward.



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



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

To replace an Electronics Assembly,

1. Open the swing away door.
2. Align the Electronics Assembly within the guides and push it down quickly.
3. Tighten the retaining screws.

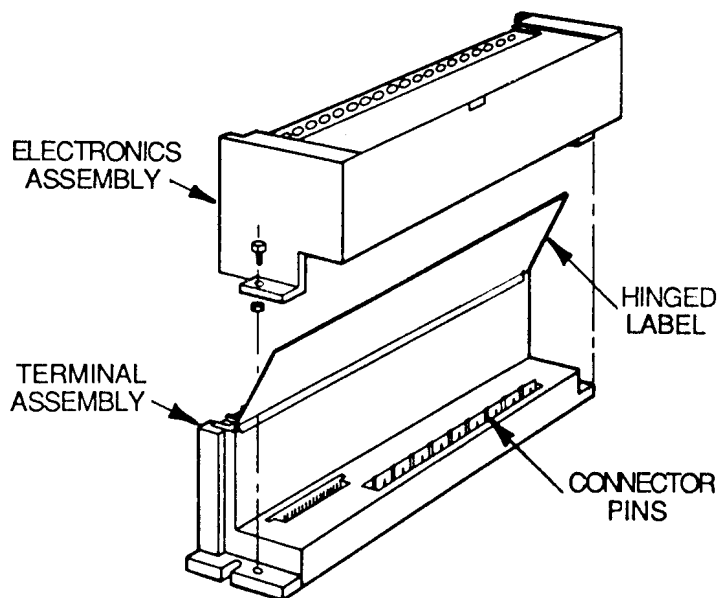


Figure 21. Removing an Electronics Assembly



When the Electronics Assembly for a 6232B 6 Circuit Thermocouple Input Block or 6233B 6 Circuit RTD Input Block is removed from the Terminal Assembly for some length of time, it is possible for contaminants to build up on the exposed connector pins on both parts of the block. After the block is re-assembled, these contaminants can affect the accuracy of measurements. Therefore, when re-assembling the block, push the Electronics Assembly in and out a few times to assure a fresh mating surface.

Procedure to Add a Block to a Field Bus

If you intend to add a block to an existing Field Bus, it is best to shut the bus down. If you try to add a block to an active bus, you should realize that there is a chance of a communications error that will cause a loss of input measurements with outputs going to their default states.

If you decide to try to add a block to an active bus, at least pre configure the block to have the correct device address and baud rate of the bus.

Procedure to Replace a Terminal Assembly

Do not replace a Terminal Assembly while the system is running unless the continuity of the bus wires has been assured by crimping or soldering them together. Removing a Terminal Assembly without taking this precaution may cause communication disruption, erratic behavior, or system shutdown.



Terminal Assemblies for the 6240B 16 Circuit dc Source and Sink I/O Block, 6245B 115 V ac Low Leakage 8 Circuit Grouped I/O Block, and 6246B 115 V ac/ 125 V dc Isolated I/O Block are not backward compatible. Therefore, if a previous model Terminal Assembly must be replaced by a newer model Terminal Assembly, you must also upgrade the Electronics Assembly for the block to the same model.

To replace a Terminal Assembly,

1. Pre configure the new Terminal Assembly. This requires it be mated to an Electronics Assembly and attached to an HHM. Assign the proper device block address and the bus baud rate to the block and place the block outputs in safe states.
2. If the existing block is receiving power, remove power from it. Take care to ensure continued operation of any other devices wired to the same power supply.



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

3. If the signal wires have been joined by soldering or crimping, remove and tape each wire pair carefully. Do not allow the signal wires to contact each other or any conductor.
4. Remove the Electronics Assembly of the block.
5. Remove the field wiring from the Terminal Assembly.

6. Remove the Terminal Assembly. Reverse the procedure to install the new Terminal Assembly.

If removal of the block is permanent, the bus should be rewired using unbroken cable at the earliest opportunity.

Section 3 Discrete I/O Block Characteristics

Overview

This section describes the basic characteristics of the TRIO discrete I/O blocks used in the AC800M installation. Included is information to aid you in determining the types of discrete blocks needed for your applications.

Discrete I/O Blocks

The discrete TRIO blocks communicate with the AC800M Controller through integer values that represent channel states, that is, a channel is 1 (ON) or 0 (OFF). Some discrete blocks are used for digital inputs and outputs. The available discrete blocks are:

- 6240B 16 Circuit dc Source and Sink I/O Block.
- 6241B 32 Circuit dc Source and Sink I/O Block.
- 6244B 115 V ac 8 Circuit Grouped I/O Block¹.
- 6245B 115 V ac 8 Circuit Grouped Block, Low Leakage I/O Block.
- 6246B 115 V ac/125 V dc 8 Circuit Isolated I/O Block.
- 6247B 115 V ac 16 Circuit Input Block.
- 6248B 16 Circuit Relay Output Block.

Flow Chart for Choosing Discrete Blocks

Figure 22 through Figure 25 contains a flow chart to aid you in determining which discrete blocks your system requires.

1. The 6244B 115 V ac 8 Circuit Grouped I/O Block is no longer available from the manufacturer and has been replaced by the 6245B 115 V ac Low Leakage 8 Circuit Grouped I/O Block. Information for the 6244B 115 V ac 8 Circuit Grouped I/O Block is provided in this document for those still being used in the field.

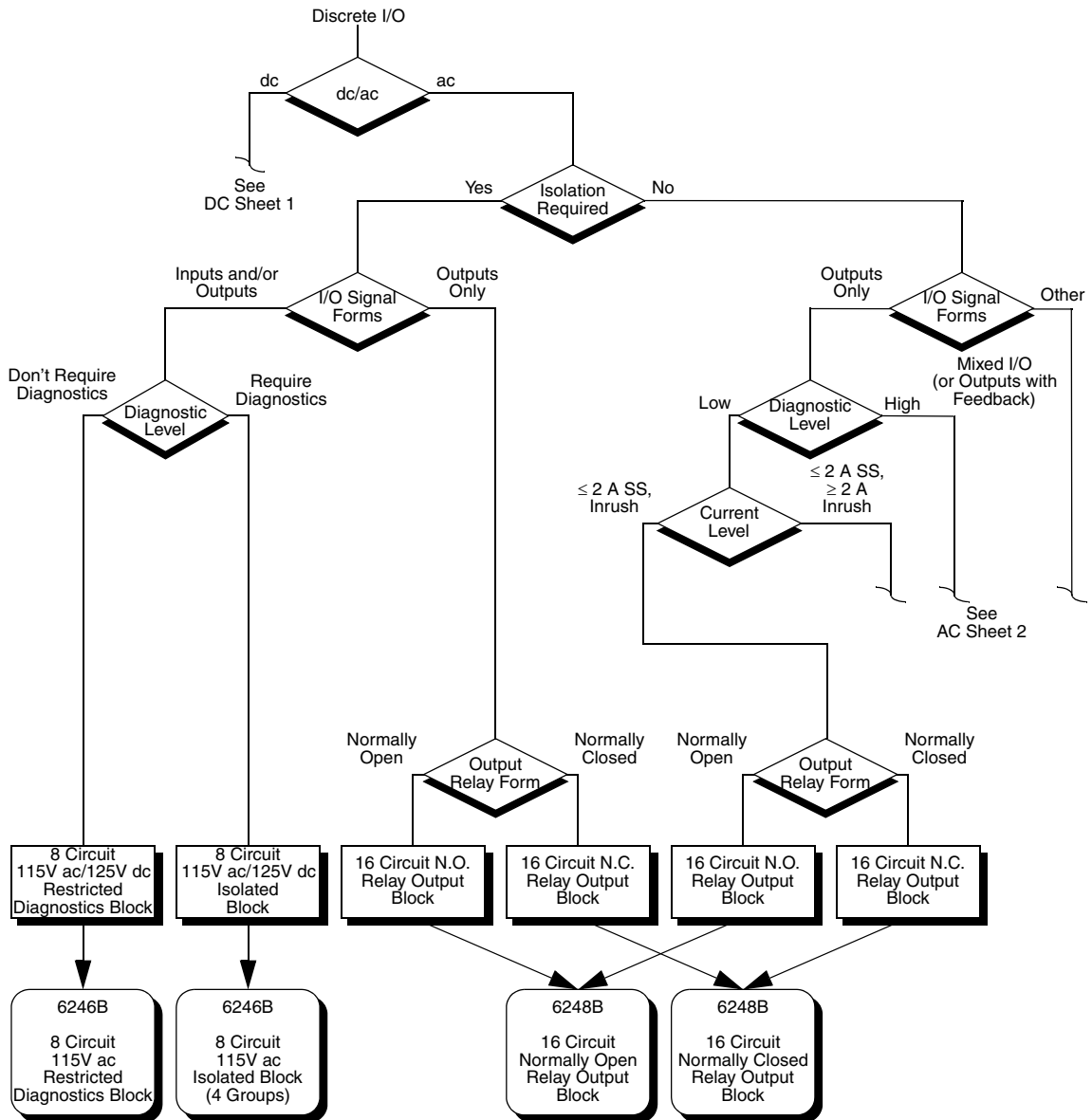


Figure 22. Flow Chart, AC Sheet 1

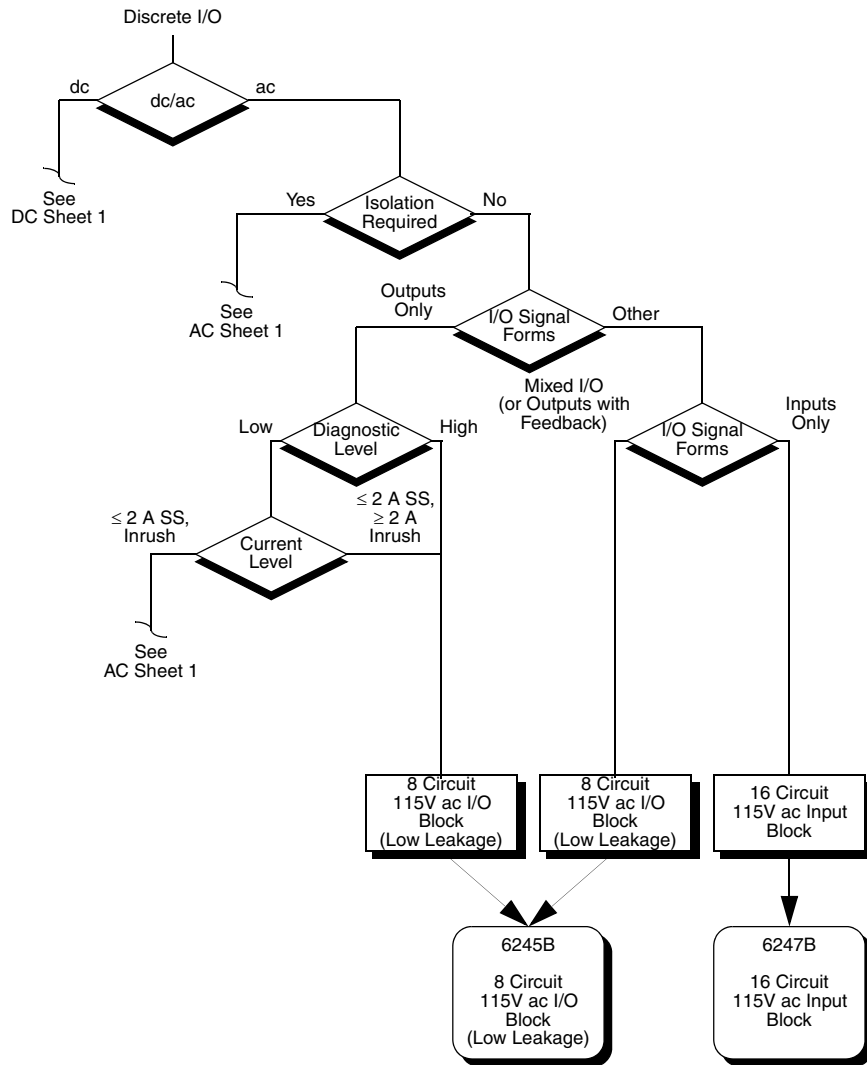


Figure 23. Flow Chart, AC Sheet 2

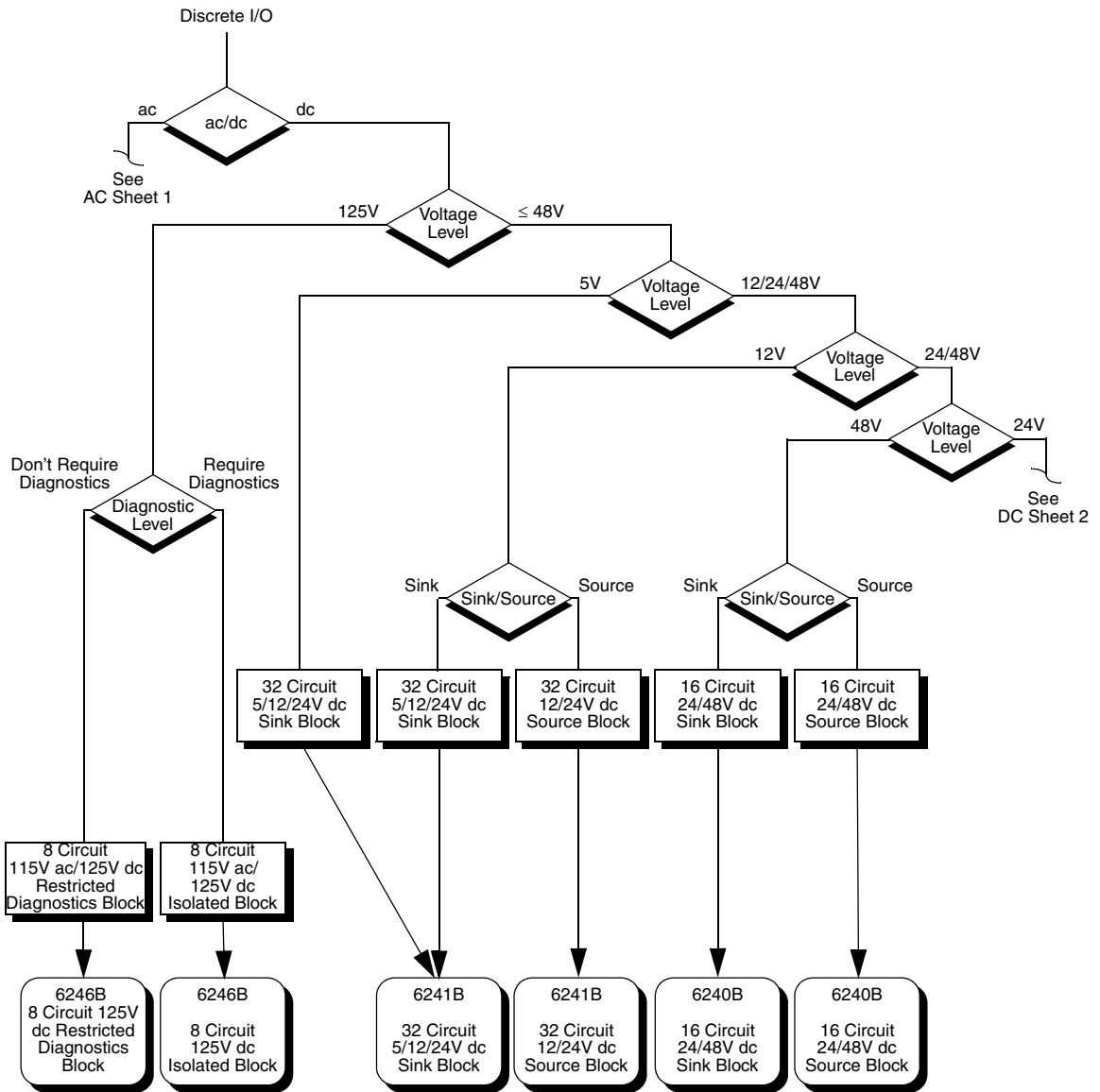


Figure 24. Flow Chart, DC Sheet 1

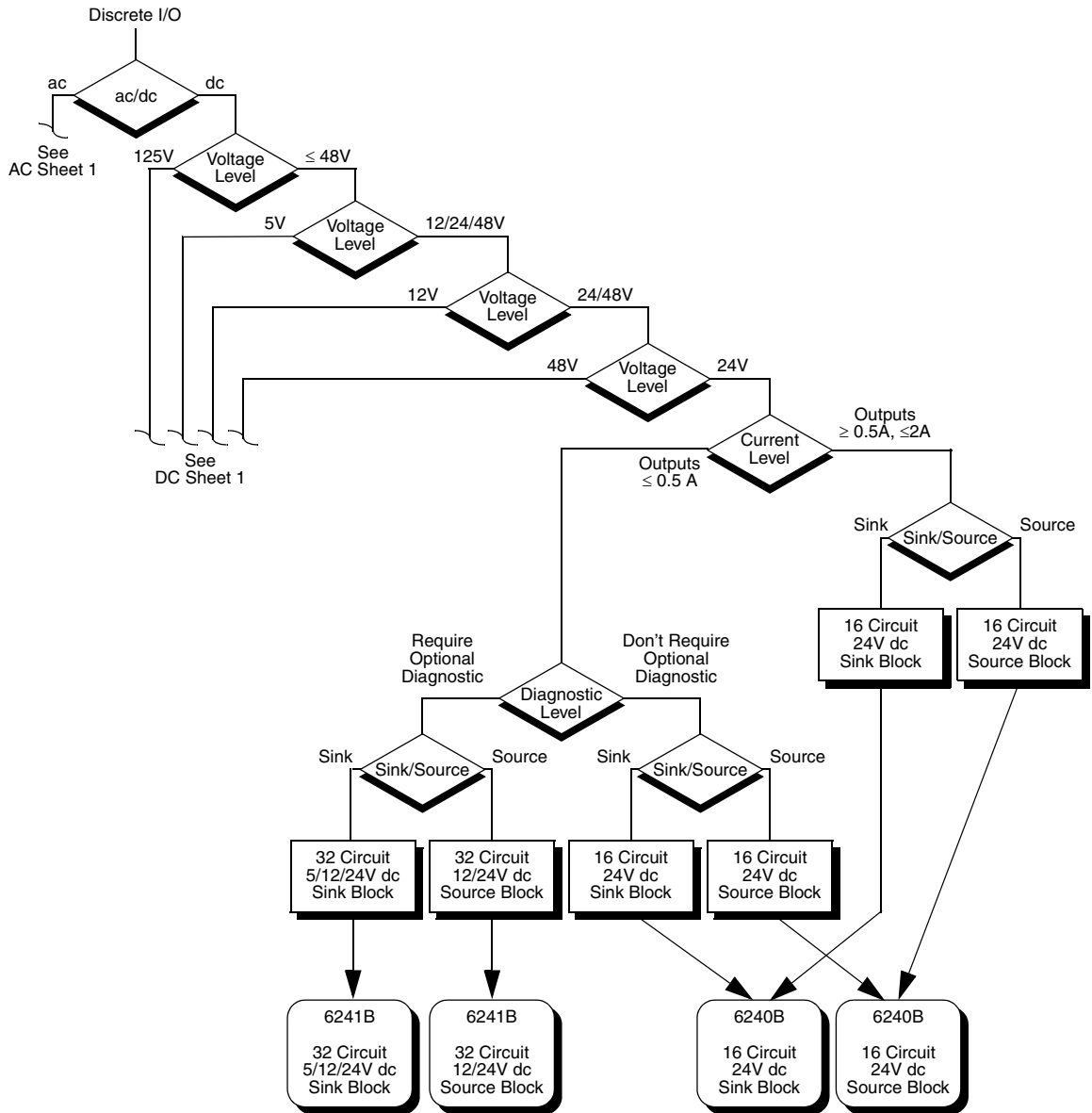


Figure 25. Flow Chart, DC Sheet 2

Quick Facts About the Discrete Blocks

This section contains additional information to help you choose between the types of discrete blocks.

6248B Relay Output Blocks do not Participate in Warmstart

The 6248B 16 Circuit Normally Open Relay Output Module and 16 Circuit Normally Closed Relay Output Module do not participate in warmstart actions. Since these blocks do not support read outputs, their outputs are enabled upon log in and calculated values from the AC800M are transmitted.

Isolation Characteristics of the 6246B Isolated Digital I/O Block

The 6246B Isolated Digital I/O Block has four groups of circuits with 2 circuits to a group. Each group is isolated from the others. Each pair of circuits can have its own power supply, isolated from other I/O circuits and the block power supply. All I/O channel power must be the same, either ac or dc. The I/O channel power does not have to be the same type as the power for the block.

External Resistors for I/O Channels

In the following scenarios, external resistors must be attached to input or output devices.

- Any tri-state input circuit using the Open Wire diagnostic on a 8 Circuit 115 V ac Block, 8 Circuit Isolated Block, or 16 Circuit Source/Sink Block.
- Any input on a 16 Circuit ac Input Block that uses Open and/or Short Detect diagnostics. See the *800xA for TRIO/Genius (3BUR002460*)* user manual for suggested resistors.
- Any load less than 50 mA driven by a standard ac discrete block. See [Interfacing Small Loads to Discrete Blocks](#) on page 116.
- The 6240B, 6244B, 6245B, and 6246B blocks can be configured to detect a no load condition for an output circuit. For this feature to work, the output current must be greater than 50 mA. Consequently, there may be some instances where it is necessary to add a resistor in parallel with the load to be able to use this feature. Be aware, if you lose the load, but do not lose the parallel resistor, the

output may still draw enough current to prevent the No Load diagnostic from going active. In such configurations, when the No Load goes active, it may indicate an open wire condition.

Source versus Sink

The 32 Circuit and 16 Circuit dc Discrete Blocks come in current sourcing and current sinking versions. Figure 26 through Figure 29 show the electrical distinctions between devices which source and sink current. Remember that TTL applications are only supported by the 6241B 32 Circuit Sink Block.

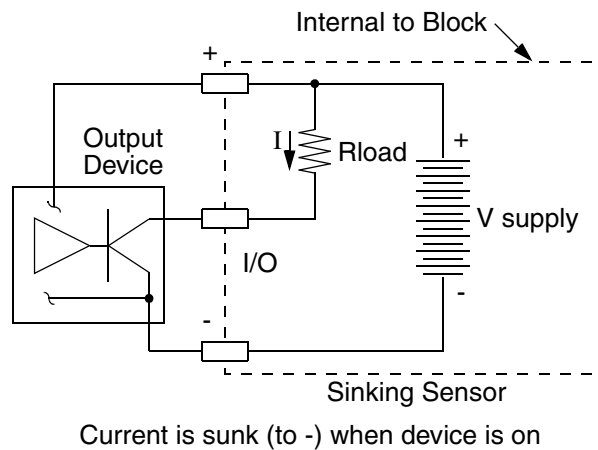


Figure 26. Diagram of a Sinking Sensor for the 16 Circuit and 32 Circuit Sink Blocks

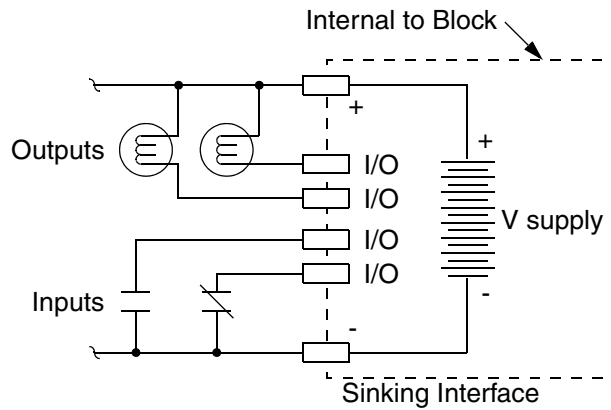


Figure 27. Diagram of a Sinking Interface for the 16 Circuit and 32 Circuit Sink Blocks

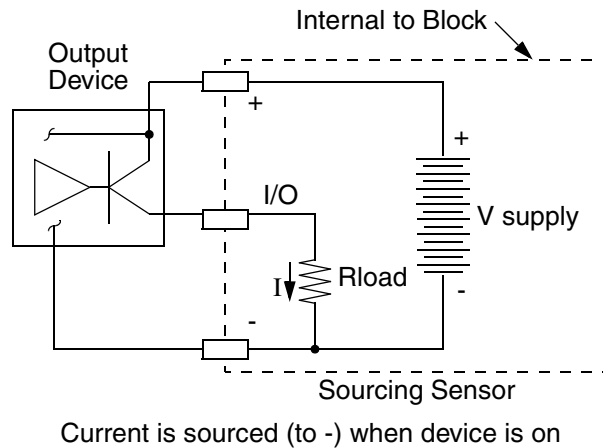


Figure 28. Diagram of a Sourcing Sensor for the 16 Circuit and 32 Circuit Source Blocks

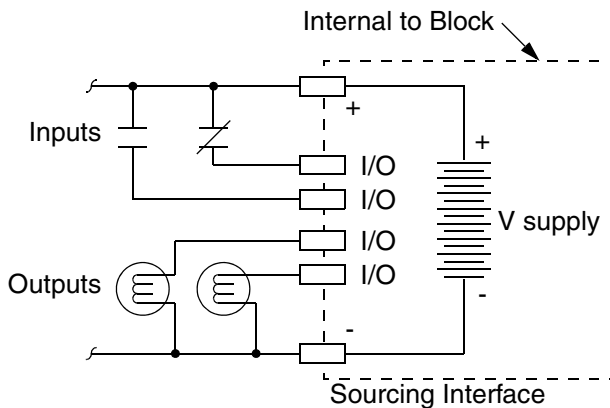


Figure 29. Diagram of a Sourcing Interface for the 16 Circuit and 32 Circuit Source Blocks

Current Loads

The descriptions of the discrete blocks contain specification tables that include the maximum load that a block can handle. You should check these to insure that no block is overloaded. If a block has loads that operate above two amps, you must under populate the block.

Discrete Block Diagnostics

The discrete blocks have diagnostic capabilities that provide both fault detection and reporting. The following diagnostics are supported by the discrete blocks:

6240B 16 Circuit Source/Sink Block:

- Open Wire (for Tri-state inputs - sink block only).
- Overtemperature.
- Short Circuit.
- Overload.
- No Load.
- Failed Switch.

6241B 32 Circuit Source/Sink Block:

- Failed Switch (Includes short circuit and overcurrent).

6244B and 6245B 8 Circuit 115 V ac Block:

- Open Wire (for Tri-state inputs).
- Overtemperature.
- Short Circuit.
- Overload.
- No Load.
- Failed Switch.

6246B 8 Circuit 115 V ac/125 V dc Isolated Block:

- Loss of I/O Power.
- Open Wire (for Tri-state inputs).
- Overtemperature.
- Short Circuit.
- Overload.
- Failed Switch.
- No Load.

6247B 16 Circuit 115 V ac Input Block:

- Open Wire.
- Shorted Wire.

6240B 16 Circuit dc Source and Sink I/O Blocks

Four different versions of the 6240B 16 Circuit dc Source and Sink I/O Blocks are available. Each has 16 discrete channels, which you can configure individually as inputs, tri-state inputs, or outputs.

For both dc Source and Sink blocks, you can connect output circuits directly to input circuits on the same block without using other components or inverting logic states.

Field Bus and Block Power Wiring

Terminals 1 through 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus or Bus Switching Module (BSM).

As [Figure 30](#) and [Figure 32](#) show, dc power is brought into the block at terminals 5 and 22. These terminals can accept one AWG #12 or two AWG #14 wires.

I/O Channel Wiring for the Source I/O Block

Source blocks provide current to field output devices. There are two types:

- 24 V dc Source block for use with 2-wire and 3-wire solid state sensors and electromechanical sensors. This version operates at 24 V dc only. It should be used where a 24 V dc supply is furnished.
- 24/48 V dc Source block for use with 3-wire solid state sensors and electromechanical sensors. This version operates from 24 to 48 V dc. It should be used where the supply voltage is greater than 30 V.

A Source block has all output devices connected between the channel terminal and the negative (-) side of the power supply. Input devices are connected between the positive (+) side of the power supply and the channel terminal as shown in [Figure 30](#).

Terminals 6 through 21 are used for the sixteen I/O channels, with terminal 6 being channel 1. You can wire any channel for either input or output. You specify your choice to the system during the software configuration. The I/O terminals can take one AWG #12 or two AWG #14 wires. Connections should be made as shown in

Figure 30.

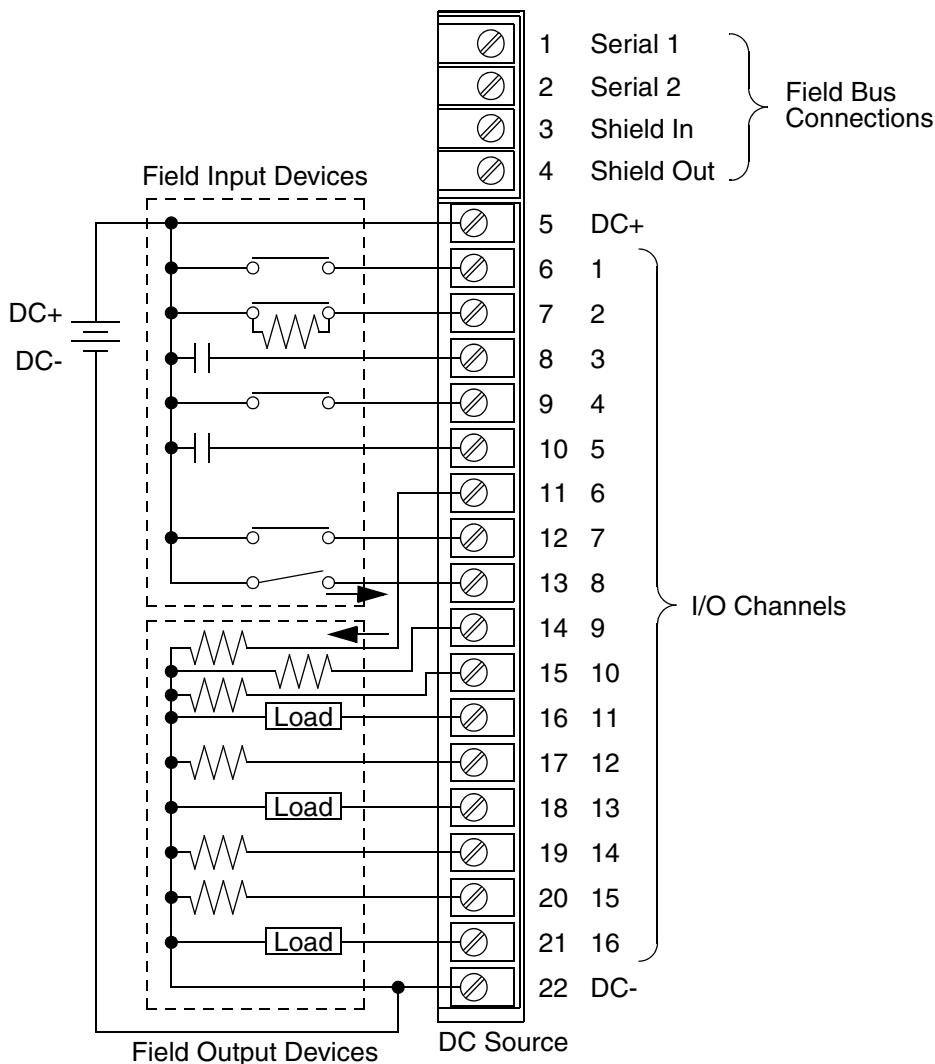


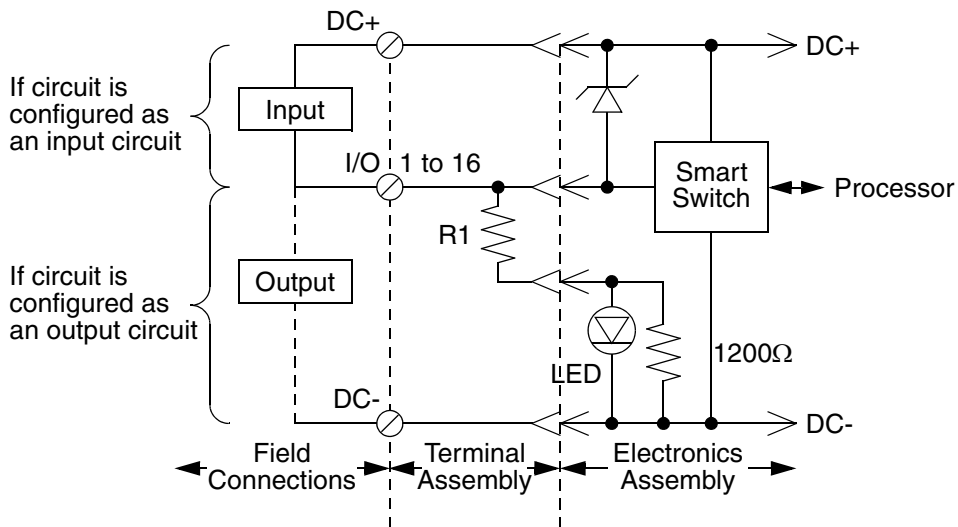
Figure 30. Terminal Connections for a 6240B 16 Circuit dc Source I/O Block

If an input circuit is to use the Open Wire diagnostic, it must have an external resistor installed across the dry contacts of the input device. This is illustrated for

input channel 2 in Figure 30. For the 24/48 V dc block, a 5.1K ohm external resistor should be used. For the 24 V dc block, a 1.6K ohm external resistor should be used. These resistors should have a power rating of at least 1/2 Watt and should be non-inductive. This type of input is called a tri-state input. If an input is wired for tri-state operation, its circuit LED glows dimly when the input is off. This does not indicate incorrect operation.

If the block is a BSM Controller, it requires a low voltage (24/48 V) BSM. The BSM must be wired between terminals 6 and 22 as an output on channel 1. You can use the other 15 channels in the normal manner.

Figure 31 shows the internal circuits of the 6240B 16 Circuit dc Source I/O Block.



R1 is 5.6K ohms for 24/48 V dc blocks or 1.8K ohms for 24 V dc blocks

Figure 31. 6240B 16 Circuit dc Source I/O Block Internal Circuits

I/O Channel Wiring for the Sink I/O Block

Sink blocks receive current from field output devices. There are two types:

- 24 V dc Sink block for use with 2-wire and 3-wire solid state sensors and electromechanical sensors. This version operates at 24 V dc only. It should be used where a 24 V dc supply is furnished.
- 24/48 V dc Sink block for use with 3-wire solid state sensors and electromechanical sensors. This block operates from 24 to 48 V dc. It should be used where the supply voltage is greater than 30 V.

A Sink block has all output devices connected between the circuit terminal and the positive (+) side of the power supply. Input devices are connected between the negative (-) side of the power supply and the circuit terminal as shown in [Figure 32](#).

Terminals 6 through 21 are used for the sixteen I/O channels, with terminal 6 being channel 1. You can wire a channel for either input or output. You specify your choice to the system during the software configuration. The I/O terminals can take one AWG #12 or two AWG #14 wires. Connections should be made as shown in [Figure 32](#).

If an input circuit is to use the Open Wire diagnostic, it must have an external resistor installed across the dry contacts of the input device. This is shown for input channel 2 in [Figure 32](#). For the 24/48 V dc block, a 5.1K ohm external resistor should be used. For the 24 V dc block, a 1.6K ohm external resistor should be used. These resistors should have a power rating of at least 1/2 Watt and should be non-inductive. This type of input is called a tri-state input. If an input is wired for tri-state operation, its circuit LED glows dimly when the input is off. This does not indicate incorrect operation.

If the block is a BSM Controller, it require a low voltage (24/48 V) BSM. The BSM must be wired between terminals 5 and 6 as an output on channel 1. You can use the other 15 channels in the normal manner.

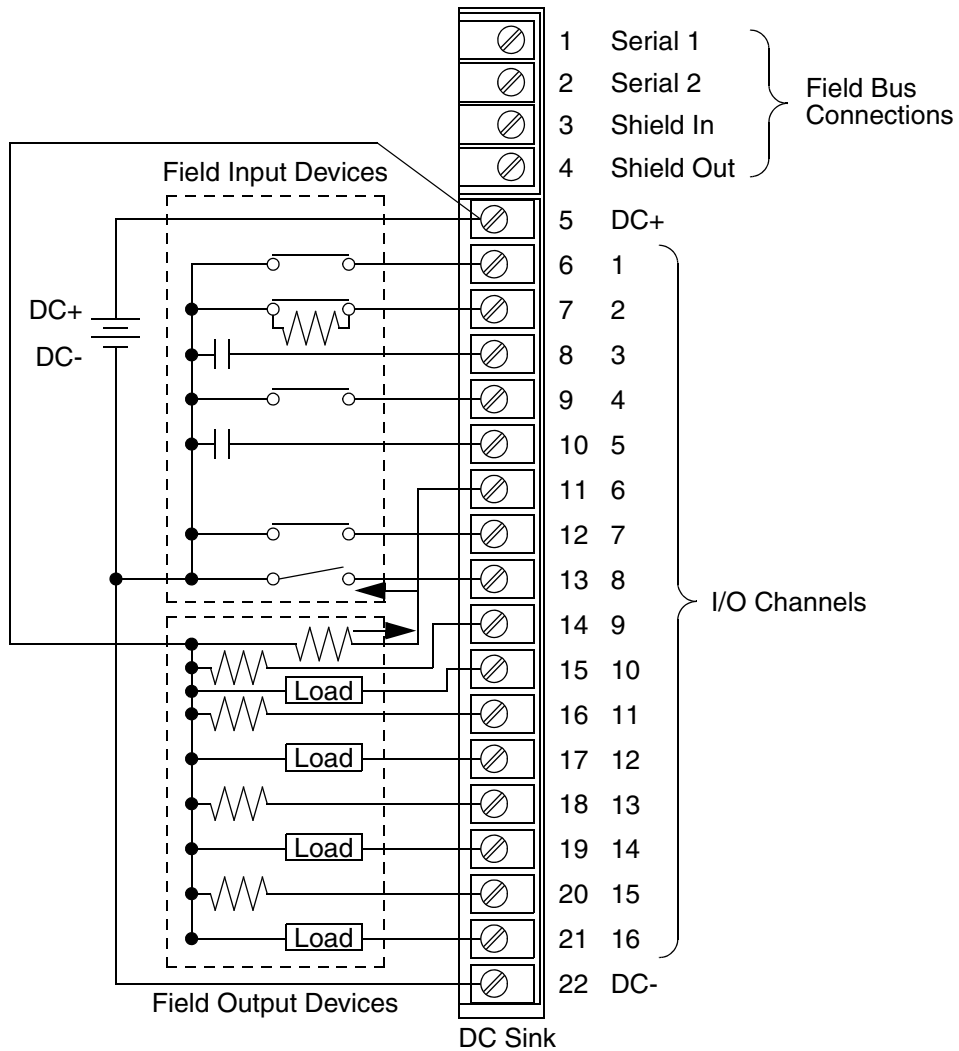
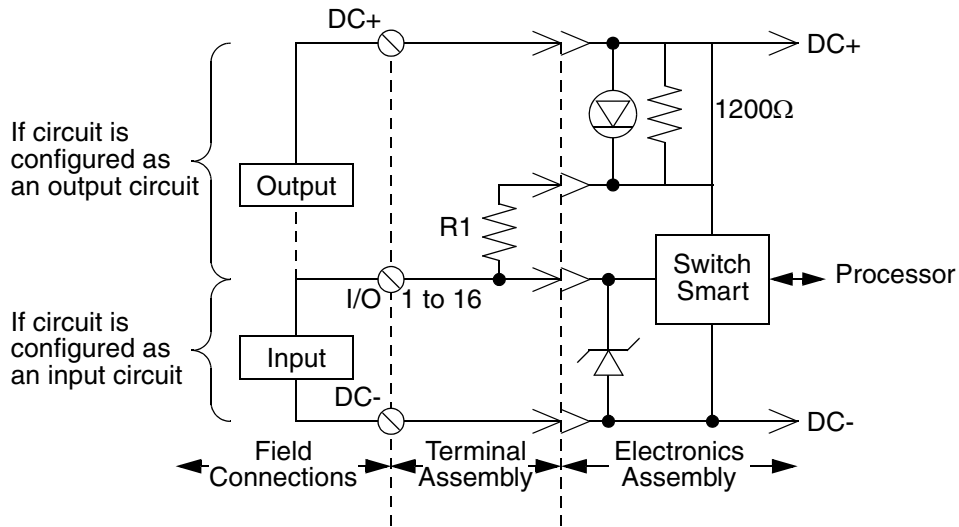


Figure 32. Terminal Connections for a 6240B 16 Circuit dc Sink I/O Block

Figure 33 shows the internal circuits of the 6240B 16 Circuit dc Sink I/O Block.



R1 is 5.6K ohms for 24/48 V dc blocks or 1.8K ohms for 24 V dc blocks

Figure 33. 6240B 16 Circuit dc Sink I/O Block Internal Circuits

6240B 16 Circuit dc Source and Sink I/O Block Specifications

Table 3. 6240B 16 Circuit dc Sink and Source I/O Block Specifications

| Characteristics | Specifications | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|-------------|---------------|-------------|--------------|-------------|--|---------------|--------------|--|-------------|---------------|--|--------------|---------------|--|---------------------------------------|--|--|---|--|--|---------------|--|--|---|--|--|
| Physical Characteristics: Block Type: Operating Voltage: Ripple (maximum): Required dc Operational Power (Excludes Loads): Power Supply Dropout Time: LEDs (I/O Block): LEDs (Each Circuit): Block to Block Isolation: Insulation Resistance: Terminal Wiring: Weight: Heat Dissipation: | 16 circuit discrete input and output 18 to 56 V dc (24/48 V), 18 to 30 V dc (24 V) 10% 150 mA typical/300 mA maximum 10 mSec Unit OK, I/O Enabled Individual load side indicators 1500 V 2.2 Megohms minimum One AWG #12 or two AWG #14 4 lbs. (1.8 Kg) 68.8 Watts with 16 outputs on at 2 amps | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Environmental: Operating Temperature: Storage Temperature: Humidity: | 0° C to +60° C (32° F to +140° F) -40° C to +100° C (-40° F to +212° F) 5% to 95% (non-condensing) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input Characteristics for 24/48 V dc Blocks: Input Voltage Relative to (dc-) Input ON, 24 V dc Supply: 48 V dc Supply: Input OFF, 24 V dc Supply: 48 V dc Supply: Input Impedance (Typical): Input Processing Time (Typical): Selectable Input Filter Times: Input Diagnostics: | <table border="0"> <thead> <tr> <th></th> <th>Source Blocks</th> <th>Sink Blocks</th> </tr> </thead> <tbody> <tr> <td>1 to 24 V dc</td> <td>0 to 8 V dc</td> <td></td> </tr> <tr> <td>38 to 48 V dc</td> <td>0 to 16 V dc</td> <td></td> </tr> <tr> <td>0 to 7 V dc</td> <td>17 to 24 V dc</td> <td></td> </tr> <tr> <td>0 to 14 V dc</td> <td>34 to 48 V dc</td> <td></td> </tr> <tr> <td>5.6K ohms (24/48 V), 1.8K ohms (24 V)</td> <td></td> <td></td> </tr> <tr> <td>1.7 mSec (plus selectable filter delay)</td> <td></td> <td></td> </tr> <tr> <td>5 to 100 mSec</td> <td></td> <td></td> </tr> <tr> <td>Open wire, Overtemperature, Failed Switch</td> <td></td> <td></td> </tr> </tbody> </table> | | Source Blocks | Sink Blocks | 1 to 24 V dc | 0 to 8 V dc | | 38 to 48 V dc | 0 to 16 V dc | | 0 to 7 V dc | 17 to 24 V dc | | 0 to 14 V dc | 34 to 48 V dc | | 5.6K ohms (24/48 V), 1.8K ohms (24 V) | | | 1.7 mSec (plus selectable filter delay) | | | 5 to 100 mSec | | | Open wire, Overtemperature, Failed Switch | | |
| | Source Blocks | Sink Blocks | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 to 24 V dc | 0 to 8 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 38 to 48 V dc | 0 to 16 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 to 7 V dc | 17 to 24 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 to 14 V dc | 34 to 48 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.6K ohms (24/48 V), 1.8K ohms (24 V) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.7 mSec (plus selectable filter delay) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 to 100 mSec | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Open wire, Overtemperature, Failed Switch | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 3. 6240B 16 Circuit dc Sink and Source I/O Block Specifications

| Characteristics | Specifications |
|--|--|
| Output Characteristics: Output Current (Steady State): Maximum Inrush Current: Block Output Current: Output OFF Leakage Current: Maximum Switching Frequency: Output Turn-on Delay (maximum): Output Voltage Drop: Minimum Recommended Load: Output Diagnostics: | 2 amps per circuit 10 amps up to 10 mSec 15 amps at 35° C 1.0 mA Once per second (high inrush current) 1 mSec 2.0 V maximum at 2 amps inrush 50 mA with No Load enabled Short Circuit, Overload, No Load, Failed Switch, Overtemperature |
| <u>Catalog Number Information</u> 6240BP10411 6240BP10421 6240BP10431 6240BP10412 6240BP10422 6240BP10432 6240BP10811 6240BP10821 6240BP10831 6240BP10812 6240BP10822 6240BP10832 | <u>Description</u> 24 V dc, Source (Complete Unit) 24 V dc, Source (Electronics Assembly Only) 24 V dc, Source (Terminal Assembly Only) 24 V dc, Sink (Complete Unit) 24 V dc, Sink (Electronics Assembly Only) 24 V dc, Sink (Terminal Assembly Only) 24/48 V dc, Source (Complete Unit) 24/48 V dc, Source (Electronics Assembly Only) 24/48 V dc, Source (Terminal Assembly Only) 24/48 V dc, Sink (Complete Unit) 24/48 V dc, Sink (Electronics Assembly Only) 24/48 V dc, Sink (Terminal Assembly Only) |

6241B 32 Circuit dc Source and Sink I/O Blocks

The 6241B 32 Circuit dc Source and Sink I/O Blocks are compatible with a wide range of input devices, including both 2-wire and 3-wire electronic proximity switches. Outputs can be low-power control and indicating devices such as relays, contactors, and lamps. Two models of the 32 circuit block are available: the 12/24 V dc Source block provides current to field output devices. The 5/12/24 V dc Sink block receives current from field output devices. Both versions operate at a nominal 12 to 24 V dc. The Sink version is also +5 V TTL-compatible when operated from a 5 V supply with a jumper connected between terminals 5 and 7. When operating from a 5 V supply, the acceptable voltage at the block power supply terminals is between 4.9 and 5.3 V.

These blocks have 32 identical discrete I/O circuits, each of which you can configure as an input or output. Each circuit contains built-in protection when used as an output, protecting the driver while allowing short-time surges. The circuit is also protected against shorted loads caused by wiring errors.

The block sends discrete signals to the controller. For example, if circuit 1 is an input, the controller receives a 1 when current is flowing and a 0 when current is not flowing. Similarly, the controller sends a 1 to an output circuit to cause current to flow and a 0 for no current flow.

For both Sources and Sinks, you can connect output circuits directly to input circuits on the same block without using other components or inverting the logic states. Direct connections between blocks and externally powered equipment including other blocks, should only be made if the design of the system prevents a failure or loss of power from adversely or unsafely affecting I/O points. When an output of a Sink block is connected to an input of a Sink block, a logic 1 command to the output turns the output ON and produces a logic 1 through the input.

Block LEDs verify proper block operation and communications. Individual circuit LEDs indicate voltage present on inputs and outputs.

Field Bus and Block Power Wiring

Terminals 1 through 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus or BSM.

I/O Channel Wiring for the Source I/O Block

A Source block provides current to field output devices. It operates at a nominal 12 to 24 V dc. A Source block has all output devices connected between the channel terminal and the negative (-) side of the power supply. Input devices are connected between the positive (+) side of the power supply and the channel terminal as shown in [Figure 34](#).

All channel and power terminals can take one AWG #14 wire. As [Figure 34](#) shows, terminals 5 through 9 are for positive dc and terminals 42 through 46 are for negative dc.

Terminals 10 through 41 are for the I/O channels, with terminal 10 being channel 1. You can wire a channel for either input or output. You specify your choice to the system during the software configuration.

If the block is a BSM Controller, it requires a low voltage (24/48 V) BSM and the block must be set up with a 24 V power supply. The BSM must be wired between terminal 10 and one of the negative dc terminals as an output on channel 1.

You can also connect proximity switches of the appropriate type to this module. The wiring is shown in [Figure 35](#).

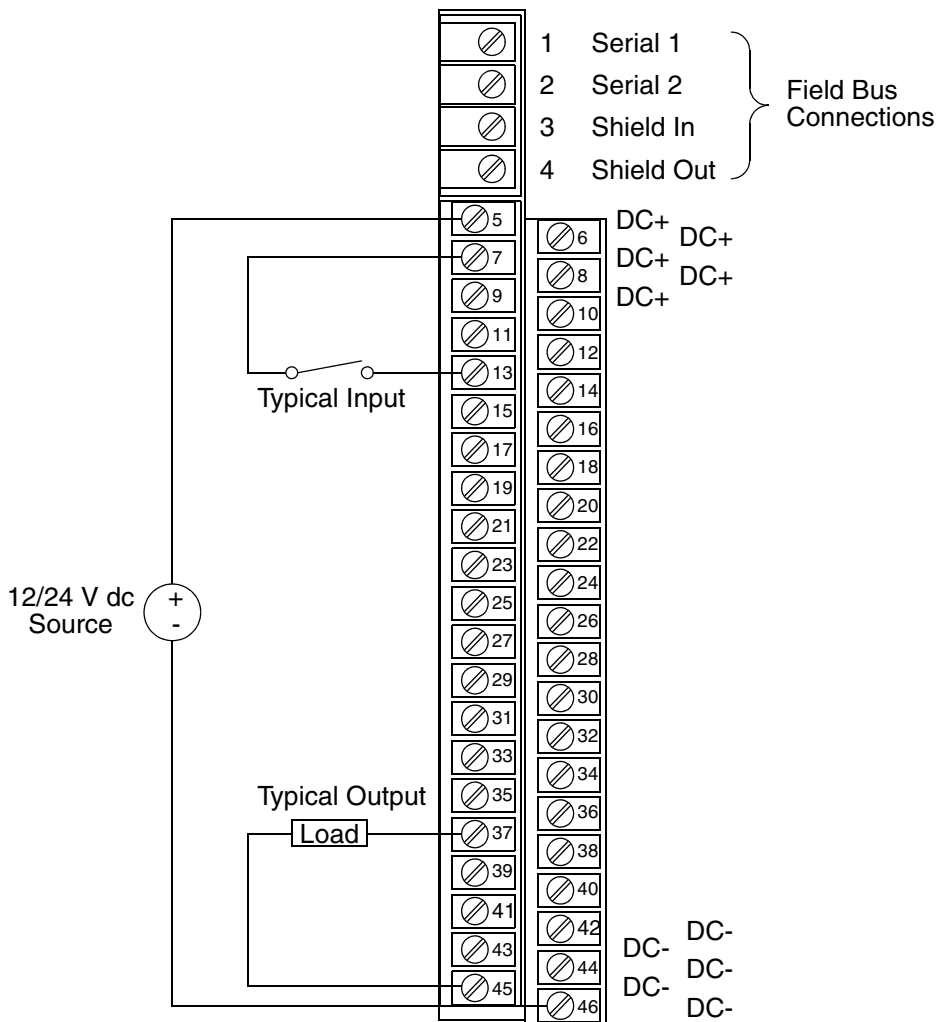


Figure 34. Terminal Connections for a 6241B 32 Circuit dc Source I/O Block

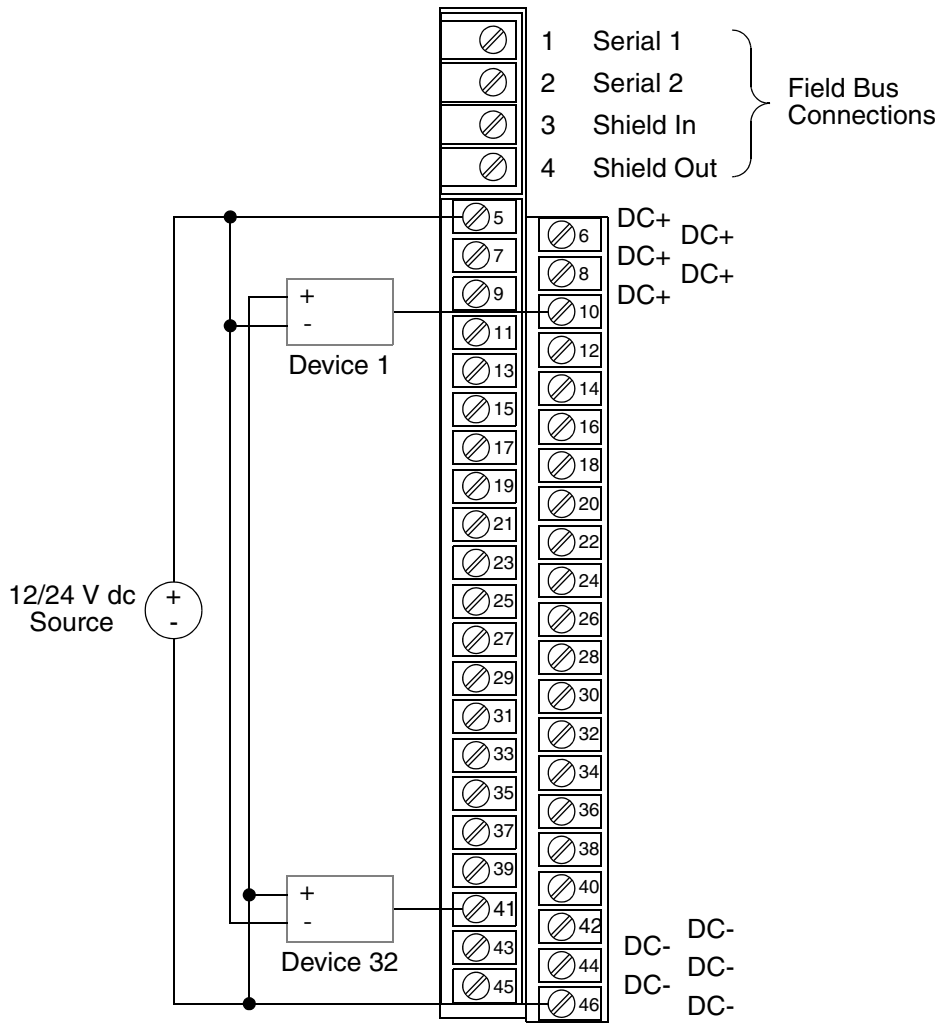


Figure 35. Terminal Connections for Proximity Switches Attached to a 6241B 32 Channel dc Source I/O Block

Figure 36 shows the internal circuits of a the 6241B 32 Circuit dc Source I/O Block

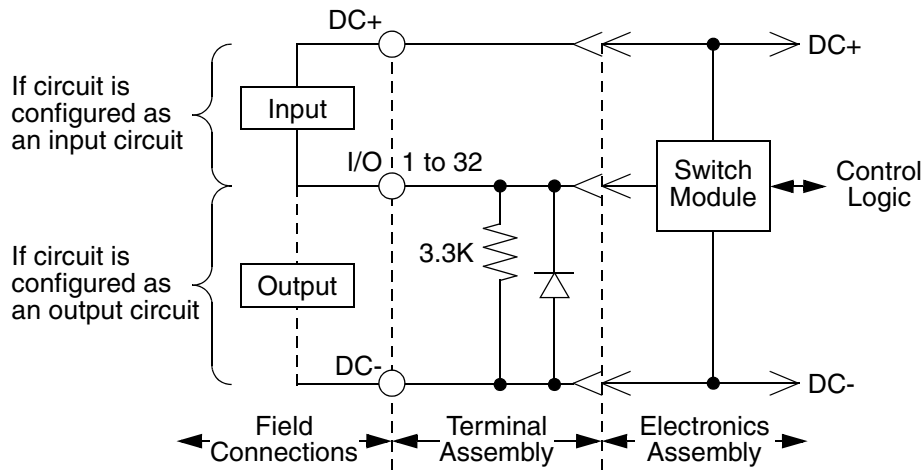


Figure 36. 6241B 32 Circuit dc Source I/O Block Internal Circuits

I/O Channel Wiring for the Sink I/O Block

A Sink block provides current to field output devices. It operates at a nominal 12 to 24 V dc. A Sink block has all output devices connected between the channel terminal and the positive (+) side of the power supply. Input devices are connected between the negative (-) side of the power supply and the channel terminal. It can operate at a nominal 12 to 24 V dc or to make it TTL compatible, it can operate from a +5 V source if a jumper is connected between terminals 5 and 6. When operating from a 5 V supply, the acceptable voltage at the block power supply terminals is between 4.9 and 5.3 V. Figure 37 and Figure 38 show the two configurations.

All channel and power terminals can take one AWG #14 wire. As Figure 37 shows, for 24 V applications, terminals 6 through 9 are for positive dc and terminals 42 through 46 are for negative dc. Do not use terminal 5 for 12 to 24 V applications.

For TTL applications attach a jumper from terminal 5 to terminal 6 and use an appropriate 5 V power supply.

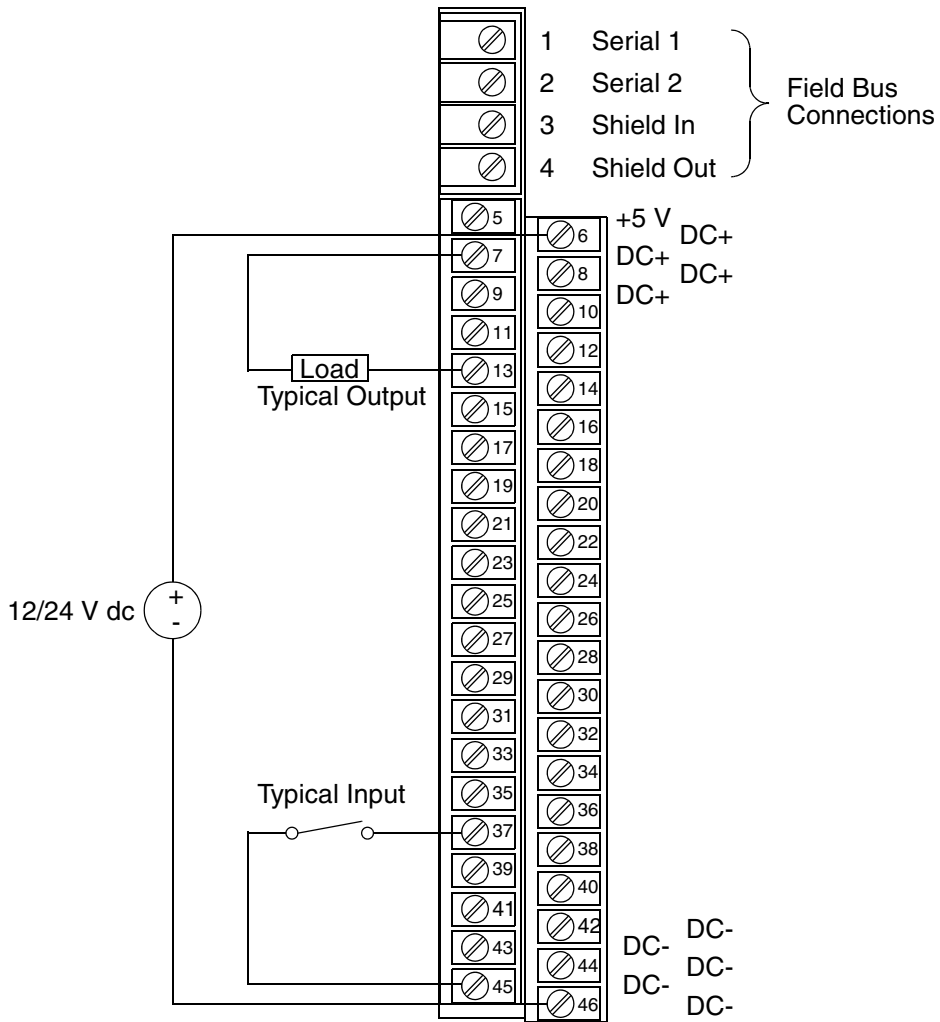


Figure 37. Terminal Connections for a 6241B 32 Circuit dc Sink I/O Block

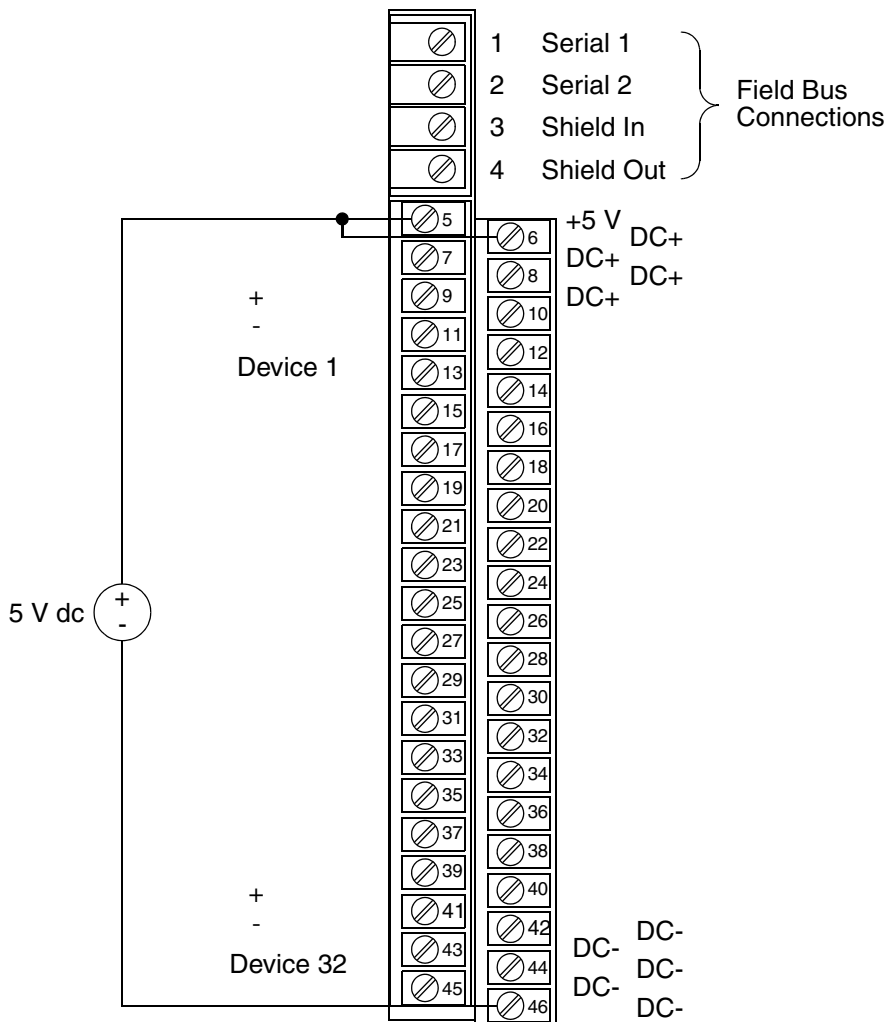


Figure 38. Power Connections for a 6241B 32 Circuit dc Sink I/O Block used for TTL Applications

Terminals 10 through 41 are for the I/O channels, with terminal 10 being channel 1. You can wire a channel for either input or output. You specify your choice to the system during the software configuration. The blocks have standard diagnostics for the input and output circuits as described in [TRIO Configuration, Block Diagnostics](#). They should be considered prior to planning the I/O circuits for the block.

If the block is a BSM Controller, it requires a low voltage (24/48 V) BSM and the block must be set up with a 24 V power supply. The BSM must be wired between terminal 11 and one of the positive dc terminals as an output for channel 1. You can use the other 31 channels in the normal manner.

You can also connect proximity switches of the appropriate type to this module. The wiring is the same as for the 6241B 32 Circuit dc Source I/O Block shown in [Figure 35](#).

[Figure 39](#) shows the internal circuitry of the 6241B 32 Circuit dc Sink I/O Block.

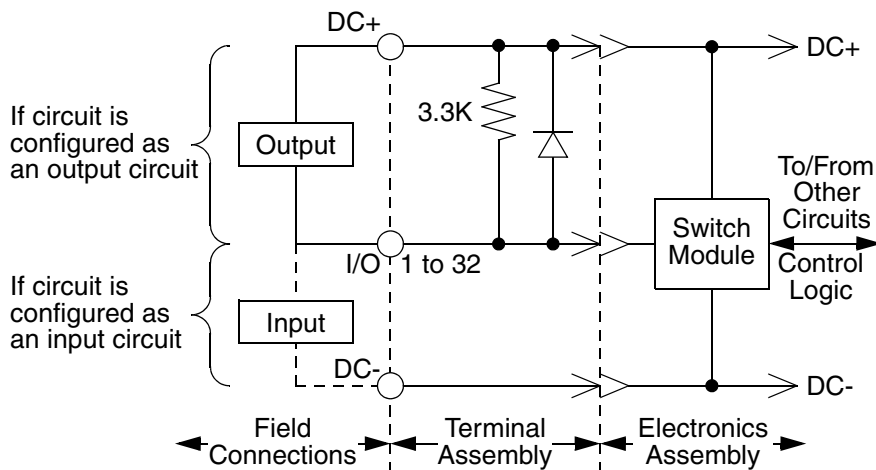


Figure 39. 6241B 32 Circuit dc Sink I/O Block Internal Circuits

6241B 32 Circuit dc Source and Sink I/O Block Specifications

Table 4. 6241B 32 Circuit dc Source and Sink I/O Block Specifications

| Characteristics | Specifications | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|---------------|---------------|-------------|----------------|----------------|---------------|--------------|--------------|-------------|---------------|---------------|-------------|----------------|----------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|------------|------------|--|---|---|--|---|---|--|
| Physical Characteristics: Block Type: Operating Voltage (Single Source): Ripple (Maximum): Required dc Power: Power Supply Dropout Times: LEDs (I/O Block): LEDs (Each Circuit): Block to Block Isolation: Insulation Resistance: Terminal Wiring: Weight: Heat Dissipation: | 32 circuit discrete input and output 10 to 30 V dc (12/24 V supply) 4.75 to 5.25 V dc (5 V supply) (Sink model only) 10% (12/24 V) / 1% (5 V) 150 mA typical/300 mA maximum 4 mSec at 12 V / 20 mSec at 24 V Unit OK, I/O Enabled Individual logic side indicators 1500 V 2.2 Megohms minimum One AWG #14 wire per terminal 4 lbs. (1.8 Kg) 11 Watts minimum with 8 inputs. 18 Watts maximum with 32 outputs at .5 amp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Environmental: Operating Temperature: Storage Temperature: Humidity: | 0° C to +60° C (32° F to +140° F) -40° C to +100° C (-40° F to +212° F) 5% to 95% (non-condensing) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input Characteristics: Input Voltage Relative to (dc-) Input ON 5 V dc Supply: 12 V dc Supply: 24 V dc Supply: Input OFF 5 V dc Supply: 12 V dc Supply: 24 V dc supply: Input Impedance (Typical): Input Processing Time (Typical): Selectable Input Filter Times: | <table border="0"> <thead> <tr> <th></th> <th>Source Blocks</th> <th>Sink Blocks</th> </tr> </thead> <tbody> <tr> <td>not applicable</td> <td>not applicable</td> <td>0 to 0.8 V dc</td> </tr> <tr> <td>8 to 12 V dc</td> <td>8 to 12 V dc</td> <td>0 to 4 V dc</td> </tr> <tr> <td>18 to 24 V dc</td> <td>18 to 24 V dc</td> <td>0 to 6 V dc</td> </tr> <tr> <td>not applicable</td> <td>not applicable</td> <td>2 to 5 V dc</td> </tr> <tr> <td>0 to 6 V dc</td> <td>0 to 6 V dc</td> <td>7 to 12 V dc</td> </tr> <tr> <td>0 to 12 V dc</td> <td>0 to 12 V dc</td> <td>12 to 24 V dc</td> </tr> <tr> <td>3.3 K ohms</td> <td colspan="2">3.3 K ohms</td> </tr> <tr> <td>1.0 mSec (plus selectable filter delay)</td> <td colspan="2">1.0 mSec (plus selectable filter delay)</td> </tr> <tr> <td>1/2/3/4/5/10/20/30/40/50/60/70/80/90/100 mSec</td> <td colspan="2">1/2/3/4/5/10/20/30/40/50/60/70/80/90/100 mSec</td> </tr> </tbody> </table> | | Source Blocks | Sink Blocks | not applicable | not applicable | 0 to 0.8 V dc | 8 to 12 V dc | 8 to 12 V dc | 0 to 4 V dc | 18 to 24 V dc | 18 to 24 V dc | 0 to 6 V dc | not applicable | not applicable | 2 to 5 V dc | 0 to 6 V dc | 0 to 6 V dc | 7 to 12 V dc | 0 to 12 V dc | 0 to 12 V dc | 12 to 24 V dc | 3.3 K ohms | 3.3 K ohms | | 1.0 mSec (plus selectable filter delay) | 1.0 mSec (plus selectable filter delay) | | 1/2/3/4/5/10/20/30/40/50/60/70/80/90/100 mSec | 1/2/3/4/5/10/20/30/40/50/60/70/80/90/100 mSec | |
| | Source Blocks | Sink Blocks | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| not applicable | not applicable | 0 to 0.8 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 to 12 V dc | 8 to 12 V dc | 0 to 4 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 to 24 V dc | 18 to 24 V dc | 0 to 6 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| not applicable | not applicable | 2 to 5 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 to 6 V dc | 0 to 6 V dc | 7 to 12 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 to 12 V dc | 0 to 12 V dc | 12 to 24 V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 K ohms | 3.3 K ohms | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.0 mSec (plus selectable filter delay) | 1.0 mSec (plus selectable filter delay) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/2/3/4/5/10/20/30/40/50/60/70/80/90/100 mSec | 1/2/3/4/5/10/20/30/40/50/60/70/80/90/100 mSec | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 4. 6241B 32 Circuit dc Source and Sink I/O Block Specifications

| Characteristics | Specifications |
|--|--|
| Output Characteristics: Output Current (Steady State): Maximum Inrush Current: Maximum Circuit Overcurrent Threshold: Block Output Current (Total): Output OFF Leakage Current (Maximum): Maximum Switching Frequency: Output Turn-on Delay (Maximum): Output Voltage Drop: Output Diagnostics: | 0.5 amps per circuit 4 amps up to 10 mSec 5 amps 16 amps 10 μ A once every 0.5 second at 3% duty cycle 4 amp inrush current 0.5 mSec 2.0 V maximum at 4 amps inrush Switch Fault |
| <u>Catalog Number Information</u> 6241BP10411 6241BP10421 6241BP10431 6241BP10812 6241BP10822 6241BP10832 | <u>Description</u> 12/24 V dc, Source (Complete Unit) 12/24 V dc, Source (Electronics Assembly Only) 12/24 V dc, Source (Terminal Assembly Only) 5/12/24 V dc, Sink (Complete Unit) 5/12/24 V dc, Sink (Electronics Assembly Only) 5/12/24 V dc, Sink (Terminal Assembly Only) |

6244B 115 V ac 8 Circuit Grouped¹ and 6245B 115 V ac Low Leakage 8 Circuit Grouped I/O Blocks

The 6244B 115 V ac 8 Circuit Grouped Block and 6245B 115 V ac Low-Leakage 8 Circuit Grouped Block interface to discrete ac input sensors and actuators. The low-leakage version is designed to control loads drawing low current without added resistance at the load. Each block has eight circuits that are rated to operate at a nominal 115 V ac.

The block exchanges discrete signals with the controller. For example, if circuit 1 is an input, the controller receives a 1 when current is flowing and a 0 when current is not flowing. Similarly, the controller sends a 1 to an output circuit to cause current to flow and a 0 for no current flow.

Field Bus and Block Power Wiring

Terminals 1 through 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus or BSM.

As [Figure 40](#) shows, you can connect the hot connector of the ac power supply to terminals 5 through 9 and connect the neutral to terminals 18 through 22. These terminals can take one AWG #12 or two AWG #14 wires. Power comes from the same source that supplies the field I/O.

I/O Channel Wiring

Terminals 10 through 17 are used for the 8 I/O channels with terminal 10 being channel 1. You can wire a channel for either input or output. You specify your choice to the system during software configuration. The terminals can take one AWG #12 or two AWG #14 wires. Connections should be made as shown in [Figure 40](#).

1. The 6244B 115 V ac 8 Circuit Grouped I/O Block is no longer available from the manufacturer and has been replaced by the 6245B 115 V ac Low Leakage 8 Circuit Grouped I/O Block. Information for the 6244B 115 V ac 8 Circuit Grouped I/O Block is provided in this document for those still being used in the field.

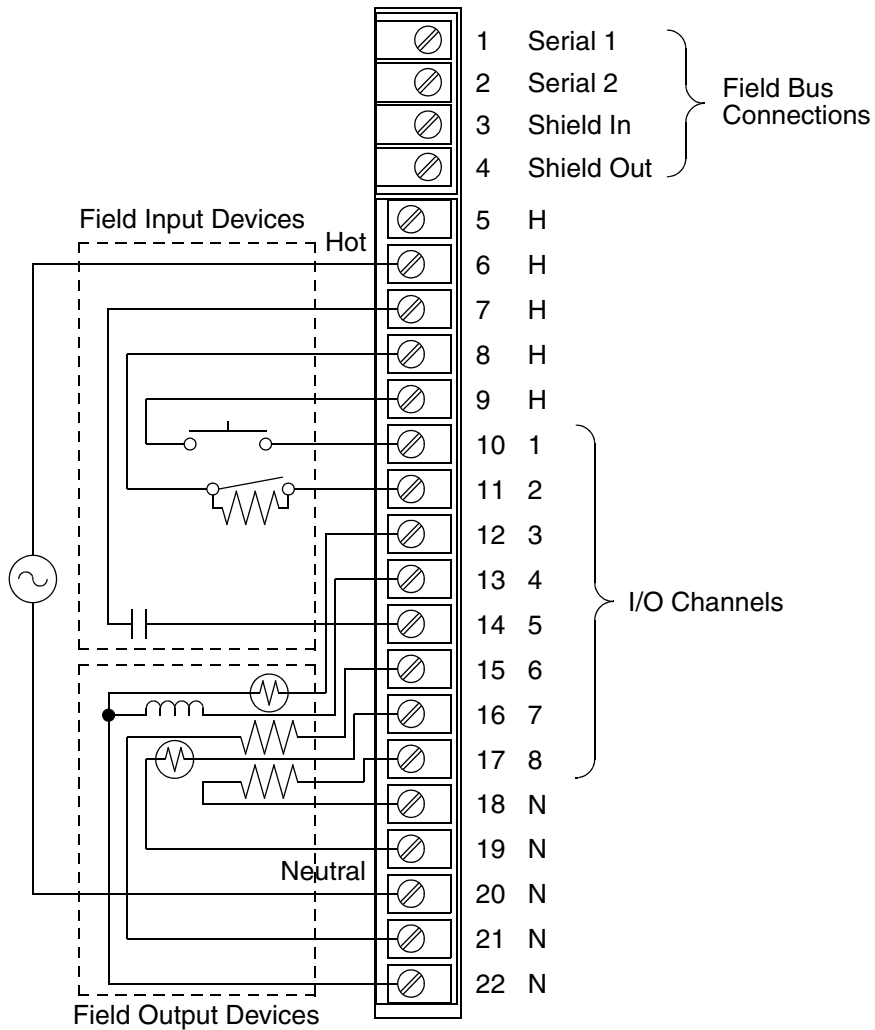


Figure 40. Terminal Connections for the 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Blocks

You can make hot and neutral connections at the I/O block or bussed at field devices depending on the I/O location. In any scenario, hot and neutral for the field devices must be the same as used by the block.

The blocks have comprehensive diagnostics for the input and output circuits. These diagnostics are described in *800xA for TRIO/Genius (3BUR002460*)*. They should be considered prior to planning the I/O for the block. In particular, if the Open Wire diagnostic is used, a 5.1K ohm, 1/2 Watt or larger non-inductive resistor must be installed across the input contacts as shown by channel 2 in [Figure 40](#).

If this block is used as a BSM Controller, it requires a high voltage (115 V ac/125 V dc) BSM. The BSM must be wired between terminals 10 and one of the N terminals as an output for channel 1. You can use the other 7 channels in the normal manner.

The 6245B 115 V ac Low-Leakage 8 Circuit Grouped I/O Block is designed to interface to small loads without added resistance at the load. Information on connecting small loads to the 6244B Block is provided in [Interfacing Small Loads to Discrete Blocks](#) on page 116.

[Figure 41](#) show the internal circuits of the 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Blocks.

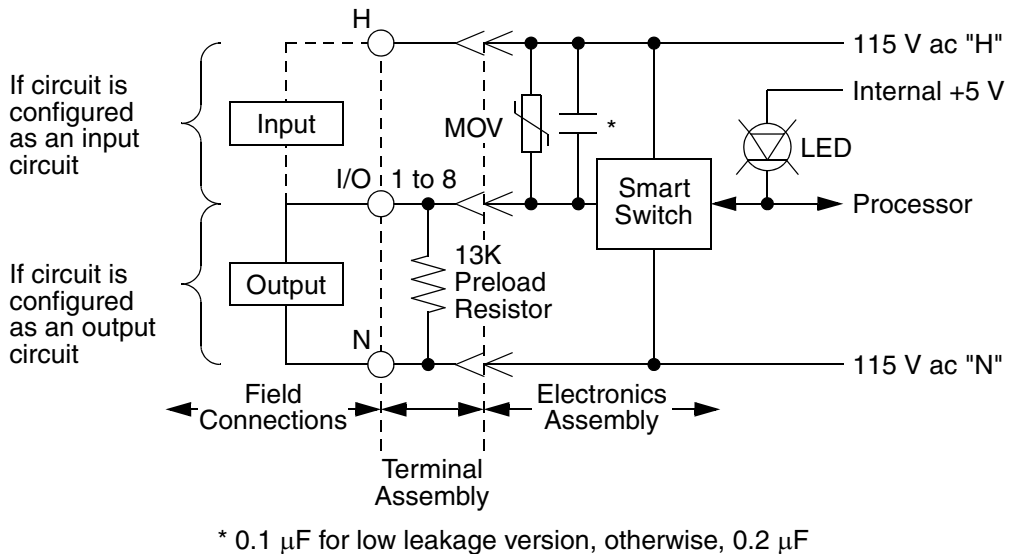


Figure 41. 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Block Internal Circuits

6244B and 6245B 115 V ac 8 Circuit Grouped I/O Block Specifications

Table 5. 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Block Specifications

| Characteristics | Specifications |
|--|--|
| Physical Characteristics: Block Type: Standby Power (All I/O Off): LEDs (I/O Block): LEDs (Each Circuit): Block to Block Isolation: Insulation Resistance: Terminal Wiring: Weight: Heat Dissipation: Operating Voltage (Single Source): Frequency: Power Supply Dropout Time: | 8 circuit combination input and output 12 Watts (Low Leakage Version: 8.5 Watts) Unit OK, I/O Enabled On logic side of switch 1500 V 2.2 Megohms minimum One AWG #12 or two AWG #14 4 lbs. (1.8 kg) 4.8 W minimum with 8 inputs. 43.5 W maximum with 8 outputs on at 2 amps. 93 to 132 V ac 47 to 63 Hz 1 cycle (17.7 mSec at 60 Hz, 20 mSec at 50 Hz) |
| Environmental: Operating Temperature: Storage Temperature: Humidity: Vibration: | 0° to +60° C (32° to +140° F) -40° to +100° C (-40° to +212° F) 5% to 95% (non-condensing) 5 to 10 Hz 0.2" displacement 10 to 200 Hz at 1G |

Table 5. 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Block Specifications

| Characteristics | Specifications | |
|---|---|----------------|
| Input Characteristics: | 8 Circuit Grouped Low Leakage Version | |
| Non Tri-state Input, OFF State: | | |
| Minimum Voltage Across Input Device (IN to H): | 60 V RMS | 60 V RMS |
| Maximum Leakage Through Input Device: | 1 mA | 1.5 mA |
| Non Tri-state Input, ON State: | | |
| Minimum Voltage Across Input Device (IN to H): | 20 V RMS | 20 V RMS |
| Maximum Switch Current Threshold: | 6 mA RMS | 6 mA RMS |
| Tri-state Input, OFF State: | | |
| Acceptable Voltage Across Input Device (IN to H): | 16 to 40 V RMS | 16 to 40 V RMS |
| Tri-state Input, ON State: | | |
| Maximum Voltage Across Input Device (IN to H): | 4 V RMS | 4 V RMS |
| Input Load Network: | | |
| Resistor to "N": | 13K ohms | 13K ohms |
| Capacitor to "H": | .22 mfd | .10 mfd |
| Input Processing Time (Typical): | 2 mSec + filter | |
| Selectable Input Filter Times: | 10 to 100 mSec in 10 mSec increments | |
| Input Diagnostics: | Open wire, Overtemperature, Failed Switch | |

Table 5. 6244B and 6245B 115 V ac 8 Circuit Grouped I/O Block Specifications

| Characteristics | Specifications | |
|---|---|----------------|
| Output Characteristics: | 8 Circuit Grouped Low Leakage Version | |
| Circuit Output Current (Steady State): | 2 amps RMS | 2 amps RMS |
| Maximum Inrush Current up to 2 Cycles: | 30 amps peak | 30 amps peak |
| Maximum Inrush Current 2-6 Cycles: | 20 amps peak | 20 amps peak |
| Maximum Block Output Current: | 15 amps maximum per block at 35° C 7.5 amps maximum per block at 60° C | |
| Output Leakage at V ac: | | |
| Current at 0 volt Output (OUT to N): | < 13 mA | < 7 mA |
| Voltage at Open Output (OUT to N): | 95 V | 65 V |
| Output Switch (OFF to ON/ON to OFF): | Zero crossing | Zero crossing |
| Maximum Switching Frequency: | Once per second (high inrush currents) | |
| Turn-on Delay (Maximum): | 0.5 Hz + 1 mSec | 0.5 Hz +1 mSec |
| Voltage Drop (at 2 amps): | 2.5 V | 2.5 V |
| Voltage Drop (at 30 amps inrush): | 10 V | 10 V |
| Recommended Minimum Load, Resistive (No Load disabled): | 30 mA | 25 mA |
| Recommended Minimum Load, Inductive (No Load disabled): | 100 mA | 40 mA |
| No Load Enabled Threshold: | 50 mA | 50 mA |
| Fusing: | Internal electronic short circuit trip. 100 mSec long time trip. | |
| Output Diagnostics: | Short Circuit, Overload, No Load, Failed Switch, Overtemperature | |
| <u>Catalog Number Information</u> | <u>Description</u> | |
| 6245BP10710 | 115 V ac, 50/60 Hz/125 V dc Low Leakage (Complete Unit) | |
| 6245BP10720 | 115 V ac, 50/60 Hz/125 V dc, Low Leakage (Electronics Assembly Only) | |
| 6245BP10730 | 115 V ac, 50/60 Hz/125 V dc, Low Leakage (Terminal Assembly Only) | |

6246B 115 V ac/125 V dc Isolated I/O Block

The 6246B 115 V ac/125 V dc Isolated I/O Block interfaces to discrete ac and dc sensors and actuators. The block, [Figure 42](#), has four isolated groups of two I/O circuits, each rated to operate at a nominal 115 V ac or 125 V dc. You can configure each circuit as an input, output, or tri-state input.

The block sends discrete signals to the controller. For example, if circuit 1 is an input, the controller receives a 1 when current is flowing and a 0 when current is not flowing. Similarly, the controller sends a 1 to an output circuit to cause current to flow and a 0 for no current flow.

Field and Block Power Wiring

Terminals 1 through 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus or BSM.

As [Figure 42](#) shows, either ac or dc power for the block is brought into terminals 5 and 6. These terminals can take one AWG #12 or two AWG #14 wires.

I/O Channel Wiring

The I/O channels are divided into groups of two. Each group has separate control power terminals for a 115 V ac or 125 V dc power source for the internal electronics. Isolation is rated at 250 V ac or dc continuous between any I/O group and ground, or between any two groups. The transient isolation rating is 2000 volts peak for 10 seconds. If separate power is used for a group of circuits on a block, all power connections within the group must be wired to that source. The separate I/O circuits can be combined into fewer groups, if desired, by jumpering I/O power H and N terminals on the Terminal Assembly. Circuits on a block must be either all ac or all dc. The block power does not have to be the same type (ac or dc) as the power for the I/O circuits.

You can wire a channel for either input or output. You specify your choice to the system during the software configuration. The I/O terminals can take one AWG #12 or two AWG #14 wires.

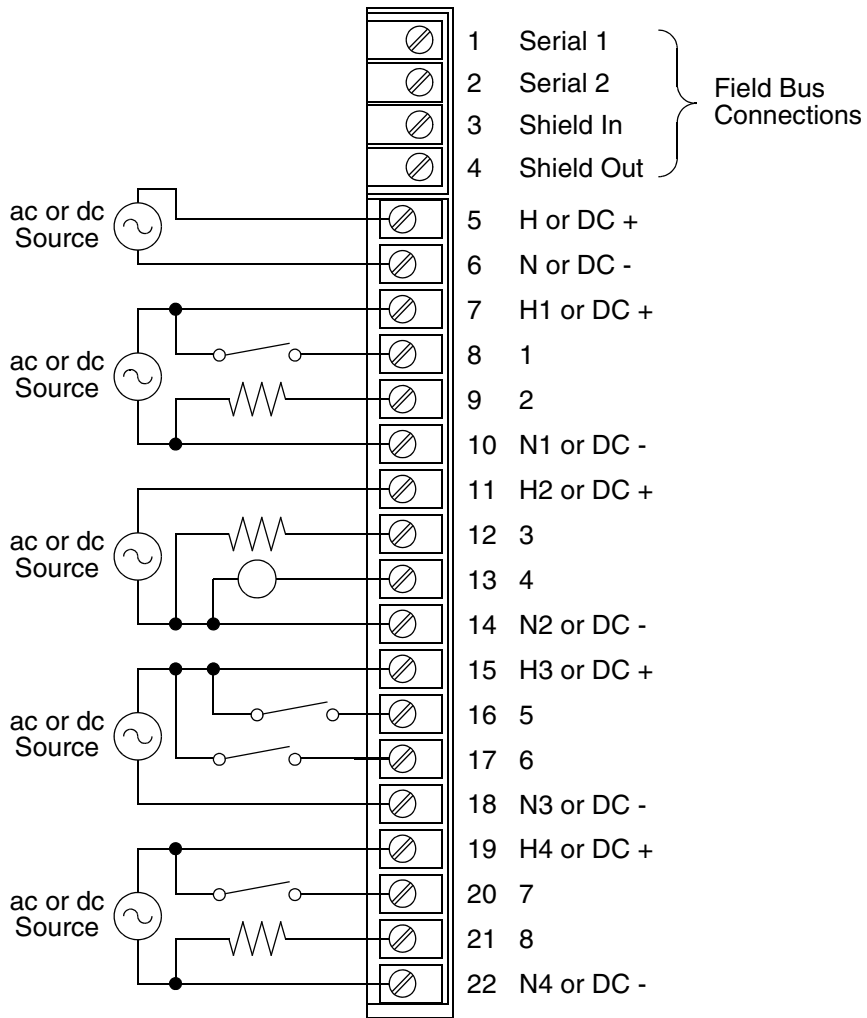


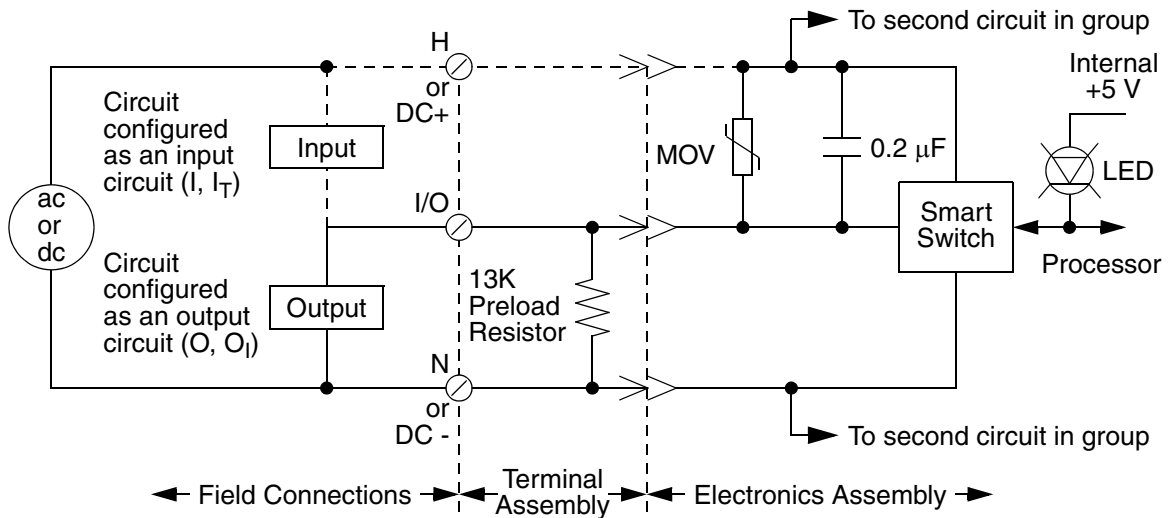
Figure 42. Terminal Connections for the 6246B 115 V ac/125 V dc Isolated I/O Block

If an input channel is to use the Open Wire diagnostic, it must have a 5.1 K ohm, 1/2 watt or larger non-inductive resistor installed across the dry contacts of the input device.

Each circuit has its own LED indicator, driven from the logic side. Block power (terminals 5 and 6) plus I/O circuit power (H, N) must be applied for these LEDs to operate. For an input circuit, the LED reflects the status of the voltage at the circuit terminal. For an output, the LED reflects the commanded output state of the Smart Switch on the logic side.

If the block is used as a BSM Controller, it requires a high voltage (115 V ac/125 V dc) BSM. The BSM must be wired between terminals 8 and 10 as an output for channel 1. You can use the other 7 channels in the normal manner.

Figure 43 shows the internal circuitry of the 6246B 115 V ac/125 V dc Isolated I/O Block.



Note: Internal 13K Preload resistor is not disconnected when Electronics Assembly section is removed.

Figure 43. 6246B 115 V ac/125 V dc Isolated I/O Block Internal Circuits

6246B 115 V ac/125 V dc Isolated I/O Block Specifications

Table 6. 6246B 115 V ac/125 V dc Isolated I/O Block Specifications

| Characteristics | Specifications |
|---|--|
| Physical Characteristics: Block Type: Required Control Power (Block Only): LEDs (I/O Block): LEDs (Each Circuit): Block to Block Isolation: Insulation Resistance: Terminal Wiring: Weight: Heat Dissipation: Operating Voltage (Four Sources): Frequency: Power Supply Dropout Time: | 8 circuit isolated input/output in 4 isolated pairs 8 Watts maximum Unit OK, I/O Enabled On logic side of switch 1500 V 2.2 Megohms minimum One AWG #12 or two AWG #14 4 lbs. (1.8 kg) 17.8 W minimum with 8 inputs. 45.6 W maximum with 8 outputs at 2 amps. 93 to 132 V ac/105 to 140 V dc 47 to 63 Hz 10% max. ripple 1 cycle 10 mSec |
| Environmental: Operating Temperature: Storage Temperature: Humidity: Vibration: | 0° to +60° C (32° to +140° F) -40° to +100° C (-40° to +212° F) 5% to 95% (non-condensing) 5 to 10 Hz 0.2" displacement 10-200 Hz at 1G |

Table 6. 6246B 115 V ac/125 V dc Isolated I/O Block Specifications

| Characteristics | Specifications | |
|---|--|------------------|
| Input Characteristics: | ac | dc |
| Non Tri-state Input, OFF State: | | |
| Minimum Voltage Across Input Device (IN to H): | 60 V RMS | 70 V dc |
| Maximum Leakage Through Input Device: | 1 mA | 2 mA |
| Non Tri-state Input, ON State: | | |
| Minimum Voltage Across Input Device (IN to H): | 20 V RMS | 35 V dc |
| Maximum Switch Current Threshold: | 6 mA RMS | 5 mA V dc |
| Tri-state Input, OFF State: | | |
| Acceptable Voltage Across Input Device (IN to H): | 16 to 40 V RMS | 16 to 35 V dc |
| Tri-state Input, ON State: | | |
| Maximum Voltage Across Input Device (IN to H): | <4 V RMS | <3.5 V RMS |
| Input Load Network: | | |
| Resistor to "N": | 13K ohms | 13K ohms |
| Capacitor to "H": | .22 MFD | .22 MFD |
| Input Processing Time (Typical): | 2 mSec + filter | 0.8 mSec +filter |
| Selectable Input Filter Times: | 10 to 100 mSec in 10 mSec increments | |
| Input Diagnostics: | Open Wire, Overtemperature, Loss of I/O Power, Failed Switch | |

Table 6. 6246B 115 V ac/125 V dc Isolated I/O Block Specifications

| Characteristics | Specifications | |
|---|---|-------------------------------------|
| Output Characteristics: | <u>ac</u> | <u>dc</u> |
| Circuit Output Current (Steady State): | 2 amps | 2 amps resistive (*1 amp inductive) |
| Maximum Inrush Current: | 25 amps (2 cycles) | 25 amps (10 mSec peak) |
| Maximum Block Output Current: | 15 amps maximum per block at 35° C 7.5 amps maximum per block at 60° C | |
| Output Leakage: | | |
| Current at 0 Volt Output: | 7 mA (Model C) 13 mA (Model B) | 2 mA |
| Voltage at Open Output: | 95 V | 40 V |
| Output Switch(OFF to ON/ON to OFF): | Zero crossing | ----- |
| Maximum Switching Frequency: | Once per second | Once per second |
| Turn-on Delay (Maximum): | 0.5 Hz + 1 mSec | 1 mSec |
| Voltage Drop (at 2 amps): | 2.5 V | 2.5 V |
| Voltage Drop (at 20 amps inrush): | 10 V | 10 V |
| Recommended Minimum Load, (No Load Disabled): | 100 mA | 10 mA |
| No Load Enabled Threshold: | 50 mA | 50 mA |
| Fusing: | Internal electronic short circuit trip. 100 mSec (ac), 10 mSec (dc) long time trip. | |
| Output Diagnostics: | Short Circuit, Overload, No Load, Failed Switch, Overtemperature, Loss of I/O Power | |
| *dc inductive load rating is 2 amps with external flyback diode or other coil suppression | | |
| <u>Catalog Number Information</u> | <u>Description</u> | |
| 6246BP10810 | 115 V ac/125 V dc (Complete Unit with Failed Switch Diagnostic) | |
| 6246BP10811 | 115 V ac/125 V dc (Complete Unit without Failed Switch Diagnostic) | |
| 6246BP10820 | 115 V ac/125 V dc (Electronics Assembly Only with Failed Switch Diagnostic) | |
| 6246BP10821 | 115 V ac/125 V dc (Electronics Assembly Only without Failed Switch Diagnostic) | |
| 6246BP10830 | 115 V ac/125 V dc (Terminal Assembly Only) | |

6247B 115 V ac 16 Circuit Input Block

The 6247B 115 V ac 16 Circuit Input Block provides an interface to 115V ac discrete input sensors. The block has 16 discrete input circuits in two banks of eight circuits. Typical inputs are contact closures from switches, push buttons, or limit switches. The block is compatible with both 2-wire and 3-wire proximity switch inputs. Control power for the block comes from the power line supplying the inputs. Two LEDs show the status of the block, and there is one LED for each I/O circuit.

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 V.

The block sends discrete signals to the controller. For example, for each circuit, the controller receives a 1 when current is flowing and a 0 when current is not flowing.

Field Bus and Block Power Wiring

Terminals 1 through 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

As [Figure 44](#) shows, ac hot is connected to terminals 5 to 14. You connect ac neutral to terminals 31 or 32. These terminals can take from AWG #22 to AWG #14 wire.

Fusing between the power supply and the block should not exceed 5 amps. Do not daisy chain the power bus to other blocks via 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.

Input Channel Wiring

Terminals 15 through 30 are for the input channels, with terminal 15 being channel 1. The Open Detect and the Short Circuit Detect diagnostics can be used for the inputs if the proper resistors are added to the input devices. These diagnostics and the required resistors are described in *800xA for TRIO/Genius (3BUR002460*)*.

The block cannot be used as a BSM Controller.

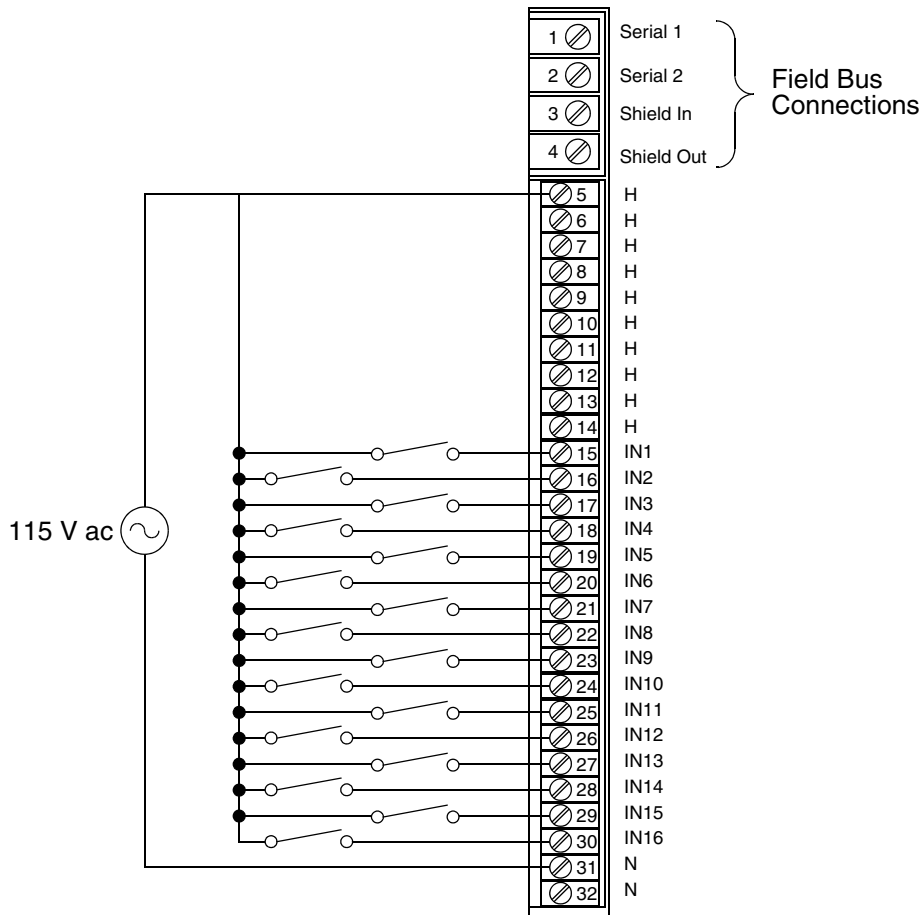


Figure 44. Terminal Connections for the 6247B 115 V ac 16 Circuit Input Block

Figure 45 shows the internal circuits for the 6247B 115 V ac 16 Circuit Input Block.

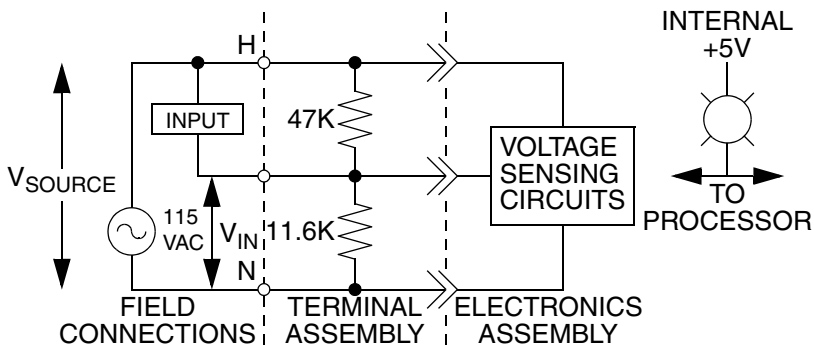


Figure 45. 6247B 115 V ac 16 Circuit Input Block Internal Circuits

6247B 115 V ac 16 Circuit Input Block Specifications

Table 7. 6247B 115 V ac 16 Circuit Input Block Specifications

| Characteristics | Specifications |
|------------------------------|--|
| Physical Characteristics: | |
| Block Type: | 16 circuits, inputs only |
| Required Power (Block Only): | 80 mA maximum block current, plus 200 mA maximum input circuit current |
| Power Supply Dropout Time: | 1 cycle (17.7 mSec at 60 Hz/20 mSec at 50Hz) |
| Operating Voltage: | 93 to 132 V ac |
| Frequency: | 47 to 63 Hz |
| LEDs (I/O Block): | Unit OK, I/O Enabled |
| LEDs (Each Circuit): | Reflect state of input (logic side) |
| Block to Block Isolation: | 1500 V |
| Insulation Resistance: | 2.2 Megohms minimum |
| Terminal Wiring: | |
| Terminals 1 to 4: | One AWG #12 or two AWG #14 |
| Terminals 5 to 32: | AWG #22 to AWG #14 |
| Weight: | 4 lbs. (1.8 Kg) |
| Heat Dissipation: | 28 Watts maximum with 16 inputs on at full current |

Table 7. 6247B 115 V ac 16 Circuit Input Block Specifications

| Characteristics | Specifications |
|--|--|
| Environmental: Operating Temperature: Storage Temperature: Humidity: Vibration: | -25° C to +60° C (-13° F to +140° F) -40° C to +100° C (-40° F to +212° F) 5% to 95% (non-condensing) 5 to 10 Hz 0.2" displacement 10-200 Hz at 1G |
| Input Characteristics: Input Off State, Input On State: Input Impedance (Typical): Input Open Wire: Input Shorted Wire: Input Processing Time (Type): Selectable Input Filter Times: Input Diagnostics: | Programmable threshold (25% to 85%) 11.6 ohms Programmable threshold (25% to 85%) Fixed 10% to 90% thresholds 1 mSec (plus selectable filter time) 10 to 100 mSec in 10 mSec increments Open Wire, Short Circuit |
| <u>Catalog Number Information</u> 6247BP10710 6247BP10720 6247BP10730 | <u>Description</u> 115 V ac, 50/60 Hz (Complete Unit) 115 V ac, 50/60 Hz (Electronics Assembly Only) 115 V ac, 50/60 Hz (Terminal Assembly Only) |

6248B Relay Output Blocks

The 6248B Relay Output Block provides 16 output circuits in four groups of four independent outputs each, [Figure 46](#). There are two types of Relay Output Blocks: one with normally open outputs and one with normally closed outputs. They are compatible with a wide range of low-power control and indicating devices such as relays, contactors, and lamps. Output devices can operate in the range of 5 to 250 V ac or 5 to 220 V dc, and switch up to 60 Watts or 125 VA.

These are discrete modules. The signals from the controller have the following meanings:

| | | | |
|-----------------|----------|---|--------------|
| Normally-open | coil on | 1 | relay closes |
| | coil off | 0 | relay opens |
| Normally-closed | coil on | 1 | relay opens |
| | coil off | 0 | relay closes |

Field Bus and Block Power Wiring

Terminals 1 through 4, [Figure 46](#), on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus or BSM.

Note: Make No Connections To "NC" Terminals

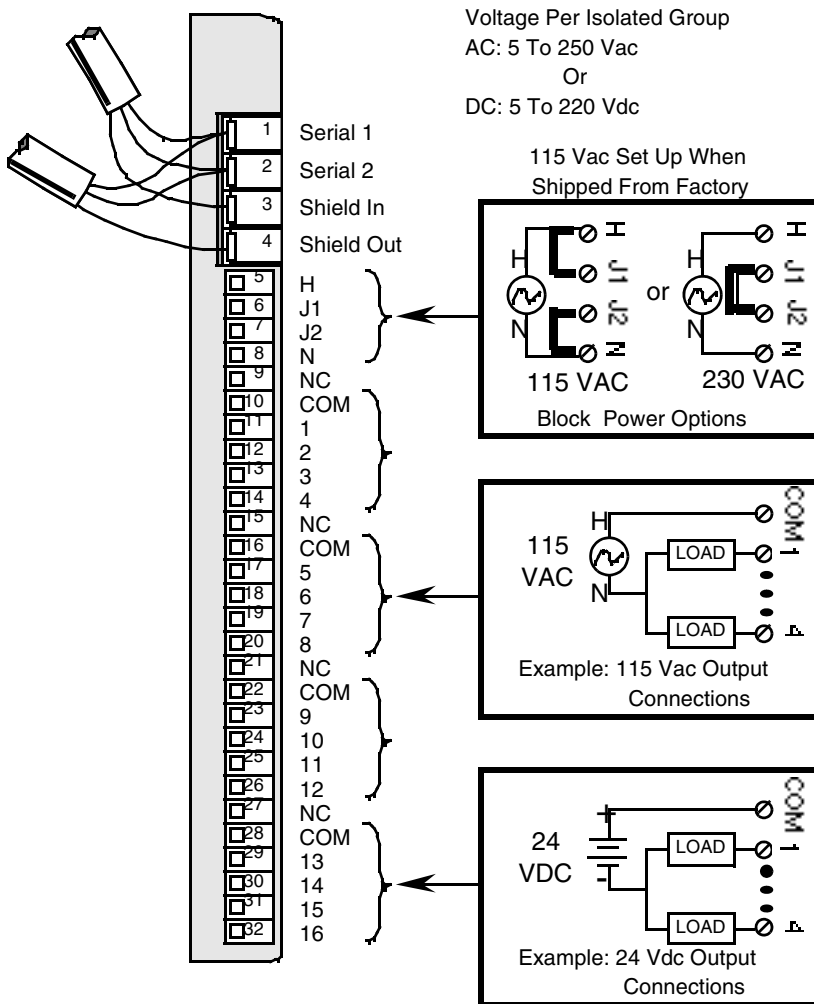


Figure 46. Terminal Connections for the 6248B Relay Output Block

Control power can be either 115 or 230 V ac. Voltage selection is made by jumpers supplied with the block as shown in Figure 47. When shipped from the factory, these jumpers are set for 115 V ac operation. Care must be taken to ensure correct jumper placement. Incorrect jumper placement can result in damage to the block.

The block has no internal fuses. External 2 amp fuses in series with the load are recommended. The type of relay used allows you to install the block in any physical orientation.

If Class 1, Division 2 conditions must be met for Factory Mutual, install an external 250 volt, one eighth amp slow blow fuse in series with the hot ac power connector.

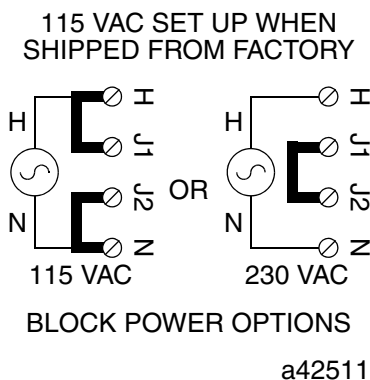
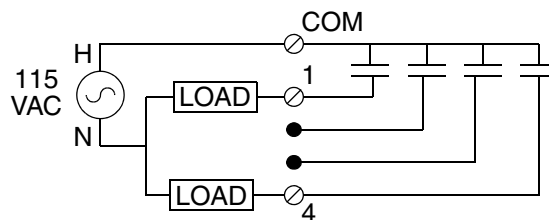


Figure 47. Control Power for the 6248B Relay Output Block

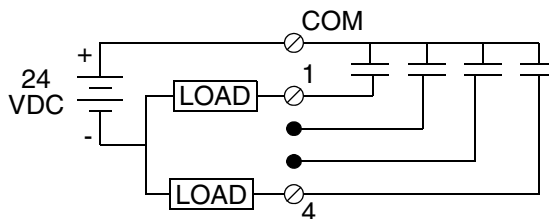
I/O Channel Wiring

These blocks have 16 relay outputs, in four groups of four circuits. Each group shares a common input terminal. Each circuit has its own LED indicator driven from the logic side of the Electronics Assembly. Each LED is labeled for easy identification. A logical 1 received from the controller causes the block to energize the corresponding relay coil, and a 0 causes the coil to be de-energized. The effect of this depends on the type of blocks. 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. [Figure 48](#) shows connections for the outputs under different power conditions.

VOLTAGE PER ISOLATED GROUP
 AC: 5 TO 250 VAC
 OR
 DC: 5 TO 220 VDC



Example: 115 VAC OUTPUT CONNECTIONS



Example: 24 VDC OUTPUT CONNECTIONS

Figure 48. Output Connections for the 6248B Relay Output Block

If the block is used as a BSM Controller, the type of BSM depends on the voltage that powers the block outputs. If this voltage is 24 or 48 V dc, a low voltage (24/48 V) BSM is needed. If this voltage is 115 V, a high voltage (115 V ac / 125 V dc) BSM is needed. The combination of block and point wiring determines the way the BSM should be wired. See [Figure 49](#) through [Figure 51](#).

Connecting a jumper from J1 to COM, as shown in [Figure 49](#), allows the points to operate on the same 115 V ac that powers the block.

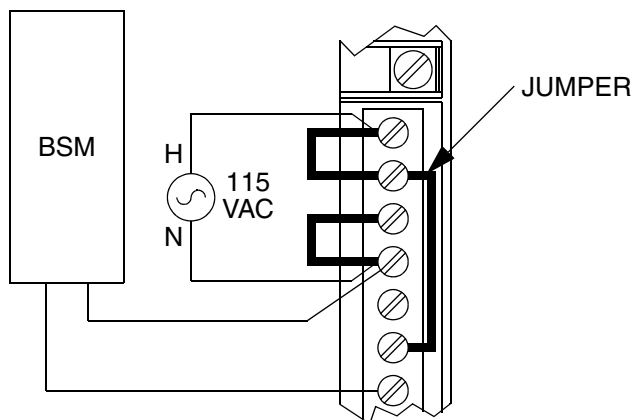


Figure 49. Block and Points Powered by 115 V ac

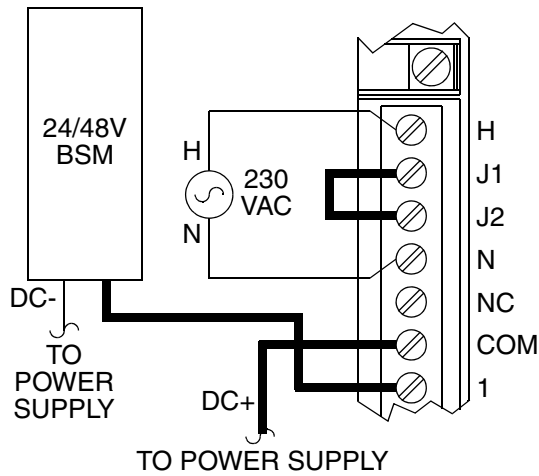


Figure 50. Block Powered by 230 V ac, Points Powered by 24 to 48 V ac

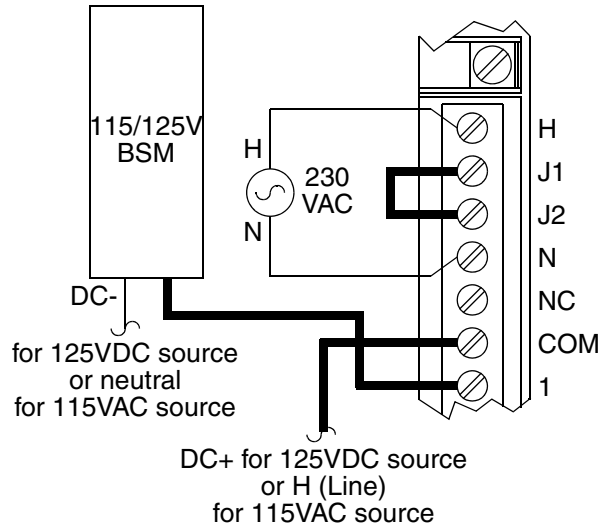


Figure 51. Block Powered by 230 V ac, Points Powered by 115 V ac or 125 V dc

6248B Relay Output Block Specifications

Table 8. 6248B Relay Output Block Specifications

| Characteristics | Specifications |
|----------------------------|---|
| Physical Characteristics: | |
| Block Type: | 16 circuit relay output in 4 isolated groups of 4 |
| Relay Type: | Fixed coil moving armature |
| Typical Life: | |
| dc (2 amps at 30 volts): | 500,000 operations |
| ac (.5 amp at 250 volts): | 100,000 operations |
| Block Power Supply: | 115 V ac 230 V ac |
| Operating Voltage: | 93 to 132 V ac 185 to 265 V ac |
| Frequency: | 47 to 63 Hz 47 to 63 Hz |
| Power Supply Dropout Time: | 1 cycle |
| LEDs (I/O Block): | Unit OK, I/O Enabled |
| LEDs (Each Circuit): | Individual relay coil state |
| Block to Block Isolation: | 1500 V |
| Insulation Resistance: | 2.2 Megohms minimum |
| Terminal Wiring Sizes: | One AWG #22 to AWG #14 |
| Weight: | 4 lbs. (1.8 Kg) |
| Heat Dissipation: | 10.1 Watts maximum with 16 outputs |
| Environmental: | |
| Operating Temperature: | -25° C to +60° C (-13° F to +140° F) |
| Storage Temperature: | -40° C to +100 °C (-40° F to +212° F) |
| Humidity: | 5% to 95% (non-condensing) |

Table 8. 6248B Relay Output Block Specifications

| Characteristics | Specifications |
|--|--|
| Output Characteristics: Maximum Output Current: Maximum Switching Power: Maximum Inrush Current: Output OFF Leakage Current: Maximum Switching Frequency: Output Turn-on Delay (Maximum): Output Voltage Range: Minimum Recommended Load: | 2 amps per circuit 60 Watts or 125 VA 2 amps per circuit 0.1 mA 20 cycles/minute (inductive loads) 5 mSec 5 to 250 V ac or 5 to 220 V dc 10 mA |
| <u>Catalog Number Information</u> 6248BP10811 6248BP10821 6248BP10831 6248BP10812 6248BP10822 6248BP10832 | <u>Description</u> 115/230 V ac Normally Open (Complete Unit) 115/230 V ac Normally Open (Electronics Assembly Only) 115/230 V ac Normally Open (Terminal Assembly Only) 115/230 V ac Normally Closed (Complete Unit) 115/230 V ac Normally Closed (Electronics Assembly Only) 115/230 V ac Normally Closed (Terminal Assembly Only) |

Table 9. Maximum Current for Load Type⁽¹⁾

| Resistive | Lamp | Solenoid | Typical Life (Operations) |
|-----------|------|----------|---------------------------|
| 0.5A | | | 200,000 |
| | 0.1A | 0.1A | 100,000 |
| 1.0A | 0.2A | 0.3A | 100,000 |
| 2.0A | | | 500,000 |
| | 0.2A | 0.3A | 100,000 |
| 3.0A | 0.3A | 0.5A | 100,000 |

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

Table 10. Current in Load Type⁽¹⁾

| Resistive | Lamp | Solenoid | Typical Life (Operations) |
|-----------|------|----------|---------------------------|
| 0.1A | | | 1,500,000 |
| 0.3A | | | 1,000,000 |
| 1.0A | | | 2,000,000 |
| 2.0A | | | 1,000,000 |

Interfacing Small Loads to Discrete Blocks

The 6245B 115 V ac Low Leakage 8 Circuit Grouped I/O Block is designed to interface to small loads without added resistance at the load. If individual output circuits on other types of discrete ac blocks are used to drive inductive loads that draw less than 50 mA, it may be necessary to add resistance to the circuit at the load as described below.

Interaction Between Leakage Currents and Load Characteristics

When closed, electromechanical devices such as contactors, starters, or relays have high inductance combined with a low value of holding current (current required through the relay coil to keep the contactor closed). The guaranteed holding current for the CR4AC contactor, for example, is approximately 79 mA. When the output is off, the inductance of the coil can interact with the block suppression capacitor to maintain a relatively high current level (15 to 25 mA) 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 10 to 13 mA range, and the load voltage drops to a 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 as shown in [Figure 52](#). The added resistance should bring the total current up to 100 mA. For example, for a specific contactor the holding current is specified as 9.1 VA. This equates to about 79 mA 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.

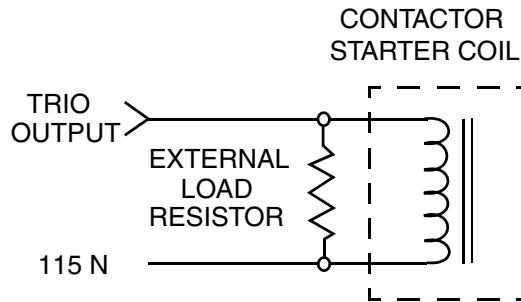


Figure 52. Interfacing an Inductive Load to a Discrete Block

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.

Section 4 Analog I/O Block Characteristics

Overview

This section describes the basic characteristics of the TRIO analog I/O blocks used in the AC800M installation.

Analog I/O Blocks

The available analog I/O blocks are:

6230B 4 In/2 Out Analog I/O Block.

6231B 4 In/2 Out Current Source Analog I/O Block.

6232B 6 Circuit Thermocouple Input Block.

6233B 6 Circuit RTD Input Block.

6235B 6 Circuit Current Source Analog Input Block.

6236B 6 Circuit Current Source Analog Output Block.

Quick Facts About the Analog Blocks

This section contains information to aid you in choosing the types of analog blocks needed for your applications. A detailed description of the Analog Blocks is provided in the following subsections:

- [6230B 4 In/2 Out Analog I/O Block Support](#) on page 120
- [6231B 4 In/2 Out Current Source Analog I/O Block Support](#) on page 120
- [6232B 6 Circuit Thermocouple Input Block Support](#) on page 121
- [6233B 6 Circuit RTD Input Block Support](#) on page 121
- [Isolation Characteristics of the 6232B and 6233B Blocks](#) on page 121

- [6235B 6 Circuit Current Source Analog Input Block Support](#) on page 121
- [6236B 6 Circuit Current Source Analog Output Block Support](#) on page 122
- [Analog Block Diagnostics](#) on page 122
- [Scaling Analog Blocks](#) on page 123

6230B 4 In/2 Out Analog I/O Block Support

The 6230B 4 In/2 Out Analog I/O Block supports the following voltage inputs:

- 0 V dc to 10 V dc.
- -10 V dc to +10 V dc.
- -5 V dc to +5 V dc.
- 0 V dc to 5 V dc.
- 1 V dc to 5 V dc.

The block supports the following current inputs:

- 4 - 20 mA two wire transmitter, (transmitter requires external power supply).

Current Outputs

- Internal power is enough to send 4 to 20 mA through a 0 to 300 ohm load. An external 24 to 48 V power supply is needed for larger loads (up to 2 K ohms at 48 V).

Voltage Outputs

- Voltage outputs require a load $> 2 \text{ k } \Omega$
- Output ranges supported are the same as the input ranges.

6231B 4 In/2 Out Current Source Analog I/O Block Support

The 6231B 4 In/2 Out Current Source Analog I/O Block supports four 4 to 20 mA inputs. Two wire transmitters do not need separate power supplies, although a transmitter with its own supply can be accommodated. Each input is isolated from the other inputs and the outputs. The outputs have a common return.

The block supports two 4 to 20 mA outputs into a 0 to 850 Ω load.

6232B 6 Circuit Thermocouple Input Block Support

One 6232B 6 Circuit Thermocouple Input Block has six channels. It supports thermocouple inputs which are chosen from the following types:

J, K, T, E, B, R, S, N

The range of inputs is -25.00 mV to +150.00 mV.

Each channel can have cold junction compensation performed using an offset value selected from one of three possible sources:

- Local - offset comes from an on-board cold junction sensor.
- Remote - offset comes from a millivolt input to the two channel group that contains the channels.
- Fixed - offset is a number entered during the software configuration.

A 6232B 6 Circuit Thermocouple Input Block can also accept millivolt inputs in the range of:

-25.00 mV to +150.00 mV.

6233B 6 Circuit RTD Input Block Support

The 6233B 6 Circuit RTD Input Block supports the following RTD types:

- Platinum - DIN 43760.
- Nickel - DIN 43760.
- Copper.

Isolation Characteristics of the 6232B and 6233B Blocks

The 6232B 6 Circuit Thermocouple Input Block and the 6233B 6 Circuit RTD Input Block have three groups of circuits with 2 circuits to a group. Each group is isolated from the others.

6235B 6 Circuit Current Source Analog Input Block Support

The 6235B 6 Circuit Current Source Analog Input Block supports six 4 to 20 mA inputs. Each input channel includes an isolated 24 V current loop power supply, and uses a voltage-to-frequency converter and counter to translate the current to a digital number.

6236B 6 Circuit Current Source Analog Output Block Support

The 6236B 6 Circuit Current Source Analog Output Block supports six 4 to 20 mA outputs. The six independent output channels of the block are electrically common to each other and the BSM circuit, but isolated from all other circuits of the block. They use a dual 12-bit digital-to-analog converter and can independently drive currents from 0 to 24 mA.

An output circuit can drive a 4 to 20 mA current through a resistance of 0 to 850 Ω .

Analog Block Diagnostics

The following diagnostics are supported by the analog blocks:

6230B 4 In/2 Out Analog I/O Block:

- Open Wire - Input current ≤ 2 mA on 1 to 5 V (4 to 20 mA range).
- Overrange.
- Underrange.

6231B 4 In/2 Out Current Source Analog I/O Block:

- Open Wire (Input current ≤ 2 mA).
- Open Wire/ feedback error on output.
- Overrange.
- Underrange.

6232B 6 Circuit Thermocouple Input Block:

- Open Wire.
- Overrange.
- Underrange.
- Internal Fault.

6233B 6 Circuit RTD Input Block:

- Open Wire.
- Overrange.
- Underrange.
- Internal Fault.
- Wiring Error.

6235B 6 Circuit Current Source Analog Input Block:

- Open Wire (Input current ≤ 2 mA).
- Overrange.

- Underrange.

6236B 6 Circuit Current Source Analog Output Block:

- Overrange.
- Underrange.
- Feedback Error.

Scaling Analog Blocks

There is a high degree of redundant fault checking for TRIO analog blocks. This is due to the underrange and overrange diagnostics of the block, as well as the capability of the controllers process alarm and event handling to determine whether an input value is unacceptably high or low. Therefore, if the block is scaled in a manner which would allow values outside of the 0 to 100 percent range to be read, you could disable TRIO fault reporting to avoid faults reported by the block. If the block is configured with such a narrow voltage range that the control system would never read a value in excess of 100 percent, then the input block would not detect an overrange condition. In this instance, if the block were configured for a broader voltage range, the control system would be able to detect the overrange condition but at a loss in resolution.

Since a 4 to 20 mA analog input may go off scale fairly often (particularly when a transmitter is being calibrated), you may prefer to sacrifice resolution rather than lose control during the period of time the fault condition is latched in the control system. If resolution cannot be sacrificed and you can accept that overrange conditions are not detected, you can leave fault reporting for the block disabled with the block scaled for 1 to 5 V (4 to 20 mA). If disabling block fault reporting is not acceptable, you must understand that the control system will latch the fault and treats the input as BAD until after the necessary repairs are made and the Clear Faults command is sent from the system.

Note that regardless of whether block fault reporting is enabled for a specific channel, the Control Builder continues to show all of the diagnostic conditions for that channel. This is because these displays upload the diagnostic tables from the blocks rather than rely on fault reports. Therefore, disabling block fault reporting does not restrict the information displayed. It only reduces the number of messages reported as alarms and situations where block diagnostics cause the control system to declare the data quality as BAD.

6230B 4 In/2 Out Analog Input/Output Block

The 6230B 4 In/2 Out Analog I/O Block, [Figure 53](#), is available in two versions: one requiring a 115 V ac power supply, and another requiring either 24 or 48 V dc power. The blocks are the same in other respects. The first four circuits of the 6230B 4 In/2 Out Analog I/O Block are inputs, numbered as inputs 1 through 4. The remaining two are outputs, numbered as outputs 1 and 2.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49 explain how to use these terminals to attach the block to a Field Bus.

As [Figure 53](#) shows, power is brought into the block at terminals 6 and 7. Terminal 6 is used for dc positive or ac hot. Terminal 7 is used for dc negative or ac neutral. These terminals can take up to one AWG #14 wire.

If Class 1, Division 2 conditions must be met for Factory Mutual, install an external 250 volt, one eighth amp slow blow fuse in series with the hot ac power connector.

Inputs to the 6230B 4 In/2 Out Analog I/O Block

You can specify the operating range of the input channel. The five choices are:

- 0 V dc to 10 V dc.
- -10 V dc to +10 V dc.
- -5 V dc to +5 V dc.
- 0 V dc to 5 V dc.
- 1 V dc to 5 V dc (also used for 4 to 20 mA).

Field devices are wired to terminals 8 to 32 which accept AWG #22 to AWG #14 wires.

The block has standard diagnostics that can detect open wire conditions at the 4 to 20 mA inputs and issue diagnostic messages when the input from the input device is outside of the standard input range.

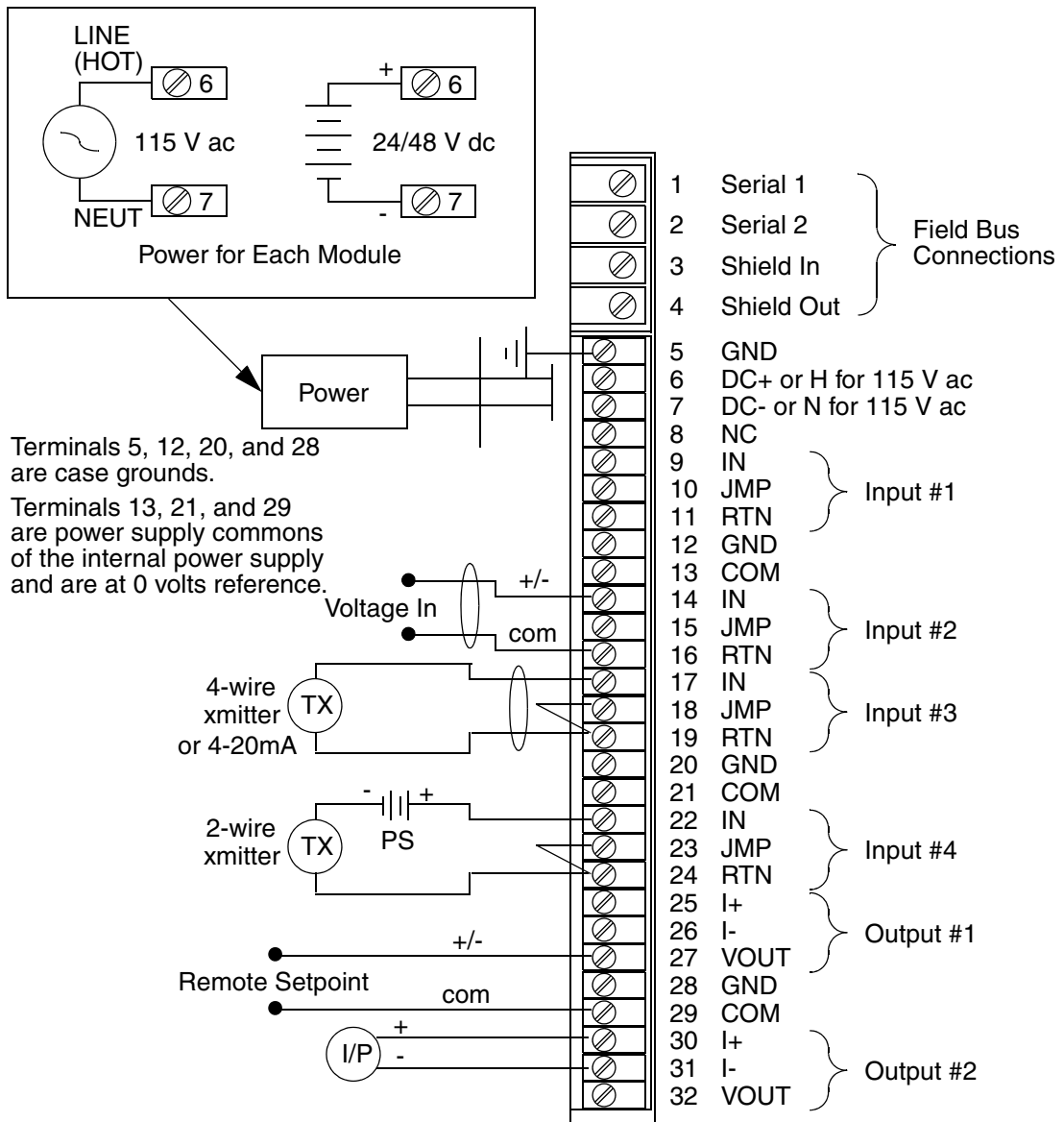


Figure 53. Terminal Connections for the 6230B 4 In/2 Out Analog I/O Block

Each input circuit has an Input (IN), Jumper (JMP), and Return (RTN) terminal as shown in Figure 54. Case ground and internal power supply common terminals are shared between two adjacent inputs. For example, inputs 1 and 2 share the internal power supply common at terminal 13 and case ground at terminal 12.

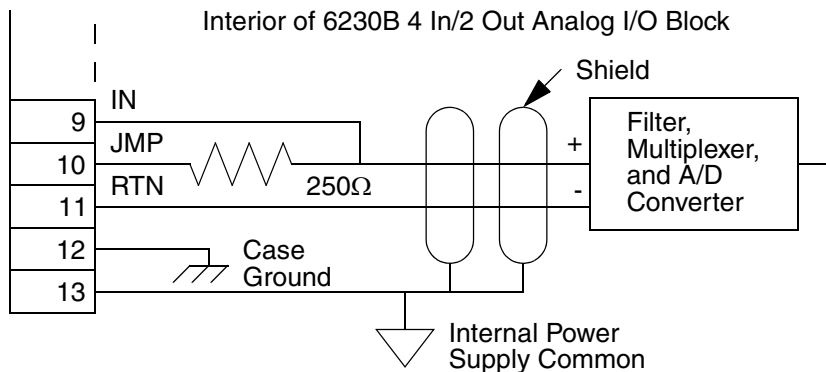


Figure 54. Terminals for Input 1 of the 6230B 4 In/2 Out Analog I/O Block

The block has one analog to digital converter shared by the input circuits. It converts an input voltage into internal numbers called *counts* in a range of -4095 to +4095. Using parameters entered at configuration, the block converts the counts to a more usable engineering units value that is sent to the controller. The block is designed so all inputs end up as voltages applied to the internal filter and analog to digital (A/D) converter as illustrated by the following descriptions:

- [Inputs from a 4 to 20 mA Transmitter](#) on page 126
- [Inputs from a 10 to 50 mA Transmitter](#) on page 128
- [Inputs from a Voltage Source](#) on page 128

Inputs from a 4 to 20 mA Transmitter

When the input device is a 4 to 20 mA current transmitter, it should be connected to the IN and JMP terminals with a jumper being used to connect JMP and RTN, Figure 55. This allows the 4 to 20 mA current to produce a 1 to 5 V signal across an internal 250 Ω resistor. This voltage is then applied to the internal filter and A/D

converter. When making the configuration entries, the voltage/current range entry would most often be either +1 to +5 V dc or 0 to 5 V dc.

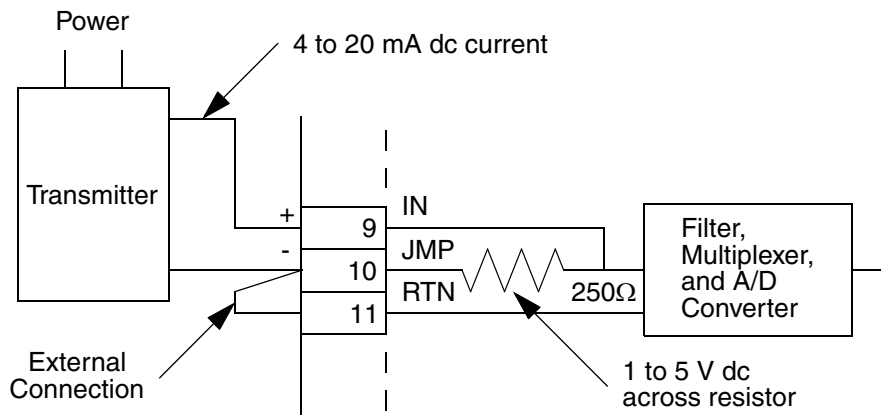


Figure 55. Connections for a 4 to 20 mA Four Wire Transmitter

Transmitters attached to this block require a user-supplied power supply. Figure 56 shows the method to attach a two wire transmitter to the block.

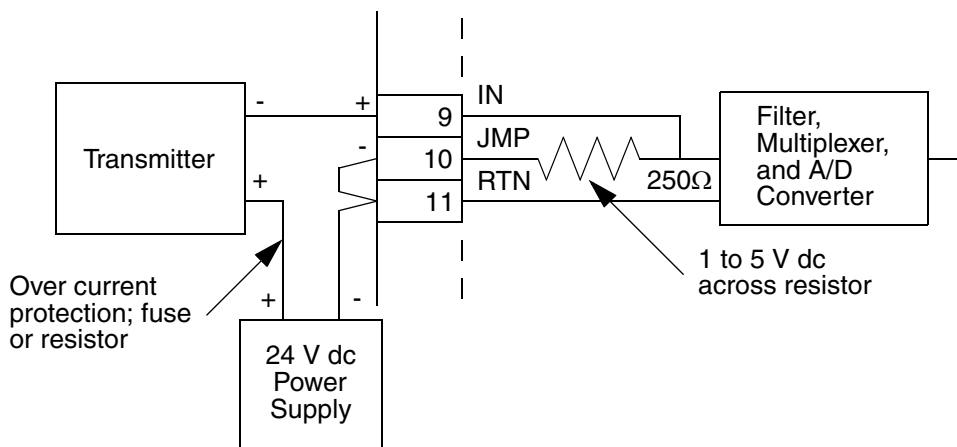


Figure 56. Typical Connections for a Two Wire Transmitter

When determining whether a 4 to 20 mA transmitter suits your application, remember that the block lets you take advantage of the [CCF underrange protection but not overrange unless the input is configured](#) for a maximum input of more than 5 V (that is, 10 V). You can also use a 4 to 20 mA transmitter to improve noise immunity on long input leads. However, it is better to use a longer Field Bus where practical than to use long input leads.

Inputs from a 10 to 50 mA Transmitter

You can attach a 10 to 50 mA transmitter, [Figure 57](#), to the IN and RTN terminals of an input if an external 100 Ω resistor is added to produce a voltage drop of 1 to 5 V. When making the configuration entries, the voltage/current range entry would most often be either +1 to +5 V dc or 0 to 5 V dc.

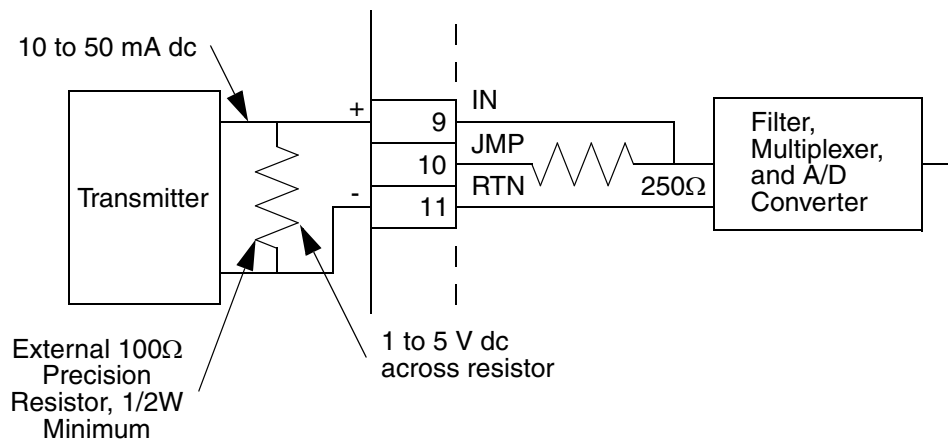


Figure 57. Connections for a 10 to 50 mA Transmitter

Inputs from a Voltage Source

When the input device is a voltage source, it should be connected between the IN and RTN terminals of the input, [Figure 58](#). When making the configuration entries, choose one of the following for the input range:

- 0 V dc to 10 V dc.
- -10 V dc to +10 V dc.

- -5 V dc to +5 V dc.
- 0 V dc to 5 V dc.
- 1 V dc to 5 V dc.
-

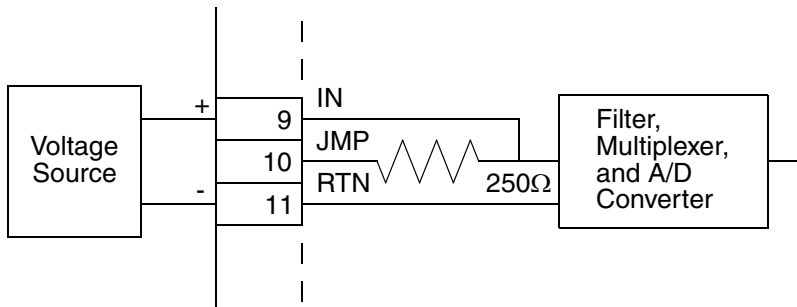


Figure 58. Connections for a Voltage Source Input

Outputs from the 6230B 4 In/2 Out Analog I/O Block

The block has standard diagnostics that affect the signal sent to the field when the controller is requesting an output outside of the standard output range.

Output circuits 1 and 2 each have I+, I-, and V output (VOUT) terminals as shown in Figure 59. The case ground, terminal 28, and the internal power supply common, terminal 29, are shared by the two outputs.

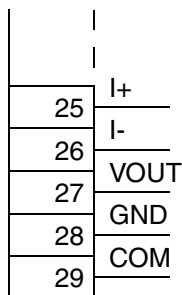


Figure 59. Output Circuit Terminals for a 6230B 4 In/2 Out Analog I/O Block

The block has one digital to analog (D/A) converter multiplexed between the two output circuits. It converts the internal counts number into either a voltage or a current output.

Voltage Outputs

If one of the voltage ranges is chosen for the output circuit, the load should be connected between VOUT and COM as shown in Figure 60. The load must be greater than 2 K Ω .

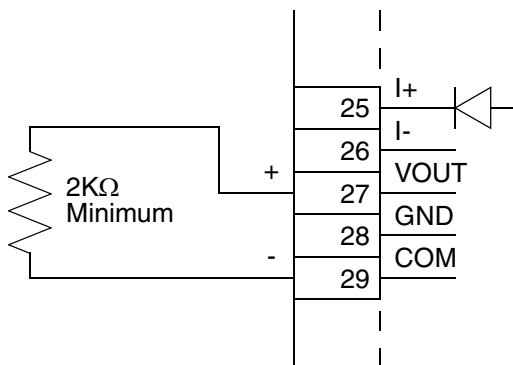


Figure 60. Connections for a Voltage Output

Current Outputs

If you use the 1 to 5 V (4 to 20 mA mode) for an output circuit, the load should be connected between I+ and I- as shown in Figure 61. The internal power supply of the block can be used to drive a load of up to 300 ohms.

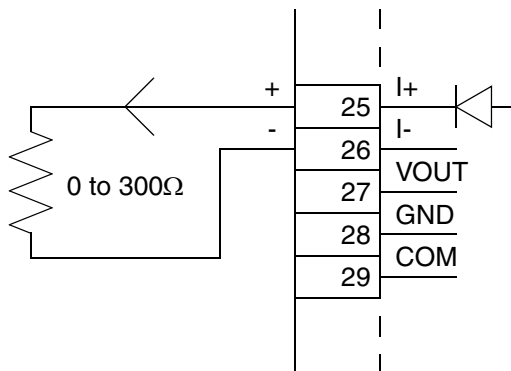


Figure 61. Connections for a Current Output with a Load Less than 300Ω

For higher resistance loads (up to $2K\Omega$ ohms at 48 volts), use an external 24 or 48 V dc power supply as shown in Figure 62.

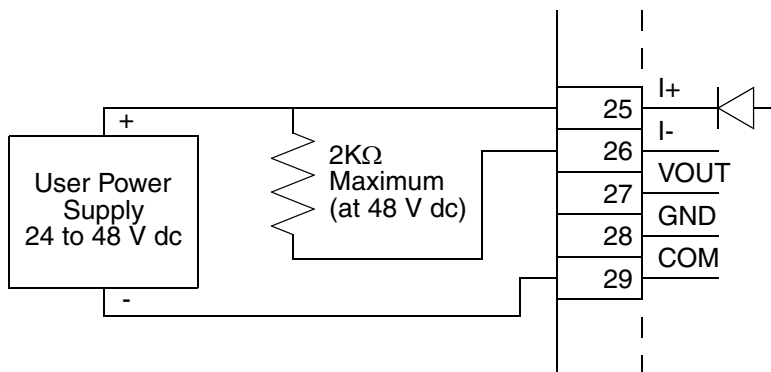


Figure 62. Connection for a Current Output that uses an External Power Supply

Accuracy

For inputs and outputs, absolute accuracy is within $\pm 0.5\%$ maximum, $\pm 0.2\%$ typical of full scale. This means accuracy is within 50 mV on the 10 V range, 25 mV on the 5 V range, and 100 μA on the 4 to 20 mA range.

Calibration

It is normal to expect small temperature drifts in the analog block electronic components. To compensate for these changes, analog I/O blocks automatically calibrate all internal A/D and D/A circuits periodically during normal operation.

6230B 4 In/2 Out Analog I/O Block Specifications

Table 11. 6230B 4 In/2 Out Analog I/O Block Specifications

| Characteristics | Specifications |
|--|---|
| Physical Characteristics: | |
| Type: | 4 input/2 output circuits |
| LEDs (I/O Block): | Unit OK, I/O Enabled |
| Block to Block Isolation: | 1500 V |
| Insulation Resistance: | 2.2 Megohms minimum |
| Terminal Wiring: | |
| Terminals 1 to 4: | one AWG #12 or two AWG #14 |
| Terminals 5 to 32: | AWG #14 to AWG #22 |
| Weight: | 4 lbs. (1.8 kg) |
| Heat Dissipation: | 6 W |
| Operating Voltage: | 115 V ac 24/48 V dc |
| Required Current (typical): | 20 mA 100 mA |
| Maximum Current: | 100 mA 500 mA |
| Frequency/Ripple: | 47 to 63 Hz 10% maximum ripple |
| Power Supply Dropout Time: | 1 cycle 10 mSec |
| Common Mode Rejection: | 60 dB (0 to 1 KHz) |
| Common Mode Voltage: | ±170 V (maximum) |
| Absolute Accuracy (at 25° C): (inputs or outputs) | ±0.5% of full scale (maximum), ±0.2% (typical) |
| Thermal Drift (from 25° C): | 10 PPM per °C (typical), 40 PPM per °C (maximum) |
| 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 to 10 Hz 0.2 inch displacement 10 to 200 Hz at 1 G |

Table 11. 6230B 4 In/2 Out Analog I/O Block Specifications

| Characteristics | Specifications |
|---|--|
| Input Characteristics: Input Resolution: Input Update Frequency: Input Filter Ranges: Range Selection (Circuits): Input Diagnostics: | 12 bit + sign Once every 4 mSec None, 8, 16, 32, 64, 128, 256, 512, 1024 mSec 0 to 10 V dc ±10 V dc ±5 V dc 0 to 5 V dc 4 to 20 mA (or 1 to 5 V dc) Underrange, overrange, open wire |
| Output Characteristics: Output Resolution: Output Update Frequency: Range Selection (Circuits): Output Diagnostics: | 12 bit + sign Once every 4 mS 0 to 10 V dc ±10 V dc ±5 V dc 0 to 5 V dc 4 to 20 mA (or 1 to 5 V dc) Underrange, overrange |
| <u>Catalog Number Information</u> 6230BP10710 6230BP10720 6230BP10730 6230BP10810 6230BP10820 6230BP10830 | <u>Description</u> 115 V ac, 50/60 Hz (Complete Unit) 115 V ac, 50/60 Hz (Electronics Assembly Only) 115 V ac, 50/60 Hz (Terminal Assembly Only) 24/48 V dc (Complete Unit) 24/48 V dc (Electronics Assembly Only) 24/48 V dc (Terminal Assembly Only) |

6231B 4 In/2 Out Current Source Analog Input/Output Block

The 6231B 4 In/2 Out Current Source Analog I/O Block, [Figure 63](#), is available in two versions: one requiring a 115 V ac or 125 V dc power supply, and another requiring either 24 or 48 V dc power. They are the same in other respects. The block is used to interface to devices that provide or accept 4 to 20 mA current signals. The first two channels of the 6231B Block are outputs, numbered as outputs 1 and 2. The remaining four are inputs, numbered as inputs 1 through 4.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

As [Figure 63](#) shows, power is brought into the block at terminals 6 and 7. Terminal 6 is used for dc positive or ac hot. Terminal 7 is used for dc negative or ac neutral. These terminals can take up to one AWG #14 wire.

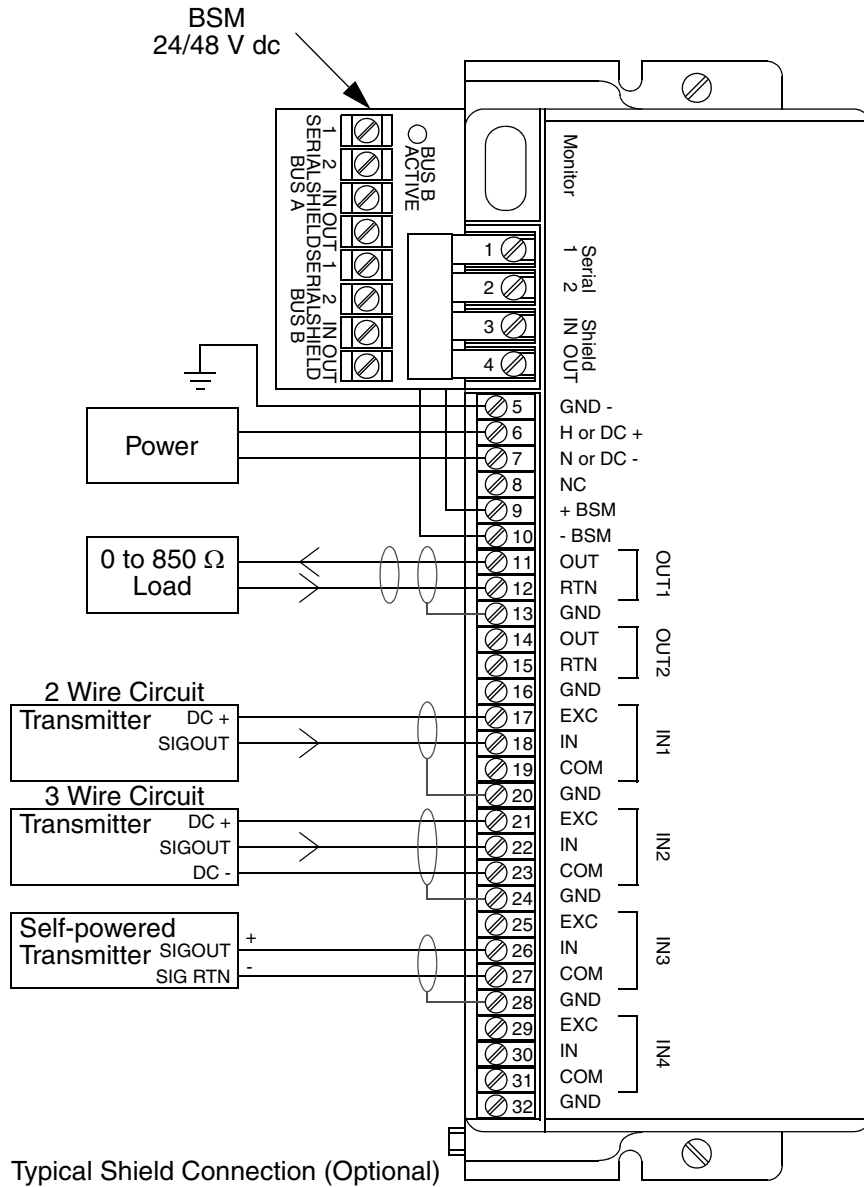


Figure 63. Terminal Connections for the 6231B 4 In/2 Out Current Source Analog I/O Block

I/O Channel Wiring

Field devices are wired to terminals 11 to 32 which accept AWG #22 to AWG #14 wires.

When this block is used as a Bus Switching Module (BSM) Controller, it requires a low voltage (24/48 V) BSM. Terminals 9 and 10 of the block are designed specifically for BSM connections, so the block can still support six I/O channels when it is a BSM Controller.

Each input channel includes an isolated 24 volt current loop power supply. It can accept a current input in the range of 4 to 20 mA. It uses a voltage-to-frequency converter and a counter to translate the current to a digital number. Input channel resolution increases as the conversion time is lengthened. Conversion times are programmable from 16 to 400 mSec.

Each input has Excitation (EXC), Input (IN), Common (COM) and Ground (GND) connections. [Figure 63](#) shows the types of connections that must be made for 2, 3, or 4 (self powered) wire transmitters. [Figure 64](#) is a simplified schematic of an input channel.

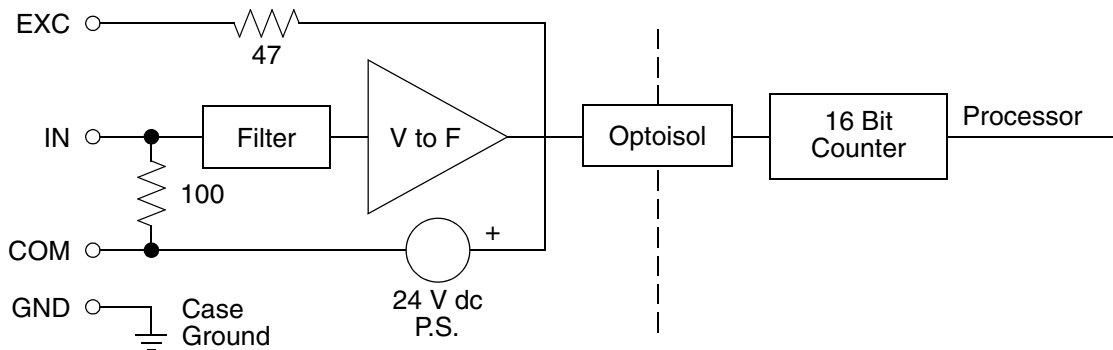


Figure 64. Input Channel Schematic for the 6231B 4 In/2 Out Current Source Analog I/O Block

The two output channels are electrically common to each other and the BSM circuit, but isolated from all other circuits on the block. They use a dual 12 bit digital-to-analog converter and can independently control currents from 0 to 24 mA.

An output circuit can drive a 4 to 20 mA current through a resistance of 0 to 850 ohms. The connection for outputs are shown in Figure 63. Figure 65 is a simplified schematic of an output channel.

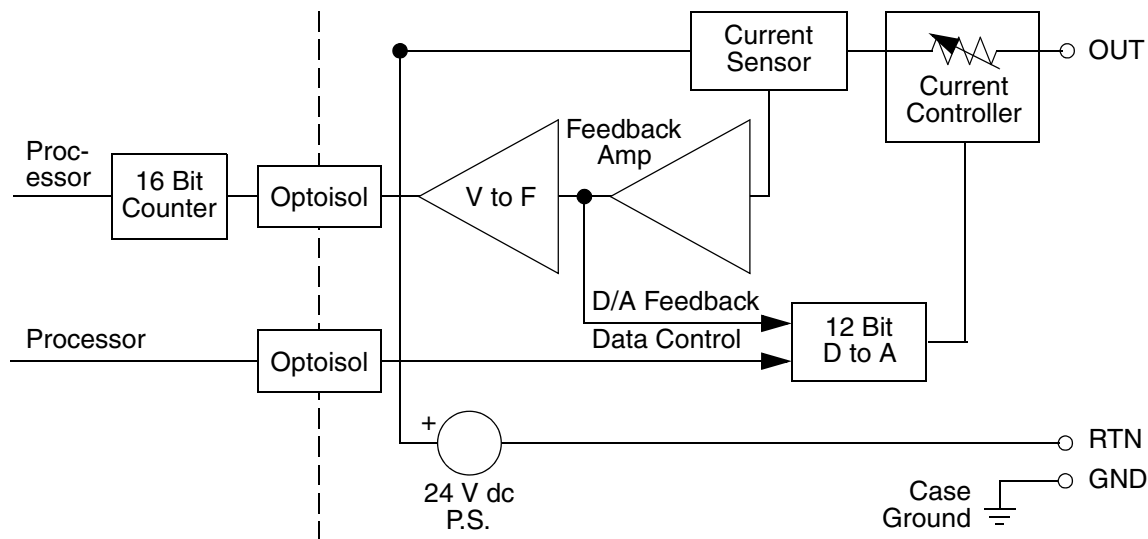


Figure 65. Output Channel Schematic for the 6231B 4 In/2 Out Current Source Analog I/O Block

If both output loads are grounded and the loads are far apart, an external resistor should be installed in the return line from each load to the block. This prevents possible damage to the block caused by high ground loop currents resulting from voltage differences that can occur between the two ground points. Ten ohm resistors are suggested.

6231B 4 In/2 Out Current Source Analog I/O Block Specifications

Table 12. 6231B 4 In/2 Out Current Source Analog I/O Block Specifications

| Characteristics | Specifications |
|--------------------------------|---|
| Physical Characteristics: | |
| LEDs (I/O Block): | Unit OK, I/O Enabled |
| Block to Block Isolation: | 1500 V |
| Insulation Resistance: | 2.2 Megohms minimum |
| Group to Group Isolation: | 300 V |
| Terminal Wiring: | |
| Terminals 1 to 4: | one AWG #12 or two AWG #14 |
| Terminals 5 to 32: | AWG #22 to AWG #14 |
| Weight: | 4 lbs (1.8 kg) |
| Heat Dissipation: | 12 W maximum |
| 115 V ac/125 V dc Block Power: | 115 V ac 125 V dc |
| Power Supply Voltage: | 93 to 132 V ac 6W 105 to 145 V dc at 6W |
| Frequency/Ripple: | 47 to 63 Hz 10% maximum ripple |
| Maximum Current: | 250 mA 140 mA |
| Power Supply Dropout Time: | 1 cycle 10 mSec |
| 24/48 V dc Block Power: | |
| Power Supply Voltage: | 18 to 56 V dc, 10% maximum ripple |
| Maximum Current: | 600 mA |
| Power Supply Dropout Time: | 10 mSec |
| Normal Mode Rejection: | -45 dB at 50/60 Hz |
| BSM Control: | 24/48 V dc BSM |
| 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" displacement 10-200 Hz at 1 G |

Table 12. 6231B 4 In/2 Out Current Source Analog I/O Block Specifications

| Characteristics | Specifications |
|--|---|
| Input Characteristics: Input Accuracy (at 25° C): Input Resolution: Input Conversion Time: Input Range: Overrange Capacity: Input Diagnostics: Channel to Channel Isolation: Thermal Drift (from 25° C): | $\pm 20 \mu\text{A}$ 12 μA to 1 μA depending on conversion time 16.6 mSec to 400 mSec user selectable 4 to 20 mA 0 to 25 mA Open wire, overrange, underrange 300 V rms 70 PPM per °C (typical), 140 PPM per °C (maximum) |
| Input Excitation Characteristics: Open Circuit Voltage: Short Circuit Current: Loop Impedance: | 24 V dc <75 mA 1000 ohms maximum (0 to 20 mA) 800 ohms maximum (0 to 25 mA) |
| Output Characteristics: Output Accuracy (at 25° C): Output Resolution: Output Update Frequency: Output Range: Overrange Capacity: Output Diagnostics: Load: Thermal Drift (from 25° C): | 0.15% FSR 6 μA equal to bus scan time (6 mSec typical) 4 to 20 mA 0 to 24 mA Overrange, underrange, feedback error 0 to 850 ohms 35 PPM per °C (typical), 70 PPM per °C (maximum) |
| <u>Catalog Number Information</u> 6231BP10810 6231BP10820 6231BP10830 6231BP10910 6231BP10920 6231BP10930 | <u>Description</u> 24/48 V dc (Complete Unit) 24/48 V dc (Electronics Assembly Only) 24/48 V dc (Termination Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Complete Unit) 115 V ac, 50/60 Hz/125 V dc (Electronics Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Termination Assembly Only) |

6235B 6 Circuit Current Source Analog Input Block

The 6235B 6 Circuit Current Source Analog Input Block, [Figure 66](#), is available in two versions: one requiring a 115 V ac or 125 V dc power supply, and another requiring either 24 or 48 V dc power. They are the same in other respects. The block is used to interface to devices that provide 4 to 20 mA current signals. The 6235B Block has six inputs, numbered as inputs 1 through 6.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

As [Figure 66](#) shows, power is brought into the block at terminals 6 and 7. Terminal 6 is used for dc positive or ac hot. Terminal 7 is used for dc negative or ac neutral. These terminals can take up to one AWG #14 wire.

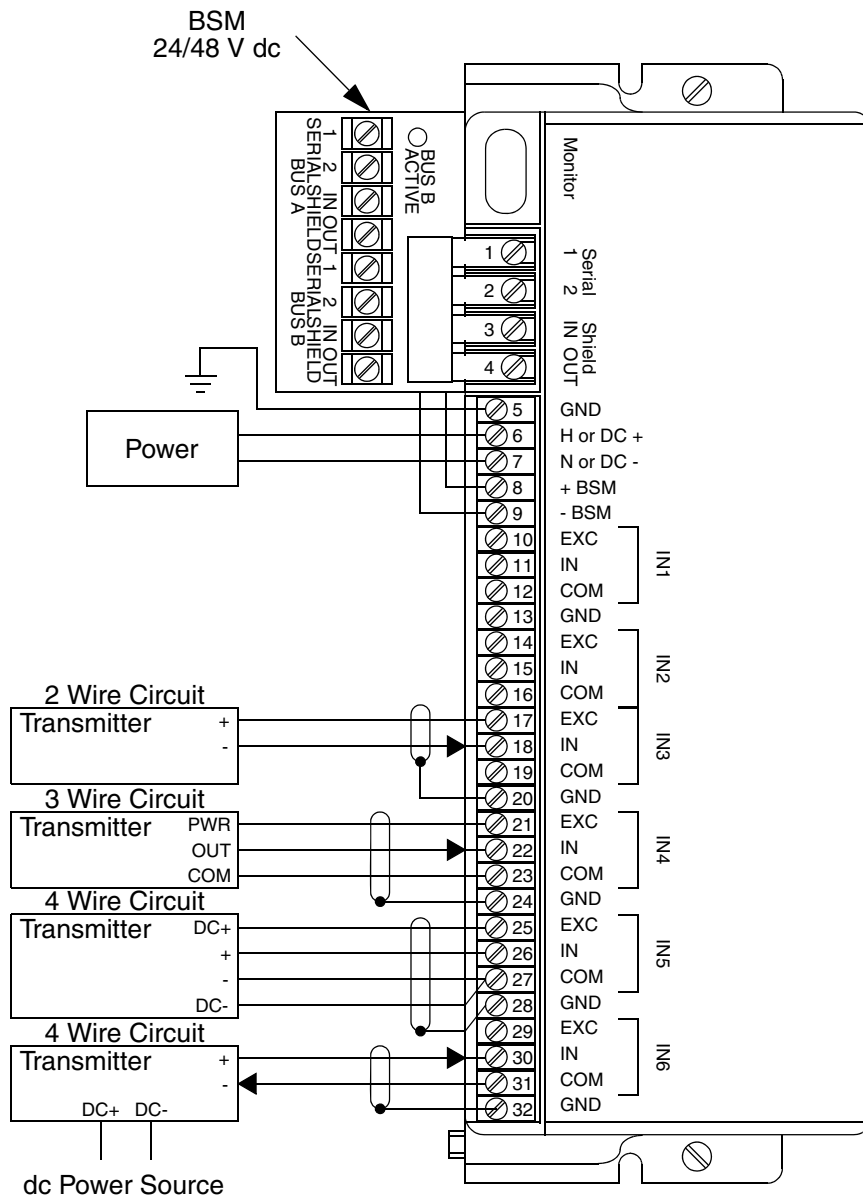


Figure 66. Terminal Connections for the 6235B 6 Circuit Current Source Analog Input Block

I/O Channel Wiring

Field devices are wired to terminals 10 through 32 which accept AWG #22 to AWG #14 wires.

When this block is used as a BSM Controller, it requires a low voltage (24/48 V) BSM. Terminals 8 and 9 of the block are designed specifically for BSM connections, so the block can still support six I/O channels when it is a BSM Controller.

Each input channel includes an isolated 24 V current loop power supply. It can accept a current input in the range of 4 to 20 mA. It uses a voltage-to-frequency converter and a counter to translate the current to a digital number. Input channel resolution increases as the conversion time is lengthened. Conversion times are programmable from 16 to 400 mSec.

Each input has Excitation (EXC), Input (IN), Common (COM) and Ground (GND) connections. [Figure 66](#) shows the types of connections that must be made for 2, 3, or 4 (self powered) wire transmitters. [Figure 67](#) is a simplified schematic of an input channel.

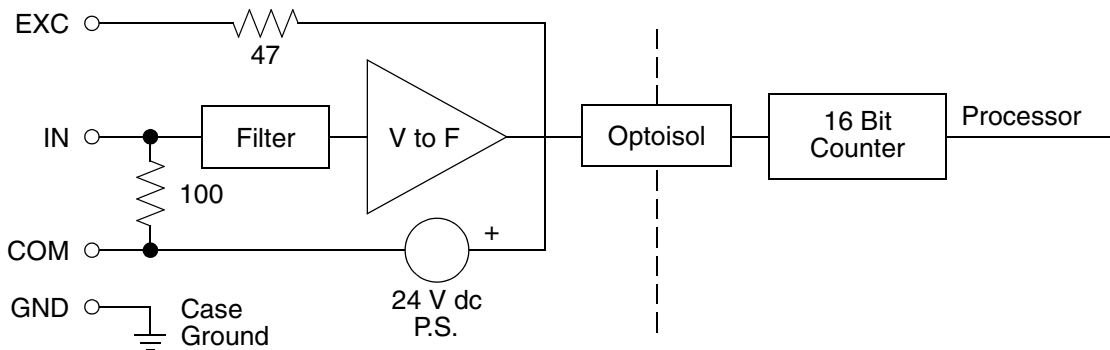


Figure 67. Input Channel Schematic for the 6235B 6 Circuit Current Source Analog Input Block

6235B 6 Circuit Current Source Analog Input Block Specifications

Table 13. 6235B 6 Circuit Current Source Analog Input Block Specifications

| Characteristics | Specifications |
|--------------------------------|---|
| Physical Characteristics: | |
| Block Type: | Six input circuits |
| LEDs (I/O Block): | Unit OK, I/O Enabled |
| Block to Block Isolation: | 1500 V for one minute |
| Insulation Resistance: | 2.2 Megohms minimum |
| Group to Group Isolation: | 1500 V rms |
| Terminal Wiring: | |
| Terminals 1 to 4: | one AWG #12 or two AWG #14 |
| Terminals 5 to 32: | AWG #22 to AWG #14 |
| Weight: | 4 lbs (1.8 kg) |
| Heat Dissipation: | 12 W maximum |
| 115 V ac/125 V dc Block Power: | 115 V ac 125 V dc |
| Power Supply Voltage: | 93 to 132 V ac 105 to 145 V dc |
| Frequency/Ripple: | 47 to 63 Hz 10% maximum ripple |
| Maximum Current: | 250 mA 140 mA |
| Power Supply Dropout Time: | 1 cycle 10 mSec |
| 24/48 V dc Block Power: | |
| Power Supply Voltage: | 18 to 56 V dc |
| Maximum Current: | 700 mA |
| Power Supply Dropout Time: | 10 mSec |
| Normal Mode Rejection: | -45 dB at 50/60 Hz |
| BSM Control: | 24/48 V dc BSM |
| 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 to 10 Hz 0.2" displacement 10 to 200 Hz at 1 G |

Table 13. 6235B 6 Circuit Current Source Analog Input Block Specifications

| Characteristics | Specifications |
|---|---|
| Input Characteristics: Input Accuracy (at 25° C): Input Resolution: Input Conversion Time: Input Range: Overrange Capacity: Input Diagnostics: Channel to Channel Isolation: Thermal Drift (from 25° C): Input Impedance: | 0.1% of full scale reading 1 μ A 16.6 mSec to 400 mSec user selectable 4 to 20 mA 0 to 25 mA Open wire, overrange, underrange 1500 V rms 70 PPM per °C (typical), 140 PPM per °C (maximum) 100 ohms \pm 5% |
| Input Excitation Characteristics: Open Circuit Voltage: Short Circuit Current: Loop Impedance: | 24 V dc < 75 mA 1000 ohms maximum (0 to 20 mA) 800 ohms maximum (0 to 25 mA) |
| <u>Catalog Number Information</u> 6235BP10810 6235BP10820 6235BP10830 6235BP10910 6235BP10920 6235BP10930 | <u>Description</u> 24/48 V dc (Complete Unit) 24/48 V dc (Electronics Assembly Only) 24/48 V dc (Termination Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Complete Unit) 115 V ac, 50/60 Hz/125 V dc (Electronics Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Termination Assembly Only) |

6236B 6 Circuit Current Source Analog Output Block

The 6236B 6 Circuit Current Source Analog Output Block, [Figure 68](#), is available in two versions: one requiring a 115 V ac or 125 V dc power supply, and another requiring either 24 or 48 V dc power. They are the same in other respects. The block is used to interface to devices that accept 4 to 20 mA current signals. The 6236B Block has six outputs, numbered as outputs 1 through 6. You can also use outputs 5 and 6 for voltage applications.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

As [Figure 68](#) shows, power is brought into the block at terminals 6 and 7. Terminal 6 is used for dc positive or ac hot. Terminal 7 is used for dc negative or ac neutral. These terminals can take up to one AWG #14 wire.

I/O Channel Wiring

Field devices are wired to terminals 11 through 32 which accept AWG #22 to AWG #14 wires.

When this block is used as a Bus Switching Module (BSM) Controller, it requires a low voltage (24/48 V) BSM. Terminals 9 and 10 of the block are designed specifically for BSM connections, so the block can still support six I/O channels when it is a BSM Controller.

The six independent output channels of the block are electrically common to each other and the BSM circuit, but isolated from all other circuits of the block. They use a dual 12-bit digital-to-analog converter and can independently drive control currents from 0 to 24 mA.

An output circuit can drive a 4 to 20 mA current through a resistance of 0 to 850 ohms. The connection for outputs are shown in [Figure 68](#). [Figure 69](#) is a simplified schematic of an output channel.

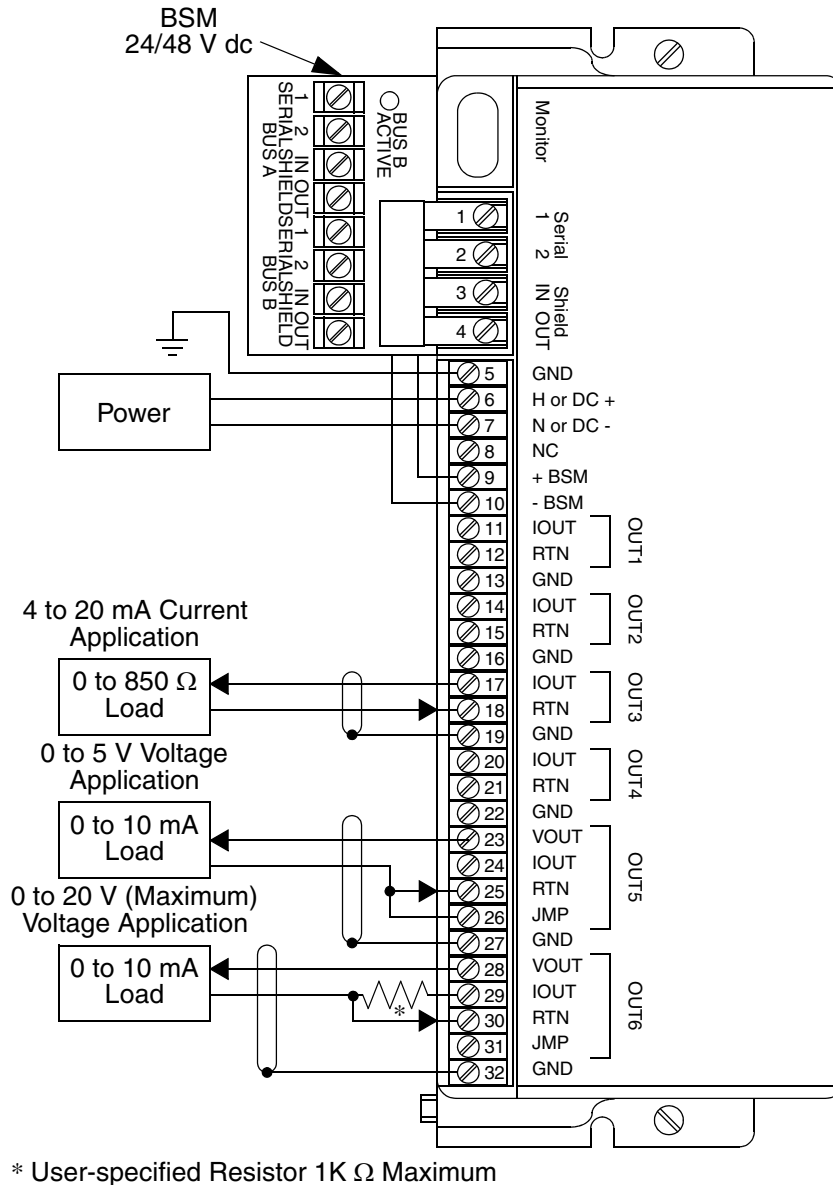


Figure 68. Terminal Connections for the 6236B 6 Circuit Current Source Analog Output Block

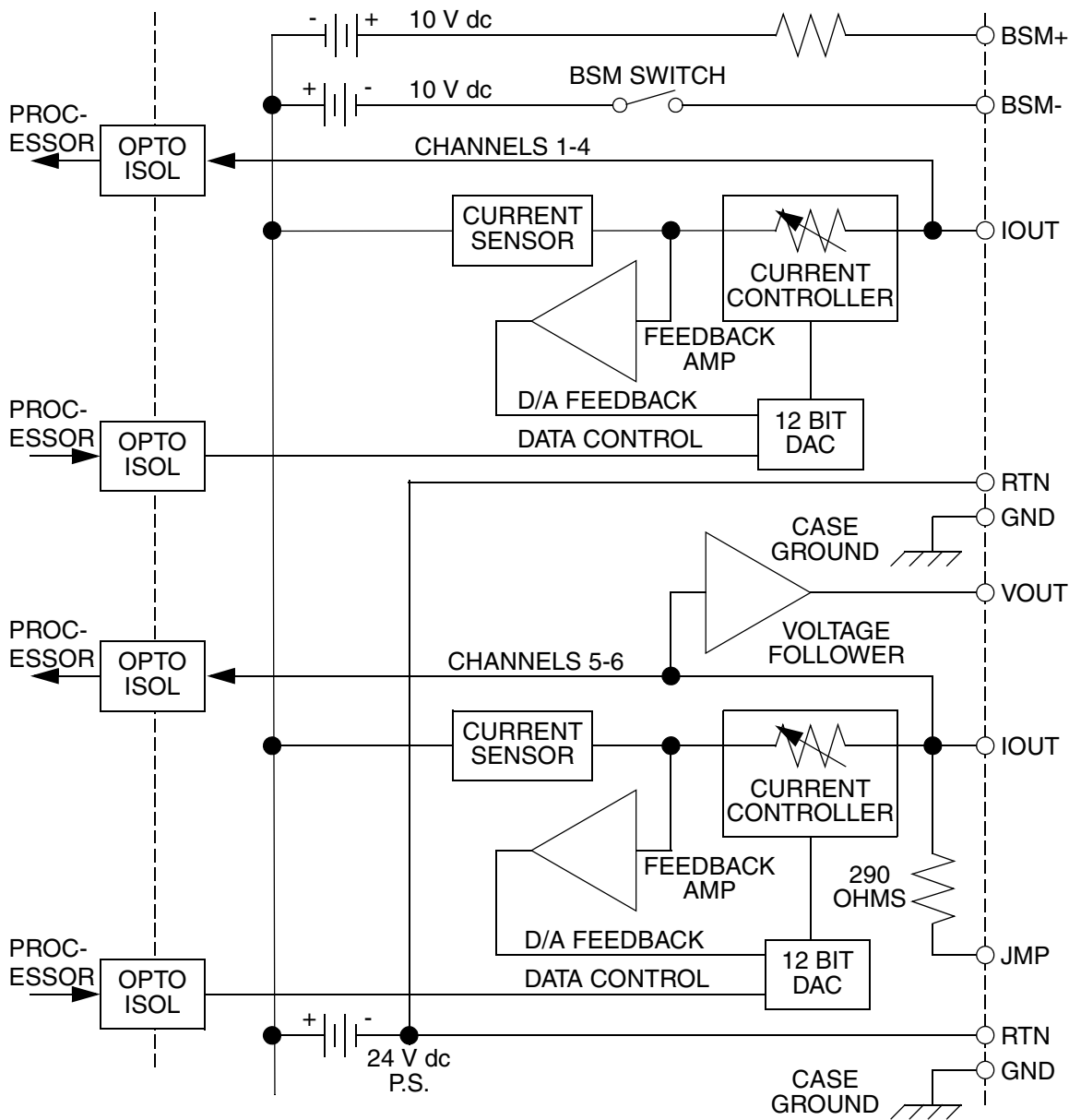


Figure 69. Output Channel Schematic for the 6236B Analog Output Block

Wiring for Current Outputs

If the output load requires current in the 4 to 20 mA range, connect it between the Isolated Output (IOUT) and Return (RTN) terminals for circuits 1 through 6.

Wiring for Voltage Outputs

If the output load requires 0 to 5 V of power, connect the load across the Voltage Output (VOUT) and Return (RTN) terminals for circuits 5 and 6 only with a jumper across the RTN and Jumper (JMP) terminals. If the output load requires a different voltage range, connect it across the VOUT and RTN terminals for circuits 5 and 6. Do not install a jumper across the RTN and JMP terminals. Instead, install an appropriate resistor across the IOUT and RTN terminals.

6236B 6 Circuit Current Source Analog Output Block Specifications

Table 14. 6236B 6 Circuit Current Source Analog Output Block Specifications

| Characteristics | Specifications |
|--------------------------------|---|
| Physical Characteristics: | |
| Block Type: | 6 current source outputs |
| LEDs (I/O Block): | Unit OK, I/O Enabled |
| Block to Block Isolation: | 1500 V |
| Insulation Resistance: | 2.2 Megohms minimum |
| Terminal Wiring: | |
| Terminals 1 to 4: | one AWG #12 or two AWG #14 |
| Terminals 5 to 32: | AWG #22 to AWG #14 |
| Weight: | 4 lbs (1.8 kg) |
| Heat Dissipation: | 12 W maximum |
| 115 V ac/125 V dc Block Power: | 115 V ac 125 V dc |
| Power Supply Voltage: | 93 to 132 Vac 6W 105 to 145 V dc at 6 W |
| Frequency/Ripple: | 47 to 63 Hz 10% maximum ripple |
| Maximum Current: | 250 mA 140 mA |
| Power Supply Dropout Time: | 1 cycle 10 mSec |
| 24/48 V dc Block Power: | |
| Power Supply Voltage: | 18 to 56 V dc |
| Maximum Current: | 600 mA |
| Ripple: | 10% maximum |
| Power Supply Dropout Time: | 10 mSec |
| BSM Control: | 24/48 V dc BSM |
| 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 to 10 Hz 0.2 inch displacement 10 to 200 Hz at 1 G |

Table 14. 6236B 6 Circuit Current Source Analog Output Block Specifications

| Characteristics | Specifications |
|---|---|
| Output Characteristics: Output Accuracy (at 25° C): Output Resolution: Output Update Frequency: Output Range: Overrange Capacity: Output Diagnostics: Load: Thermal Drift (from 25° C): | 0.15% FSR 6 μ A 25 mSec 4 to 20 mA 0 to 24 mA Overrange, underrange, feedback error 0 to 850 ohms (current application) 0 to 10 mA (0 to 5 V voltage application) 0 to 10 mA (0 to 20 V voltage application) 35 PPM per °C (typical), 70 PPM per °C (maximum) |
| <u>Catalog Number Information</u> 6236BP10810 6236BP10820 6236BP10830 6236BP10910 6236BP10920 6236BP10930 | <u>Description</u> 24/48 V dc (Complete Unit) 24/48 V dc (Electronics Assembly Only) 24/48 V dc (Termination Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Complete Unit) 115 V ac, 50/60 Hz/125 V dc (Electronics Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Termination Assembly Only) |

6232B 6 Circuit Thermocouple Input Block

The 6232B 6 Circuit Thermocouple Input Block, [Figure 70](#), is available in two versions: one requiring a 115 V ac power supply, and another requiring either 24 or 48 V dc power. The blocks are the same in other respects. The block has six input channels, in three isolated groups of two channels apiece. Each input can be used with thermocouple types J, K, T, E, B, R, S, and N. A linear (L) option allows for millivolt inputs in the range of -25.00 to 150.00 mV.

The input data for each channel is linearized according to the thermocouple type selected. The value can be scaled in tenths of degrees Celsius or tenths of degrees Fahrenheit, for example, if the temperature is 115.6, 1156 is put on the Field Bus. [Table 15](#) lists the supported thermocouple types and their temperature ranges.

Table 15. Supported Thermocouple Types and Ranges

| Type | Minimum °C | Maximum °C |
|------------------|------------|------------|
| J | -210.0 | 1200.0 |
| K | -270.0 | 1370.0 |
| T | -270.0 | 400.0 |
| E | -270.0 | 1000.0 |
| B | 20.0 | 1820.0 |
| R | -50.0 | 1770.0 |
| S | -50.0 | 1770.0 |
| N ⁽¹⁾ | 0.0 | 1300.0 |

(1) The supported N type thermocouples are the #14 AWG Nicrosil vs. Nisil variety.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

As [Figure 70](#) shows, power is brought into the block at terminals 5 and 6. Terminal 5 is used for dc positive or ac hot. Terminal 6 is used for dc negative or ac neutral. These terminals can take up to one AWG #14 wire.

I/O Channel Wiring

Terminals 7 and 8 allow the block to be a BSM Controller while it still services a full complement of six input channels. This allows it to be the first module on a Field Bus stub.

The input channels are divided into three isolated groups with two channels per group. Each group has connections for two thermocouples plus voltage and current remote temperature sensors. The connections for a thermocouple depend on the cold junction compensation technique.

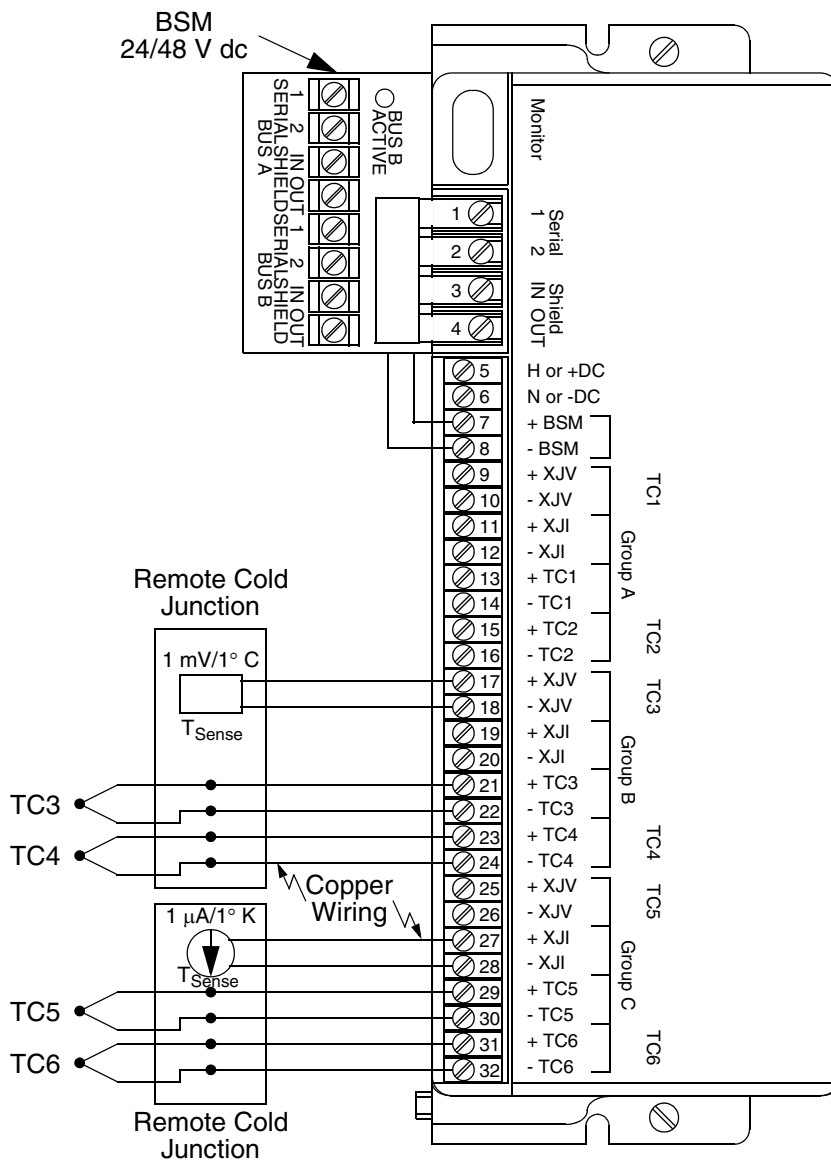


Figure 70. Terminal Connections for a 6232B 6 Circuit Thermocouple Input Block

Using Internal Sensor for Cold Junction Compensation

Figure 71 shows the terminal connections for a thermocouple using an internal temperature sensor for cold junction compensation.

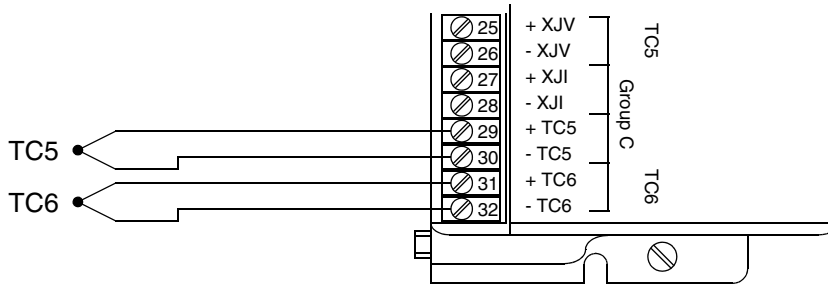


Figure 71. Terminal Connections for a Thermocouple using an Internal Temperature Sensor for Cold Junction Compensation

The 6232B 6 Circuit Thermocouple Input Block has temperature sensors mounted within its terminal strip. The signals from the sensors can be used to compensate for cold junction effects if the thermocouple wires are directly attached to the terminal strip. It is assumed the TRIO block is in an area where the temperature range is no greater than 0 to 60 degrees Celsius.

When internal compensation is used, the following entry must be made when the block is configured:

| <u>Thermocouple Templet Field</u> | <u>Entry</u> |
|-----------------------------------|--------------|
| CHAN n COMPENSATION | INTERNAL |

Using Remote Sensor for Cold Junction Compensation

Figure 72 shows the terminal connections for a thermocouple using a remote sensor for cold junction compensation.

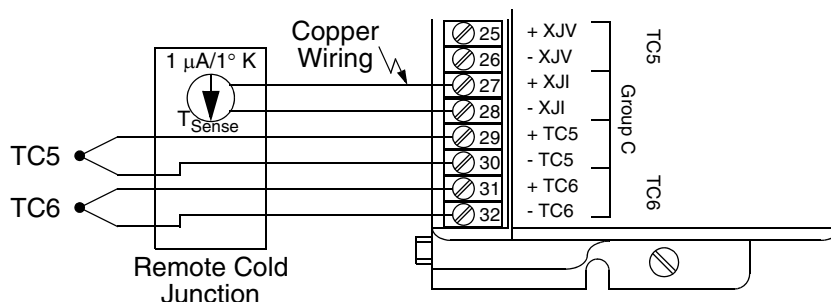


Figure 72. Terminal Connections for a Thermocouple using a Remote Temperature Sensor for Cold Junction Compensation

When remote cold junction compensation is used, the thermocouple wires are connected to copper wires on a remote terminal panel. The copper wires are then attached to the terminal strip on the 6232B 6 Circuit Thermocouple Input Block. A sensor is mounted on the terminal board to measure its temperature. The signal from this sensor is used to compensate for the effects of the junction between the thermocouple and the copper wires on the board.

The +XJI and -XJI terminals are used for sensors that produce current signals. The block is set up to process a signal in which 1 microamp represents 1 degree Kelvin. The Analog Device AD592CN Temperature Sensitive Diode has this characteristic. Terminals +XJI and -XJI provide the power required by this diode.

+XJV and -XJV are used for voltage sensors. The block is set up to process a signal in which one millivolt represents one degree Celsius.

It is possible to use remote sensor compensation for junctions whose temperature is in the range of -25 to +100 degree Celsius.

When a remote sensor is used the following entries must be made when the block is configured:

| <u>Thermocouple Templet Field</u> | <u>Entry</u> |
|-----------------------------------|--|
| CHAN _n COMPENSATION | XJA [if the sensor produces a current signal] |
| | XJV [if the sensor produces a voltage signal] |

Using Fixed Configurable Value for Cold Junction Compensation

Figure 73 shows the terminal connections for a thermocouple using a fixed configured value for cold junction compensation.

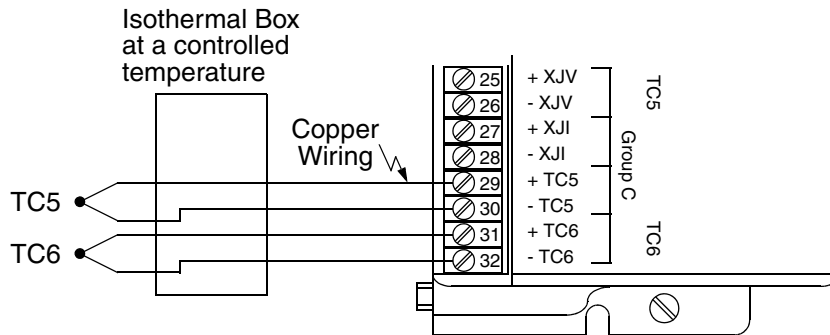


Figure 73. Terminal Connections for a Thermocouple Using a Fixed Configured Value for Cold Junction Compensation

It is possible to use a fixed configurable value to compensate for junction effects. This technique is usually used when the thermocouple wire/copper junction is made within an isothermal box whose temperature is maintained at a constant value.

When user compensation is used, the following entries must be made when the block is configured:

| <u>Thermocouple Templet Field</u> | <u>Entry</u> |
|-----------------------------------|--------------|
| CHAN n COMPENSATION | USER DEFINED |
| CHAN n USER VALUE | nnnn |

where:

nnnn is a number of millivolts in the range of -327.67 to +327.67.

You must use thermocouple tables to determine the effect in millivolts for junctions of that type of thermocouple maintained at the temperature within the isothermal box.

Millivolt Inputs

Figure 74 shows the terminal connections for millivolt inputs.

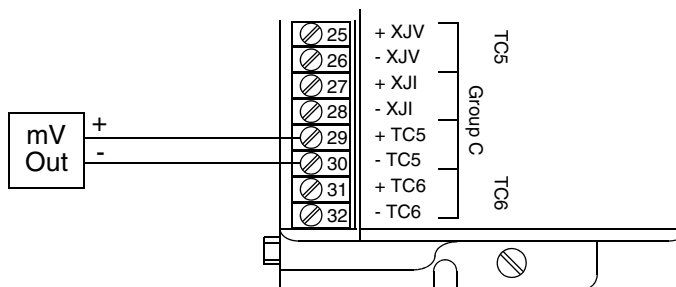


Figure 74. Terminal Connections for Millivolt Inputs

The block can accept a millivolt input if it is in the range of -25.00 to 150.00 mV.

There are two methods for configuring millivolt inputs. If all inputs to the block are millivolt inputs, it is handled with the entry:

| <u>Thermocouple Templet Field</u> | <u>Entry</u> |
|-----------------------------------|--------------|
| ENG UNITS | MV |

If some block inputs are from millivolt sources while others are from thermocouples, the entries are:

| <u>Thermocouple Templet Field</u> | <u>Entry</u> |
|-----------------------------------|----------------|
| ENG UNITS | DEGC (or DEGF) |

The entries for a millivolt channel are:

| <u>Thermocouple Templet Field</u> | <u>Entry</u> |
|-----------------------------------|---|
| CHAN <i>n</i> TC TYPE | L (for Linear, treats 1 mV as equal to 10° C) |
| CHAN <i>n</i> COMPENSATION | USER DEFINED |
| CHAN <i>n</i> USER VALUE | 0 |

6232B 6 Circuit Thermocouple Input Block Specifications

Table 16. 6232B 6 Circuit Thermocouple Input Block Specifications

| Characteristics | Specifications |
|---|--|
| Physical Characteristics: LEDs (I/O Block): Block to Block Isolation: Insulation Resistance: Group to Group Isolation: Terminal Wiring: Terminals 1 to 4: Terminals 5 to 22: Weight: Heat Dissipation: 115 V ac/125 V dc Block Power: Power Supply Voltage: Frequency/Ripple: Power Supply Dropout Time: 24/48 V dc Block Power: Power Supply Voltage: Power Supply Dropout Time: BSM Control: | Unit OK, I/O Enabled 1500 V 2.2 Megohms minimum 300 V AWG #12 or 2 AWG #14 AWG #22 to AWG #14 4 lbs (1.8 kg) 9 W maximum 115 V ac 125 V dc 93-132 V ac at 9 W 105 to 145 V dc at 9 W 47 to 63 Hz 10% maximum ripple 1 cycle 10 mSec 18 to 56 V dc at 9 W, 10% maximum ripple 10 mSec 24/48 V dc BSM |
| Environmental: Operating Temperature: Storage Temperature: Humidity: | 0° to 60° C (32° to 140° F) -40° to +100° C (-40° to +212° F) 5% to 95% (non-condensing) |

Table 16. 6232B 6 Circuit Thermocouple Input Block Specifications

| Characteristics | Specifications |
|---|---|
| <p>Input Characteristics:</p> <p>Voltage Measurement:</p> <p> Range:</p> <p> Resolution:</p> <p> Accuracy (at 25 °C):</p> <p> Bandwidth of Input Amplifier</p> <p> Filter:</p> <p> Temperature Coefficient:</p> <p>Internal Cold Junction Measurement:</p> <p> Range:</p> <p> Offset (at 25 °C):</p> <p> Linearity:</p> <p> Temperature Coefficient:</p> <p> Resolution:</p> <p>External Cold Junction Measurement:</p> <p> Range:</p> <p> Scale Factors:</p> <p> Resolution:</p> <p> Accuracy:</p> <p>Input Update Time:</p> <p>Open Wire Detection Response:</p> <p>Diagnostics:</p> | <p>-25.0 mV to +150.0 mV</p> <p>less than $\pm 4 \mu\text{V}$</p> <p>less than $\pm 10 \mu\text{V}$ typical, $\pm 20 \mu\text{V}$ maximum</p> <p>8 Hz</p> <p>± 2 microvolts/°C typical, ± 4 microvolts/°C maximum</p> <p>0 to 60 °C</p> <p>$\pm 2^\circ \text{C}$ typical, user adjustable to zero at any temperature</p> <p>$\pm 0.15 \text{ }^\circ\text{C}$</p> <p>$\pm 0.05$ per °C</p> <p>less than $\pm 0.01 \text{ }^\circ\text{C}$</p> <p>-25.0 °C to +150.0 °C</p> <p>1.0 °C per millivolt, 1.0 °K per microampere</p> <p>less than $\pm 0.01 \text{ }^\circ\text{C}$</p> <p>$\pm 0.1 \text{ }^\circ\text{C}$</p> <p>2.2 seconds typical, 3.0 seconds maximum</p> <p>less than 5.0 seconds</p> <p>Open wire, overrange, underrange, internal faults</p> |
| <p><u>Catalog Number Information</u></p> <p>6232BP10710</p> <p>6232BP10720</p> <p>6232BP10730</p> <p>6232BP10810</p> <p>6232BP10820</p> <p>6232BP10830</p> | <p><u>Description</u></p> <p>115 V ac, 50/60 Hz (Complete Unit)</p> <p>115 V ac, 50/60 Hz (Electronics Assembly Only)</p> <p>115 V ac, 50/60 Hz (Termination Assembly Only)</p> <p>24/48 V dc (Complete Unit)</p> <p>24/48 V dc (Electronics Assembly Only)</p> <p>24/48 V dc (Termination Assembly Only)</p> |

6233B 6 Circuit RTD Input Block

The 6233B 6 Circuit RTD Input Block is used to monitor temperature with Resistive Temperature Detectors (RTDs) connected to the inputs. The blocks are available in two versions: one uses a 115 V ac or 125 V dc power supply, the other requires either 24 or 48 V dc power. They are the same in other respects.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

Field devices are wired to terminals 9 through 32 which accept AWG #22 to AWG #14 wires. As [Figure 75](#) shows, power is brought into the block via terminals 6 and 7. Terminal 6 is used for dc positive or ac hot. Terminal 7 is used for dc negative or ac neutral.

Inputs to the 6233B 6 Circuit RTD Input Block

This section describes the connection required to attach RTDs to the inputs. The block automatically performs a number of diagnostic test that affect the inputs.

A 6233B 6 Circuit RTD Input Block has six input circuits, in three groups of two circuits ([Figure 75](#)). 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. The value can be scaled in degrees Celsius, degrees Fahrenheit, or ohms. To increase resolution, the block puts a value in tenths of degrees on the Field Bus, for example, if the temperature is 115.6, 1156 is put on the Field Bus.

Each input channel has Signal (SIG), Return (RTN), Reference (REF) and Shield (SHLD) terminals. The SHLD terminal is connected to the block chassis and to the input power safety ground terminal.

For a two wire RTD, connect the RTD leads to SIG and RTN. The REF terminal should be connected to RTN. If provided, the shield of the RTD cable can be connected to SHLD.

For a three wire RTD, connect the RTD leads to SIG and RTN and the third wire to REF. If provided, the shield of the RTD cable can be connected to SHLD.

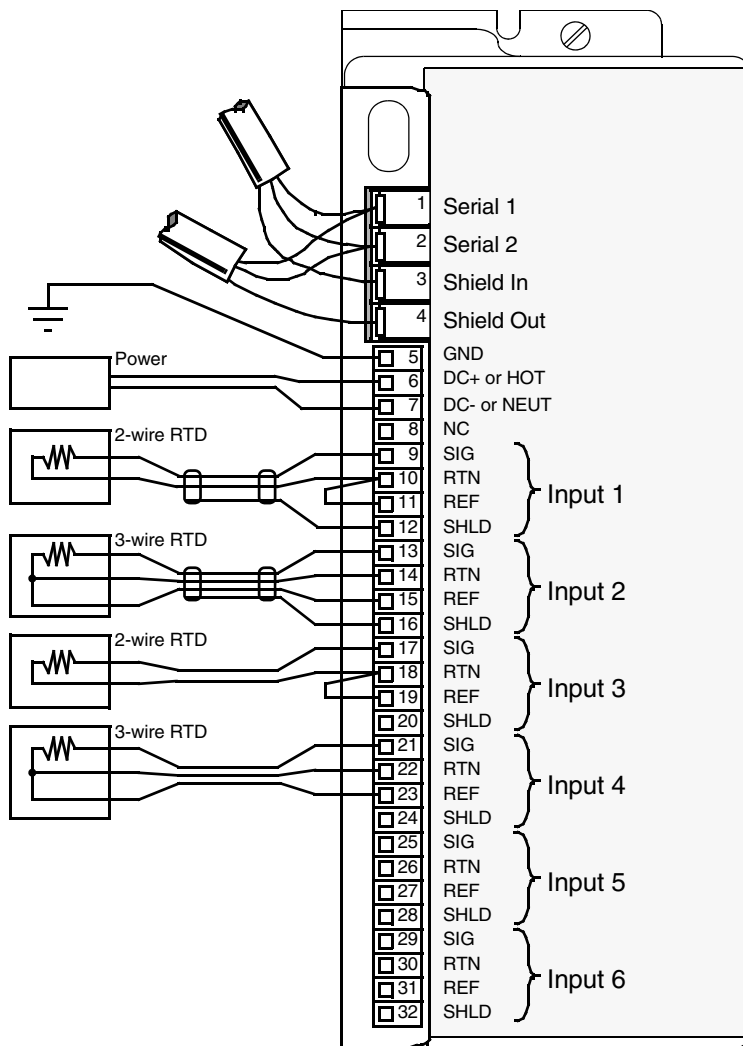


Figure 75. Terminal Connections for a 6233B 6 Circuit RTD Input Block

The 6233B 6 Circuit RTD Input Block is factory-calibrated. Its automatic self-calibration feature eliminates the need for subsequent recalibration. 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. Figure 76 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 (SVFC) changes the measured signals to the proportional frequency sent via an opto-coupler to the processor. The frequency counter in the processor converts this synchronous frequency to a 16-bit binary number.

The processor corrects each input measurement for lead resistance, internal offset and gain drifts as it converts the input to a value in ohms. 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 to 1600 mSec (16 bit resolution). You can change it to 400 or 800 mSec which provide 14 and 15 bit resolution respectively.

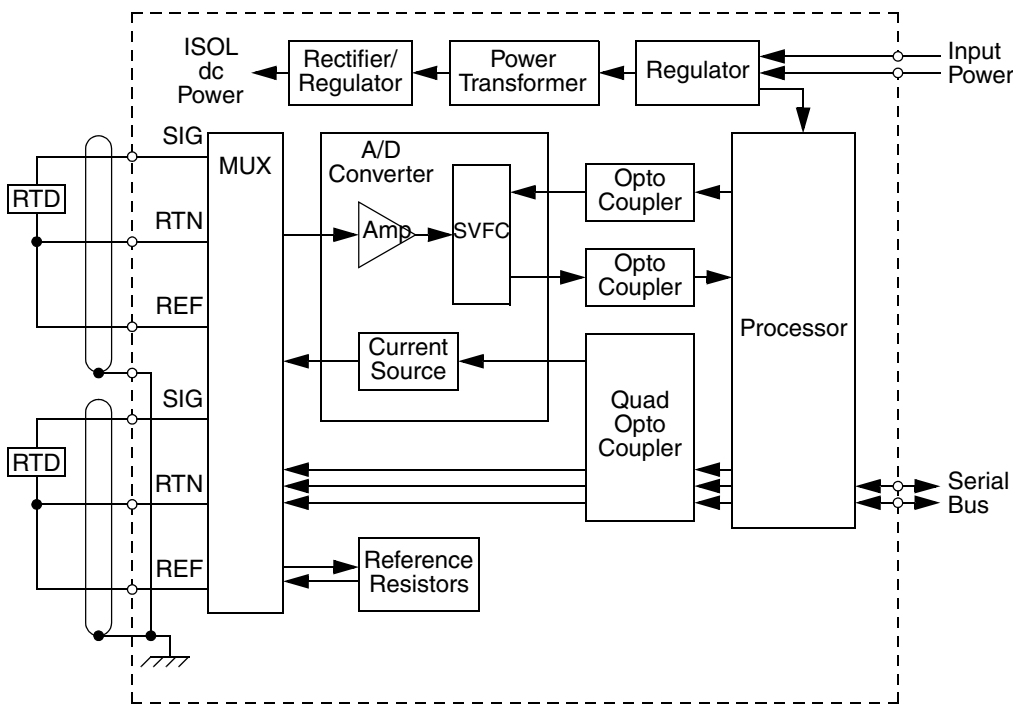


Figure 76. Multiplexer Circuitry for RTD Inputs

6233B 6 Circuit RTD Input Block Specifications

Table 17. 6233B 6 Circuit RTD Input Block Specifications

| Characteristics | Specifications |
|--|--|
| Physical Characteristics: Block Type: LEDs (I/O Block): Block to Block Isolation: Insulation Resistance: Group to Group Isolation: Terminal Wiring: Terminals 1 to 4: Terminals 5 to 22: Weight: Heat Dissipation: 115 V ac/125 V dc Block Power: Power Supply Voltage: Power Supply Frequency: Power Supply Dropout Time: 24/48 V dc Block Power: Power Supply Voltage: Power Supply Dropout Time: | 6 RTD-compatible inputs, 3 isolated groups of 2 Unit OK, I/O Enabled 1500 V 2.2 Megohms minimum 300 V one AWG #12 or two AWG #14 AWG #22 to AWG #14 4 lbs. (1.8 kg) 10 W maximum 115 V ac 125 V dc 93-132 V ac at 10 W/105 to 145 V dc at 10 W 47 to 63 Hz 10% maximum ripple 1 cycle 10 mSec |
| Environmental: Operating Temperature: Storage Temperature: Humidity: | 0° to 60° C (32° to 140° F) -40° to +100° C (-40° to +212° F) 5% to 95% (non-condensing) |

Table 17. 6233B 6 Circuit RTD Input Block Specifications

| Characteristics | Specifications |
|--|--|
| Input Characteristics: Input Resolution: Absolute Accuracy (at 25° C): Platinum or Nickel: 10Ω Copper: Temperature Coefficient: Platinum or Nickel: Copper: Input Update Frequency: Input Filter Ranges (per Block): RTD Linearization: Resistance Measurement Range: Diagnostics: | $\pm 0.1^{\circ} \text{C}$ $\pm 0.5^{\circ} \text{C}$ typical, $\pm 1.0^{\circ} \text{C}$ maximum $\pm 5^{\circ} \text{C}$ typical, $\pm 10^{\circ} \text{C}$ maximum 0.2°C per $^{\circ} \text{C}$ maximum 2°C per $^{\circ} \text{C}$ maximum Once every 400, 800, or 1600 mSec 400, 800, 1600 mSec Platinum (DIN 43760), Nickel (DIN 43760), Copper, Linear 0 to 5000Ω Input shorted, internal fault, wiring error, open wire, overrange, underrange, high alarm, low alarm |
| <u>Catalog Number Information</u> 6233BP10810 6233BP10820 6233BP10830 6233BP10910 6233BP10920 6233BP10930 | <u>Description</u> 24/48 V dc (Complete Unit) 24/48 V dc (Electronics Assembly Only) 24/48 V dc (Termination Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Complete Unit) 115 V ac, 50/60 Hz/125 V dc (Electronics Assembly Only) 115 V ac, 50/60 Hz/125 V dc (Termination Assembly Only) |

Section 5 High Speed Counter Block Characteristics

Overview

The 6234B High Speed Counter block, [Figure 77](#), is a self contained configurable I/O block which provides processing for pulse signals of up to 200 kHz.

The four outputs of the block can drive indicating lights, solenoids, relays, and other devices. Each output has a response delay of one millisecond maximum; repeatability is 0.5 mSec or less. Each output circuit provides built-in protection against overload and short circuit conditions caused by wiring errors.

The state of each output is shown by an individual LED on the block. The outputs of the block are programmable to turn on or off when the accumulated count reaches appropriate values. Short circuits and surges of short duration are tolerated. Outputs can be forced on or off using the Hand-held Monitor (HHM). This is useful during installation and checkout. Use a HHM at version 3.5 or higher to set the block baud rate and number and monitor the block.

The block also provides a square wave oscillator output for use as a timing reference for measurement. The output oscillates at a basic frequency of 10 kHz. You can change the frequency when the block is configured.

The block provides a +5 V output that delivers 4.75 to 5.25 V at 200 mA.

Power to operate the block may be either 115 VAC or 10-30 VDC. For backup block power, both block power voltage types can be used simultaneously. Outputs may be powered by any adequate 5-30 VDC source. A 5 VDC output is provided on the block to power loads that do not total more than 200 mA.

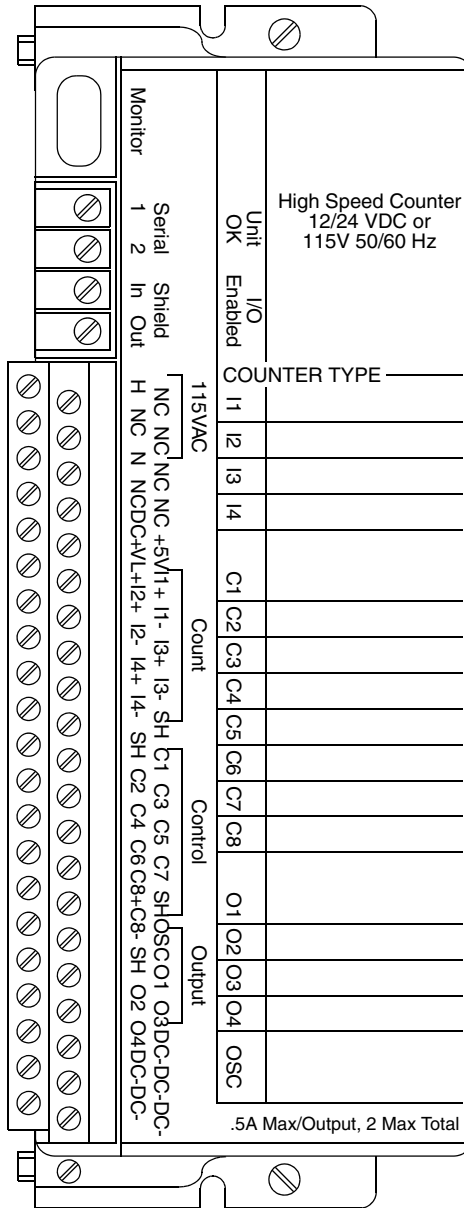


Figure 77. 6234B High Speed Counter Block

The High Speed Counter block accumulates digital inputs and, through direct processing, can switch outputs within one millisecond of reaching a target count. The block can also calculate rate information by measuring the incremental counts over a selectable time base from 1 millisecond to 65535 milliseconds.

Typical applications include:

- Turbine flowmeter.
- Velocity measurement.
- Motion control.

For precise control of the amount of material added in a batch process, the counter can accumulate pulses from a flow meter until a predetermined amount of material has been added, then turn off an output within one millisecond. It can also be used to setup a two rate flow, a high rate until the total material flow approaches the target value, and then a reduced rate to assure the target is not exceeded.

Field Bus and Block Power Wiring

Terminals 1 to 4 on the block are the standard TRIO Block Field Bus Connectors. Instructions in [Connecting Devices to the Field Bus](#) on page 49, explain how to use these terminals to attach the block to a Field Bus.

Field devices are wired to terminals 9 through 32 which accept AWG #22 to AWG #14 wires. As [Figure 82](#) and [Figure 87](#) show, ac power is brought into the block via terminals 5 and 9. Terminal 5 is used for ac hot. Terminal 9 is used for ac neutral. DC power is brought in to terminal 13 (DC+).

Power to operate the block may be 115 V ac or 10 to 30 V dc. Loads (outputs) may be powered by any adequate 5 to 30 V dc source. For backup block power, both 115 V ac and 10 to 30 V dc can be used simultaneously.

If Class 1, Division 2 conditions must be met for Factory Mutual, install an external 250 volt, one eighth amp slow blow fuse in series with the hot ac power connector.

If no dc voltage is connected to VL+, the Pulse Test feature should be disabled to prevent false Failed Switch messages when the block is powered up. With no dc voltage on VL+, the outputs do not turn on and the output LEDs do not light.

Block Power, No Outputs

If the block is powered by 115 V ac and outputs O1 through O4 are not used, connect the HOT lead to the H terminal (terminal 5), and connect neutral to the N terminal (terminal 9), [Figure 78](#). Ground the block using the ground screw on the outer casing of the block.

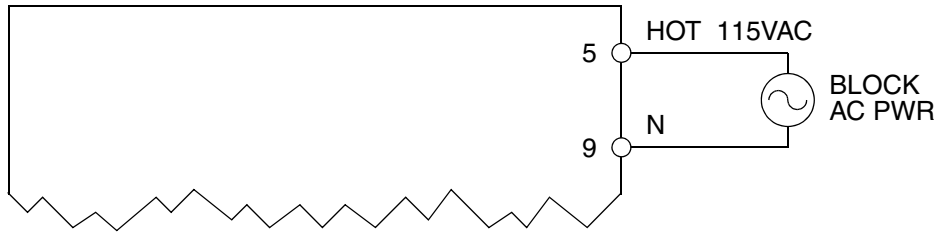


Figure 78. Block Power Connections When No Outputs are Used

Block Power When Outputs Used

If any of the outputs (O1 through O4) are used, also connect a dc power source of 5 to 30 V dc across the VL+ and DC- terminals to drive the loads, [Figure 79](#). The +5 V dc output may also be used if logic-level output signals are adequate.

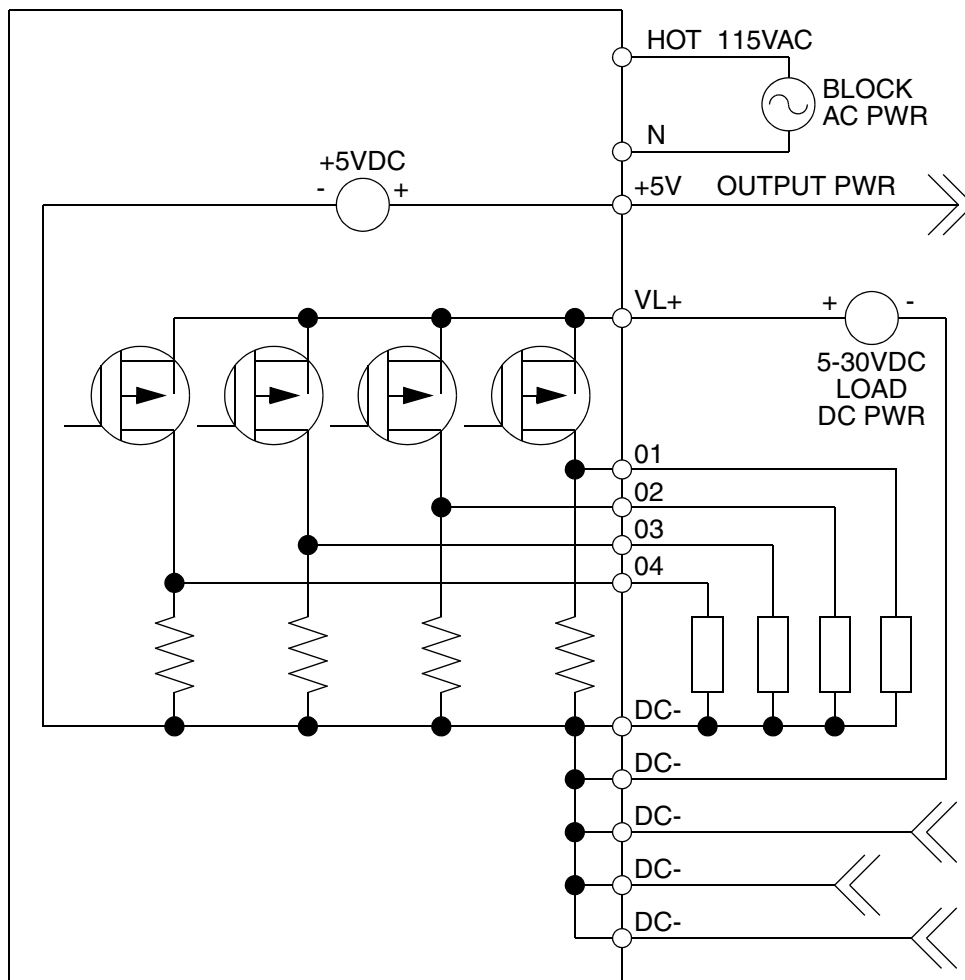


Figure 79. Block Power Connections When Outputs are Used

Backup Block Power

The block allows the use of auxiliary dc power when the main power to the block is supplied by 115 V ac. Both 115 V ac and dc power may be supplied simultaneously. If the 115 V ac source fails, the block continues to operate on the dc backup power. Any dc source that can provide an output in the range of 10 to 30 V dc can be used. The source must meet the specifications listed in this chapter. With both ac and dc power applied, block power is taken from the ac input as long as the dc voltage is less than 20 volts.

Figure 80 shows an external battery used for backup block power, with loads powered by the 5 V dc output of the block.

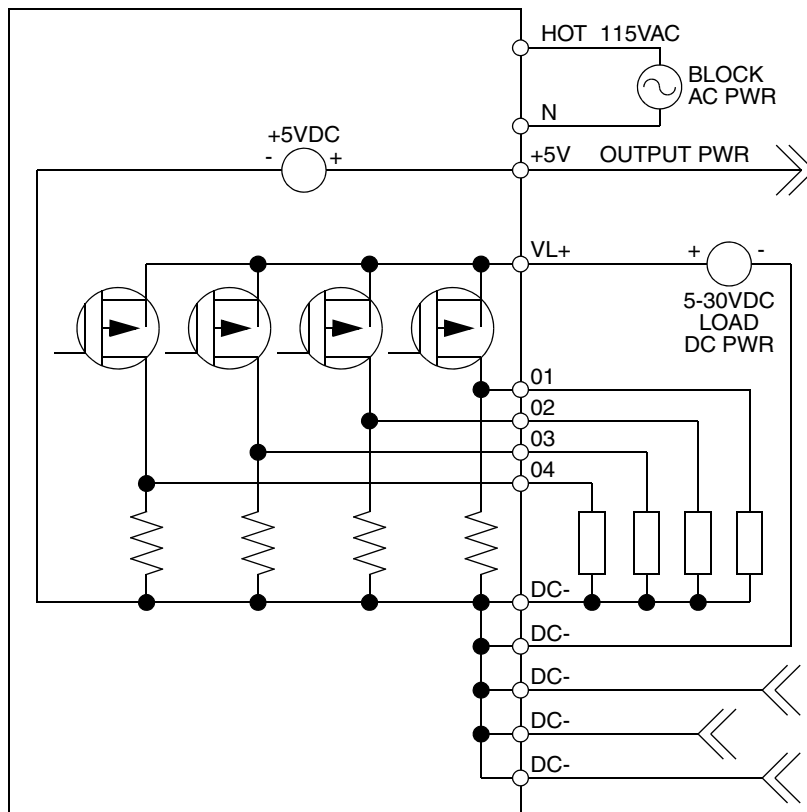


Figure 80. dc Battery as Backup Power Supply

DC Block Power

If the block is powered by a dc source, connect the '+' side of the source to the DC+ terminal (terminal 13). Connect the '-' side to any DC- terminal (terminals 42 through 46).

If any of the block outputs (O1 through O4) are used, power to drive the outputs can be obtained from the same 10 to 30 V dc source connected across the DC+ and DC- terminals by jumpering VL+ (terminal 15) to DC+. Alternately, a separate 10 to 30 V dc source can be used for outputs when connected across DC- and VL+ terminals. If logic-level outputs are needed, and the overall output loading is less than 200 mA, jumper the 5 V output to VL+. The return line of all external dc sources should be connected to the DC- terminal. See [Figure 81](#).

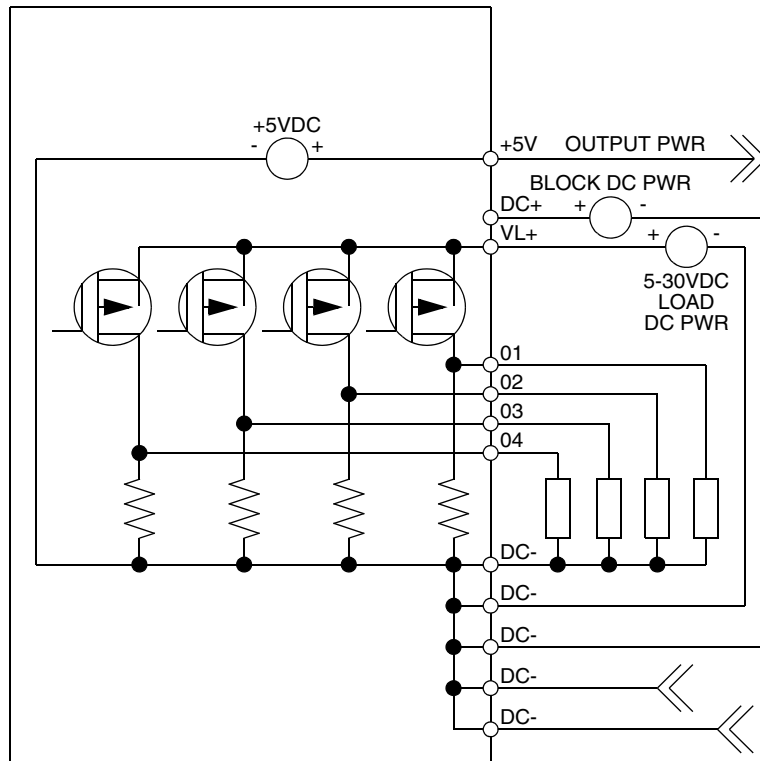


Figure 81. dc Block Power Connections

+5 V dc Output

In addition to the four control outputs of the block, it also provides a +5 V output that delivers 4.74 to 5.25 V at 200 mA. This source can be used to power the output loads and/or any other load that does not exceed 200 mA.

Terminal Connections

When the block is powered up, if the Powerup Pulse Test is enabled, but no dc load voltage is connected to the VL+ terminal, a Failed Switch diagnostic is reported.

Terminal Connections for a Type A Block

[Figure 82](#) shows the terminal connections for the block when the Type A Configuration is chosen. [Figure 83](#) through [Figure 86](#) show the circuitry within the block for the inputs. For single ended inputs, the signal lead goes to the designated terminal and the common lead goes to DC-. Leave the negative input unconnected for differential inputs used single-endedly.

| TERMINAL CONTACT | SIGNAL NAME | DESCRIPTION |
|------------------|-------------|------------------------------------|
| 1 | SERIAL 1 | serial communications bus |
| 2 | SERIAL 2 | serial communications bus |
| 3 | SH IN | shield for serial bus |
| 4 | SH OUT | shield for serial bus |
| 5 | HOT | for hot side of AC line |
| 6 | NC | no connection |
| 7 | NC | no connection |
| 8 | NC | no connection |
| 9 | N | for neutral side of AC line |
| 10 | NC | no connection |
| 11 | NC | no connection |
| 12 | NC | no connection |
| 13 | DC+ | block power (+ side 10-30V source) |
| 14 | +5V | +5V output at 200mA |
| 15 | VL+ | load power (+ side 5-30V source) |
| 16 | I1+ | pulse input for ctr 1 (se/diff) |
| 17 | I2+ | pulse input for ctr 2 (se/diff) |
| 18 | I1- | pulse input for ctr 1 (diff only) |
| 19 | I2- | pulse input for ctr 2 (diff only) |
| 20 | I3+ | pulse input for ctr 3 (se/diff) |
| 21 | I4+ | pulse input for ctr 4 (se/diff) |
| 22 | I3- | pulse input for ctr 3 (diff only) |
| 23 | I4- | pulse input for ctr 4 (diff only) |
| 24 | SHD | shield |
| 25 | SHD | shield |
| 26 | C1 | preload 1 |
| 27 | C2 | preload 2 |
| 28 | C3 | preload 3 |
| 29 | C4 | preload 4 |
| 30 | C5 | strobe 1 |
| 31 | C6 | strobe 2 |
| 32 | C7 | strobe 3 |
| 33 | C8+ | strobe 4 (se/diff) |
| 34 | SHD | shield |
| 35 | C8- | strobe 4 (diff only) |
| 36 | OSC | oscillator output |
| 37 | SHD | shield |
| 38 | O1 | output 1 |
| 39 | O2 | output 2 |
| 40 | O3 | output 3 |
| 41 | O4 | output 4 |
| 42 | DC- | return for all DC sources |
| 43 | DC- | return for all DC sources |
| 44 | DC- | return for all DC sources |
| 45 | DC- | return for all DC sources |
| 46 | DC- | return for all DC sources |

Figure 82. High Speed Counter Block Type A Wiring Diagram

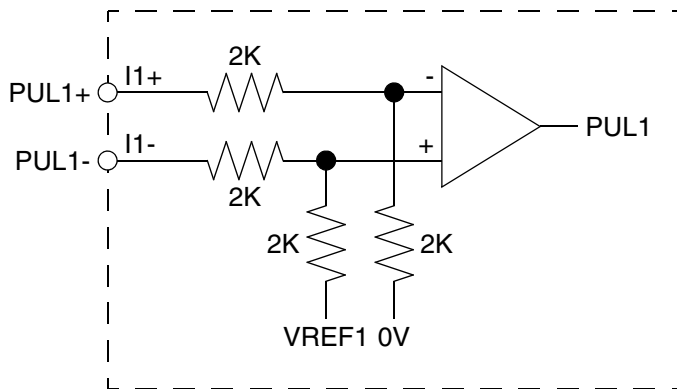


Figure 83. Internal Circuitry for Type A Counter 1

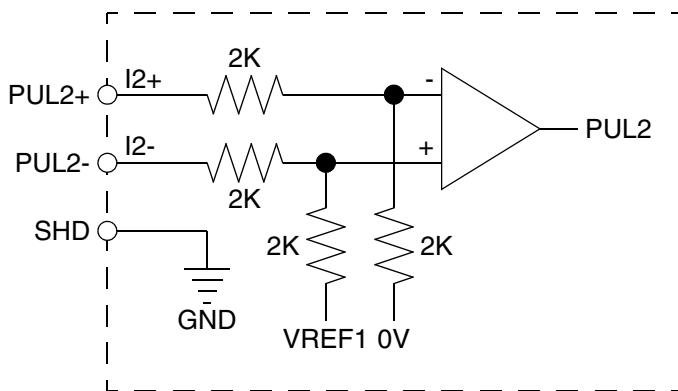


Figure 84. Internal Circuitry for Type A Counter 2

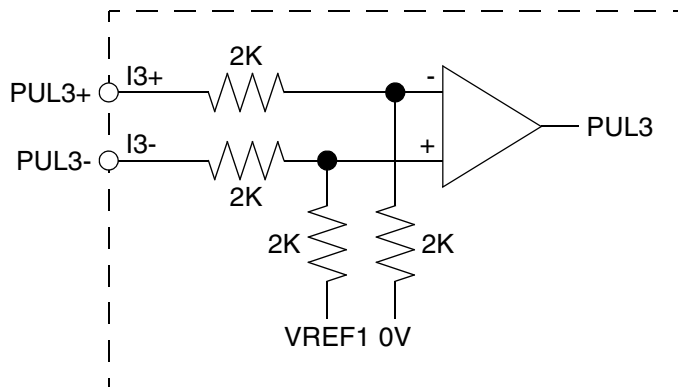


Figure 85. Internal Circuitry for Type A Counter 3

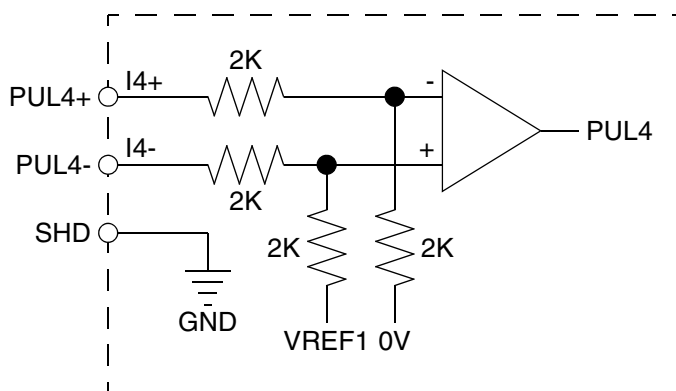


Figure 86. Internal Circuitry for Type A Counter 4

Terminal Connections for a Type B Block

Figure 87 shows the terminal connections for the block when the Type B Configuration is chosen. Figure 88 through Figure 90 show the circuitry within the block for the inputs. For single ended inputs, the signal lead goes to the designated terminal and the common lead goes to DC-. Leave the negative input unconnected for differential inputs used single-endedly.

| TERMINAL CONTACT | SIGNAL NAME | DESCRIPTION |
|------------------|-------------|--|
| 1 | SERIAL 1 | serial communications bus |
| 2 | SERIAL 2 | serial communications bus |
| 3 | SH IN | shield for serial bus |
| 4 | SH OUT | shield for serial bus |
| 5 | HOT | for hot side of AC line |
| 6 | NC | no connection |
| 7 | NC | no connection |
| 8 | NC | no connection |
| 9 | N | for neutral side of AC line |
| 10 | NC | no connection |
| 11 | NC | no connection |
| 12 | NC | no connection |
| 13 | DC+ | block power (+ side 10-30V source) |
| 14 | +5V | +5V output at 200mA |
| 15 | VL+ | load power (+ side 5-30V source) |
| 16 | I1+ | pul1 / up1 / A1+ for ctr 1 (se/diff) |
| 17 | I2+ | dir1 / dn1 / B+ for ctr 2 (diff only) |
| 18 | I1- | pul1 / up1 / A- for ctr 1 (diff only) |
| 19 | I2- | dir1 / dn1 / B- for ctr 2 (diff only) |
| 20 | I3+ | pul2 / up2 / A2+ for ctr 3 (se/diff) |
| 21 | I4+ | dir2 / dn2 / B2+ for ctr 4 (se/diff) |
| 22 | I3- | pul2 / up2 / A2- for ctr 3 (diff only) |
| 23 | I4- | dir2 / dn2 / B2- for ctr 4 (diff only) |
| 24 | SHD | shield |
| 25 | SHD | shield |
| 26 | C1 | preload 1 |
| 27 | C2 | preload 2 |
| 28 | C3 | disable 1 |
| 29 | C4 | disable 2 |
| 30 | C5 | strobe 1 for counter 1 |
| 31 | C6 | strobe 2 for counter 1 |
| 32 | C7 | strobe 1 for counter 2 |
| 33 | C8+ | strobe 2 for counter 2 (se/diff) |
| 34 | SHD | shield |
| 35 | C8- | strobe 2 for counter 2 (diff only) |
| 36 | OSC | oscillator output |
| 37 | SHD | shield |
| 38 | O1 | output 1 for counter 1 |
| 39 | O2 | output 2 for counter 1 |
| 40 | O3 | output 1 for counter 2 |
| 41 | O4 | output 2 for counter 2 |
| 42 | DC- | return for all DC sources |
| 43 | DC- | return for all DC sources |
| 44 | DC- | return for all DC sources |
| 45 | DC- | return for all DC sources |
| 46 | DC- | return for all DC sources |

Figure 87. High Speed Counter Block Type BWiring Diagram

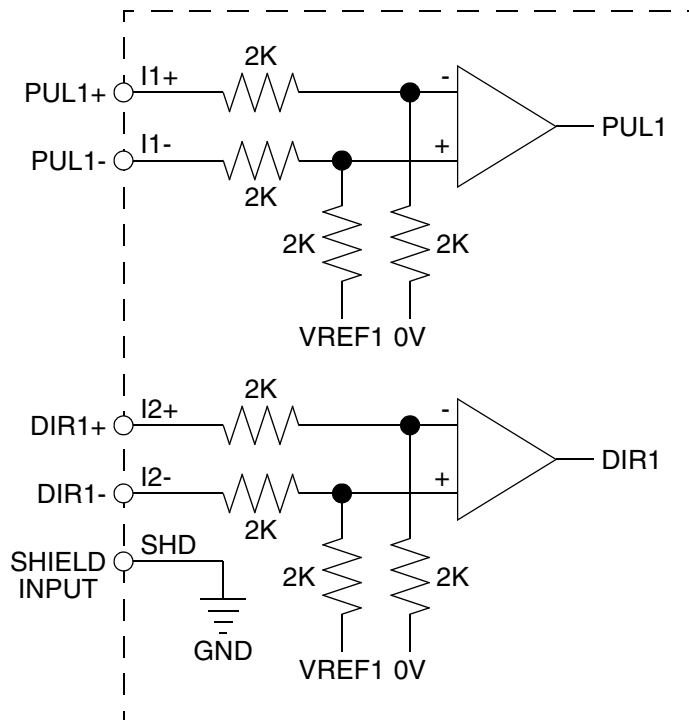


Figure 88. Internal Circuitry for Type B Counter 1 - PUL/DIR Mode

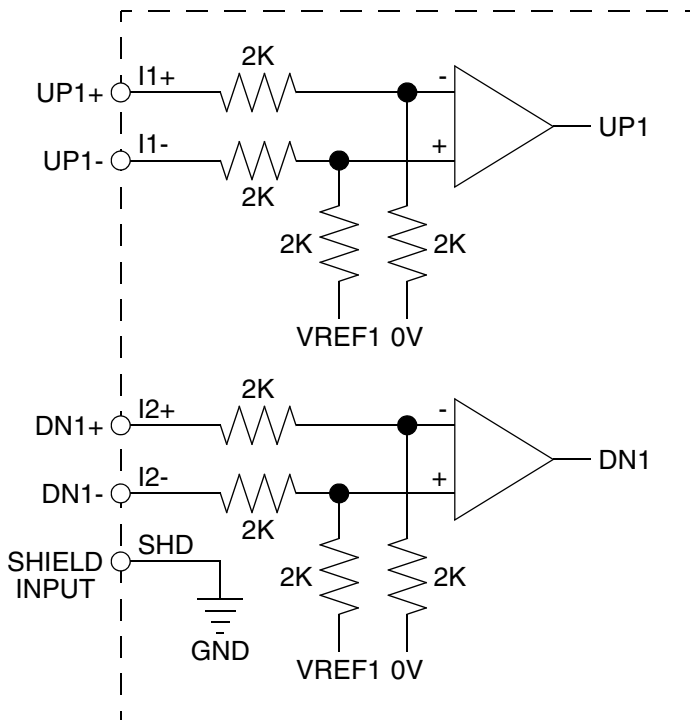


Figure 89. Internal Circuitry for Type B Counter 1 - UP/DN Mode

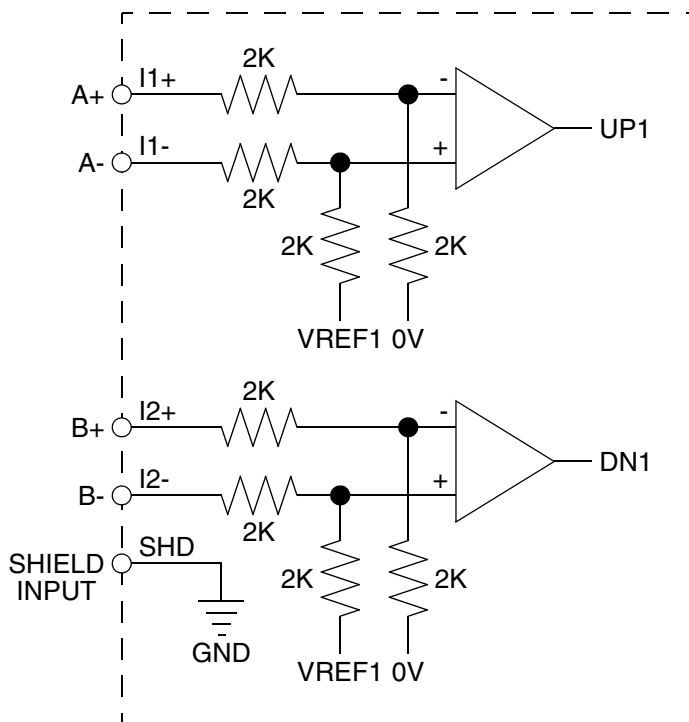


Figure 90. Internal Circuitry for Type B Counter 1 - A QUAD B Mode

Wiring for TTL Open Collector Input Devices

An external resistor must be provided for TTL open collector inputs. Be sure the input device is capable of handling the load current represented by the suggested resistor.

When using the +5 V power supply of the High Speed Counter Block, use a nominal pull-up resistor of 1K ohm, 1/4 Watt, 5% as shown in [Figure 91](#).

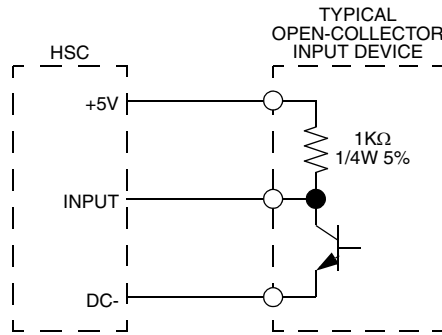


Figure 91. TTL Open Collector Device Powered by Block's 5 V Power Supply

For an external power supply, suggested nominal resistors are:

- 1K ohm, 1/4 Watt, 5% for a +5 V power supply, [Figure 92](#).
- 1.5K ohm, 1/4 Watt, 5% for a +12 V power supply.
- 4.7K ohm, 1/4 Watt, 5% for a +24 V power supply.

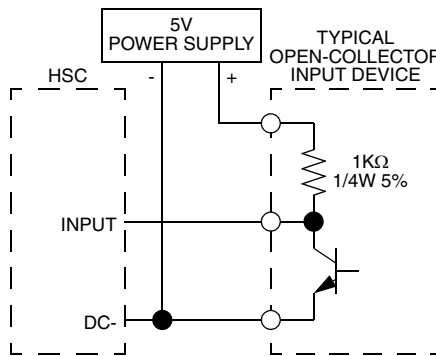


Figure 92. TTL Open Collector Device Powered by External Power Supply

6234B High Speed Counter Block Specifications

Table 18. 6234B High Speed Counter Block Specifications

| Parameter | Specification |
|--|--|
| Physical: Weight: LEDs (Block): LEDs (Circuit): Terminal Wiring: Terminals 1 to 4: Terminals 5 to 32: | 4 lbs. (1.8 kg) Unit OK, I/O Enabled Output status (four on logic side) (1) AWG#12 or (2) AWG#14 (1) AWG#14 to AWG#22 |
| Environmental: Operating Temperature: Storage Temperature: Humidity: Vibration: | 0° to 60° C (32° to 140° F) -40° to +100° C (-40° to +212° F) 5% to 95% (non-condensing) 5-10 Hz 0.2" displacement 10-200 Hz at 1G |
| Electrical: Operating Voltage: Frequency/Ripple: Current: dc Power Supply Dropout Time: ac Power Supply Dropout Time: | 93 to 132 V ac 10 to 30 V dc 47 to 63 Hz 10% maximum 60 mA typical 250 mA typical 10 mSec at 12 V dc, 75 mSec at 24 V dc 1 cycle |

Table 18. 6234B High Speed Counter Block Specifications

| Parameter | Specification |
|--|---|
| Inputs: | |
| Types: | Counting, Preset, Strobe |
| Input voltage relative to DC-Terminal: | 5 to 30 V dc |
| Input ON | |
| TTL Single-ended: | $V_{in} \geq 2.0$ V dc (sourcing 1 mA minimum) |
| Non-TTL Single-ended: | $V_{in} \geq 7.2$ V dc (sourcing 1.75 mA minimum) |
| TTL Differential: | $V_{in+} \geq 0.85$ V dc (sourcing 1 mA minimum) |
| Non-TTL Differential: | $V_{in+} \geq 4.1$ V dc (sourcing 1 mA minimum) |
| Input OFF | |
| TTL Single-ended: | $V_{in} < 0.8$ V dc |
| Non-TTL Single-ended: | $V_{in} < 6.0$ V dc |
| TTL Differential: | $V_{in+} < 0.5$ V dc |
| Non-TTL Differential: | $V_{in+} < 4.1$ V dc |
| Input Impedance: | 4.0K ohms typical |
| Input Response Time: | 0.5 mSec plus selectable filter |
| Selectable Input Filter Time: | High (25 μ s) or low (12.5 mSec) frequency |
| Input Pulse Width Selected: | |
| High Frequency Filter: | 25 μ s minimum |
| Low Frequency Filter: | 12.5 mSec minimum |
| Count Rate Selected: | |
| High Frequency Filter: | 200 kHz maximum |
| Low Frequency Filter: | 40 Hz maximum |

Table 18. 6234B High Speed Counter Block Specifications

| Parameter | Specification |
|---|--|
| Outputs: +5 V Output: Steady State Output Current: Oscillator Output: Maximum Inrush Current: Maximum Overcurrent: Block Steady State Output Current: Output OFF Leakage Current: Maximum Switching Frequency: Input-to-Output Delay: Output Voltage Drop: | 4.75 to 5.25 V dc at 200 mA 0.5 A maximum per output 3.8 V dc at 4.0 mA 3 A per output for up to 10 mSec 4 A 2 A maximum total 10 μ A maximum once per second (with high inrush current) 200 μ s (minimum) to 1 mSec (maximum) plus programmable input filter selected 2.0 V maximum at 4 A inrush 0.25 V maximum at 0.5 A |
| <u>Catalog Number Information</u> 6234BP10910 6234BP10920 6234BP10930 | <u>Description</u> High Speed Counter (Complete Unit) High Speed Counter (Electronic Assembly only) High Speed Counter (Terminal Assembly only) |

Section 6 Field Bus

Field Bus Guidelines

This section describes the factors to consider when choosing the bus configuration. Topics covered include:

- Number of TRIO devices on the Field Bus.
- Order of the devices (device numbers).
- Type of cable.
- Baud rate (as required by bus length).
- Non-redundant versus redundant bus. If it is a redundant bus, the following questions must be considered:
 - Which blocks will be directly attached to BSMs and which will be attached to stubs?
 - How will the two cables be routed to provide maximum protection against cable breakage?
 - Are the stub lengths within the permitted ranges for both cables?
 - Has the “stub length” of the Controller been considered?

Devices on the Field Bus

A Field Bus carries serial communications among the devices of the TRIO I/O system.

One AC800M Controller can have four Field Buses.

Field Bus communications are brought into the AC800M Controller using a CI862 TRIO Interface module. Non-redundant Field Buses consist of a single cable as shown in [Figure 5](#). A redundant bus consists of two cables each connected to a

separate CI862 TRIO CEX module. Figure xxx shows two redundant buses connected to a redundant AC800M Controller. The controller can be at either end of the bus or it can be in a central position. You can connect up to 30 TRIO blocks to the bus. You can also attach Hand-held Monitors (HHMs) to the bus at either the CI862 TRIO Interface module, at the I/O blocks, or, as an option, at special HHM connectors on the bus.

Device Numbers

Each I/O block, HHM, and CI862 TRIO Interface module has a device number which serves as its address on the Field Bus. Duplicate device numbers on a bus are not permitted. Device numbers can be from 0 to 31. 0 is used for the HHM, 1 through 30 are used for TRIO Blocks, and 31 is used for the CI862 TRIO Interface module.

A device number is assigned to the HHM via its own keyboard. A number is assigned to an I/O block via an HHM directly connected to the HHM connector of the block. A number is assigned to a CI862 TRIO Interface module through configuration. Communication on the bus is most efficient when the devices are connected in device number order.

Cable Parameters

The preferred cable type is 6201C Taylor Field Bus Cable. Parameters for it and the other possible cables are listed in [Table 19](#). See [CI862 Field Bus Termination](#) on page 57 for switch selectable resistances on the CI862 module.

Table 19. Cables for the Field Bus

| Cable | Outer Diameter in (mm) | Terminating Resistor (Ω) | Indoor Installation | Conductors / AWG | DiElectric Voltage | Ambient Temp. Rating ($^{\circ}\text{C}$) | NEC Rating |
|-----------------------|------------------------|-----------------------------------|---------------------------|------------------|--------------------|---|--------------------|
| Taylor 6201C | .35 (8.89) | 150 | in conduit | 2 / #22 | 30 | 60 | CL2 ⁽¹⁾ |
| B3078F ⁽²⁾ | .385 (9.78) | 150 | cable tray ⁽³⁾ | 2 / #22 | 300 | 75 | PLTC/CM |
| A9823C ⁽⁴⁾ | .35 (8.89) | 150 | in conduit | 2 / #22 | 30 | 60 | CL2 |

Table 19. Cables for the Field Bus

| Cable | Outer Diameter in (mm) | Terminating Resistor (Ω) | Indoor Installation | Conductors / AWG | DiElectric Voltage | Ambient Temp. Rating ($^{\circ}\text{C}$) | NEC Rating |
|----------------------|------------------------|-----------------------------------|---------------------|------------------|--------------------|---|------------|
| C4596 ⁽⁵⁾ | .35 (8.89) | 150 | in conduit | 2 / #22 | 30 | 60 | |
| B89182 | .308 (7.82) | 150 | in plenum | 2 / #22 | 150 | 200 | CL2P |
| B9207 | .33 (8.38) | 100 ⁽⁶⁾ | in conduit | 2 / #20 | 300 | 75 | CM |
| B89207 | .267 (6.78) | 100 ⁽⁶⁾ | in plenum | 2 / #20 | 150 | 200 | CMP |
| A4794 | .282 (7.16) | 100 ⁽⁶⁾ | in plenum | 2 / #20 | 150 | 200 | |
| B9815 | .33 (8.38) | 100 ⁽⁶⁾ | direct burial | 2 / #20 | | 80 | NONE |
| B9855 | .270 (6.86) | 100 ⁽⁶⁾ | in conduit | 4 / #22 | 150 | 60 | CM/MP |
| B89696 | .264 (6.71) | 100 ⁽⁶⁾ | in plenum | 4 / #22 | 150 | 200 | CMP/MPP |
| B89855 | .240 (6.10) | 100 ⁽⁶⁾ | in plenum | 4 / #22 | 150 | 200 | CMP/MPP |
| B9463 | .243 (6.17) | 75 | in conduit | 2 / #20 | 300 | 80 | CM |
| A9814 | .243 (6.17) | 75 | in conduit | 2 / #22 | 150 | 60 | CM |
| B9302 | .244 (6.2) | | in conduit | 4 / #22 | 300 | 80 | CM |

- (1) Cables rated CL2 can go into a wire tray.
- (2) B stands for Belden.
- (3) Can also be used in cable tray outdoors.
- (4) A stands for Alpha.
- (5) C stands for Consolidated.
- (6) Use the 110 ohm option on the [CI862](#) if termination is required.

Length of Bus, Baud Rates

Baud rates are set by the HHM and must be matched during configuration in the Control Builder. All blocks on a bus must have the same baud rate.

The possible rates are 153.6 K baud standard, 153.6 K baud extended, 76.8 K baud and 38.4 K baud. The preferred baud rate for the Field Bus is 153 K Baud extended. If a long Field Bus is required, it is necessary to choose a lower baud rate. [Table 20](#)

shows the relationship between baud rates and maximum bus lengths.



For a redundant Field Bus, Bus A and Bus B must have the same baud rate.

Table 20. Baud Rates and Maximum Bus Lengths

| Cable | Maximum Length in Feet of Cable at Baud Rate | | | |
|-----------------------|--|----------------|------|---------------------|
| | 153.6 Standard | 153.6 Extended | 78.6 | 38.4 |
| Taylor 6201C | 2000 | 3500 | 4500 | 7500 ⁽¹⁾ |
| B3078F ⁽²⁾ | 2000 | 3500 | 4500 | 7500 ⁽¹⁾ |
| A9823C ⁽³⁾ | 2000 | 3500 | 4500 | 7500 ⁽¹⁾ |
| C4596 ⁽⁴⁾ | 2000 | 3500 | 4500 | 7500 ⁽¹⁾ |
| B89182 | 2000 | 3500 | 4500 | 7500 ⁽¹⁾ |
| B9207 | 1500 | 2500 | 3500 | 6000 ⁽¹⁾ |
| B89207 | 1500 | 2500 | 3500 | 6000 ⁽¹⁾ |
| A4794 | 1500 | 2500 | 3500 | 6000 ⁽¹⁾ |
| B9815 | 1500 | 2500 | 3500 | 6000 ⁽¹⁾ |
| B9855 | 1200 | 1700 | 3000 | 4500 ⁽¹⁾ |
| B89696 | 1200 | 1700 | 3000 | 4500 ⁽¹⁾ |
| B89855 | 1200 | 1700 | 3000 | 4500 ⁽¹⁾ |
| B9463 | 800 | 1500 | 2500 | 3500 ⁽¹⁾ |
| A9814 | 800 | 1500 | 2500 | 3500 ⁽¹⁾ |
| B9302 | 200 | 500 | 1200 | 2500 ⁽¹⁾ |

(1) Limited to 16 devices (14 blocks) at maximum length.

(2) B stands for Belden.

(3) A stands for Alpha.

(4) C stands for Consolidated.

Redundant Field Bus Guidelines

Redundant Field Buses should be used if there is a likelihood of cable breakage. If one cable is damaged, communication can be switched to the other.

The two cables should be physically separate so that if one of them is severed, the other remains intact.

When you attach a redundant bus to the controller, you should designate one cable as Bus A and the other as Bus B.

During normal operation of a redundant Field Bus connected to a controller, both buses are active and communication occurs on both Bus A and Bus B. A block can only communicate on one bus at a time so some blocks communicate on Bus A and some on Bus B. If communications on one bus fails, the BSMs on that bus switch communications to the other bus. For example, if Bus A fails, all BSMs on Bus A switch communications to Bus B.



Distribute blocks on the buses so that there is at least one block on each bus. A diagnostic is generated if there are no blocks detected on a bus.

Communications can also be switched between the buses manually using the **Remote I/O Overview xxx** display.

As [Figure 93](#) shows, blocks can be directly connected to the cables via a Bus Switching Module (BSM) or they can be in clusters in which the first block is connected to the bus trunk via a BSM. These clusters can have a maximum of 8 blocks. The cable that connects the blocks in the cluster is called a stub. When you set up a redundant bus, several things must be considered about the stubs and the BSMs.

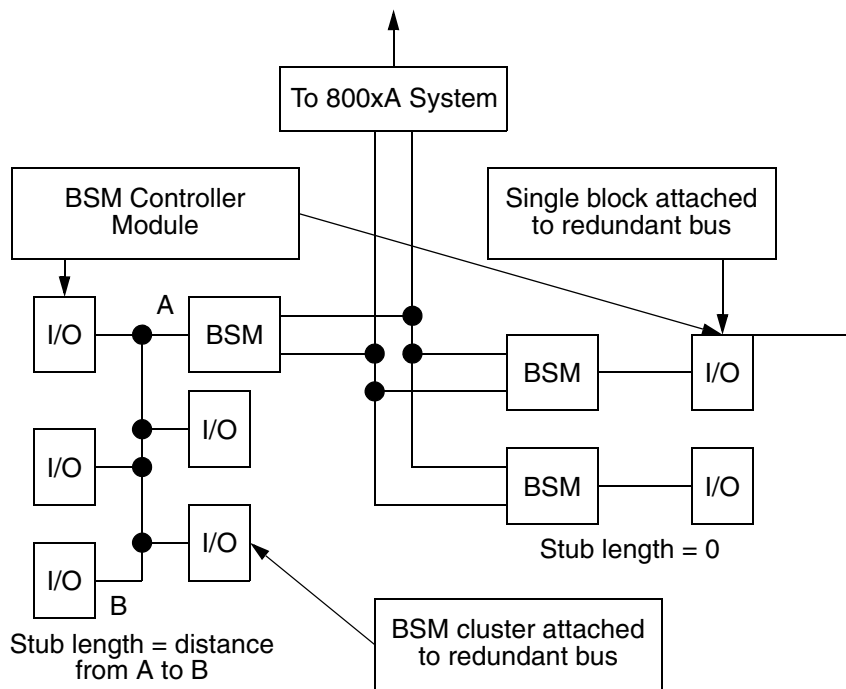


Figure 93. Blocks Attached to Redundant Field Bus

A block that is attached to a BSM is called a BSM Controller. When you use a block as a BSM Controller, note the following:

- The 6231B Current Source Analog I/O Block, 6232B 6 Circuit Thermocouple Input Block, 6235B 6 Circuit Current Source Analog Input Block, and 6236B 6 Circuit Current Source Analog Output Block have dedicated BSM+ and BSM- terminals to which a BSM can be wired. They can still have a full complement of I/O channels.
- When a discrete block is equipped with a BSM, the BSM must be wired as an output using the first I/O channel. The first channel cannot be used as a regular input or output.
- The BSM is physically attached to the block and adds 1.75 inches to the width of the block. When you plan any cabinets or other enclosures as described in

Section 7, [Mounting and Power Planning](#), leave enough room for the BSM.

- BSMs come in low voltage (24/48 V dc) and high voltage (115 V ac/125 V dc) versions.
 - The 6231B 4 In/2 Out Current Source Analog I/O Block, 6232B 6 Circuit Thermocouple Input Block, 6235B 6 Circuit Current Source Analog Input Block, and 6236B 6 Circuit Current Source Analog Output Block require the low voltage BSM, whether or not they are powered by 115 or 24/48 volts.
 - The 24/48 V discrete blocks (6240B 16 Circuit dc Source or Sink I/O Block and 6241B 32 Circuit dc Source or Sink I/O Block) require the low voltage units.
 - The 115 V discrete blocks (6244B 8 Circuit Grouped I/O Block, 6245B Low Leakage 8 Circuit Grouped I/O Block, and 6246B 8 Circuit Isolated I/O Block) require the high voltage BSM.
 - The 6248B 16 Circuit Relay Output Blocks require a BSM voltage that matches the I/O supply voltage being used for channel 1.
- A 6241B 32 Circuit dc Source or Sink I/O Block must be operated on 24 V dc if it is to serve as a BSM Controller.
- The following blocks cannot be BSM controllers. They must be connected to a BSM stub when a redundant bus is used:
 - 6230B 4 In/2 Out Analog I/O Block.
 - 6233B 6 Circuit RTD Input Block.
 - 6234B High Speed Counter Block.
 - 6247B 115 V ac 16 Circuit Input Block.

You should exercise care when planning a stub since a stub acts electrically like a fixed capacitor located at the BSM position on the main trunk line. This capacitance results in increased attenuation and reflection on the bus. If communications errors occur due to the stub, they are likely to be between stations on the stub and those further down the trunk line.

To avoid problems with stubs, follow the rules:

- Maximum number of blocks on a stub is 8.

- Keep stub lengths as short as possible. Mount blocks on the stubs close together.
- Use the lowest capacitance cable for the stub, regardless of the type used for the trunk. The preferred choices in order for the stub cable are:
 - 6200CP0015A prefabricated connecting cable.
 - 6200CP0036A prefabricated connecting cable.
 - 6201C Taylor Field Bus Cable.
 - Belden 3078F or equivalent.
- The maximum length for a single stub is determined by the capacitance (between conductors) per foot of the cable used. See [Table 21](#).

Table 21. Maximum Stub Lengths

| Cable | Capacitance (pf/ft) | Maximum Stub Length (ft) |
|--------------|---------------------|--------------------------|
| Taylor 6201 | 9 | 20 |
| Belden 3078F | 9 | 20 |
| Belden 9207 | 16 | 12.5 |
| Belden 9463 | 20 | 10 |

For other cables, calculate the maximum length using the following equation:

$$\text{Maximum Length} = \frac{200\text{pf}}{\text{Capacitance per unit length}}$$

- The maximum number and total length of the stubs depends on the length of the trunk line.
 - For short buses (trunk line less than 20% of maximum possible length as listed in [Table 20](#)):

Number of stubs is limited only by the 30 station maximum for the Field Bus.

The combined length of all stubs must be less than four times the length of the theoretical maximum stub length ([Table 21](#) or the formula above).

- For long buses:

Calculate 20% of the maximum possible bus length as listed in [Table 20](#). Within any span of cable equal to this 20% length, the maximum total length of all stubs allowed is twice the maximum length for one stub ([Table 21](#)).

For example, for 6201C Taylor Field Bus Cable the maximum allowed bus length is 3500 feet at a baud rate of 153.6 Kbaud extended. Since twenty percent of 3500 is 700 and the maximum length for a single stub is 20 feet, no more than 40 feet of stub can be used in any 700 foot length of cable. Note that this is a “sliding window.” There can be no more than 40 feet of stub between foot 0 and foot 700; the same is true between foot 1 and foot 701, and so on. There can be multiple stubs within a 700 length as long as their total length is less than 40 feet.

The combined length of all stubs must be less than six times the length of the maximum length for one stub ([Table 21](#) or the formula above).

- The internal cables of the SC Controller Subsystem act as stubs with the following lengths:
 - SC Controller with no redundancy 2 feet.
 - SC Controller with 3 to 1 redundancy 8 feet.
 - SC Controller with 11 to 1 redundancy with 2 card files 11 feet.
 - SC Controller with 11 to 1 redundancy with 3 card files 15 feet.
- Both cables in a redundant bus are subject to the stub rules. This is important if the length of the cables varies significantly because of their separate routing.
- Consider the effects of any anticipated expansions on stub length distribution. Failure to do this may result in communications difficulties when you expand the bus.

Bus Scan Time

The CI862 TRIO Interface module of an AC800M controller exchanges data with both the control system and the Field Bus. Information is written into this module from both the Field Bus and the control system side.

Controller Scans and Field Bus Scans

On the Field Bus side, information is written at the Field Bus scan rate whose period is determined by the baud rate and number of devices on the bus. The Field Bus scan rate is usually in the order of 20 mSec.

On the controller side, information is written at the loop scan rate which is a slower rate with a period of 100 mSec or more.

Field Bus Scan Calculations

The Field Bus scan time in mSec is calculated using the information in [Table 22](#) and the following:

| Factor | Calculation |
|--|-------------|
| Overhead | 1.93 |
| Field Bus Interface | 1.17 |
| (Number of unused device addresses) x .052 | _____ |
| Contribution for first block on bus | _____ |
| Contribution for second block on bus | _____ |
| . | |
| . | |
| . | |
| Contribution for last block on bus | _____ |
| Contribution for HHM(s) | _____ |
| (Sub Total) | _____ |
| Multiply by 1 if baud rate is 153.6 K extended | |
| Multiply by 1 if baud rate is 153.6 K standard | |
| (using 1 results in a good approximation) | |

Multiply by 2 if baud rate is 76.8K

Multiply by 4 if baud rate is 38.4K

Scan Rate _____

Table 22. Scan Times for Devices on the Field Bus

| Block Type | I/O Configuration | Bus Load (mSec) at 153.6 K Extended |
|--|--------------------------|--|
| 115 V ac 8 Circuit Grouped | Inputs only | 0.59 |
| 115 V ac 8 Circuit Grouped | Outputs/Combination | 0.66 |
| 115 V ac/125 V dc 8 Circuit Isolated | Inputs only | 0.59 |
| 115 V ac/125 V dc 8 Circuit Isolated | Outputs/Combination | 0.66 |
| 115 V ac 16 Circuit Input | Inputs only | 0.66 |
| 24/48 V dc 16 Circuit Source/Sink | Inputs only | 0.66 |
| 24/48 V dc 16 Circuit Source/Sink | Outputs/Combination | 0.81 |
| 32 Circuit Source/Sink | Inputs only | 0.81 |
| 32 Circuit Source/Sink | Outputs/Combination | 1.09 |
| 16 Circuit Relay Output | Outputs only | 0.81 |
| 4 In/2 Out Analog | Input/Output | 1.38 |
| 4 In/2 Out Current Source Analog | Input/Output | 1.38 |
| 6 Circuit Current Source Analog Input | Inputs only | 1.38 |
| 6 Circuit Current Source Analog Output | Outputs only | 1.38 |
| High Speed Counter | Inputs only | 2.96 |
| 6 Circuit RTD Input | Inputs only | 1.38 |
| 6 Circuit Thermocouple Input | Inputs only | 1.38 |

Table 22. Scan Times for Devices on the Field Bus (Continued)

| Block Type | I/O Configuration | Bus Load (mSec) at 153.6 K Extended |
|----------------------|-------------------|-------------------------------------|
| HHM | n/a | 0.31 |
| Field Bus Interface | n/a | 1.17 |
| Overhead | n/a | 1.93 |
| Unused Bus Addresses | n/a | 0.052 |

Noise Rejection and Immunity

This section discusses some methods to reduce electrical noise interference with the TRIO system. A detailed discussion of the noise reduction topic is provided in *IEEE Std 518-1982, IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources*. A second useful source of information is *Noise Reduction Techniques in Electronic Systems*. Both user manuals are available from John Wiley and Sons, Inc.

The serial bus signal is typically 5 V and 100 mA. These levels are higher than most commonly used digital communication lines (such as RS-422) and provide a higher level of noise rejection. Bus signals are still low, however, compared to power circuits and are considered to be signal level signals.

Precision differential transformers and detectors in each TRIO I/O device provide a high noise rejection capability and galvanic isolation from the I/O circuits to the bus.

Routing Guidelines

Four types of wiring may be encountered in a typical factory installation:

- Power wiring - the plant power distribution and high power loads such as high horsepower motors. These circuits may be rated from tens to thousands of kVA at 220 V ac or higher.
- Control wiring - usually either low voltage dc or 120 V ac of limited energy rating. Examples are wiring to start/stop switches, contactor coils, and machine limit switches. This is generally the interface level of TRIO discrete I/O.

- Analog wiring - transducer outputs and analog control voltages. This is the interface level to TRIO analog blocks.
- Communications and signal wiring - the communications network that ties everything together, including various computer LANs, MAP, and the TRIO Field Bus.

These four types of wiring should be separated as much as possible to reduce the hazards from insulation failure, wiring errors, and interaction between signals. A typical TRIO system may require some mixing of the latter three types of wiring, particularly in cramped areas inside motor control centers and on control panels. In general, it is safe to mix the serial bus with the I/O wiring from the blocks, as well as associated control level wiring. Noise pickup is cumulative, depending on both the spacing between wires, and the distance they run together. I/O and serial bus wires, laying randomly in a wiring trough for lengths of up to 50 feet, do not exhibit any problem. If wiring is cord-tied (harnessed), do not include the serial bus cable in the harness, since binding wires tightly together increases the coupling and mechanical stress that can damage the relatively soft insulation of some serial cable types. Wiring external to the equipment and in cable trays should be separated, following NEC practices. The pickup over long-distance runs with adequate spacing consists of common mode and ground voltage differences. These are rejected due to the differential transmission mode of the serial bus and the bus isolation transformers in each TRIO I/O block.

Running the Bus Cable Outdoors or Between Buildings

The isolation and noise rejection of the bus is sufficient to handle typical indoor factory noise. Running the bus cable outdoors or between buildings may subject it to lightning transients beyond the 1,500 V transient rating of the system. Running the cable underground reduces the probability of a direct lightning strike. It is recommended to install two (only) silicon surge suppressors or spark gaps onto the cable when running outdoors or between buildings. These devices should be installed close to the entrance of the bus to the outdoors with a solid ground connection. There are several manufacturers of silicon surge suppressors and spark gaps to control transients of 1 to 25 kV from 100 to 1000 A or more. Silicon surge suppressors are available from Ledex/Lucas (Ledex type DFPO27), Clare/General Instrument, and Motorola. Spark gaps are available from Clare. Refer to the vendor literature for installation details.

Device Placement on the Bus

TRIO I/O blocks and Field Bus Interface Modules can be placed in any physical order on the bus. However, communications is most efficient if devices are placed in the same sequence as their Device Numbers (Block Numbers). Because of reflections caused by the high speed of the bus, taps from a non-redundant bus should not be made. Neither “T” nor “star” configurations are supported, [Figure 94](#).

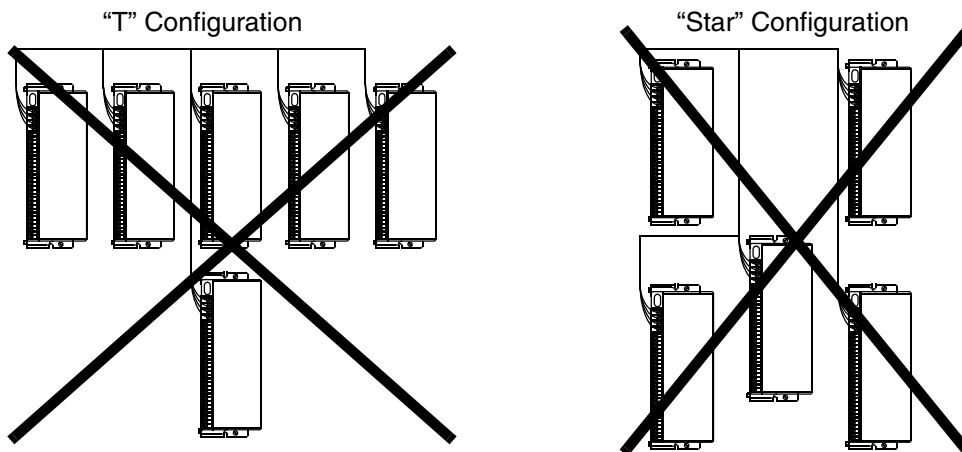


Figure 94. Invalid Bus Configurations

Planning for the Hand-held Monitors (HHMs)

Hand-held Monitors (HHMs) are not used for configuration except to set the block baud rate and device number. It can be used to read block parameters. An HHM operates on either ac power or its rechargeable battery pack. If an HHM is operated using its battery pack, extra battery packs or HHMs may be needed to allow time for recharging. It is also possible to permanently install an HHM on a Field Bus. Decide whether you need any permanently installed monitors.

Section 7 Mounting and Power Planning

Overview

The factors that affect the way blocks are mounted and supplied with power are described here. TRIO blocks are mounted on equipment, in junction boxes, inside panels, behind operator stations, and in other locations where space is limited. Blocks are mounted in any position. However, to assure adequate heat dissipation, vertical mounting is recommended.

Environmental Specifications

Vibration

The blocks perform well in conditions where vibration is a factor. All block designs are vibration-tested (according to Mil-Std 810C, IEC 68-2-6, and SAMA PMC 31.1) to meet the following specifications:

5 to 10 Hz 0.200 inches displacement peak to peak.

10 to 200 Hz at 1 G.

Shock: 15 G.

Noise

The block designs 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)

Heat

The blocks operate reliably in temperatures up to 60× C (140× F) with the temperature being measured adjacent to the block at the bottom of the Electronics Assembly. Reliability is improved by running them at cooler temperatures.

Cold

The lower limit for storage temperature is -40× C.

Mounting Blocks in Cabinets

TRIO blocks are frequently mounted in cabinets. Consider the following when using a cabinet design:

- The enclosure must provide space for free flow of air along the Electronics Assembly (the side opposite the Terminal Assembly) of each block. Do not plan to place conduits, shelves, or other components (including projections on the cover or door) that will inhibit cooling air flow around the blocks.
- As a rough guide, each block requires a space approximately 12 inches high, 5 inches wide, and 6 inches deep. A 6241B 32 Circuit dc Source or Sink I/O Block has a higher and wider Terminal Assembly than other I/O blocks, requiring an enclosure that is about one half inch deeper and one half inch wider.
- Leave at least 1 inch of space at the top and bottom of the block and about 1 inch at the right side (the side with the Electronics Assembly). This permits future removal of the Electronic Assembly with a Block Puller. More space is desirable, especially if wiring is bundled together.
- If a block is used as a BSM controller, the BSM is physically attached to it and adds 1.75 inches to the width of the block.
- Locate the blocks and other electronic components near the bottom of the enclosure. Do not put blocks in the top 3 to 6 inches (80 to 150 mm) of the cabinet.
- Place the “hotter” blocks (such as blocks with 115 V ac outputs or 23-48 V dc outputs) in the upper positions, so the heat they produce does not affect blocks

placed above them. Put the “cooler” blocks (such as analog blocks and inputs only blocks) in the lower positions.

- 6232B 6 Circuit Thermocouple Input Blocks should be installed in a location where temperature changes and the rate of temperature change is minimized. This will aid the cold junction compensation feature of the block.
- At times, it is advantageous to stagger blocks, to allow hot air generated by lower blocks to pass through the upper blocks. See [Figure 95](#).
- Circulation fans in an enclosure can appreciably improve heat dissipation.
- If the enclosure is located in direct sunlight, consider placing a shade over it and/or painting it white to reflect heat.
- For large cabinets with a high amount of heat dissipation, air conditioning or forced air cooling should be considered.
- In some scenarios, you may want to add additional terminal blocks for distributing I/O power for the TRIO blocks such as the 6240B 16 Circuit dc Source or Sink I/O Blocks and 6241B 32 Circuit dc Source or Sink I/O Blocks.

Connecting Blocks to Field Bus Within a Cabinet

Prefabricated lengths of cable, [Figure 96](#), provide a convenient method for making block to block connections within a cabinet. Cables in 15 inch 6200CP0015A and 36 inch 6200CP0036A lengths are available. These cables terminate in mating connectors that simplify connections to I/O blocks.

Bus Grounding

The enclosure of each block should be connected to ground. The I/O Bus Shield Out termination of a block is connected directly to its chassis ground. The Shield Out termination is capacitively coupled to Shield In. The purpose of this configuration is to break up any differences in small ground voltages which may be present at different blocks on the bus (up to 50 V of continuous difference of ground potential).

Blocks Not Mounted in Enclosures

When TRIO blocks are mounted on equipment or in any other type of a non cabinet environment, you should take precautions against contamination, the environment, or someone making contact with live connections.

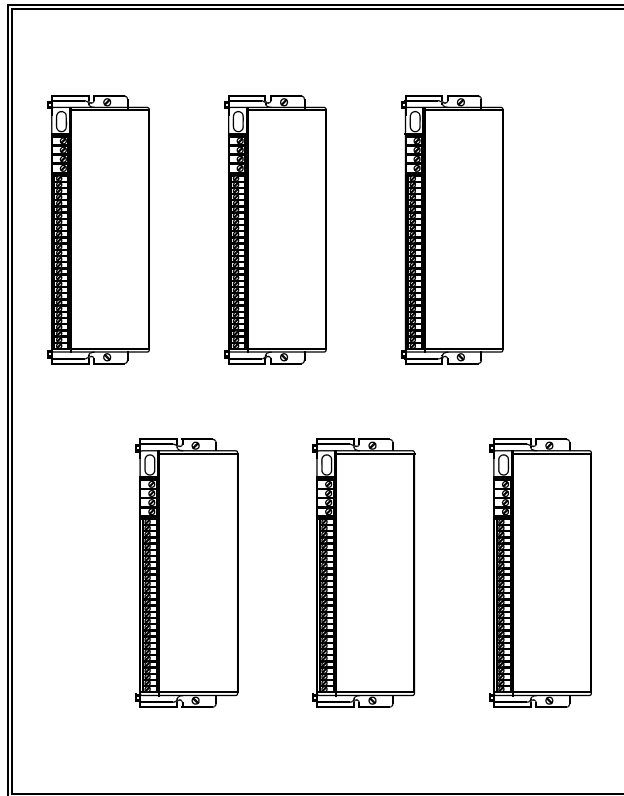


Figure 95. Staggered Configuration of Blocks in a Cabinet

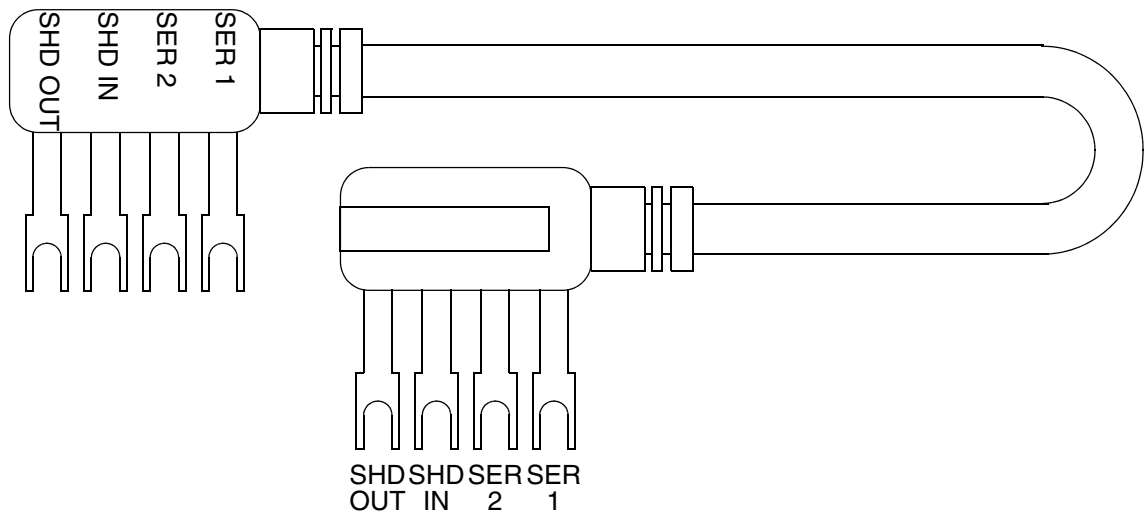


Figure 96. Prefabricated Connecting Cable

Calculating the Power Required for a Cabinet

The following procedure describes how to estimate the power to supply to an enclosure that contains TRIO blocks:

1. Calculate the power required for each block in the enclosure. An example and further description of this is provided in **Calculating** the Power Required for a Block.
2. Calculate any power required if you use separate power supplies for I/O channels of the 6246B 115 V ac/125 V dc 8 Circuit Isolated Blocks.
3. The calculations in steps 1 and 2 give you power requirements of three different types: 115 V ac, 125 V dc, and low voltage dc. Take into account the power supply efficiencies and power factors of the 125 V dc and low voltage dc supplies before choosing the size of your power supplies.

Calculating the Power Required for a Block

For a block, the power required is calculated using the following equation:

Total power = overhead power for block + power for inputs + power for outputs.

Table 23 lists information required for this calculation.

Table 23. Power Required for TRIO I/O Blocks

| Block Type | Overhead per Block (watts) | Load per Input (watts) | Maximum Load per Output (watts) | Maximum Current per Output (amps) | Maximum Current per Output (amps) |
|--|----------------------------|------------------------|---------------------------------|-----------------------------------|-----------------------------------|
| 115 V ac 8 Circuit Grouped | 6 | 1.1 | 240 | 2 | 15 |
| 115 V ac 8 Circuit Low Leakage | 6 | 1.1 | 240 | 2 | 15 |
| 115 V ac /125 V dc 8 Circuit Isolated | 8 | 1.1 | 240 | 2 | 15 |
| 115 V ac 16 Circuit Input | 8 | 1.25 | n/a | n/a | n/a |
| 24/48 V dc 16 Circuit Source/Sink | 4.8 | 0.1 | 96 | 2 | 15 |
| 24 V dc 16 Circuit Source/Sink | 4.8 | 0.3 | 48 | 2 | 15 |
| 24 V dc 32 Circuit Source/Sink | 2 | 0.28 | 12 | 0.5 | 16 |
| 12V dc 32 Circuit Source/Sink | 2 | 0.28 | 6 | 0.5 | 16 |
| 5V dc 32 Circuit Source/Sink | 2 | 0.28 | 2.5 | 0.5 | 16 |
| 16 Circuit Relay Output | 4.8 | n/a | 125 ⁽¹⁾ | 2 | |
| 4 In/2 Out Analog | 6 | 0 ⁽²⁾ | 0 | n/a | |
| 4 In/2 Out Current Source Analog | 12 | 0 | 0 | n/a | |
| 6 Circuit Current Source Analog Input | 12 | 0 | n/a | n/a | |
| 6 Circuit Current Source Analog Output | 12 | n/a | 0 | 24 mA | |

Table 23. Power Required for TRIO I/O Blocks

| Block Type | Overhead per Block (watts) | Load per Input (watts) | Maximum Load per Output (watts) | Maximum Current per Output (amps) | Maximum Current per Output (amps) |
|------------------------------|----------------------------|------------------------|---------------------------------|-----------------------------------|-----------------------------------|
| High Speed Counter | 8 | 0 | n/a | n/a | |
| 6 Circuit RTD Input | 7 | 0 | n/a | n/a | |
| 6 Circuit Thermocouple Input | 10 | 0 | n/a | n/a | |

- (1) Does not include power for outputs switched by the relays.
(2) Does not include power for analog input equipment (for example, transmitters).

For example, a 6244B 115 V ac 8 Circuit Grouped I/O Block is configured with 5 inputs and 3 outputs. The entry from row 1 of Table 23 is calculated as follows:

Overhead power: 6 W

Power for inputs: $5 \times 1.1 = 5.5 \text{ W}$

Power for outputs: When calculating the power requirements for the outputs, you have to estimate the duty cycle and the percent of maximum output power that outputs will use. For example, assume the 3 outputs for this block are going to be run at 0.5 amps at 100% duty cycle.

0.5 amps is 25% of the maximum current (2 amps) per output. Therefore, for the outputs of this block:

$$\begin{aligned} \text{Power} &= \text{outputs} \times \% \text{ of maximum load} \times \text{duty cycle} \times \\ &\text{maximum load} \\ &= 3 \times 0.25 \times 1.00 \times 240 \\ &= 180 \end{aligned}$$

$$\text{Total power} = 6 + 5.5 + 180 = 191.5 \text{ W}$$

It is a good idea to refer to the *Maximum Current per Block* column to insure that the block rating is not exceeded.

Calculating Heat Generation for an Enclosure

The surface area of an enclosure must be adequate to dissipate the heat generated within it. Heat generation is calculated as follows:

1. Identify the types of I/O blocks within the enclosure.
2. Estimate the I/O mix and duty cycle of each block.

As an example, if there are 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 switches 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.

3. Use [Table 24](#) to estimate heat dissipation for each block.
 - Begin with the overhead for the block.
 - Multiply the number of inputs by the additional number of watts per input circuit.
 - Multiply the number of outputs by the additional number of watts for each output circuit. This number represents the number of watts of dissipated heat when outputs conduct full current at 100% duty cycle. You can make modifications to those values if you know that the output will not have a 100% duty cycle or a full current load.
 - Add the total number of watts for the block, for outputs, and for inputs.
4. Add the estimated heat from each block to that generated by other electronics in the enclosure. Remember that most of the heat is generated by field devices connected to the I/O blocks, not by the I/O blocks themselves.

Table 24. Heat Dissipated by Blocks

| Block Type | Overhead per Block (watts) | Load per Input (watts) | Maximum Output Dissipation (watts) | Maximum Current per Output (amps) |
|--|----------------------------|------------------------|------------------------------------|-----------------------------------|
| 115 V ac 8 Circuit Grouped | 6 | 1.1 | 4.7 | 2 |
| 115 V ac 8 Circuit Low Leakage | 6 | 1.1 | 4.7 | 2 |
| 115 V ac /125 V dc 8 Circuit Isolated | 8 | 1.1 | 4.7 | 2 |
| 115 V ac 16 Circuit Input | 8 | 1.25 | n/a | n/a |
| 24/48 V dc 16 Circuit Source/Sink | 4.8 | 0.1 | 4 | 2 |
| 24 V dc 16 Circuit Source/Sink | 4.8 | 0.3 | 4 | 2 |
| 32 Circuit Source/Sink | 2 | 0.28 | 0.5 | 0.5 |
| 16 Circuit Relay Output | 4.8 | n/a | 0.33 | 2 |
| 4 In/2 Out Analog | 6 | In Overhead | In Overhead | |
| 4 In/2 Out Current Source Analog | 12 | In Overhead | In Overhead | |
| 6 Circuit Current Source Analog Input | 12 | In Overhead | n/a | n/a |
| 6 Circuit Current Source Analog Output | 12 | n/a | In Overhead | |
| High Speed Counter | 8 | In Overhead | In Overhead | |
| 6 Circuit RTD Input | 7 | In Overhead | In Overhead | |
| 6 Circuit Thermocouple Input | 10 | In Overhead | In Overhead | |

If you decide to use fans in the cabinets, you should be aware that forcing air through any analog block should be avoided because it may result in changing the temperature rise of components in the block to values significantly different from those present during calibration of the block. These changes can make the block appear to be more sensitive to temperature than it actually is.

When using fans, they should be installed in a manner to lower the ambient temperature within the cabinet without forcing air through the analog blocks. In a

sealed cabinet, fans can minimize temperature gradients within the cabinet and increase the heat transfer to the walls of the enclosure.

Selecting an Enclosure When You Know the Total Heat Generation

Table 25 through Table 27 show the smallest non-vented NEMA-type enclosures recommended for use at various levels of heat generation at ambient temperatures of 25° C, 35° C, and 45° C, such that the internal temperature of the enclosure does not exceed 55° C. The tables list heat dissipation and dimensions for 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.

Table 25. Heat Dissipated from Typical Enclosures (Ambient Temperature 25° C)

| Watts Generated | Minimum Volume (cubic inches) | Standard Enclosure H x W x D (inches) |
|-----------------|-------------------------------|---------------------------------------|
| 150 | 1170 | 20 16 12 20 24 8 |
| 200 | 1560 | 36 24 6 30 24 8 |
| 250 | 1950 | 30 24 12 |
| 300 | 2340 | 30 30 12 |
| 350 | 2730 | 42 36 8 |
| 400 | 3120 | 36 30 16 |
| 450 | 3510 | 60 36 8 |
| 500 | 3900 | 42 36 16 |
| 550 | 4290 | 48 36 16 |
| 600 | 4680 | *60 48 12 |
| 650 | 5070 | 48 36 20 |
| 700 | 5460 | *60 48 16 |
| 750 | 5850 | *60 36 20 |

Table 25. Heat Dissipated from Typical Enclosures (Ambient Temperature 25° C)

| Watts Generated | Minimum Volume (cubic inches) | Standard Enclosure H x W x D (inches) |
|-----------------|----------------------------------|--|
| 800 | 6240 | 72 30 20 |
| 850 | 6630 | *72 60 12 |
| 900 | 7020 | 72 30 24 |

Table 26. Heat Dissipated from Typical Enclosures (Ambient Temperature 35° C)

| Watts Generated | Minimum Volume (cubic inches) | Standard Enclosure H x W x D (inches) |
|-----------------|----------------------------------|--|
| 150 | 1890 | 24 20 16 |
| 200 | 2520 | 36 30 12 |
| 250 | 3150 | 36 30 16 |
| 300 | 3780 | 42 36 16 |
| 350 | 4410 | 48 36 16 |
| 400 | 5040 | 48 36 20 |
| 450 | 5670 | *60 60 12 |
| 500 | 6300 | *72 60 10 |
| 550 | 6930 | 72 30 24 |
| 600 | 7560 | *90 36 20 *72 60 16 |
| 650 | 8190 | *72 60 20 |
| 700 | 8820 | *72 72 18 *72 36 36 |
| 750 | 9450 | *72 72 20 |
| 800 | 10080 | *72 72 24 |

Table 26. Heat Dissipated from Typical Enclosures (Ambient Temperature 35° C)

| Watts Generated | Minimum Volume (cubic inches) | Standard Enclosure H x W x D (inches) |
|-----------------|-------------------------------|---------------------------------------|
| 850 | 10710 | *90 36 36 |
| 900 | 11340 | *90 72 20 |

Table 27. Heat Dissipated from Typical Enclosures (Ambient Temperature 45° C)

| Watts Generated | Minimum Volume (cubic inches) | Standard Enclosure H x W x D (inches) |
|-----------------|-------------------------------|---------------------------------------|
| 150 | 4950 | 48 36 20 |
| 200 | 6600 | *72 24 30 *72 60 12 |
| 250 | 8250 | *72 60 20 |
| 300 | 9900 | *72 72 24 |
| 350 | 11550 | *72 60 36 |
| 400 | 13200 | *86 112 14 |
| 450 | 14850 | *90 72 36 |
| 500 | 16500 | *84 117 24 |
| 550 | 18150 | *84 154 18 |
| 600 | 19800 | *84 154 24 |
| 650 | 21450 | *84 194 18 |
| 700 | 23100 | *84 194 24 |
| 750 | 24750 | 84 194 24 |
| 800 | 26400 | 84 231 18 |
| 850 | 28050 | 84 231 24 |
| 900 | 29700 | 84 271 18 |

Calculating Required Surface Area for Non Standard Enclosures

To use an enclosure size not listed in [Table 25](#) through [Table 27](#), 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 25° C ambient temperature: Watts x 7.8

for 35° C ambient temperature: Watts x 12.6

for 45° C ambient temperature: Watts x 33

For example, if the total amount of heat generated is 400 Watts, the minimum enclosure surface area at 35° C ambient necessary to prevent the enclosure interior temperature from exceeding 55° C would be:

$$400 \times 12.6 = 5040 \text{ sq. in.}$$

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

If you already know an enclosure size and want to find the maximum amount of power dissipation, refer to [Table 25](#) through [Table 27](#). In the tables, locate the surface area that most closely matches the exposed surface of the enclosure. The left most column of the table shows the maximum number of Watts of heat generation.

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 20° C temperature difference. However, it is less accurate for other temperature differences.

Appendix A Hand-Held Monitor

Initial Setup for Blocks

Configure the complete database with the Control Builder. Only use the Hand-held Monitor (HHM) to assign a device number and baud rate to the blocks and to read the database.

Setting Up an HHM

A new HHM comes with a standard configuration that you can change from its keypad. [Table 28](#) lists the HHM configuration settings that are needed.

Table 28. HHM Parameters and Settings

| Parameter | Setting | Description |
|----------------|--|---|
| Baud rate: | 153.6K Standard | The baud rate of the HHM must match the baud rate of the block. If you plan to read blocks that have been changed to 153.6K extended, you must change the HHM to 153.6K extended. |
| Device number: | 0 | The default device number, 0, should be kept. |
| Host CPU: | Series 90/PCIM (HHM at revision level 3.7 or below) PCIM/QBIM/GENI (HHM at revision level 3.8 or above) | An entry that prevents the HHM from displaying a number of screens that are not applicable to TRIO. |

The following procedures describe how to configure the HHM so you can use it to read TRIO blocks:

- [Powering the HHM](#) on page 216
- [Changing the HHM Configuration](#) on page 217

Powering the HHM

You can operate the HHM with either ac power or its internal battery pack. When you receive a new HHM, its battery pack is not charged. You can use the HHM immediately by plugging it into appropriate ac power (first, set the power selection switch on the adapter to match the incoming ac power). Before you can operate the HHM on battery power, you must charge the battery pack. For a new HHM (or a new battery pack) the time required for the first charging is 24 hours. Subsequent charging takes 16 hours. The charger/adapter performs one function at a time; the battery does not charge while the HHM is operating on ac power.

Changing the HHM Configuration

Turn on the HHM by pressing the ON/OFF key. Perform the following steps to change the HHM configuration:

1. Set the HHM baud rate.

The HHM screen initially called up, [Figure 97](#), shows that the HHM is set to use the 153.6K Std baud rate.

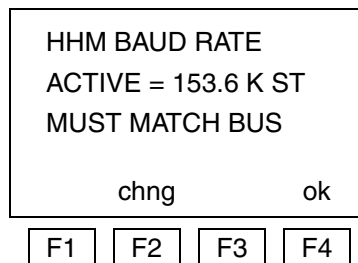


Figure 97. Initial HHM Baud Rate Configuration Screen

You should keep the baud rate of the HHM at 153.6K STD if you are setting the baud rate and device number for blocks that are at their default baud rate of 153.6K STD. If you decide to keep the HHM baud rate at 153.6 K STD, press F4 to access the Home menu and proceed to step 2 of this procedure to set the device number for the HHM.

To change the HHM baud rate, press F2 and the screen shown in [Figure 98](#) is called up.

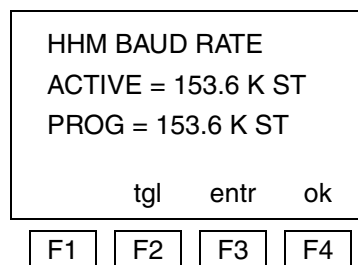


Figure 98. Configuration Screen for Changing HHM Baud Rate

Each time you press F2 (Toggle) a new choice is displayed in the PROG = XXX line. When the desired choice is shown, press F3 (Enter). The initial screen returns with the new value, [Figure 99](#). The baud rate shown goes into effect after you press F4 or cycle power to the HHM by turning it off and on.

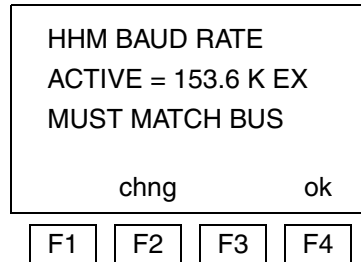


Figure 99. Configuration Screen for Changed Baud Rate

Press F4 to access the Home menu, [Figure 100](#).

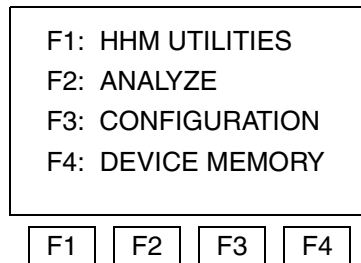


Figure 100. Home Menu

2. Set the HHM device number.

To start the process to configure the device number and host CPU, press F1 to access the HHM Utilities menu as shown in [Figure 101](#).

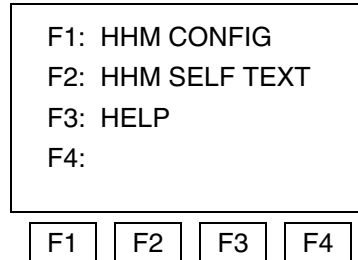


Figure 101. HHM Utilities Menu

Press F1 to access the HHM Configurator Displays. [Figure 102](#) shows the initial HHM Configurator screen.

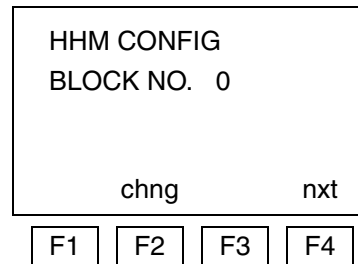


Figure 102. Initial HHM Configurator Screen

The device number should be 0 for the HHM when it is used to configure baud rates and block device numbers. An HHM is set to 0 before it is shipped from the factory and should usually be left at 0. If your HHM is at Device Number 0, press F4 and proceed to step 3, to set the HHM language. If you have to change the device number, press F2 (Change), type the new device number using the HHM decimal keypad, and press F4 (Next). This accesses the HHM language screen.

3. Set the HHM language.

If English is the proper language, press F4 (Next) to go to the Host CPU screen, see [Figure 103](#).

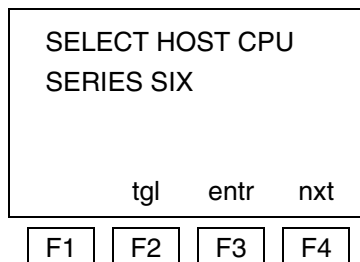


Figure 103. Host CPU Screen

4. Set the Host CPU.

If your HHM is at revision level 3.7 or below, press F2 (Toggle) until the screen contains SERIES 90/PCIM as shown in [Figure 104](#). Then press F3 (Enter).

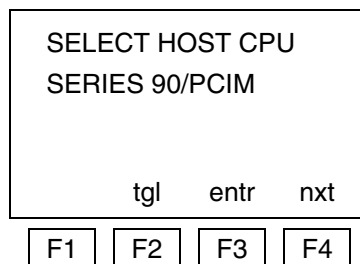


Figure 104. Host CPU Setting for HHM at Revision Level 3.7 or Below

If your HHM is at revision level 3.8 or above, press F2 (Toggle) until the screen contains PCIM/QBIM/GENI. Then press F3 (Enter).

This entry prevents some screens that are not applicable to TRIO from being displayed.

Setting Baud Rate and Device Number on Blocks

This section explains how to use the HHM to set the device numbers and baud rates to I/O blocks.

As you set a block, you should record channel information (such as channel I/O type and tag name) on the block label. This is especially important if you are using similar blocks. In addition, be sure to write the baud rate for the block on the label.

Setting Up a Block

A block must be connected to an appropriate source of power and earth ground before you can read it off-line. To prepare a block:

1. Connect a 75 ohm resistor across the Serial 1 and Serial 2 terminals or use the 75 ohm terminator plug (6200FP00075A), [Figure 105](#).
2. Attach a grounding strap to the ground screw on the side of the block. See [Figure 105](#). Be sure the strap is connected to earth ground.



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

3. Wire the block to the power source. The descriptions of the blocks in [Section 3, Discrete I/O Block Characteristics](#), and [Section 4, Analog I/O Block Characteristics](#), have illustrations to show how power should be applied to each type of block.



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.

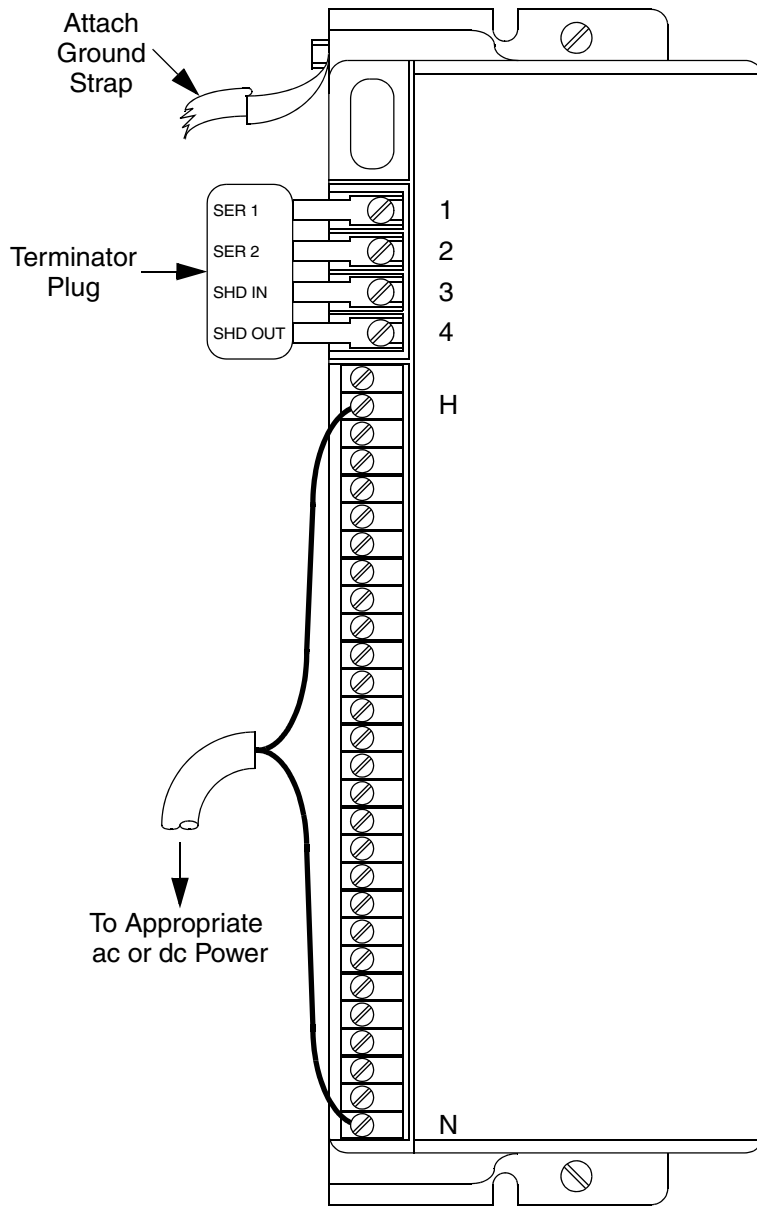


Figure 105. Preparing a Block for Off-Line Configuration

Starting HHM

If the HHM displays an error message, turn the HHM off and on. If the other measures do not clear error conditions, remove and re-insert the battery pack. Begin with the HHM turned off.

1. Attach the HHM to the block. See [Figure 106](#).

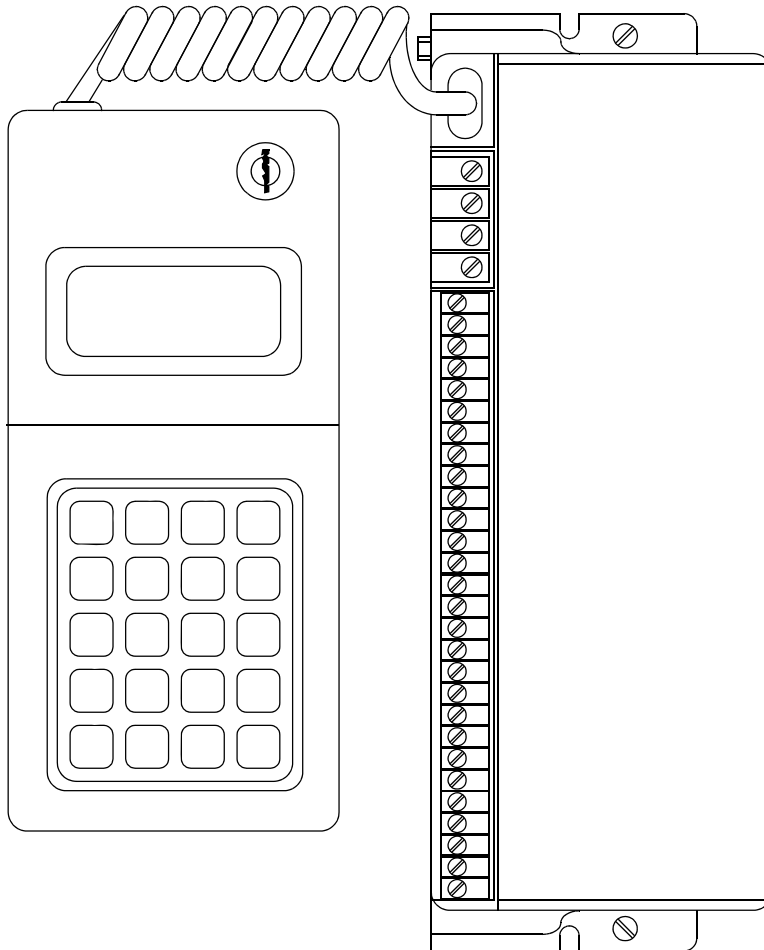


Figure 106. Attaching HHM to a Block for Off-Line Configuration

- Turn the HHM on. After the HHM completes its powerup sequence, the initial HHM Baud Rate screen is called up, [Figure 107](#).

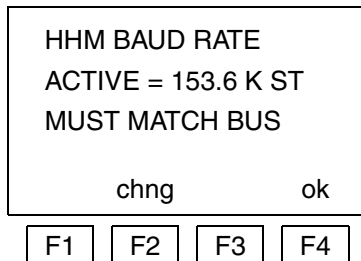


Figure 107. Initial HHM Baud Rate Configuration Screen

The baud rate of the HHM must match the baud rate of the blocks. If you are configuring a new block with a default baud rate of 153.6K std, go to the next step. Otherwise, see [Changing the HHM Configuration](#) on page 217.

Setting Block Baud Rate and Device Number

- Press F4 (ok) to access the Home menu, [Figure 108](#).

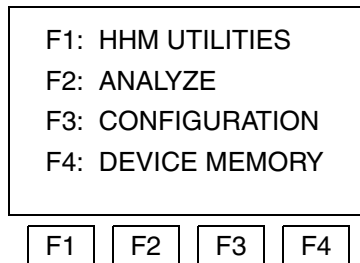


Figure 108. Home Menu

- Press F3 (CONFIGURATION) to access the Configuration menu [Figure 109](#).

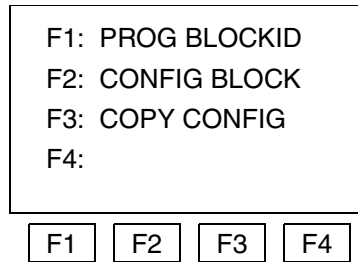


Figure 109. Configuration Menu

5. Press F1 (PROG BLOCKID) and the screen shown in [Figure 110](#) is called up.

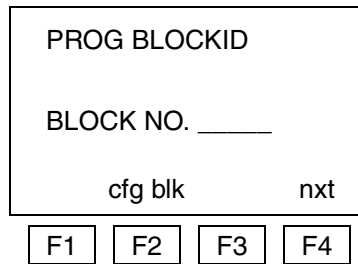


Figure 110. Block ID Configuration Screen

6. Press F2 (Configure Block). This calls up the function keys shown in [Figure 111](#).

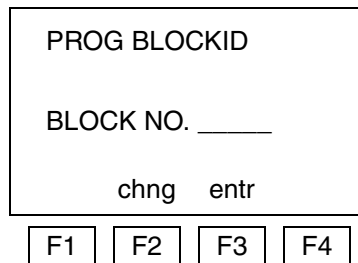


Figure 111. Block ID Configuration Function Keys

7. Type the new block number. It is displayed in the BLOCK NO. Field. If it is the correct block number, press F3 (Enter) to enter it. If it is not the correct number, press F2 (Change) to clear the BLOCK NO. Field so that you can type the correct number.
8. After the block number is entered, F4 becomes the Next key. Press it to go to the baud rate screen, [Figure 112](#).

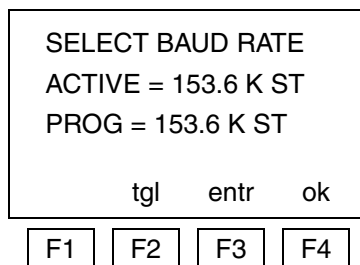


Figure 112. Block Baud Rate Configuration Screen

9. Each time you press F2 (Toggle) a new choice is displayed in the PROG = XXX line. When the desired choice is shown, press F3 (Enter). The baud rate shown goes into effect the next time the block is powered up.

The block is now in a situation where you can place it on a Field Bus so that you can complete its configuration with the Control Builder as described in the *800xA for TRIO/Genius (3BUR002460*)* user manual.

Adding a HHM Connector to a Field Bus

To add an HHM connector to the bus:

1. Attach the mounting plate and Cannon connector (DE-9P) to the mounting surface using two Cannon mounting hardware (D-20418). See [Figure 113](#).
2. Secure two ends of the serial bus cable to the rear of the mounting surface using strain relief brackets.
3. Strip the ends of the wires. Twist the Serial 1 wires together and attach them to pin 5 of the connector. Similarly, attach the Serial 2 wires to pin 9 and the Shield wires to pin 4.

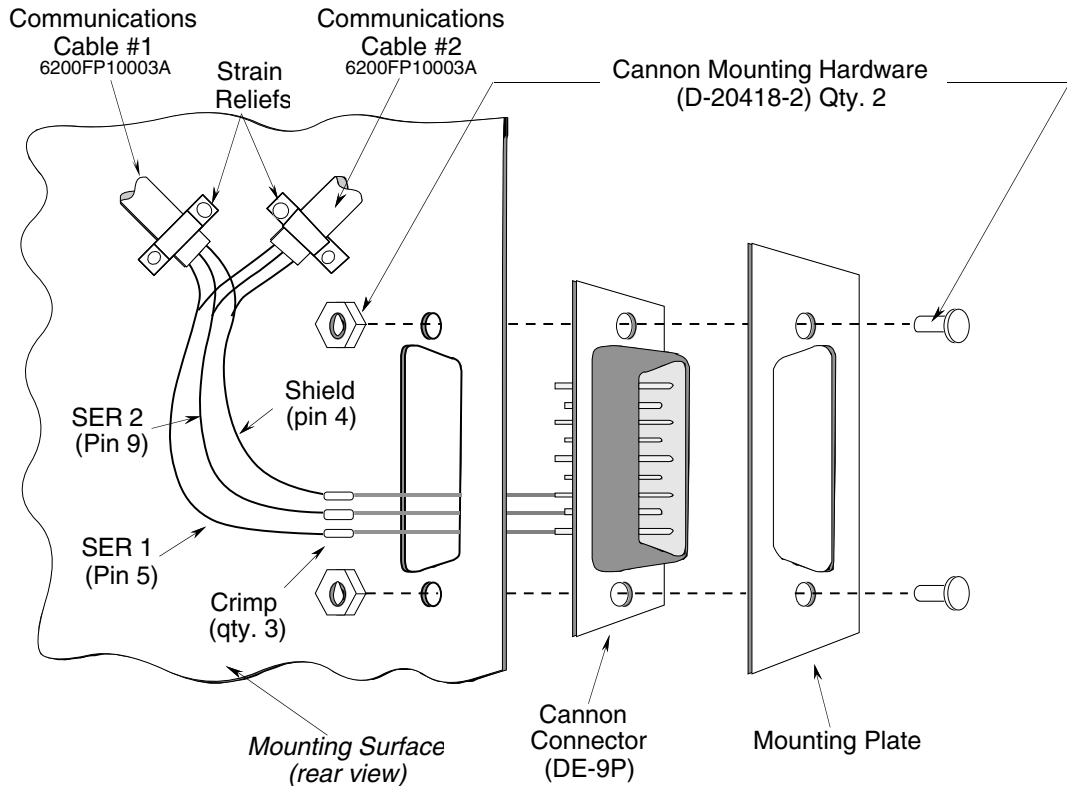


Figure 113. Adding a HHM Connector to a Field Bus

Installing a Hand-held Monitor as a Permanent Workstation

This section explains how to permanently install an additional HHM. Do not install the HHM now if it is being used to configure I/O blocks. The HHM must be connected directly to a block to configure its device number and baud rate.

1. Select a suitable location, with access to either 115 V ac or 230 V ac power. For permanent installation, the signal cable should be attached to a connector on the bus. Instructions for adding a connector to the bus are provided in [Section](#) , .
2. Cut an opening 3.75" wide x 8" high in the panel. Drill four mounting holes. See [Figure 114](#).

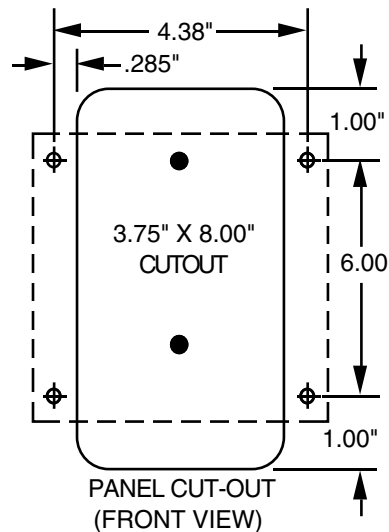


Figure 114. Drilling Guide for Mounting a HHM as a Permanent Workstation

3. Using the panel mount kit provided with the HHM, attach the mounting bracket to the HHM with two screws. See [Figure 115](#).

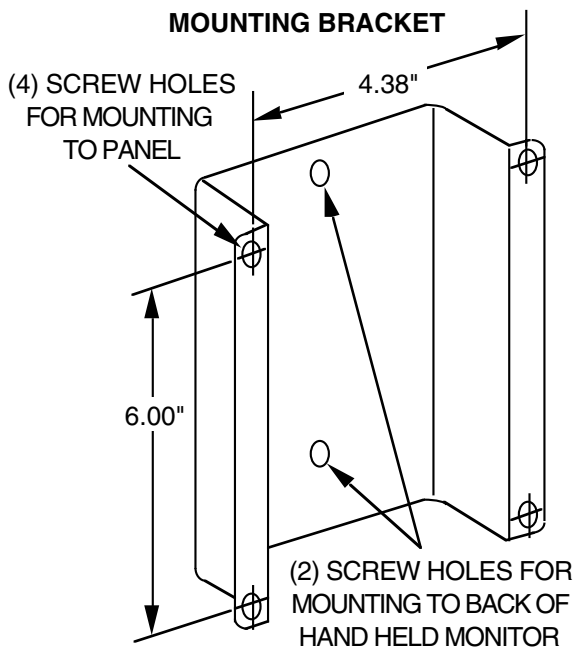


Figure 115. Panel Mount Kit for an HHM

4. Mount the HHM and bracket in the cutout.
5. Connect the power cord to the HHM.
6. Connect the signal cable to the connector.

It is highly advisable to change the device number of a HHM from 0 before permanently installing it. This allows future use of portable HHMs, which ordinarily use Device Number 0.

Numerics

- 6230B 4 in/2 out block 119, 124 to 133, 191
 - Accuracy 131
 - Block power wiring 124
 - Calibration 132
 - Current inputs 120, 126
 - Current outputs 120, 130
 - Diagnostics 122
 - Field bus wiring 124
 - Inputs 120, 124
 - Outputs 120, 129
 - Voltage inputs 120, 128
 - Voltage outputs 120, 130
- 6231B 4 in/2 out current source block 119, 134 to 139
 - Block power wiring 134
 - BSM Controller 136, 190
 - Diagnostics 122
 - Field bus wiring 134
 - I/O channel wiring 136
 - Inputs 120
 - Outputs 120
- 6232B 6 circuit thermocouple block 119, 121, 151 to 159
 - Block power wiring 152
 - BSM Controller 152, 190
 - Cold junction compensation 152, 154, 156
 - Diagnostics 122
 - Field bus wiring 152
 - I/O channel wiring 152
 - Inputs 121
 - Isolation 121
- 6233B 6 circuit RTD block 119, 160 to 164, 191
 - Block power wiring 160
 - Diagnostics 122
 - Field bus wiring 160
 - Inputs 121, 160
 - Isolation 121
- 6234B High Speed Counter block 165, 167
 - Field bus wiring 167
 - Inputs 172
- 6234B high speed counter block 191
- 6235B 6 circuit current source input block 119, 121, 140 to 144
 - Block power wiring 140
 - BSM Controller 142, 190
 - Diagnostics 122
 - Field bus wiring 140
 - I/O channel wiring 142
 - Inputs 121
- 6236B 6 circuit current source output block 119, 122, 145 to 150
 - Block power wiring 145
 - BSM Controller 145, 190
 - Current output wiring 148
 - Diagnostics 123
 - Field bus wiring 145
 - I/O channel wiring 145
 - Outputs 122, 148
 - Voltage output wiring 148
- 6240B 16 circuit source/sink block 63, 68 to 69, 71, 73 to 80
 - 24 V dc sink block I/O channels 76
 - 24 V dc source block external resistor 75
 - 24 V dc source block I/O channels 73
 - 24/48 V dc sink block I/O channels 76
 - 24/48 V dc source block external resistor 75
 - 24/48 V dc source block I/O channels 73
 - Block power wiring 73
 - BSM Controller 75 to 76, 191

- Diagnostics 71
- External resistors 68, 75 to 76
- Field bus wiring 73
- Open wire diagnostic 75 to 76
- Sink I/O channel wiring 76
- Source I/O channel wiring 73
- 6241B 32 circuit source/sink block 63, 69, 72, 81 to 90
 - Block power wiring 81
 - BSM Controller 82, 88, 191
 - Diagnostics 72
 - Field bus wiring 81
 - Sink I/O channel wiring 85, 88
 - Source I/O channel wiring 82
- 6244B 8 circuit grouped block 63, 68, 72, 91
 - ac power considerations 44
 - Block power wiring 91
 - BSM Controller 93, 191
 - Diagnostics 72
 - External resistors 68
 - Field bus wiring 91
 - I/O channel wiring 91
 - Open wire diagnostic 93
- 6245B 8 circuit grouped, low leakage block 63, 68, 72, 91 to 96
 - Block power wiring 91
 - BSM Controller 93, 191
 - Diagnostics 72
 - External resistors 68, 116
 - Field bus wiring 91
 - I/O channel wiring 91
 - Open wire diagnostic 93
- 6246B 8 circuit isolated block 63, 68, 72, 97 to 102
 - ac power considerations 44
 - Block power wiring 97
 - BSM Controller 99, 191
 - Diagnostics 72
 - External resistors 68
 - Field bus wiring 97
 - I/O channel wiring 97

- Open wire diagnostic 99
- 6247B 16 circuit input block 63, 68, 72, 103 to 106, 191
 - ac power considerations 44
 - Block power wiring 103
 - Diagnostics 72
 - External resistors 68
 - Field bus wiring 103
 - I/O channel wiring 103
 - Inputs 103
 - Open wire diagnostic 103
 - Short circuit diagnostic 103
 - Specifications 105
- 6248B 16 circuit relay output block 63, 68, 107 to 114
 - ac power considerations 44
 - Block power wiring 107
 - BSM Controller 111, 191
 - Field bus wiring 107
 - I/O channel wiring 110
 - Normally closed outputs 107
 - Normally open outputs 107
 - Outputs 110
 - Specifications 113

A

- ac power considerations
 - 6244B 8 circuit grouped block (discrete) 44
 - 6246B 8 circuit isolated block (discrete) 44
 - 6247B 16 circuit input block (discrete) 44
 - 6248B 16 circuit relay output block (discrete) 44
- Adding I/O block to field bus 58 to 59
- Advant Controller 410 34
- Advant Controller 460 34
- Analog I/O block
 - 6230B 4 in/2 out 119 to 120, 124 to 133
 - 6231B 4 in/2 out current source 119 to 120, 134 to 139
 - 6232B 6 circuit thermocouple 119, 121, 151 to

159
 6233B 6 circuit RTD 119, 121, 160 to 164
 6234B High Speed Counter 165, 167
 6234B high speed counter 191
 6235B 6 circuit current source input 119, 121,
 140 to 144
 6236B 6 circuit current source output 119,
 122, 145 to 150
 Diagnostics 122
 Isolation 121
 Analog I/O blocks 119 to 123
 Analog wiring 197
 Assigning I/O channels 41
 Attaching hand-held monitor to I/O block 223

B

Baud rate
 Field bus 187
 Hand-held monitor configuration 217
 I/O block 187
 I/O block configuration 221
 Block power wiring
 6230B 4 in/2 out (analog) 124
 6231B 4 in/2 out current source (analog) 134
 6232B 6 circuit thermocouple block
 (analog) 152
 6233B 6 circuit RTD (analog) 160
 6235B 6 circuit current source input
 (analog) 140
 6236B 6 circuit current source output
 (analog) 145
 6240B 16 circuit source/sink (discrete) 73
 6241B 32 circuit source/sink (discrete) 81
 6244B 8 circuit grouped (discrete) 91
 6245B 8 circuit grouped, low leakage
 (discrete) 91
 6246B 8 circuit isolated (discrete) 97
 6247B 16 circuit input (discrete) 103
 6248B 16 circuit relay output (discrete) 107
 BSM Controller 190

6231B 4 in/2 out current source block
 (analog) 136
 6232B 6 circuit thermocouple block
 (analog) 152
 6235B 6 circuit current source input block
 (analog) 142
 6236B 6 circuit current source output block
 (analog) 145
 6240B 16 circuit sink block (discrete) 76
 6240B 16 circuit source block (discrete) 75
 6241B 32 circuit sink block (discrete) 88
 6241B 32 circuit source block (discrete) 82
 6244B 8 circuit grouped block (discrete) 93
 6245B 8 circuit grouped, low leakage block
 (discrete) 93
 6246B 8 circuit isolated block (discrete) 99
 6248B 16 circuit relay output block
 (discrete) 111

BSM, *see* *Bus Switching Module*
 Bus Switching Module 49, 189

C

Cabinet heat generation calculation 208
 Cabinet power dissipation calculation 213
 Cabinet selection 210
 Cabinet size calculation 213
 Calculating
 Cabinet heat generation 208
 Cabinet power dissipation 213
 Size of non-standard cabinet 213
 CHAN n COMPENSATION field 154 to 155, 157
 CHAN n TC TYPE field 157
 CHAN n USER VALUE field 156 to 157
 Changing
 Hand-held monitor configuration 217
 CI560 TRIO MIB submodule 34
 CI862 TRIO Interface Module 185
 Clear Faults 123
 Cold junction compensation 152, 154, 156
 Communications wiring 197

Configuration menu 224
Configuring
 Hand-held monitor 215
 Hand-held monitor baud rate 217
 Hand-held monitor host CPU 220
 Hand-held monitor language 220
 I/O block baud rate 221
Connecting
 Devices to field bus 49
Control wiring 197
Counts 126
Current inputs, 6230B 4 in/2 out block
 (analog) 120, 126
Current load 71
Current outputs
 6230B 4 in/2 out block (analog) 120, 130
 6236B 6 circuit current source output block
 (analog) 148

D

Device number 186
 Hand-held monitor 186
 I/O block 186
Diagnostics
 6230B 4 in/2 out block (analog) 122
 6231B 4 in/2 out current source block
 (analog) 122
 6232B 6 circuit thermocouple block
 (analog) 122
 6233B 6 circuit RTD block (analog) 122
 6235B 6 circuit current source input block
 (analog) 122
 6236B 6 circuit current source output block
 (analog) 123
 6240B 16 circuit source/sink block
 (discrete) 71
 6241B 32 circuit source/sink block
 (discrete) 72
 6244B 8 circuit grouped block (discrete) 72
 6245B 8 circuit grouped, low leakage block

 (discrete) 72
 6246B 8 circuit isolated block (discrete) 72
 6247B 16 circuit input block (discrete) 72
 Analog I/O block 122
 Discrete I/O block 71
Disabling
 I/O block 58
Discrete I/O block
 6240B 16 circuit source/sink 63, 68 to 69, 71,
 73 to 80
 6241B 32 circuit source/sink 63, 69, 72, 81 to
 90
 6244B 8 circuit grouped 63, 68, 72, 91
 6245B 8 circuit grouped, low leakage 63, 68,
 72, 91 to 96
 6246B 8 circuit isolated 63, 68, 72, 97 to 102
 6247B 16 circuit input 63, 68, 72, 103 to 106,
 191
 6248B 16 circuit relay output 63, 68, 107 to
 114
 Current load 71
 Diagnostics 71
 External resistors 68
 Isolation 68
Discrete I/O blocks 63 to 72

E

Electronics assembly 58
 Removing 58
 Replacing 58
ENG UNITS field 157
External resistors
 6240B 16 circuit source/sink block
 (discrete) 68, 75 to 76
 6244B 8 circuit grouped block (discrete) 68
 6245B 8 circuit grouped, low leakage block
 (discrete) 68, 116
 6246B 8 circuit isolated block (discrete) 68
 6247B 16 circuit input block (discrete) 68
Discrete I/O blocks 68

F

- Field bus 49
 - 6230B 4 in/2 out block wiring 124
 - 6231B 4 in/2 out current source block wiring 134
 - 6232B 6 circuit thermocouple block wiring 152
 - 6233B 6 circuit RTD block wiring 160
 - 6234B High Speed Counter block wiring 167
 - 6235B 6 circuit current source input block wiring 140
 - 6236B 6 circuit current source output block wiring 145
 - 6240B 16 circuit source/sink block wiring 73
 - 6241B 32 circuit source/sink block wiring 81
 - 6244B 8 circuit grouped block wiring 91
 - 6245B 8 circuit grouped, low leakage block wiring 91
 - 6246B 8 circuit isolated block wiring 97
 - 6247B 16 circuit input block wiring 103
 - 6248B 16 circuit relay output block wiring 107
 - Adding I/O block 58 to 59
 - Baud rate 187
 - Cable 52, 197
 - Cable parameters 186
 - Connection to BSM cluster 53
 - Device connection 49
 - Devices 33, 185
 - HHM connector 227
 - HHM installation 228
 - I/O block connections 50
 - Length 188
 - Non-redundant 185
 - Redundant 185, 189
 - Removing I/O block 58
 - Scan rate 194
 - Scan rate calculations 194
 - Termination 56 to 57
- Field bus address, *see Device number*

G

- Grounding
 - I/O block 48

H

- Hand-held monitor 34, 165, 186, 198, 215, 223
 - Attaching to I/O block 223
 - Baud rate configuration 217
 - Configuration 215
 - Configuration changes 217
 - Configuration menu 224
 - Device number 186
 - Field bus connector 227
 - Home menu 224
 - Host CPU configuration 220
 - Installation on field bus 228
 - Language configuration 220
 - Power 216
 - Turning on 224
- HHM, *see Hand-held monitor*
- Home menu 224

I

- I/O block
 - ac power considerations 44
 - Adding to field bus 58 to 59
 - Attaching hand-held monitor 223
 - Baud rate 187
 - Baud rate configuration 221
 - Device number 186
 - Device number assignment 221
 - Disabling 58
 - Electronics assembly 58
 - Field bus connection 50
 - Grounding 48
 - Hand-held monitor attachment 223
 - Initial configuration setup 221
 - Location 41
 - Mounting 43
 - Power disconnect 47

- Removing electronics assembly 58
 - Removing from field bus 58
 - Replacing electronics assembly 58
 - Replacing terminal assembly 60
 - Terminal assembly 58
 - I/O blocks 23
 - 6230B 4 in/2 out (analog) 119 to 120, 124 to 133
 - 6231B 4 in/2 out current source (analog) 119 to 120, 134 to 139
 - 6232B 6 circuit thermocouple (analog) 119, 121, 151 to 159
 - 6233B 6 circuit RTD (analog) 119, 121, 160 to 164
 - 6234B 6 circuit RTD (analog) 165, 167
 - 6234B high speed counter (analog) 191
 - 6235B 6 circuit current source input (analog) 119, 121, 140 to 144
 - 6236B 6 circuit current source output (analog) 119, 122, 145 to 150
 - 6240B 16 circuit source/sink (discrete) 63, 68 to 69, 71, 73 to 80
 - 6241B 32 circuit source/sink (discrete) 63, 69, 72, 81 to 90
 - 6244B 8 circuit grouped (discrete) 63, 68, 72, 91
 - 6245B 8 circuit grouped, low leakage (discrete) 63, 68, 72, 91 to 96
 - 6246B 8 circuit isolated (discrete) 63, 68, 72, 97 to 102
 - 6247B 16 circuit input (discrete) 63, 68, 72, 103 to 106, 191
 - 6248B 16 circuit relay output (discrete) 63, 68, 107 to 114
 - Analog 119 to 123
 - Discrete 63 to 72
 - I/O channel assignment 41
 - I/O channel wiring
 - 6231B 4 in/2 out current source block (analog) 136
 - 6232B 6 circuit thermocouple block (analog) 152
 - 6235B 6 circuit current source input block (analog) 142
 - 6236B 6 circuit current source output block (analog) 145
 - 6240B 16 circuit sink block (discrete) 76
 - 6240B 16 circuit source block (discrete) 73
 - 6241B 32 circuit sink block (discrete) 85, 88
 - 6241B 32 circuit source block (discrete) 82
 - 6244B 8 circuit grouped block (discrete) 91
 - 6245B 8 circuit grouped, low leakage block (discrete) 91
 - 6246B 8 circuit isolated block (discrete) 97
 - 6247B 16 circuit input block (discrete) 103
 - 6248B 16 circuit relay output block (discrete) 110
 - Inputs
 - 6230B 4 in/2 out block (analog) 120, 124
 - 6231B 4 in/2 out current source block (analog) 120
 - 6232B 6 circuit thermocouple block (analog) 121
 - 6233B 6 circuit RTD block (analog) 121, 160
 - 6234B High Speed Counter block (analog) 172
 - 6235B 6 circuit current source input block (analog) 121
 - 6247B 16 circuit input block (discrete) 103
 - Tri-state 75 to 76
 - Isolation
 - 6232B 6 circuit thermocouple block (analog) 121
 - 6233B 6 circuit RTD block (analog) 121
 - Analog I/O block 121
 - Discrete I/O block 68
- L**
- LAN redundancy 50
 - Locating I/O blocks 41

M

Mounting I/O blocks 43
 Multibus Field Bus Interface Module 34
 Multibus Subsystem 33 to 34

N

Noise 196
 Non-redundant field bus 185
 Normally closed outputs 107
 Normally open outputs 107

O

Open wire diagnostic
 6240B 16 circuit source/sink block
 (discrete) 75 to 76
 6244B 8 circuit grouped block (discrete) 93
 6245B 8 circuit grouped, low leakage block
 (discrete) 93
 6246B 8 circuit isolated block (discrete) 99
 6247B 16 circuit input block (discrete) 103
 Outputs
 6230B 4 in/2 out block (analog) 120, 129
 6231B 4 in/2 out current source block
 (analog) 120
 6236B 6 circuit current source output block
 (analog) 122, 148
 6248B 16 circuit relay output block
 (discrete) 110

P

Power disconnect 47
 Power wiring 197

R

Redundant
 Field bus 185, 189
 LAN 50
 Removing
 I/O block electronics assembly 58

I/O block from field bus 58

Replacing

I/O block electronics assembly 58
 I/O block terminal assembly 60

S

SC Controller 34
 SC Controller Field Bus Interface Module 34
 Scan rate
 Calculations for field bus 194
 Field bus 194
 Selecting a cabinet 210
 Short circuit diagnostic
 6247B 16 circuit input block (discrete) 103
 Signal wiring 197
 Sink current 69
 Size calculation for non-standard cabinet 213
 Source current 69
 Specifications
 6247B 16 circuit input block (discrete) 105
 6248B 16 circuit relay output block
 (discrete) 113

T

Terminal assembly 58
 Terminal assembly replacement 60
 Terminating field bus 56 to 57
 TRIO blocks, *see I/O blocks*
 Tri-state input 75 to 76
 Turning on hand-held monitor 224

V

Voltage inputs, 6230B 4 in/2 out block
 (analog) 120, 128
 Voltage outputs
 6230B 4 in/2 out block (analog) 120, 130
 6236B 6 circuit current source output block
 (analog) 148

W

Warmstart 68

Wiring

- 6230B 4 in/2 out block (analog) 124
- 6231B 4 in/2 out current source block
(analog) 134
- 6232B 6 circuit thermocouple block
(analog) 152
- 6233B 6 circuit RTD block (analog) 160
- 6235B 6 circuit current source input block
(analog) 140
- 6236B 6 circuit current source output block
(analog) 145
- 6240B 16 circuit source/sink block
(discrete) 73
- 6241B 32 circuit source/sink block
(discrete) 81
- 6244B 8 circuit grouped block (discrete) 91
- 6245B 8 circuit grouped, low leakage block
(discrete) 91
- 6246B 8 circuit isolated block (discrete) 97
- 6247B 16 circuit input block (discrete) 103
- 6248B 16 circuit relay output block
(discrete) 107
- Analog 197
- Communications 197
- Control 197
- Power 197
- Signal 197

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3BUR002459-600

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