FISHER

GB600-SERIES CONTROLLERS

of the GridBoss™ System

Instruction Manual

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Page	**Revision**
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SECTION 1 — GENERAL INFORMATION

1.1 MANUAL OVERVIEW

This manual describes the controllers manufactured by Fisher Controls, which are used in a GridBoss™ Pressure Control and Management System. The GridBoss System consists specifically of the GB601 District Regulator (DR) Controller, the GB602 Low Pressure Point (LPP) Controller, the GRIDLINK configuration software, and optionally the GridManager Host. The GridBoss System controls the setpoint at the GB601 DR Controller through a Kixcel, such as a Fisher Type 662 Kixcel™. An I/P or servo valve may be used in place of the Kixcel. The setpoint is "predicted" by the historical profile of the District Regulator outlet pressure versus the time-of-day and temperature. The GB602 LPP Controller monitors the average pressure at a low-pressure point downstream from the District Regulator. The average pressure and change in setpoint for the regulator is relayed back to the District Regulator when the average pressure is out of range.

The Included in this manual are the following sections:

- Table of Contents — Table of Contents
- Section 1 — General Information
- Section 2 — Using the GridBoss Controllers
- Section 3 — The Pressure Module
- Section 4 — Communications Cards
- Section 5 — Input/Output Card
- Appendix A — Lightening Protection Module
- Glossary — Glossary of Terms
- Index — Topical Index

Table of Contents lists each section and information contained in that section of the document.

Section 1 describes this manual and mentions related manuals. This section provides a summary of the controller hardware, installation requirements, mounting the controller units, and power requirements.

Section 2 provides information and specifications concerning the use of the GridBoss Controllers. Topics covered include the Main Electronics Board, wiring, processes, and troubleshooting. The Main Electronics Board provides the pressure sensor input channel, one built-in discrete output channel, a direct Resistance Temperature Detector (RTD) input, an operator interface port, and a Host communications port. In addition, Section 2 details the optional AC power supply and battery charger.

Section 3 describes the Pressure Module (PM) which is used to measure the inlet and outlet pressures of the District Regulator (DR) and the line pressure at the Low Pressure Point (LPP).

Section 4 provides information and specifications for the optional communications cards.

Section 5 provides information and specifications for the Input/Output (I/O) Card, which changes the pressure using an Analog Output (AO) or two Discrete Outputs (DO). An Analog Input (AI) can be used to receive the position signal of the Kixcel, I/P, or servo valve. Optionally, a Discrete Input (DI) on the I/O card can be used the for a tamper-resistant intrusion switch.

Appendix A describes the optional Lightning Protection Module (LPM).

Glossary of Terms defines terms used in Fisher Controls documentation.

Topical Index alphabetically lists the items contained in this manual along with their page numbers.

NOTE

An I/P or servo valve may be used in place of the Kixcel. To ensure ease of readability, Kixcel is used throughout this manual to represent all three devices.

1.2 SECTION CONTENTS

This section contains the following information:

1.3 ADDITIONAL INFORMATION

The following manuals may be used to acquire additional information not found in this manual:

- *GRIDLINK Configuration Software User Manual* – Part Number D301131X012
- *Function Sequence Table (FST) User Manual* – Part Number D301058X012
- *ROC/FloBoss Accessories Instruction Manual* – Part Number D301061X012
- *Type 662 Kixcel Remote Control Pilot Drive Actuator* – Part Number D102273X012

1.4 PRODUCT OVERVIEW

Both GridBoss controllers are 32-bit microprocessor-based devices. One is the GB601 District Regulator (DR) Controller and the other is the GB602 Low Pressure Point (LPP) Controller. The DR is automated with a Kixcel. The GridBoss System automates the delivery of natural gas at an optimized and adequate pressure for distribution systems. The GB601 provides functions required for measuring the inlet and outlet pressure of the District Regulator, and the GB602 measures the line pressure at the Low Pressure Point.

The **GB601 DR Controller** computes historical load profiles based on ambient temperature and time-of-day to determine the "predicted" Setpoint of the District Regulator. By using historical load profiles and relaying the Setpoint and average temperature originating at the GB602 LPP Controller to the District Regulator, the DR automates the delivering of natural gas at an optimized and adequate pressure. The GridBoss System predicts system requirements to improve system integrity and reduces the average system pressure. The District Regulator controls the regulator and stores the historical load profile for the pressure versus the time-of-day and temperature.

The controllers provide on-site functionality and support remote monitoring, pressure monitoring, data archival, communications, and control. The controller design allows you to configure specific applications including those requiring calculations, logic, and sequencing control using Function Sequence Tables (FSTs).

The **GB602 LPP Controller** measures the average pressure at the Low Pressure Point downstream from the District Regulator. The average line pressure at the Low Pressure Point and the required change in Setpoint for the District Regulator is relayed back to the GB601 when the LPP pressure goes out of range.

The primary input used for measurement at the LPP is static pressure. The primary inputs used for measurement at the DR are static pressures and outside ambient temperature. The static pressure inputs come from the attached Pressure Module (PM), and the temperature input comes from a built-in Resistance Temperature Detector (RTD) probe.

The GRIDLINK configuration software allows you to set up the DR and LPP controllers, while the Host software monitors both the District Regulator and the Low Pressure Point and provides remote access for changing the configuration and taking control of the system.

The GridBoss controllers have the following components and features:

- Weather-tight enclosures.
- Main Electronics Boards.
- Built-in Liquid Crystal Displays (LCD) with two-line alphanumeric viewing.
- A 32-bit microprocessors with 512K of flash ROM and 512K of static memory storage.
- Built-in Inputs and Outputs (I/O).
- Built-in Pressure Modules (PM) for sensing static pressure.
- Built-in Resistance Temperature Detector (RTD) input.
- Input/Output (I/O) Card (optional on GB602).
- Operator interface (LOI) port.
- Communications ports (COM1) for optional Host communications card.
- User Level Security.
- Up to 28 amp-hour battery capacity (21 amp-hour capacity with optional AC power supply).
- Extensive applications firmware.

Physically, the GridBoss controllers consist of a printed circuit Main Electronics Board and a display housed in a compact, weather-tight case. The case is a NEMA 4 windowed enclosure that can mount on a wall or a pipestand. A protective cover is provided for the display to protect it from adverse weather conditions. Refer to Figure 1-1.

The steel enclosure protects the electronics from physical damage and harsh environments. The enclosure consists of two pieces: the body and the front cover. A foam-rubber gasket seals the unit when the cover is closed. The cover hinge, located on the left side, is stainless steel and fastened to the body with machine screws, allowing removal of the cover. The cover is secured by a lockable hasp.

The enclosure is fabricated from carbon steel. Enclosure external dimensions, including the Pressure Module (PM), are approximately 16.56 inches high by 13.80 inches wide by 7.25 inches deep (420 mm by 350 mm by 184 mm). The Pressure Module mounts to the bottom of the enclosure with four bolts.

The enclosure contains the Main Electronics Board with its built-in I/O capabilities and LCD display. It also has room for batteries, a communications card, I/O card, AC power supply/battery charger, and one radio with an optional mounting bracket.

The **Main Electronics Board** mounts on stand-offs located on the front of the swing-out panel. The dimensions of the board are approximately 5 by 7.5 inches. The majority of the components are surface-mounted with only the front of the board used for components. The Main Electronics Board provides built-in I/O capabilities, an LCD display, connections to an optional I/O card, and provisions for an optional communications card. Screw terminals located on the Main Electronics Board provide terminations for input power, an RTD input, a discrete output (DO), radio communications (RADIO), Pressure Module (P/PD), and operator interface (LOI) communications. For more information on the Main Electronics Board, refer to Section 2.

The built-in **Liquid Crystal Display** (LCD) provides the ability to look at data and configuration parameters while on site without using the local operator interface (LOI) and a personal computer (PC). The LCD display is factory-mounted directly to the Main Electronics Board and visible through the window on the front panel. Through this display, you can view pre-determined information stored in the controller. Up to 16 configuration parameters can be configured for display. The display automatically cycles through the configured list of items displaying a new value approximately every three seconds.

A Motorola 32-bit CMOS **microprocessor** runs at 14.7 Mhz and has low-power operating modes, including inactivity and low battery conditions. The controllers come standard with 512 KB of built-in, super capacitor-backed static random access memory (SRAM) for storing data and history. The controllers also have 512 KB of programmable read-only memory (flash ROM) for storing operating system firmware, applications firmware, and configuration parameters.

The **built-in inputs and outputs (I/O)** consist of a port for a Pressure Module (PM), a 4-wire Resistance Temperature Detector (RTD) input interface, and a discrete output. Three diagnostic inputs are dedicated to monitoring input power, battery voltage, and enclosure/battery temperature.

The **Pressure Module (PM)** uses a Hitachi 16-bit micro-controller and calculates static pressure. At the District Regulator, the Pressure Module reads the inlet static (line) pressure and the outlet static pressure. At the Low Pressure Point, the Pressure Module reads the pressure downstream of the DR. The Pressure Module communicates this information to the Main Electronics Board. The sensor housing flange mounts with four bolts to the bottom of the enclosure. The Pressure Module cable plugs directly into the Main Electronics Board at the P/DP connector. For more information on the Pressure Module, refer to Section 3.

The **RTD temperature** probe supplied on the GB601 mounts on the bottom of the enclosure. RTD wires should be protected either by a metal sheath or by conduit connected to a liquid-tight conduit fitting on the bottom of the enclosure if installed farther away from the controller. The RTD wires connect directly to the four-terminal RTD connector on the Main Electronics Board inside the enclosure.

The **I/O Card** provides additional inputs and outputs as required by the controllers. The I/O Card contains analog inputs (AIs), an analog output (AO), discrete inputs (DIs), pulse inputs (PIs), and discrete outputs (DOs). A DI on the card can be connected to an intrusion switch in both the District Regulator and Low Pressure Point controllers. Refer to Section 5 for details concerning the I/O card.

The GB601 DR typically uses a **Kixcel** such as the Fisher Type 662 Kixcel™. An I/P or servo valve can be used in place of a Kixcel. An AO or pair of Discrete Outputs can be used to open and close the Kixcel. The Kixcel is a motorized device that is coupled to the adjusting screw of a Pilot regulator, which actually adjusts the Setpoint of the DR. To supply the power required by the Kixcel, the DR typically uses an AC power supply and battery charger. The GB601 DR communicates with the GB602 LPP. The GB601 also initiates and accepts communications with a Host.

The GB602 LPP, often powered by AC power with battery backup, provides power to its Pressure Module (PM) sensor and a radio. The GB602 may also be solar powered. The GB602 LPP has a dedicated communications link with its corresponding DR Controller. A GB602 LPP, which can communicate with up to five GB601 DRs, initiates communications with the DR controller. The GB602 also initiates and accepts communications with a Host.

The **operator interface (LOI) port**, located on the bottom left-hand side of the enclosure (refer to Figure 1-1), provides for a direct, local link between the controller and a personal computer through an Operator Interface Cable. With the personal computer running the GRIDLINK™ Configuration Software, you can configure the functionality of a GridBoss controller and monitor its operation. User-level security can be enabled or disabled for the LOI port.

The **Host communications** port (located at COM1) is available for use with an optional communications card to permit serial communication protocols and dial-up modem communications. User level security can be enabled or disabled for the Host communications port (COM1). Through this port, the DR and LPP controllers can communicate periodically with a central Host. The Host gathers the history data and checks the status and health of the system. Alarm limits can be set in the Host to monitor the system and improve overall system integrity.

The DR and LPP controllers have the ability to communicate with each other and the Host on the same communications port or on separate communications ports. If two communication ports are used, the LOI is used for peer-to-peer communications between the DR and the LPP controller, while COM1 is used for Host communications. **If only one communications port is used, the LPP controller, the DR controller, and the Host all use COM1.**

User Level Security allows the system manager to set up individual user security with various levels of access to the individual GridBoss controllers. Security can be different for the LOI port and the Host port.

The I/O parameters, pressure calculations, power control, security, and FST programmability are configured and accessed using the GRIDLINK Configuration Software. Refer to the *GRIDLINK Configuration Software User Manual* for details concerning software capabilities.

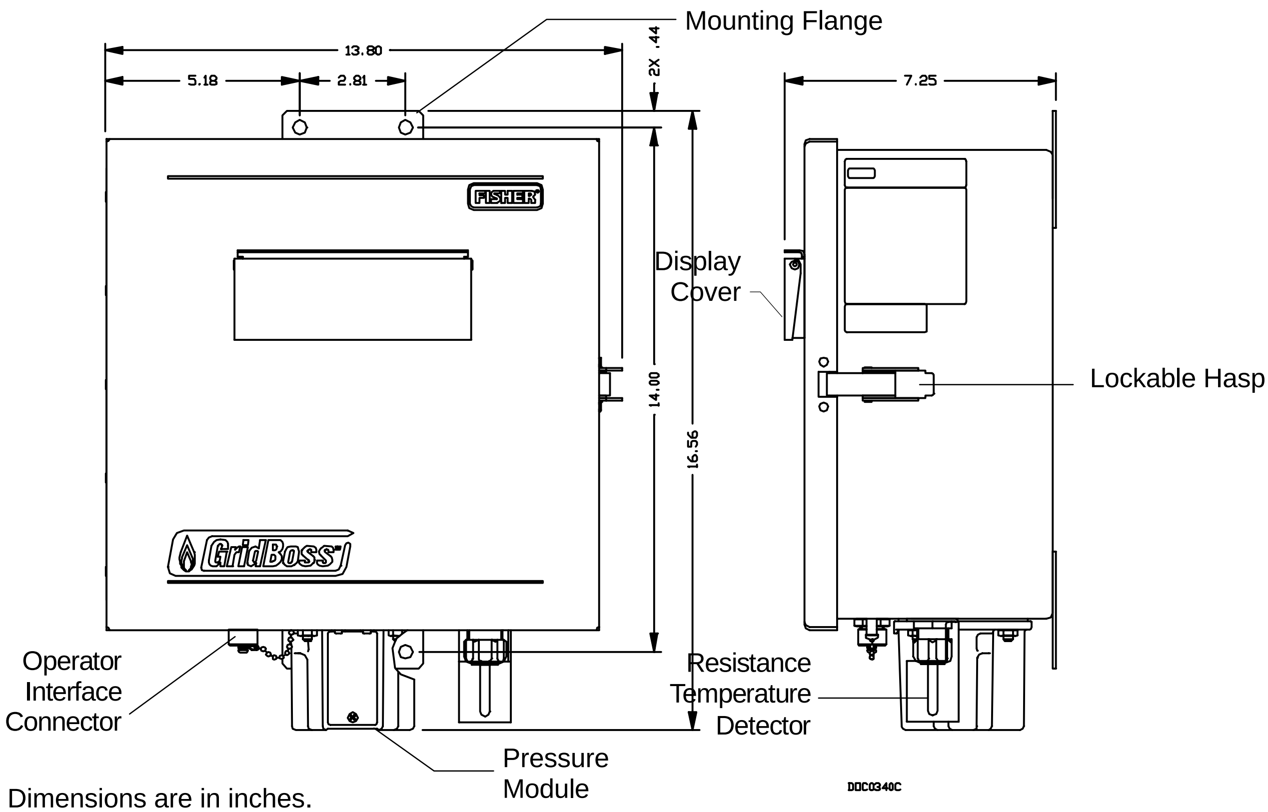

Figure 1-1. GB600-Series Controller (GB601 DR shown)

1.4.1 Firmware

The **firmware**, contained in flash ROM on the electronics board, determines much of the functionality of the GridBoss units, such as:

- ♦ Memory logging of 240 alarms and 240 events.
- ♦ Extensive archival of data into daily averages, 15-minute averages, and minute averages.
- ♦ Power cycling control for a radio through the optional EIA-232 communications card.
- ♦ Memory logging of two time-of-day profiles with 1440 entries (DR controller only).
- ♦ Closed-loop (PID) control.
- ♦ Logic and sequencing control for one user-defined Function Sequence Table (FST) program.
- ♦ Communications based on the ROC protocol.
- ♦ User level security.

Refer to Section 2.3 for more information about the functionality provided by the firmware.

1.4.2 Options and Accessories

The GB600-Series controllers support the following options and accessories:

- ♦ Communications Cards for DR/LPP/Host communications (COM1).
- ♦ Radio for Host communications.
- ♦ Bracket for one internally-mounted radio.
- ♦ AC Power Supply / Battery Charger.
- ♦ Local Operator Interface (LOI) cable.
- ♦ Lightening Protection Module (LPM).
- ♦ Batteries.
- ♦ Solar Panels.
- ♦ Intrusion Switch.

A variety of plug-in **communication cards** are available that allow you to customize the controller installation for most communications requirements. COM1 provides the necessary communications to receive data to and from the LPP and DR controllers and provides an interface for the Host communications. In addition, a Host computer can remotely configure and take control of the DR and LPP controllers through the COM1 port. The LPP controller can communicate with up to five DRs. These cards permit serial communication protocols, as well as dial-up modem communications. One card of the following types can be accommodated:

- ♦ EIA-232 (RS-232) for asynchronous serial communications.
- ♦ EIA-485 (RS-485) for asynchronous serial communications.
- ♦ Dial-up modem for communications over a telephone network.

Stand-offs on the Main Electronics Board allow the optional communications cards to be added easily. Refer to Section 4 for more information.

One radio can be mounted inside a GridBoss enclosure using the optional **radio bracket** (see Section 1.6). The radio bracket allows a radio up to 2.25 inches high to be mounted securely in the battery compartment inside the enclosure. Power for the radio can be controlled through the EIA-232 communications card. Clearance is provided for the radio antenna cable to exit the bottom of the enclosure. If you require two radios, one for peer-to-peer and one for peer-to-host, one of the radios must be mounted outside of the enclosure.

An internal **AC power supply** is available from Fisher as a factory-installed option. The AC power supply converts AC line power to DC power for use by a GridBoss controller and its associated accessories. The power supply typically is used in line-powered installations. If a battery is used in the line-powered installation, the AC supply also functions as a battery charger. The unit provides a fully regulated, temperature-compensated output that is protected from overcurrent conditions. The AC supply is factory-installed in the battery compartment of the controller enclosure. Refer to Section 2 for details concerning the AC power supply. Due to the power requirements associated with the Kixcel, the DR controller normally requires an AC power supply.

The **local operator interface (LOI)** port provides for a direct local connection between the DR or LPP and a personal computer using an **Operator Interface Cable**. With the personal computer (PC) running the GRIDLINK Configuration Software, you can configure the functionality of the controller units and monitor their operation. The Operator Interface Cable is available as an accessory from Fisher.

The optional **Lightning Protection Module (LPM)** provides additional protection from any high-voltage transients that may occur in field wiring for Analog Inputs (AIs). LPMs are available from Fisher. Refer to Appendix A for additional information.

The GridBoss enclosures can hold up to four sealed lead-acid **batteries**. The 12-volt batteries provide approximately 7 amp-hours each, resulting in up to 28 amp-hours of backup capacity or up to 21 amp-hours of backup capacity when used with an AC power supply. The batteries are mounted behind the electronics swing-out panel and are retained by the panel when it is secured. The batteries are connected to a wiring harness that allows the batteries to be changed without removing power from the unit. Input wiring is connected at the POWER wiring terminal connector.

A **solar panel** can be installed to recharge the backup batteries of a controller; it connects to the POWER charge inputs on the Main Electronics Board. Circuitry on the Main Electronics Board monitors and regulates the charge based on battery voltage, charging voltage, and temperature. The typical panels used are 12-volt panels with output ratings of 5, 10, or 11 watts. The panels are typically bracket-mounted on a pole or pipe, and the wiring is brought into the bottom of the GridBoss enclosure through a liquid-tight fitting. Due to power requirements, solar panels are normally used only on the GB602.

The **intrusion switch** acts as a tamper detector for the GridBoss controllers. The intrusion switch is a momentary contact switch used to detect whether the door to the enclosure is open or closed. The switch, which has a normally closed contact, is designed to be mounted in the GridBoss enclosure. When the normally-closed contacts are wired to a Discrete Input (DI), an “On” status is detected when the door is closed and an “Off” status when it is open. The status of the switch can be configured to generate an alarm when the door to the enclosure is open. An I/O Card must be installed in order to use the intrusion switch.

1.5 INSTALLATION REQUIREMENTS

This section provides generalized guidelines for successful installation and operation of the GridBoss controllers. Planning helps to ensure a smooth installation. Be sure to consider location, ground conditions, climate, and site accessibility as well as the suitability of the controller application while planning an installation.

The versatility of the GB600-Series controller allows it to be used in many types of installations. For additional information concerning a specific installation, contact your Fisher Representative. For detailed wiring information, refer to Section 2.

The Installation Requirements section includes:

- ♦ Environmental Requirements
- ♦ Site Requirements
- ♦ Compliance with Hazardous Area Standards
- ♦ Power Installation Requirements
- ♦ Grounding Installation Requirements
- ♦ I/O Wiring Requirements

NOTE

The GB600-Series controller has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, the controller may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

1.5.1 Environmental Requirements

The GridBoss controller case is classified as a NEMA 4 equivalent enclosure. This provides the level of protection required to keep the units operating under a variety of weather conditions.

The controller is designed to operate over a wide range of temperatures. However, in extreme climates it may be necessary to moderate the temperature in which the unit must operate.

The controller is designed to operate over a -40 to 75° C (-40 to 167° F) temperature range. The LCD temperature range is -25 to 70° C (-13 to 158° F). When mounting the unit, be aware of external devices that could have an effect on the operating temperature. Operation beyond the recommended temperature range could cause errors and erratic performance. Prolonged operation under extreme conditions could also result in failure of the unit.

Check the installation for mechanical vibration. The controller units should not be exposed to levels of vibration that exceed 2g for 15 to 150 hertz and 1g for 150 to 2000 hertz.

1.5.2 Site Requirements

Careful consideration in locating the controller on the site can help prevent future operational problems. The following items should be considered when choosing a location:

- ♦ Local, state, and federal codes often place restrictions on monitoring locations and dictate site requirements. Examples of these restrictions are distance from pipe flanges and hazardous area classifications.
- ♦ Locate the controller to minimize the length of signal and power wiring.
- ♦ When using solar-powered controller units, orient solar panels to face due South (not magnetic South) in the Northern Hemisphere and due North (not magnetic North) in the Southern Hemisphere. Make sure nothing blocks the sunlight from 9:00 AM to 4:00 PM.
- ♦ Antennas equipped for radio communications must be located with an unobstructed signal path. If possible, locate antennas at the highest point on the site and avoid aiming antennas into storage tanks, buildings, or other tall structures. Allow sufficient overhead clearance to raise the antenna.
- ♦ To minimize interference with radio communications, locate the controller away from electrical noise sources such as engines, large electric motors, and utility line transformers.
- ♦ Locate the controller away from heavy traffic areas to reduce the risk of being damaged by vehicles. However, provide adequate vehicle access to aid in monitoring and maintenance.

1.5.3 Compliance with Hazardous Area Standards

The controller units have hazardous location approvals pending for Class I, Division 2, Groups C and D exposures. The Class, Division, and Group terms are defined as follows:

Class defines the general nature of the hazardous material in the surrounding atmosphere. Class I is for locations where flammable gases or vapors may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Division defines the probability of hazardous material being present in an ignitable concentration in the surrounding atmosphere. Division 2 locations are presumed to be hazardous only in an abnormal situation.

Group defines the hazardous material in the surrounding atmosphere. Groups C and D are defined as follows:

- Group C – Atmosphere containing ethylene, gases or vapors of equivalent hazards.
- Group D – Atmosphere containing propane, gases or vapors of equivalent hazards.

For the controller to be approved for hazardous locations, it must be installed according to the National Electrical Code (NEC) Article 501.

CAUTION

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous.

1.5.4 Power Installation Requirements

The primary source of power for controller installations is line power. Where power requirements are lower, such as for GB602 controllers, installations may use solar power. Care must be taken to route line power away from hazardous areas, sensitive monitoring devices, and radio equipment. Local and company codes generally provide guidelines for line power installations. You must adhere rigorously to local and National Electrical Code (NEC) requirements for line power installations.

Solar power allows installation of the controller in locations where line power is not available. The two important elements in a solar installation are solar panels and batteries. Each must be properly sized for the application and geographic location to ensure continuous, reliable operation. Refer to Section 1.7.4, Solar Powered Installations, on page 1-22 and Section 1.7.5, Batteries, on page 1-24 for information that can help you determine the solar panel and battery requirements to fit your installation.

1.5.5 Grounding Installation Requirements

Ground wiring requirements for line-powered equipment are governed by the National Electrical Code (NEC). When the equipment uses line power, the grounding system must terminate at the service disconnect. All equipment grounding conductors must provide an uninterrupted electrical path to the service disconnect.

> The National Electrical Code Article 250-83 (1993), paragraph c, defines the material and installation requirements for grounding electrodes.
>
> The National Electrical Code Article 250-91 (1993), paragraph a, defines the material requirements for grounding electrode conductors.
>
> The National Electrical Code Article 250-92 (1993), paragraph a, provides installation requirements for grounding electrode conductors.
>
> The National Electrical Code Article 250-95 (1993), defines the size requirements for equipment grounding conductors.

Proper grounding of the controller helps to reduce the effects of electrical noise on the unit's operation and protects against lightning. Lightning protection is built-in to the controller, providing lightning protection for built-in field wiring inputs and outputs. A surge protection device installed at the service disconnect on line-powered systems offers lightning and power surge protection for the installed equipment. You may also consider a telephone surge protector for the dial-up modem communications card. Refer to Appendix A concerning the Lightning Protection Module (LPM) used with the AI on the I/O card.

All earth grounds must have an earth to ground rod or grid impedance of 25 ohms or less as measured with a ground system tester. The grounding conductor should have a resistance of 1 ohm or less between the controller case ground lug and the earth ground rod or grid.

The grounding installation method for the controller depends on whether the pipeline has cathodic protection. On pipelines with cathodic protection, the controller must be electrically isolated from the pipeline.

Electrical isolation can be accomplished by using insulating flanges upstream and downstream on the distribution system. In this case, the controller could be flange mounted or saddle-clamp mounted directly on the distribution system and grounded with a ground rod or grid system.

On pipelines without cathodic protection, the pipeline itself may provide an adequate earth ground and the controller could mount directly on the distribution system. Using a ground system tester, test to make sure the pipeline to earth impedance is less than 25 ohms. If an adequate ground is provided by the pipeline, do not install a separate ground rod or grid system. All grounding should terminate at a single point.

If the pipeline to earth impedance is greater than 25 ohms, the controller installation should be electrically isolated and a ground rod or grid grounding system installed.

The recommended cable for I/O signal wiring is an insulated, shielded, twisted-pair. The twisted pair and the shielding minimize signal errors caused by EMI (electromagnetic interference), RFI (radio frequency interference), and transients. A ground bar is provided for terminating shield wires and other connections that require earth ground. A lug on the outside of the enclosure is provided to ground the enclosure. Note that the ground bar should be directly wired to the ground lug, rather than depending on the enclosure to make the connection between the ground bar and ground lug. Refer to Section 2 for further details.

CAUTION

Do not connect the earth ground to any wiring terminal on the Main Electronics Board.

1.5.6 I/O Wiring Requirements

I/O wiring requirements are site and application dependent. Local, state, or NEC requirements determine the I/O wiring installation methods. Direct burial cable, conduit and cable, or overhead cables are options for I/O wiring installations. Section 2 contains detailed information on connecting I/O wiring to the controller.

The Main Electronics Board containing the field wiring terminal connections is accessed by opening the front door after removing the lock (if installed) and releasing the hasp on the right-hand side. The input terminal wiring is arranged on the lower edge of the Main Electronics Board. Refer to **Error! Reference source not found.**. The terminal designations are printed on the circuit board.

1.6 MOUNTING AND INSTALLATION

When choosing an installation site, be sure to check all clearances. Provide adequate clearance for the enclosure door to be opened for wiring and service. The door is hinged on the left side. The LCD display should be visible and accessible for the on-site operator. When using a solar panel with a controller, there should be adequate clearance, and view of the sun should not be obstructed. Allow adequate clearance and an obstructed location for antennas when using radios.

The Pressure Module (PM) is factory-mounted directly to the controller enclosure with four bolts. See Section 3 for more information.

The Mounting section includes:

- ♦ Mounting the GB600-Series Controller
- ♦ Mounting a Radio
- ♦ Accessing the Battery Compartment
- ♦ Installing the Intrusion Switch

1.6.1 Mounting the GB600-Series Controller

Mounting of the controller can be accomplished using either of the following methods:

- ♦ **Pipe mounted –** The enclosure provides top and bottom mounting flanges with holes for 2-inch pipe clamps (U-bolts and brackets supplied). The 2-inch pipe can be mounted to another pipe with a pipe saddle, or it can be cemented into the ground deep enough to support the weight and conform to local building codes.

- ♦ **Wall or panel mounted –** Fasten to the wall or panel using the mounting flanges on the enclosure. Use 3/8-inch bolts through all four holes. Mounting dimensions are given in Figure 1-1.

The pressure inputs must be piped to the ¼-18 NPT connections on the Pressure Module.

CAUTION

Do not mount the controller with the Pressure Module supporting the entire weight of the unit. Due to the weight of the unit with batteries and a radio, the unit does not meet vibration requirements unless the enclosure is installed using its mounting flanges.

CAUTION

The controller must be mounted vertically with the Pressure Module (PM) at its base.

1.6.2 Mounting a Radio

One radio up to 2.25 inches high can be mounted inside the controller enclosure by using the optional radio bracket. This bracket allows most radios to be secured in the compartment. Fasten the radio to the bracket using one of the predrilled mounting patterns and the four 6-32 × 0.25 pan-head screws (supplied).

NOTE

If you require two radios, one for peer-to-peer and one for peer-to-host, one of the radios must be mounted outside of the controller enclosure.

For an MDS radio:

1. Remove the winged brackets supplied with the radio.
2. Fasten the radio through the bottom of the radio bracket using the four 6-32 × 0.25 flat-head screws supplied.
3. Place the radio and bracket into the enclosure, aligning the assembly over the two studs on the back panel of the enclosure and the screw next to the swing-out panel.
4. Slide the bracket to the right to engage the slots, and tighten the screw.
5. Route the radio antenna either to the right or to the left and then out the bottom of the controller enclosure.

1.6.3 Accessing the Battery Compartment

As many as four 7-amp-hour batteries can be mounted inside the controller enclosure. Refer to Section 1.7.5, Batteries, on page 1-24. To access the battery compartment:

1. Unscrew the two captive screws on the left side of the swing-out mounting panel containing the main electronics board.
2. Unplug the printed-circuit cable going to the Pressure Module by pressing down on the connector tab and pulling straight out.
3. Push down on the detent immediately below the Pressure Module connector and swing the mounting panel out. You now have full access to the battery compartment.

Refer to Section 2 for information on battery wiring.

1.6.4 Installing the Intrusion Switch

The intrusion switch is a momentary contact switch used to detect whether the door to the enclosure is open or closed. The switch, which has a normally closed contact, is designed to be mounted in the controller enclosure. When the normally-closed contacts are wired to the I/O Card's Discrete Input (DI) in the controller, an "On" status is detected when the door is closed and an "Off" status when it is open. The status of the switch can be configured to generate an alarm when the door to the enclosure is open.

NOTE

An I/O Card is required in order to use the Intrusion Switch.

The Intrusion Switch kit (FSACC-1 / ITS3) includes the items in the following list. Refer to Section 2 for specifications on the intrusion switch.

Description	Quantity	Key*
Switch Assembly	1	1
Three feet of 22 AWG, 2-conductor cable	1	
Push-On Terminals	2	
Mounting Bracket	1	2

*Key numbers are associated with Figure 1-2.

Use the following steps to install the intrusion switch. Refer to Figure 1-2.

1. Inspect the Intrusion Switch kit and verify that all parts are present.
2. Secure the Mounting Bracket using the ground bar and ground bar screw.
3. Fasten the Intrusion Switch to the mounting bracket as shown in Figure 1-2. Place the hex nut, lock washer, and anti-rotation washer in that order on the Intrusion Switch Assembly.
4. Place the Intrusion Switch Assembly through the Mounting Bracket.
5. Place the decorative nut on the Intrusion Switch Assembly.
6. Tighten the Intrusion Switch Assembly.
7. Wire the switch to a Discrete Input on the I/O Card to monitor access activity and to provide logging and alarm capability. Refer to Intrusion Switch Wiring in Section 2.5.

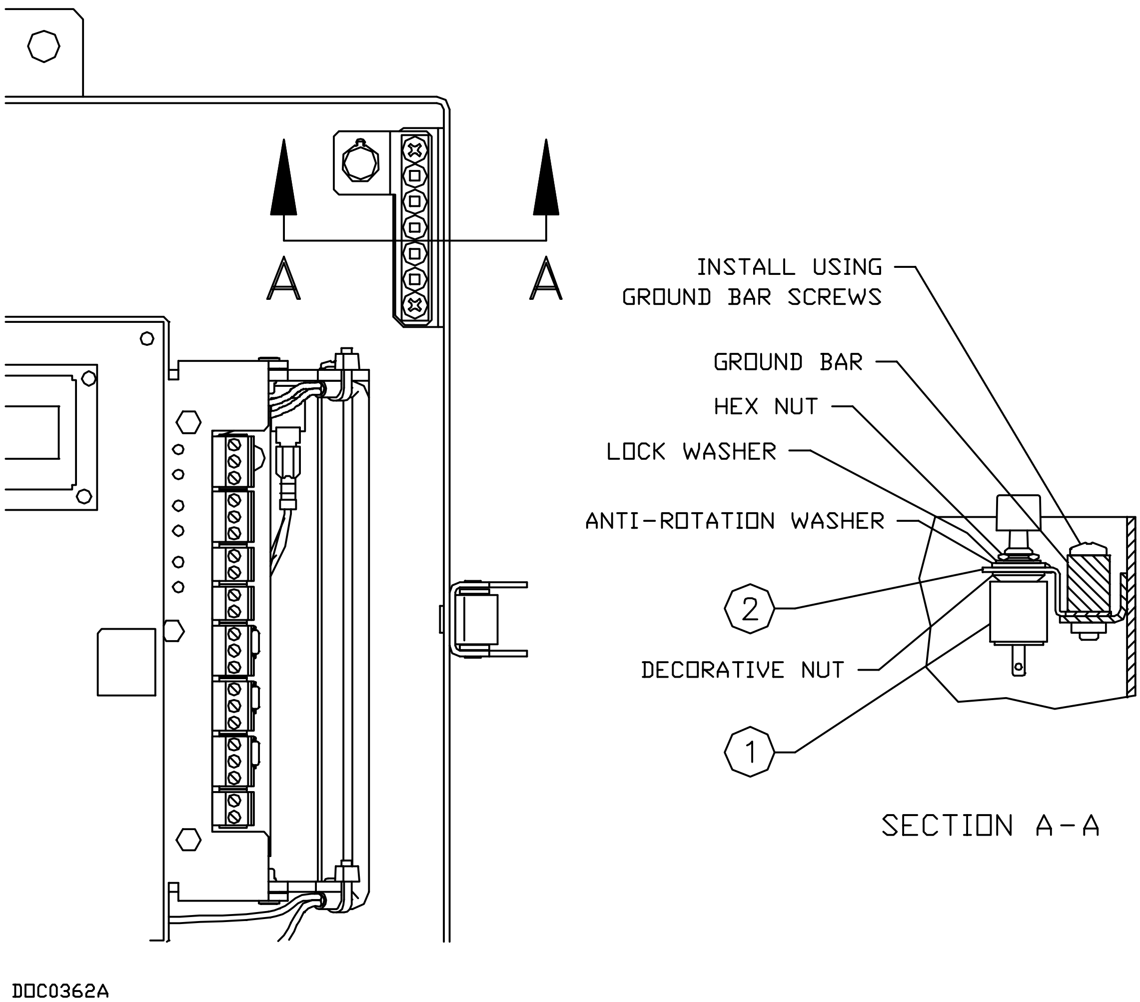

Figure 1-2. Intrusion Switch Mounting for GB600-Series Enclosures

1.7 POWER CONSUMPTION CALCULATION

A GridBoss controller's power consumption determines power supply and battery sizing for both line and solar power. Table 1-1 provides information to assist in determining power requirements. The controller has low power consumption due to a typical duty cycle of 10 to 20% for its microprocessor; the other 80 to 90% of the time the microprocessor is shut off, with external wake-up signals reactivating it.

The Power Consumption Calculation section includes:

- ♦ Determining I/O Channel Power Consumption
- ♦ Determining Radio Power Consumption
- ♦ Totaling Power Requirements
- ♦ Solar Powered Installations
- ♦ Batteries
- ♦ Determining Battery Requirements

1.7.1 Determining I/O Channel Power Consumption

In estimating total I/O power requirements, the "duty cycle" of each I/O channel must be estimated. For example, if a discrete output is active for 15 seconds out of every 60 seconds, the duty cycle is:

Duty Cycle = Active time/(Active time + Inactive time) = 15 sec/60 sec = 0.25

Table 1-1. Power Consumption of the Controller and Powered Devices

Device	Power Consumption (mW) 12V System		Quantity	Duty Cycle	Sub-Total (mW)
	P_{min}	P_{max}			
Main Electronics Board; includes minimum built-in I/O power consumption, RTD, and PM.	190	400	1	N/A	
Kixcel, I/P or Servo Valve					
I/O Expansion Card	210	210	1	N/A	
I/O Card – Analog Input	90	365			
I/O Card – Analog Output	130	650			
I/O Card – Discrete Output (Two DOs for TDO)	0	110			
I/O Card – Discrete Input (Intrusion Switch)	0	30			
I/O Card – Pulse Input	0	70			
Built-in Discrete Output (load dependent with a maximum of 15 volts and 0.3 amps).	0	4	1		
Serial Communications Card	30			N/A	
Dial-up Modem Communications Card.	250			N/A	
Radio from Section 1.7.2 (1 of 2)					
Radio from Section 1.7.2 (2 of 2)					
Total					

NOTE

The Kixcel, I/P, Servo Valve, and Radio(s) values are based upon the type of device you are installing.

1.7.2 Determining Radio Power Consumption

In determining power requirements for radios, the duty cycle for the radio must be estimated. The duty cycle is the percentage of time the radio is transmitting (TX). For example, if a radio is transmitting 1 second out of every 60 seconds, and for the remaining 59 seconds the radio is drawing receive (RX) power, the duty cycle is:

Duty Cycle = TX time / (TX time + RX time) = 1 sec / 60 sec = 0.0167

To calculate the total power consumed by a radio, obtain the power (P) consumption values for transmit and receive from the radio manufacturer's literature, then use the following equation to calculate the power consumption for a particular duty cycle:

$$\text{Power} = (P_{TX} \times \text{Duty Cycle}) + [P_{RX} (1 - \text{Duty Cycle})]$$

Determine the power consumption for all radios that use power from the controller, and enter the total calculated value in Table 1-1.

1.7.3 Totaling Power Requirements

To adequately meet the needs of the controller, it is important to determine the total power consumption, size of the solar panel, and battery backup requirements accordingly. For total controller power consumption, add the device values in Table 1-1. Although Table 1-1 takes into account the power supplied by the controller to its connected devices, be sure to add the power consumption (in mW) of any other devices used with the controller in the same power system, but not accounted for in the table.

Convert the total value (in mW) to Watts by dividing it by 1000.

mW / 1000 = Watts

For selecting an adequate power supply, use a safety factor (SF) of 1.25 to account for losses and other variables not factored into the power consumption calculations. To incorporate the safety factor, multiply the total power consumption (P) by 1.25.

$P_{SF} = P \times 1.25 =$ _____ Watts

To convert P_{SF} to current consumption in amps (I_{SF}), divide P_{SF} by the system voltage (V), either 12 or 24 volts.

$I_{SF} = P_{SF} / V =$ _____ Amps

1.7.4 Solar Powered Installations

Solar power allows installation of the GB602 LPP controller in locations where line power is not available. The two important elements in a solar installation are solar panels and batteries. Solar panels and batteries must be properly sized for the application and geographic location to ensure continuous, reliable operation.

The 12-volt solar panel can be installed to provide charging power for the backup batteries. The panel can be rated at 5, 10, or 11 watts (to correspond to the CSA rating of the controller) and is sized depending upon the power requirements of the unit. The solar panel is typically mounted to the same 2-inch pipe that supports the controller. The solar panel wiring is brought into the controller enclosure through the pre-punched holes in the bottom of the enclosure and is terminated at the charge (CHG) power terminals on the Main Electronics Board.

Fisher Controls does not offer solar panels for GridBoss controllers. However, a list of acceptable solar panels is provided below. Refer to the manufacturer's literature for installation instructions. The following solar panels are approved by CSA for use in Class I, Division 2 locations.

- Solarex MSX-5 4.5 watt
- Solarex MSA-5 5.1 watt
- Solarex MSX-10 10.0 watt
- Uni-Solar RM-1212 11.0 watt

The panel must face due South (not magnetic South) in the Northern Hemisphere and due North (not magnetic North) in the Southern Hemisphere. The panel must also be tilted at an angle from the horizontal dependent on the latitude to maximize the energy output. The angles for different latitudes are normally included in the solar panel documentation. At most latitudes, the performance can be improved by less of an angle during the summer and more of an angle during the winter.

As a site may have additional power requirements for radios, repeaters, and other monitoring devices, power supply and converter accessories may be used to minimize the number of separate power sources required for an installation.

Solar arrays are used to generate electrical power for the controller from solar radiation. The size and number of solar panels required for a particular installation depends on several factors, including the power consumption of all devices connected to the solar array and the geographic location of the installation. Refer to Section 1.7.4.

1.7.4.1 System Solar Panel Sizing

To determine solar panel output requirements, first determine the solar insolation for your geographic area. The map in Figure 1-3 shows solar insolation (in hours) for the United States during winter months. Call your local Fisher Representative for a map detailing your specific geographic area.

Insolation (from map) = _____ hours

Next, calculate the amount of current required from the solar array per day using the following equation. I_{SF} is the system current requirement. Refer to Section 1.7.3 on page 1-21.

I_{array} = [I_{SF} (amps) $\times$ 24 (hrs)]/Insolation (hrs) = _____ amps

Finally, the number of solar panels can be determined using the following equation:

Number of Panels = I_{array} amps/(I_{panel} amps/panel) = _____ panels

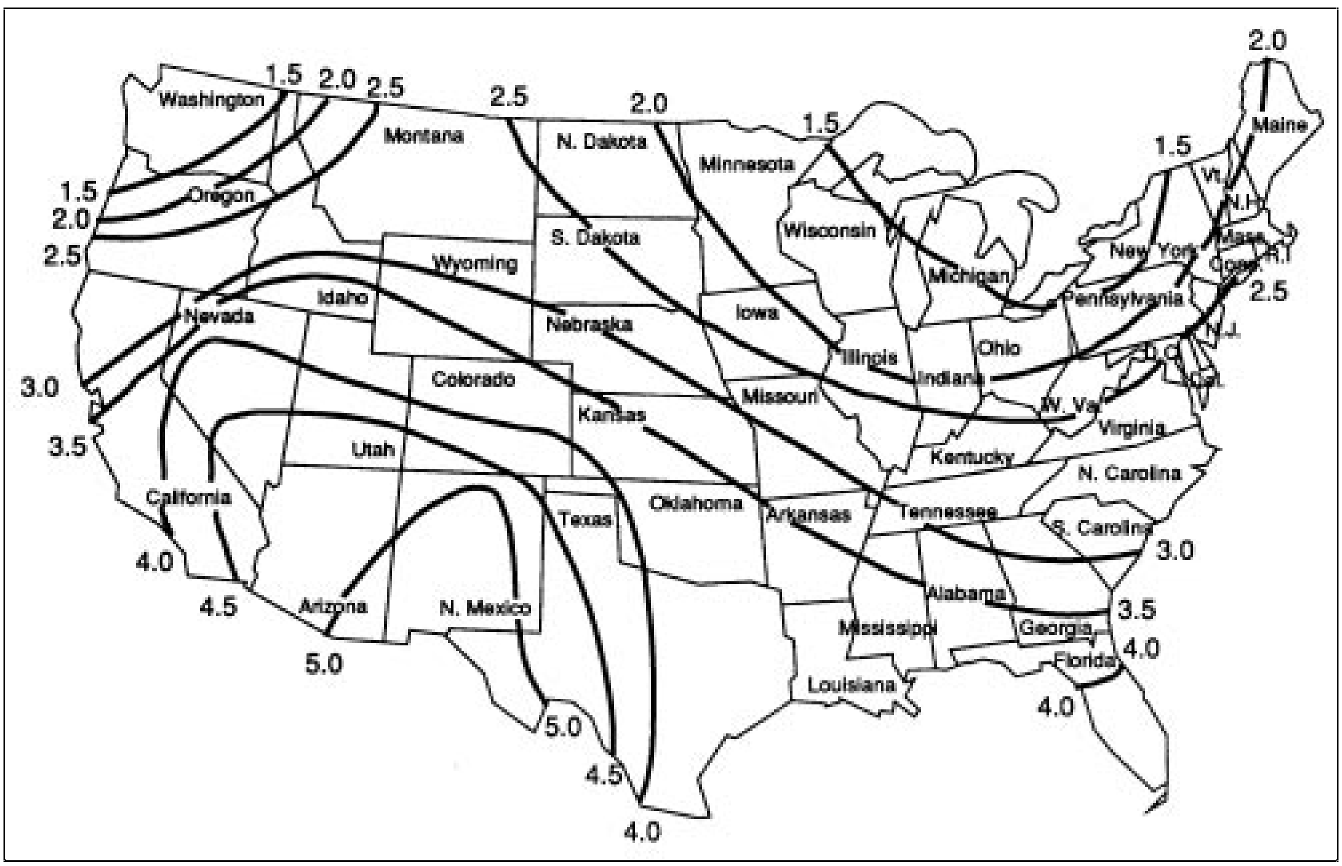

Figure 1-3. Solar Insolation in Hours for the United States

For example, if I_{array} equals 0.54 amps, and I_{panel} equals 0.29 amps for a 5-watt panel, then the number of panels required equals 1.86, which would be rounded up to 2 (panels connected in parallel). Alternatively, the next larger solar panel can be used, which in this case would be a 10-watt panel. Table 1-2 gives I_{panel} values for solar panels recommended by Fisher Controls.

NOTE

The "I_{panel}" value varies depending on the type of solar panel installed. Refer to the vendor's specifications for the solar panel being used.

NOTE

The current accepted by the controller is limited by its charging circuit to around 1 amp. Therefore, it is not practical to install a solar array that supplies significantly more than 1 amp to the controller.

Table 1-2. Solar Panel Sizing

Panel	I_{panel}
4.5 watt	0.27 amps
5 watt	0.29 amps
10 watt	0.58 amps
11 watt	0.7 amps
22 watt	1.4 amps

1.7.5 Batteries

Batteries are used to supplement both line-powered and solar-powered installations. When used in line-powered installations, the batteries serve as backup in case of line power failure. When used in solar installations, they provide power for the controller when the solar panels are not generating sufficient output.

The standard battery configurations use a 12-volt, sealed, lead-acid battery. These configurations can provide 7, 14, 21, or 28 amp-hour capacities. The batteries are connected in parallel to achieve the current capacity. The amount of battery capacity required for a particular installation depends upon the power requirements of the equipment and days of reserve (autonomy) desired.

Recommended 7 amp-hour battery types (up to four batteries) for controller units are listed below. If other batteries are used, Fisher Controls recommends rechargeable, sealed, gel-cell, lead-acid batteries.

- Powersonic PS-1270 7.0 Amp-Hour
- Panasonic LCR12V7.2P 7.2 Amp-Hour
- Yuasa NP7-12 7.0 Amp-Hour

1.7.5.1 Determining Battery Requirements

Battery requirement calculations are based on power consumption of the controller and all devices that will be powered by the batteries.

Battery reserve is the amount of time that the batteries can provide power without discharging below 20 percent of their total output capacity. A minimum of two days of battery reserve is recommended for a line-powered unit.

For solar-powered units, a minimum reserve of five days is recommended, with ten days of reserve preferred. Add 24 hours of reserve capacity to allow for overnight discharge. Space limitations, cost, and solar panel output are all factors that affect the actual amount of battery capacity available.

To determine the system capacity requirements, multiply the system current load (I_{SF}) on the batteries by the amount of reserve time required. Compute "I_{SF}" as described in the Section 1.7.3, Totaling Power Requirements. The equation is as follows:

System Requirement = I_{SF} amps × Reserve hrs = _____ amp-hrs

Next, determine the number of batteries required for the calculated power consumption: 7, 14, 21, or 28 amp-hour capacity.

1.8 STARTUP AND OPERATION

Before starting the controller, perform the following checks to ensure the unit is properly installed.

- ♦ Make sure the enclosure has a good earth ground connected to the earth ground bus inside the enclosure.
- ♦ Check the field wiring for proper installation. Refer to Section 2.
- ♦ Make sure the input power has the correct polarity.
- ♦ Make sure the input power is fused at the power source.

CAUTION

It is important to check the input power polarity before turning on the power. Incorrect polarity can damage the GB600-Series Controller.

CAUTION

When installing equipment in a hazardous area, ensure that all components are approved for use in such areas. Check the product labels.

1.8.1 Startup

Apply power to the controller by plugging the input power terminal block into the connector labeled POWER located at the bottom left of the Main Electronics Board. Refer to **Error! Reference source not found.**. After the controller completes start-up diagnostics (RAM and other internal checks), the LCD displays the date and time to indicate that the controller completed a valid reset sequence. If the LCD does not come on, refer to the Troubleshooting and Repair paragraphs in Section 2 for possible causes.

1.8.2 Operation

Once startup is successful, it is necessary to configure the controller to meet the requirements of the application. The *GRIDLINK Configuration Software User Manual (Form A6074)* details the procedure for configuring the controller and calibrating the I/O. Once the controller is configured and calibrated, it can be placed into operation.

CAUTION

Local configuration or monitoring of the controller through its LOI port must be performed only in an area known to be non-hazardous.

During operation, the controller can be monitored (to view or retrieve current and historical data) either locally or remotely. Local monitoring is accomplished either by viewing the LCD panel detailed in Section 2.3.3, or by using GRIDLINK on a PC connected through the LOI port. Remote monitoring is performed through the Host port (COM1) of the controller, using either GRIDLINK or Host software. Refer to the GRIDLINK User Manual for more information on monitoring.

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SECTION 2 — USING THE GRIDBOSS CONTROLLER

2.1 SCOPE

This section describes the GB601 and GB602 controllers of the GridBoss System, focusing on how the controller works, its various components, connecting wiring, and troubleshooting. This section also describes the AC power supply used in line-powered installations.

2.2 SECTION CONTENTS

This section contains the following information:

NOTE

An I/P or servo valve may be used in place of the Kixcel. To ensure ease of readability, Kixcel is used throughout this manual to represent all devices.

2.3 PRODUCT FUNCTIONS

This section describes the functions of the GridBoss controller, most of which are determined by its firmware and must be configured by using the GRIDLINK Configuration Software. The features and applications provided by the hardware and firmware include:

- Adaptive Predictive Control for gas distribution using Load Profiles and Control Mode Levels.
- District Regulator used to maintain a user defined Setpoint.
- Low Pressure Point used to measure the average pressure at the low pressure point in the gas distribution system.
- Inputs and Outputs used to measure and control the Setpoint.
- Archival of data for up to 15 history points and other historical logs.
- Memory logging of 240 alarms and 240 events.
- Security with local and remote password protection.
- Logic and sequencing control using a user-defined FST program.
- Power cycling control for a radio through the DTR signal or power switch on the optional EIA-232 communications card.
- Closed loop control (PID) capability.

2.3.1 Adaptive Predictive Control

The GridBoss System uses two types of GridBoss controllers:

- GB601 District Regulator (DR) Controller
- GB602 Low Pressure Point (LPP) Controller

NOTE

Throughout the rest of Section 2, "DR" generally refers to the GB601 District Regulator Controller, and "LPP" refers to the GB602 Low Pressure Point Controller.

The DR controller is located at the vault and the LPP controller is located downstream from the DR controllers at the low pressure point on the gas distribution system. Refer to Figure 2-1. An LPP controller can support up to five DRs. The GridBoss algorithm uses data gathered from the Low Pressure Point to automatically create historical load profiles at the District Regulator controllers. Load profiles are based on ambient temperature and the time-of-day. The District Regulator is automated with a Kixcel, I/P, or servo valve. The District Regulator Setpoint is determined by the load profiles.

The GridBoss System uses adaptive predictive control to automate gas distribution regulators; it manipulates the system pressures in order to deliver gas not only at the lowest possible pressure, but also at an optimized and adequate pressure to the system. The GridBoss algorithm predicts system requirements to improve system integrity and reduce the average system pressure.

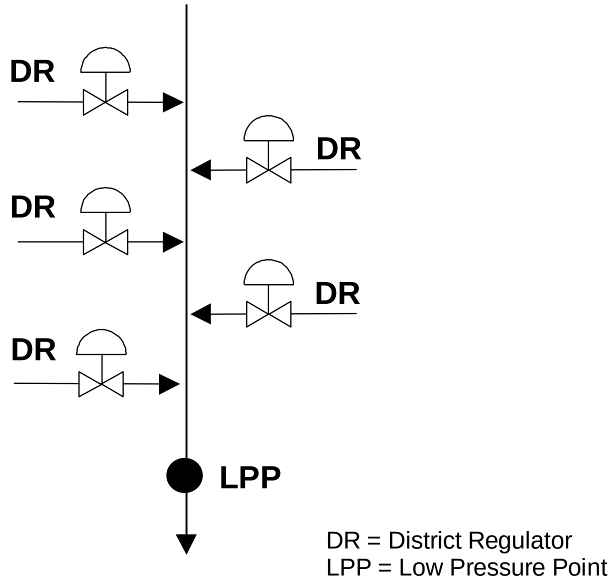


Figure 2-1. GridBoss Gas Distribution System

The GridBoss algorithm tracks the time-of-day to predict the outlet pressure; it also tracks the outside ambient air temperature to adapt the output pressure setting. The GridBoss algorithm learns the corresponding bias points relative to temperature and time-of-day. This learning period is typically 1-2 weeks for the time-of-day profile.

The DR and LPP controllers have a dedicated communications link and communicate with each other to confirm that the DR is keeping the LPP within the Setpoint Deadband. The Kixcel, I/P, or servo valve receives the signal (Analog Output or Timed Duration Output) from the controller and converts the signal into an outlet pressure, adjusting the Setpoint at the DR. When an AO is used, an Analog Input (AI) can be relayed back to the GB601 DR Controller to indicate the position of the Kixcel and ensure that it is approximately within the monitor Deadband. Refer to Figure 2-2.

The **Kixcel** (I/P or servo valve) is used to adjust the District Regulator Setpoint. Using electronic control signals to switch the electric stepping motor on and off, the Kixcel turns the pilot adjusting screw, changing the spring compression to increase or decrease the output pressure. The Kixcel provides smooth and highly accurate positioning, with positive position-lock when not in motion.

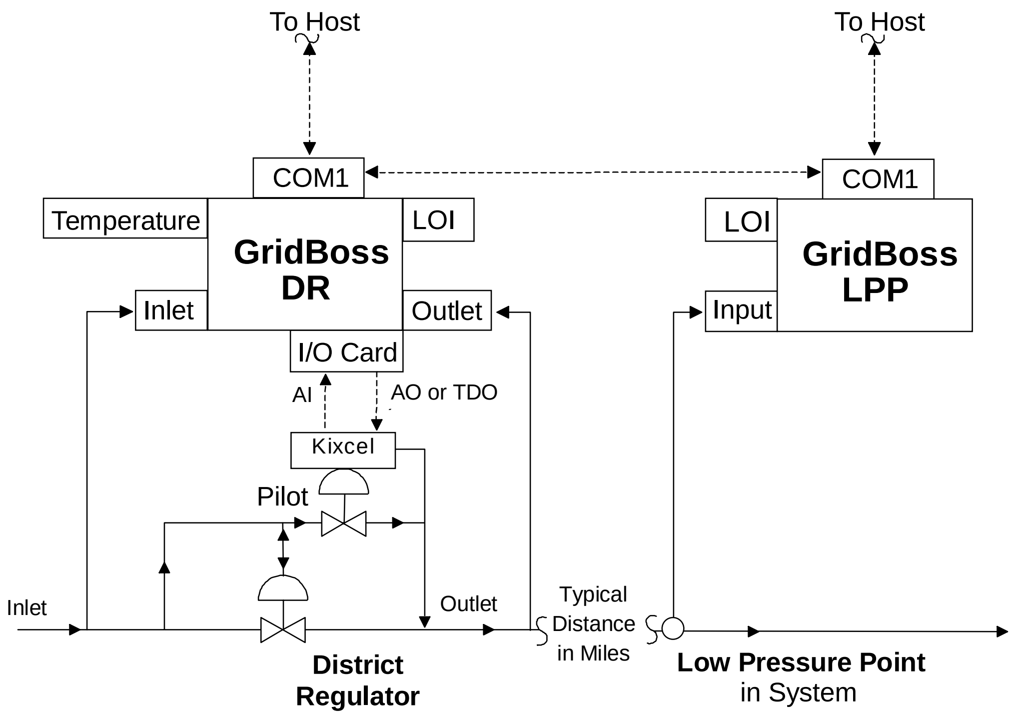


Figure 2-2. GridBoss System Setup

NOTE

An Analog Output is used to send the Setpoint to the Kixcel. An Analog Input may be used to communicate the position of the Kixcel to the GB601. The AI is compared to the AO to ensure that the Kixcel is approximately within the monitor Deadband.

2.3.1.1 Load Profiles

The control approach requires a Low Pressure Point (LPP) monitor. The algorithm uses data gathered from the LPP to automatically create load profiles at the DR controllers. At startup, the system operates in a closed loop feedback mode. Initially, there is a high volume of communication between the LPPs and their associated DR controllers. As the daily load profiles accumulate at the DR, the communication volume drops. After a sufficient "training" period, the DR operates in a predictive mode. The training period takes approximately two weeks. The DR controller sets the outlet pressure based on the actual temperature and the stored time-of-day profile and then adjusts the pressure as necessary.

Two load profiles are generated:

- pressure versus outside temperature
- pressure versus time-of-day

The DR Controller creates and stores one temperature load profile that contains a coefficient for calculating an adjustment to the DR outlet pressure Setpoint based on the ambient temperature.

The DR Controller creates and stores two time-of-day load profiles with 1440 entries each that represent the adjustments to the DR outlet pressure Setpoint for each minute of the day. One profile is the **Weekday load profile** for Monday through Friday, and one profile is the **Weekend and Holiday load profile** for Saturday, Sunday, and holidays. The Weekend profile can be used for up to 30 dates specified as holidays that you establish using GRIDLINK.

The LPP Controller is left permanently in place to update the load profiles if there are long-term changes in the system loading. The LPP Controller also provides rapid notification of pressure emergencies. Other than emergency and periodic integrity checks, the LPP Controller does not require extended communications once the load profiles are well established.

The load profiles generate a bias value that is added to the minimum system pressure value (Setpoint) determined by the user. When the temperature is colder, the bias is larger, allowing increased pressure. When the temperature is warmer, the bias is smaller and less pressure is released.

The DR Controller can clear the time-of-day and temperature profiles and receive time-of-day profiles through the communications ports (LOI or COM1). The DR Controller can also send load profiles through the communications port (LOI or COM1) to a PC running GRIDLINK.

2.3.1.2 Control Mode Levels

The District Regulator controls the regulator outlet pressure by adjusting the output to the Kixcel in one of four control modes. The four control modes that can be enabled are:

- **Off –** Control processing does not occur if Off is selected.
- **Manual Mode –** Values in Manual Mode are manually manipulated and do not include information from either the DR or the LPP controller.
- **Inner Loop Mode –** Inner Loop tuning includes only information from the DR Controller (Inner Loop) and the Kixcel, I/P, or servo valve. Information from the Low Pressure Point is not included.
- **Outer Loop Mode –** Outer Loop tuning includes both information from the DR (Inner Loop) and the LPP (Outer Loop).
- **Adaptive Mode** (Outer Loop with Adaptive Control Mode) – Adaptive Mode tuning includes both information from the DR (Inner Loop) and the LPP (Outer Loop); in addition, biases based on the time-of-day and temperature load profiles are also calculated and used.

NOTE

All changes to the control modes are logged to the Event Log.

Manual Mode occurs when you manually adjust the Control Output. In Manual Mode, no PID (Proportional, Integral, and Derivative) control occurs. Time-of-day and temperature load profiles are not generated.

In Manual Mode, LPP does not communicate with that DR again until the value entered in the Error Time Delay for DRs field has been meet. After the Error Time Delay period, the LPP communicates with the DR to determine if it is in the Outer Loop Mode or Adaptive Mode. The Error Time Delay for DRs should always be less than the Check-in Time for DRs.

In **Inner Loop Mode**, a single PID loop compares the Outlet Pressure of the District Regulator with a manually entered Setpoint and uses the regulator Outlet Pressure for the process variable. If the difference between the Output Pressure and Setpoint is greater than the Error Deadband, a change in output is calculated. Otherwise, no calculation occurs. The Control Output has a Maximum Output and Minimum Output limit, which the calculated output cannot exceed. The Inner Loop contains a default Kixcel (Default Output) position entry. If the DR battery or outlet pressure transducer produce an equipment failure alarm, the control loop goes to Manual Mode and the Kixcel moves to the Default Output position. The fastest loop period for the PID loop is one second. If the Default Output is less than zero, then the output remains in its current position. When using Discrete Outputs, the output also remains in its current position.

The LPP does not communicate with that DR again until the value entered in the Error Time Delay for DRs field has been meet. After the Error Time Delay period, the LPP communicates with the DR to determine if it is in the Outer Loop Mode or Adaptive Mode. The Error Time Delay for DRs should always be less than the Check-in Time for DRs.

Time-of-day and temperature load profiles are not generated in Inner Loop Control Mode. All alarms are enabled when in Inner Loop Mode.

Outer Loop Mode uses the LPP calculated change in the Inner Loop Setpoint. Outer Loop Mode is defined with a cascade PID control of the regulator Outlet Pressure with the Setpoint calculated from a PID loop controlling the Low Pressure Point (LPP).

In Outer Loop Mode, the LPP verifies the average pressure against a user-defined Setpoint and Deadband. If the average pressure varies from the Setpoint by more than the Setpoint Deadband, the LPP calculates the change in Inner Loop Setpoint for a DR. The LPP sends the change in Inner Loop Setpoint and the average LPP pressure (Avg. Low Press Value) to the DR when the LPP average pressure is outside of the LPP Setpoint Deadband. If the average LPP pressure is still out of the Setpoint Deadband value after the Deadband Time Delay for DRs has expired, then the LPP recalculates the change in Inner Loop Setpoint and retransmits it and the average pressure to the DR. The Inner Loop Setpoint has a Maximum Setpoint and Minimum Setpoint limit, which the Setpoint cannot exceed.

An LPP may communicate with up to five DRs and each DR may have different gains so the LPP calculates a change in Inner Loop Setpoint for each DR. The LPP regularly communicates the average pressure and change in Inner Loop Setpoint to each DR after the Check-in Time has expired if the average pressure has not varied from the Setpoint by more than the Deadband. The Error Time Delay for DRs should always be less than the Check-in Time for DRs. The Check-in Time has a maximum limit of 8 hours.

Communications are accepted by the District Regulator from one LPP and the control message is used to adjust the Inner Control Loop (DR to Kixcel) Setpoint. Outer Loop Mode contains a default Inner Loop Setpoint for when alarm conditions occur that terminate the Outer Loop Mode. If the Default Setpoint is less than zero, then the Setpoint remains at its current value.

Temperature and time-of-day adaptation occurs in the background. If the time-of-day profiles have been cleared, then the DR creates the time-of-day profiles. If the time-of-day profiles already exist, then the DR modifies them by averaging the LPP calculated change in Inner Loop Setpoint and the current time-of-day value. The DR temperature is stored in a temperature profile, which modifies a temperature coefficient every minute.

If the LPP communicates an equipment failure or fails to check in within a preset time interval maximum (Check-in Time with DRs), the Outer Loop terminates and the Inner Loop Setpoint is set to the Setpoint Default value. Both the DR and the LPP software maintain a 15 minute averaging of pressure.

The final control mode is the **Adaptive Mode** (Outer Loop with Adaptive Control Mode). In Adaptive Mode, the DR uses a time-of-day and temperature load profile to modify the Inner Loop Setpoint and uses the LPP calculated change in Inner Loop Setpoint. Adaptive Mode is defined as a cascade PID control of the District Regulator outlet pressure with the Setpoint calculated from a PID loop controlling the Low Pressure Point (LPP) biased by the time-of-day and temperature load profile adjustments. The adaptive pattern is used to control the Inner Loop (DR to Kixcel) Setpoint. Communications from the LPP override and update the adaptive control parameters. All control features available in Outer Loop Mode are present in Adaptive Mode.

The LPP calculates the inlet pressure average over a minute and compares it to the Setpoint Deadband. The Setpoint Deadband is the Low Press Setpoint plus or minus a user-defined value. The average pressure must be within the set Setpoint Deadband or a message is sent to the DR. The message sent to the DR includes the average input pressure and the calculated change in the Setpoint for the Inner Control Loop. If the average LPP pressure is still out of the Deadband after the Deadband Time Delay has expired, the LPP recalculates the change in the Inner Loop Setpoints and re-transmits the average pressure and the calculated change in the Setpoint for the Inner Control Loop. Each District Regulator can have a different gain so the LPP calculates a change in the Inner Loop Setpoint for each DR.

In Adaptive Mode, the DR uses a time-of-day and temperature load profile to modify the Inner Loop Setpoint and also incorporates the LPP calculated change in Inner Loop Setpoint as detailed in the previous Outer Loop Mode description. If the time-of-day profiles have been cleared, then the DR creates the time-of-day profiles and uses the information to modify the Inner Loop Setpoint and continues to develop both profiles. The DR temperature is stored in a temperature profile, which modifies a temperature coefficient every minute. In addition, the temperature profile does not calculate a new coefficient when the Inner Loop output or Setpoint is against either limit.

A predicted adaptive value (Temperature Profile) and a current time-of-day value (TOD Profile) are added to the Inner Loop Setpoint every minute along with any change in Inner Loop Setpoint from the LPP. If the time-of-day load profiles are already created, then the DR uses the current load profiles for modifying the Inner Loop Setpoint and continues to develop both profiles. An LPP may communicate with up to five DRs and each DR may have different gains so the LPP calculates a change in Inner Loop Setpoint for each DR. The LPP regularly communicates the average pressure and change in Inner Loop Setpoint to each DR after the Check-in Time has expired if the average pressure has not varied from the Setpoint by more than the Deadband. The Check-in Time has a maximum limit of eight hours. The District Regulator executes the PID control loops at a maximum rate of once per second and can limit the output of the Inner Loop and Setpoint.

When power is applied to the controller, the LED on the Pressure Module flashes and the LCD displays information based on the type of controller and user defined information. When the District Regulator receives communications from the Low Pressure Point, the controller records and time stamps the input pressure at Low Pressure Point. The LPP calls the DR(s) when the pressure at the LPP exceeds the range of a Setpoint plus or minus a Setpoint Deadband. The LPP transfers data from the DR to determine if the DR Kixcel or the Inner Loop Setpoint should be increased or decreased. If required, the DR sends an output signal (AO or TDO) to the Kixcel to adjust the Setpoint of the District Regulator.

2.3.1.3 Time of Day Profiles

The Low Pressure Point change in Inner Loop Setpoint is stored in one of two time-of-day profiles with 1440 entries that represent each minute of the day. A new value is stored at the current minute of the day by adding 1% of the new change in Inner Loop Setpoint to the existing value in the time-of-day profile. The previous 15 minutes in the profile are changed to allow the District Regulator to ramp up or down to the new value. If the Inner Loop Output or Setpoint is against either limit, then the time-of-day profile performs a slow decay using 99% of the current time-of-day value. This repositions the Inner Loop Output or Setpoint off the limit. One time-of-day profile is for weekdays (Monday, Tuesday, Wednesday, Thursday, and Friday) and the other for weekends (Saturday and Sunday) and holidays. You may specify up to 30 holiday dates (month, day, and year).

2.3.1.4 Input Calculation

After power-up, the Master Controller Unit (MCU) enters the normal operation mode and the inlet and outlet pressure values are read. These values are stored for retrieval by the DR controller. Next, the temperature is read and compensation is applied if necessary. The MCU enters a low power mode and waits for the next one second interrupt.

- ♦ Static pressure is sampled once per second.
- ♦ Temperature is sampled and linearized once per second. The RTD is internally re-calibrated for every 5° C temperature change as sensed by enclosure (battery) temperature.

At the configured Contract Hour, the values are stored to the Daily Historical Log and zeroed for the start of a new day.

2.3.2 District Regulator

The District Regulator computes load profiles based on ambient temperature and time-of-day to determine the “predicted” Setpoint of the regulator. The RTD mounts on the GB601 enclosure and reads the ambient temperature. The GB601 uses the Pressure Module (PM) sensor to acquire the inlet and outlet pressure from the District Regulator. The inlet pressure is located at Analog Input point number A1. The outlet pressure is located at Analog Input point number A2. All hardware has an ambient operating temperature of -40^{o} to 150^{o} F.

The GB601 DR Controller includes one I/O expansion card. The I/O card is used to send a signal (Setpoint) to the Kixcel, I/P, or servo valve, which readjusts the outlet pressure at the regulator. The signal to the Kixcel can be sent as an Analog Output (AO) or as a Timed Duration Output (TDO) in which case two Discrete Outputs (DOs) are used to open and close the regulator. When using an AO, an Analog Input (AI) can be used to send the approximate position signal of the Kixcel back to the GB601 to ensure that the Kixcel has moved to the correct position. Refer to Figure 2-3. The DR may also use a Discrete Input (DI) on the I/O card for the optional intrusion switch.

Other inputs included within the DR are diagnostic Analog Inputs and include: battery voltage (AI point number E1), input voltage (AI point number E2), and board temperature (AI point number E5).

The DR samples the regulator inlet pressure, regulator outlet pressure, ambient temperature, and the Kixcel output position (if connected) once per second. The GB601 and Kixcel, I/P, or servo valve acquire power from an AC power supply with charger and battery.

As an option, an I/P may be used in place of the Kixcel or servo valve to adjust the Setpoint of the District Regulator. An I/P is a device that receives the 4-20 mA current input signal and converts it to a pneumatic / pressure output. The Kixcel turns the adjusting screw (adjusts compression of spring) of the regulator to change the Setpoint. An I/P supplies a pressure to the spring case, which proportionally changes the Setpoint.

The DR performs Inner Loop control of the District Regulator. The PID control loop compares the outlet pressure of the District Regulator with a Setpoint and controls the outlet pressure via the Kixcel, I/P, or servo valve. The DR also builds the temperature and time-of-day load profiles while in Outer Loop Mode. In Outer Loop Mode, calls are accepted by the District Regulator from one LPP and the control message is used to adjust the Inner Loop Setpoint. Temperature and time-of-day adaptation occurs in the background.

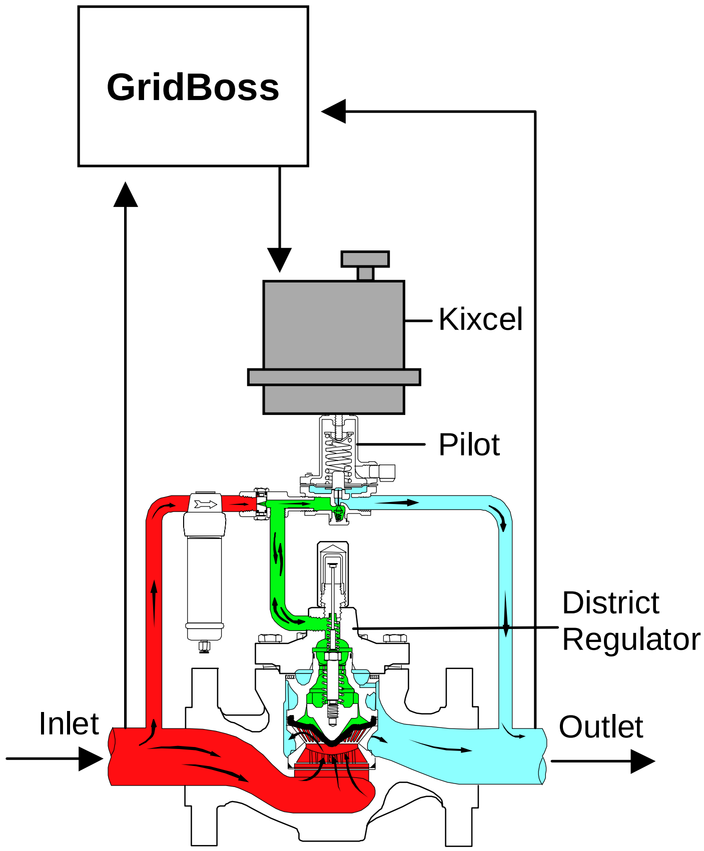


Figure 2-3. District Regulator

The District Regulator can accept remote operational changes from the Host. The District Regulator and Low Pressure Point have the ability to communicate with each other and the Host on the same communications port or on separate communications ports. If two communication ports are used, the LOI is used for peer-to-peer communications between the DR and the LPP while COM1 is used for Host communications. **If only one communications port is used, the LPP, DR and Host all use COM1.**

The DR has a dedicated communications link with its corresponding Low Pressure Point through the LOI or COM1. The DR does not log an event for LPP communications that write to the low pressure point value or for a regular verification of the LPP communications. The DR records the last time the LPP successfully communicated with the DR in the Last LPP Comm Time field.

2.3.2.1 District Regulator Alarms

An Alarm Log documents alarms such as when the DR sends a Spontaneous Report-by-Exception (SRBX or RBX) message to the Host upon LPP communications failure or Kixcel failure (monitor alarm). The alarm is sent as a standard I/O alarm.

Besides, standard alarms informing you of high or low alarm limits and the intrusion switch (DI) alarm, alarms that occur automatically include:

- DR low battery voltage, which is checked against the Low Battery Voltage Limit.
- DR temperature or pressure transmitter point fail, which checks Point Fail High and Low Limits and checks for Point Fail alarms from the AI alarm code.
- DR output failure, assuming output position feedback is connected.
- LPP communications failure, did not receive a valid LPP communication since the maximum Check-In Time for DRs.

RBX alarming for the DR low battery voltage, DR Outlet Pressure Point Fail, and DR Temperature Point Fail must be set at individual I/O points. For the Low and High Point Fail Limits, use the Low and High Alarms of the I/O alarming.

When an alarm occurs, special actions are taken based upon what alarm is generated. Refer to Table 2-1.

Table 2-1. District Regulator Alarms

Alarm	Actions
DR temperature point fail	Change PID Control to Outer Loop Control if it was in Outer Loop with Adaptive Control.
DR regulator outlet pressure transmitter point fail	Change PID Control to Manual Mode, and set output to Default Output.
DR low battery voltage	Change PID Control to Manual Mode, and set output to Default Output.
DR output failure	RBX message sent to Host (if enabled) and change PID Control to Manual Mode.
LPP communications failure	RBX message sent to Host (if enabled) and change PID Control to Inner Loop Mode using the default Inner Loop Setpoint if it was in Outer Loop Mode or Outer Loop with Adaptive Mode.
LPP low battery	RBX message sent to Host (if enabled) and change PID Control to Inner Loop Mode using the default Inner Loop Setpoint if it was in Outer Loop Mode or Outer Loop with Adaptive Mode.
LPP pressure transmitter failure	RBX message sent to Host (if enabled) and change PID Control to Inner Loop Mode using the default Inner Loop Setpoint if it was in Outer Loop Mode or Outer Loop with Adaptive Mode.

2.3.3 Low Pressure Point

The Low Pressure Point is located downstream from the District Regulator. The Low Pressure Point (LPP) GB602 uses the Pressure Module (PM) sensor to acquire the average pressure from the low pressure point in the gas distribution system. The pressure is associated with Analog Input point number A1.

The LPP samples the pressure once per second while keeping a minute average of the pressure. The LPP calculates the pressure average over a minute and compares it to the Setpoint Deadband. The Setpoint Deadband is the Low Press Setpoint plus or minus a user-defined value. The average pressure must be within the Setpoint Deadband or a message is sent to the DR. The message sent to the DR includes the average pressure and the calculated change in the Setpoint for the Inner Loop. If the average LPP pressure is still out of the Deadband after the Deadband Time Delay has expired, the LPP recalculates the change in the Inner Loop Setpoints and re-transmits the average pressure and the calculated change in the Setpoint for the Inner Control Loop. Each District Regulator can have different gains so the LPP calculates a change in the Inner Loop Setpoint for each DR.

The LPP communicates with the DR to read information from the DR and to write information from the LPP to the DR. The LPP can initiate communications with up to five DRs. The LPP initially communicates with the DRs to determine in which of the four PID control modes the units are configured. The Low Pressure Point contacts the District Regulator when:

- the average low pressure point value varies from the Setpoint by more than the defined Deadband,
- an LPP transmitter failure or low battery occurs, or
- at the specified user defined time interval (Check-In Time for DRs).

The Low Pressure Point can accept remote operational changes from the Host. The LPP can also log an alarm and send an RBX message to the Host upon DR communications failure, or a standard I/O alarm.

The Low Pressure Point monitors the average pressure to a user defined Setpoint and Deadband. When the average pressure travels outside of the Deadband, the LPP places a call to the DR. The LPP also calls the DR periodically to check settings and communications.

The LPP may use the Discrete Input (DI) on the optional I/O card for the optional intrusion switch.

Other inputs included with the LPP are diagnostic Analog Inputs and include: battery voltage (AI point number E1), input voltage (AI point number E2), and board temperature (AI point number E5).

The LPP controller acquires power either from an AC power supply or from solar power.

2.3.3.1 Low Pressure Point Alarms

Besides, standard alarms informing you of high or low alarm limits and the intrusion switch (DI) alarm, alarms that occur automatically include:

- LPP low battery voltage, which is checked against the Low Battery Voltage Limit.
- LPP pressure transmitter point fail, which checks Point Fail High and Low Limits and checks for Point Fail alarms from the AI alarm code.
- DR communications failure, DR failed to reply to LPP communication.

RBX alarming for LPP low battery and LPP Pressure Point Fail must be set at individual I/O points. Us the Low and High alarms of the I/O alarming for the Low and High pint Fail limits.

The LPP low battery voltage and LPP pressure transmitter point fail alarms that are sent from the LPP to the DR are not logged to the Alarm Log. However, these alarms can be sent by the DR to the Host if RBX alarming is enabled. Alarms can also be enabled when the appropriate point number is enabled for alarming. When enabled, the LPP communications failure alarm can be sent to the Alarm Log.

When an LPP alarm occurs, special actions are taken based upon what alarm is generated. Refer to Table 2-2.

Table 2-2. Low Pressure Point Alarms

Alarm	Actions
LPP pressure transmitter point fails	Communicate failure to DRs.
LPP low battery voltage	Communicate failure to DRs.
DR communications failure	RBX message sent to Host (if enabled).

If the DRs and Host are on the same communication port (COM1), then the LPP communicates with the DRs first, and then attempts to send an RBX message to the Host (if enabled).

2.3.4 Inputs and Outputs

Although the GridBoss controllers have extensive input and output capabilities, not all of the I/O capabilities are required by the GridBoss System. Only the I/Os required by the GridBoss System are discussed in this manual.

The DR has inputs for the following:

- ♦ Ambient temperature – Input.
- ♦ Inlet pressure – Input.
- ♦ Outlet pressure – Input.
- ♦ Setpoint change to Kixcel, I/P, or servo valve – Output.
- ♦ Position signal from the Kixcel, I/P, or servo valve – Input.
- ♦ Optional Intrusion Switch – Input.

Table 2-3 lists all input and outputs, the physical location, and the point number associated with the I/O.

Table 2-3. District Regulator Inputs and Outputs

Input or Output	Location	Point Number
Input pressure	PM	AI point number A1
Output pressure	PM	AI point number A2
Ambient temperature	RTD	AI point number A3
Setpoint change to Kixcel, I/P, or servo valve	I/O Card and Built-in DO	AO point number B1 or DO point numbers B5, B6, or A4 (two are required for TDO functionality)
Position signal from the Kixcel, I/P, or servo valve	I/O Card	AI point number B2, B3, or B4 (available only when AO is used for Setpoint change to Kixcel, I/P, or servo valve)
Optional Intrusion Switch	I/O Card	DI point number B7, B8, B9, or B10

All Pressure Monitor sensors are accurate to 1% of range and have a selectable operating range from 0-5 psig to 0-1000 psia, depending on the installation.

The District Regulator has an Analog Output or a Timed Duration Output (TDO) connected to the Kixcel, I/P, or servo valve. When using an AO, an AI can be sent back to the controller to indicate the position of the Kixcel, I/P, or servo valve to ensure that it is approximately within the monitor Deadband. The position verification is not available when using a TDO. The TDO requires two DOs to open and close the Kixcel.

The LPP has inputs for the following:

- ♦ Input Pressure Module – Input
- ♦ Optional Intrusion Switch – Input

Table 2-4 lists all inputs, the physical location, and the point number associated with the I/O.

Table 2-4. Low Pressure Point Inputs and Outputs

Input or Output	Location	Point Number
Input pressure	PM	AI point number A2
Optional Intrusion Switch	I/O Card	DI point number B7, B8, B9, or B10

The Low Pressure Point uses the Pressure Module to acquire the inlet pressure at the low pressure point in the system and has a selectable operating range 0-5 psig to 0-1000 psia. The pressure sensors are accurate to 1% of range.

2.3.5 History Points

A total of fifteen history points may be accessed in the controller. At the **District Regulator Controller**, the first nine history points are pre-configured. Refer to Table 2-5. At the **Low Pressure Point Controller**, the first seven history points are pre-configured. Refer to Table 2-6.

Table 2-5. DR Default History Points

History Point	Definition	Point Type	Type of Archiving
1	Inner Loop Ambient Temperature Value	APC #1, TMPVAL	Average
2	Differential Pressure	AIN A 1, EU	Average
3	Inner Loop Regulator Input Pressure	DRC #1, PRSVAL	Average
4	Inner Loop Regulator Output Pressure	DRC #1, OUTVAL	Average
5	Inner Loop Regulator Output Pressure Monitor	DRC #1, MONVAL	Average
6	Inner Loop Coefficient of Temperature	APC #1, TCOEFF	Current Value
7	Inner Loop Adaptive Error	APC #1, AERROR	Current Value
8	PID Control Output Value Setpoint	DRC #1, SETPT	Current Value
9	Battery Voltage	AIN E 1, EU	Average

Table 2-6. LPP Default History Points

History Point	Definition	Point Type	Type of Archiving
1	Input Pressure	LPC #1, LPVAL	Average
2	Number of Calls from District Regulator 1	DR #1, Calls	Current Value
3	Number of Calls from District Regulator 2	DR #2, Calls	Current Value
4	Number of Calls from District Regulator 3	DR #3, Calls	Current Value
5	Number of Calls from District Regulator 4	DR #4, Calls	Current Value
6	Number of Calls from District Regulator 5	DR #5, Calls	Current Value
7	Battery Voltage	AIN E 1, EU	Average

History points for the controller are configured using GRIDLINK and are selected in the History Setup screen located in the History menu’s Setup option. All history points in a controller may be configured as desired. All history points are configured using Point Type, Logical Number, and Parameter Number (TLP).

2.3.5.1 Minute Historical Log

The GridBoss controller has a 60-minute Historical Log for the LPP and DR history point parameters. The Minute Historical Log stores the last 60 minutes of data from the current minute. Thus, the controller has one hour of minute history. Each history point has Minute Historical Log entries unless the history point is configured for FST-controlled logging.

The District Regulator samples ambient temperature, regulator inlet pressure, regulator outlet pressure, output signal to the Kixcel position, and battery voltage once a second; it then stores one hour of minute averages to the Minute Historical Log.

The Low Pressure Point samples the low pressure point value and battery voltage once a second; it then stores one hour of minute averages to the Minute Historical Log.

2.3.5.2 15-Minute Historical Log

The GridBoss controller stores eight days of 15-minute averages of every history point parameter. The controller has a total of 840 15-Minute Historical Logs. The time stamp for periodic logging consists of the month, day, 15-minute period, and minute. The exception is for FST Second logging, in which the time stamp consists of the day, 15-minute, minute, and second.

The District Regulator parameters include: ambient temperature, regulator inlet pressure, regulator outlet pressure, output signal to the Kixcel position, and battery voltage once a second.

The LPP parameters include: the low pressure point value and battery voltage once a second. The LPP stores eight days of 15-minute averages of the low pressure point value and battery voltage.

2.3.5.3 Daily Historical Log

The GridBoss controller has a total of 35 Daily Historical Logs for the LPP and DR history point parameters. The controller logs 35 days of daily history for the LPP and DR parameters and 2 days of daily minimum and maximum values of their parameters.

The Daily Log is recorded at the configured Contract Hour every day. The time stamp for Daily Historical logging consists of the month, day, hour, and minute. The exception is for FST Second logging, in which the time stamp consists of the day, hour, minute, and second. Each history point has daily historical log entries unless the history point is configured for FST-controlled logging.

The District Regulator parameters include: ambient temperature, regulator inlet pressure, regulator outlet pressure, output signal to the Kixcel valve position, and battery voltage once a second.

The LPP parameters include: the low pressure point value and battery voltage once a second.

2.3.5.4 Alarm Log

The Alarm Log contains the change in the state of any alarm signal that has been enabled for alarms. The system Alarm Log has the capacity to maintain and store up to 240 alarms in a “circular” log. The Alarm Log has information fields which include time and date stamp, alarm clear or set indicator, and either the tag name of the point which was alarmed with the current value or a 14-character ASCII description.

In addition to providing functionality for appending new alarms to the log, it allows host packages to request the index of the most recently logged alarm entry. Alarm logging is available internally to the system, to external host packages, and to the FST. Alarm Logs are not stored to the flash ROM during the GRIDLINK Save Configuration function.

The Alarm Log operates in a circular fashion with new entries overwriting the oldest entry when the buffer is full. The Alarm Log provides an audit history trail of past operation and changes. The Alarm Log is stored separately to prevent recurring alarms from overwriting configuration audit data.

2.3.5.5 Event Log

The Event Log contains changes to any parameter within the GridBoss controller made through the protocol. The Event Log also contains other controller events such as power cycles, cold starts, and disk configuration downloads.

The system Event Log has the capacity to maintain and store up to 240 events in a circular log. The Event Log has information fields which include point type, parameter number, time and date stamp, point number if applicable, the operator identification, and either the previous and current parameter values or a 14 byte detail string in ASCII format.

In addition to providing functionality for appending new events to the log, it allows host packages to request the index of the most recently logged event entry. Event Logging is available internally to the system, to external host packages, and to the FST. Event Logs are not stored to flash ROM when the Save Configuration function is issued in the GRIDLINK Configuration Software.

The Event Log operates in a circular fashion, with new entries overwriting the oldest entry when the buffer is full. The Event Log provides an audit trail history of past operation and changes. The Event Log is stored separately to prevent recurring alarms from overwriting configuration audit data.

NOTE

An event is not logged when the LPP communicates the change in Inner Loop Setpoint and Pressure.

2.3.6 Security

The GridBoss controller provides for security within the unit. A maximum of 16 log-on identifiers (IDs) may be stored. In order for the unit to communicate, the log-on ID supplied to the GRIDLINK Configuration Software must match one of the IDs stored in the controller. The Operator Interface port (Security on LOI) has security Enabled by default. The Host port (COM1) can likewise be configured to have security protection, but is disabled by default. Refer to the GRIDLINK Configuration Software User Manual concerning security.

2.3.7 Function Sequence Tables (FST)

The GridBoss controller supports FST user programmability. The FST program can be from 200 to 300 lines of code depending upon the FST. The FST code resides in static RAM and is backed up to flash memory when the "Save Configuration" function is issued through the GRIDLINK Configuration Software. See the *GRIDLINK Configuration Software User Manual* and the *Function Sequence Table User Manual (Form A4625).*

2.3.8 Power Control

The Power Control function is used with the RS-232 communications card to provide power savings when using a radio or cell telephone for communications. Two modes of Power Control are possible: Second and Minute. In Second mode, the time base for the timers is in 100-millisecond increments and is primarily used with radios. In Minute mode, the time base for the timers is in 1-minute increments that are kept in tune with the Real-Time Clock and is primarily used with cellular telephones. Three cycling zones are provided, but zones can be disabled as desired. The RS-232 communications card provides the switching mechanism and is controlled by the DTR signal.

The Power Control function calculates which zone should be currently active. In Second mode, the Power Control begins in the ON state and continues with a full On Time and then goes to the OFF state for the full Off Time. In Minute mode, the Power Control determines if it should be ON or OFF and how much time it needs until it switches.

2.4 PRODUCT ELECTRONICS

This section describes the Main Electronics Board of the GridBoss controllers.

2.4.1 Main Electronics Board Overview

The Main Electronics Board components support the functionality of the GridBoss controllers. Refer to Figure 2-4. The board provides:

- 32-bit microprocessor
- Built-in static RAM
- Flash ROM
- Liquid Crystal Display (LCD) display
- Communications card connector (P3) for Host COM1 port
- Operator interface port (LOI)
- Built-in Discrete Output (DO)
- Board temperature (RTD) and voltage monitor inputs
- Real-time clock
- Battery backup power
- Automatic self-tests
- Input power regulation

2.4.2 Microprocessor and Memory

The GridBoss controller derives processing power from a 32-bit microprocessor. The 32-bit CMOS microprocessor features dual 32-bit internal data buses and a single 8-bit external data bus. The unit can address up to four megabytes of memory, including high-speed direct memory access.

The Main Electronics Board has 512 Kbytes of static random access memory (SRAM) for storing interrupt vectors, Function Sequence Tables (FST), alarms, events, and history data.

The Main Electronics Board also has a 512 Kbyte flash memory chip for storing the operating system factory code and configuration parameters.

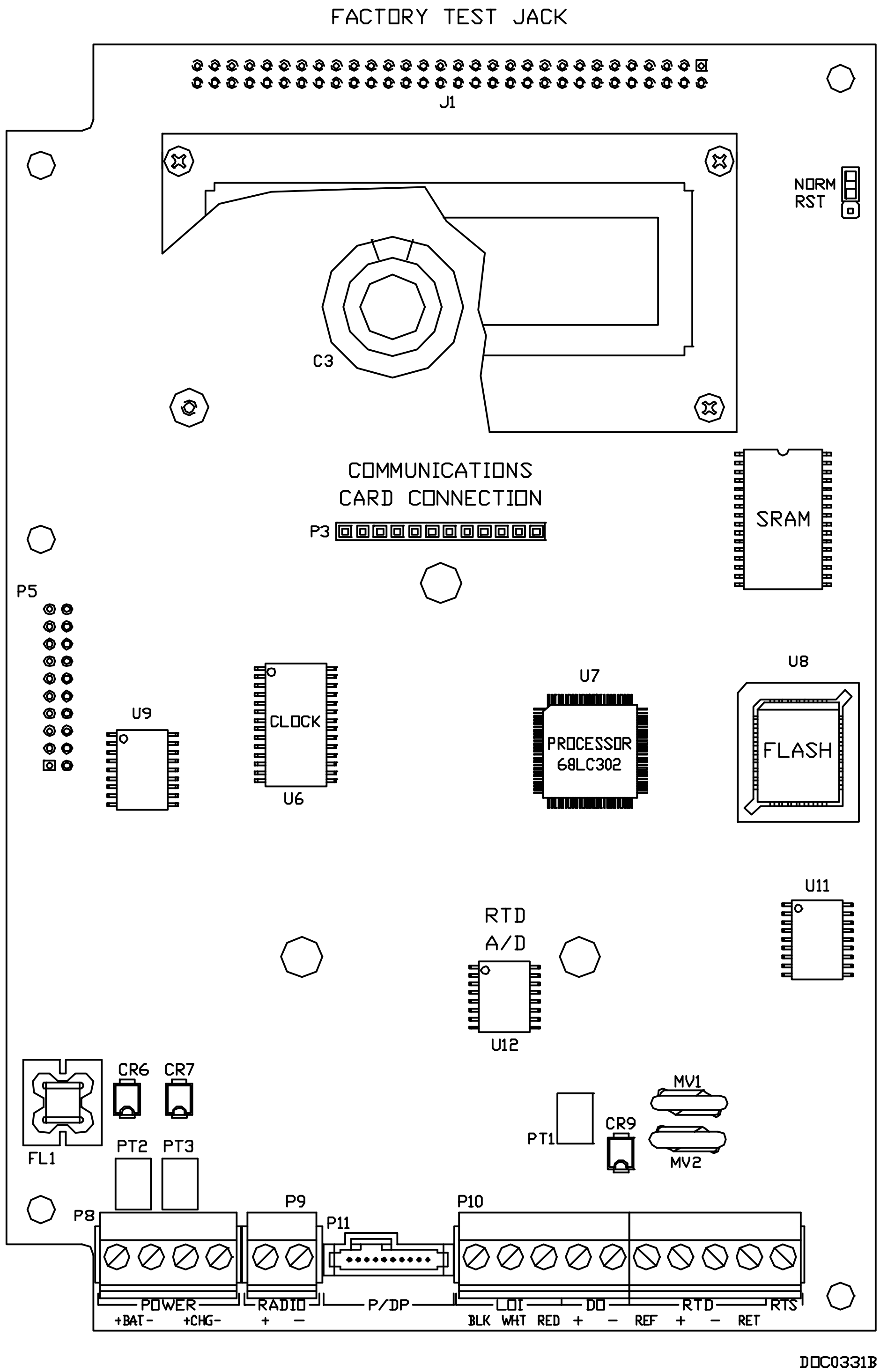


Figure 2-4. Main Electronics Board

2.4.3 Liquid Crystal Display

A two-line Liquid Crystal Display (LCD) panel is mounted on the Main Electronics Board. The panel has automatic contrast adjustment due to temperature sensing and bias adjustment circuitry on the Main Electronics Board.

The LCD panel remains on at all times when the power applied is in the valid operating range of 8 to 15 volts. The panel cycles its display through a configured list of parameter values. Up to 16 parameter values can be configured. The first displays show values for time and date, operating voltages, and battery condition. The District Regulator LCD also displays the ambient Temperature, District Regulator input pressure, District Regulator Output Pressure, and PID control Mode. The Low Pressure Point LCD also displays the average pressure, the calculated change in Inner Loop Setpoint for each DR, and the PID control Mode of each DR.

2.4.4 Communications Ports

The GridBoss controller provides two communication ports:

- Operator interface port – LOI.
- Port for communication from the LPP/DR/Host – COM1.

The DR and LPP controllers have the ability to communicate with each other and the Host on the same communications port or on separate communications ports. If two communication ports are used, the LOI is used for peer-to-peer communications between the DR and the LPP while COM1 is used for Host communications. **If only one communications port is used, the LPP, DR and Host all use COM1.** The DR timestamps (Last LPP Comm Time) the last time the LPP communicated with it. The DR only communicates with one LPP. The DR receives a message from the LPP at the minimum of once every maximum Check-In Time for DRs.

Each District Regulator has a DR Retry Count that the LPP uses when it does not receive a reply from the DR. The LPP waits until the DR Retry Time has expired before re-transmitting the last message. After the allotted time of the value entered in the DR Retry Count, the LPP generates the DR communications failure alarm and waits for the Error Time Delay for DRs before trying to communicate with that DR again.

2.4.4.1 Operator Interface Port – LOI

The Operator Interface port, also called the Local Operator Interface (LOI) port, provides direct communications between the controller and the serial port of an operator interface device such as an IBM compatible computer. The LOI also provides the ability for the DR controller and the LPP controller to communicate peer-to-peer. The DR and LPP can communicate with each other and the personal computer using the same Local Operator Interface (LOI) port. The LOI port of both the LPP and DR have an optional switch that allows you to connect locally without disconnecting the line of peer-to-peer communication.

The interface allows you to access the GridBoss controller (using the GRIDLINK Configuration Software) for configuration and transfer of stored data. The LOI terminal on the Main Electronics Board provides wiring access to a built-in EIA-232 serial interface and is capable of up to a 19.2k baud rate. The operator interface port supports only ROC protocol communications. The LOI also supports the log-on security feature of the controller if the Security on LOI is Enabled in GRIDLINK.

A cannon-type waterproof connector on the bottom of the enclosure provides connection through a prefabricated cable (available from Fisher) for an operator interface device, typically an IBM-compatible personal computer (PC) running the GRIDLINK Configuration Software. Inside the GridBoss enclosure, the cannon-type connector is wired to three terminals (LOI) on the Main Electronics Board.

2.4.4.2 Host Port – COM1

The Host port (also called the COM1 port) is activated by the installation of the optional communications card. COM1 is used to monitor or alter the Low Pressure Point GB602 or the District Regulator GB601 from a remote site using a Host and configuration software. The Host port automatically configures itself based upon the specific communications card installed. The Host port supports baud rates up to 19.2k. COM1 also supports the log-on security feature of the GridBoss controller if the Security on COM1 is Enabled in GRIDLINK.

The Host port is capable of initiating a message in support of Spontaneous Report by Exception (SRBX or RBX) and Store and Forward. Refer to the *GRIDLINK Configuration Software User Manual*.

For installations using radio communications, battery power can be conserved by cycling power to the radio or a cellular telephone. The power cycling control for a radio is acquired through the Data Terminal Ready (DTR) signal on the optional EIA-232 communications card. Refer to the GRIDLINK Configuration Software User Manual concerning radio power control. The radio is connected to the signal wiring terminals located on the EIA-232 communications card. Refer to Section 4.

NOTE

If you require two radios, one for peer-to-peer and one for peer-to-host, one of the radios must be mounted outside of the GridBoss enclosure.

The communications connectors on the Main Electronics Board provide the controller with electrical access and mounting provisions for the optional communications cards. The communications cards mount directly on the connectors at P3 on the Main Electronics Board and are held in place with three compression stand-offs. The stand-offs on the Main Electronics Board pass through the communications card.

The communications cards available for the District Regulator and Low Pressure Point controllers allow the options of serial data communication and modem communications. Refer to Section 4.

2.4.5 Built-In Discrete Output

The built-in Discrete Output may be used as a standard DO. This includes one of the DOs required by the Timed Duration Output mode. A pair of Discrete Outputs acting as a Timed Duration Output for open/close control can be used to control the Kixcel, I/P, or servo valve. Typically, the built-in DO is not used and the two DOs on the I/O card are used for TDO control.

The built-in discrete output is located at DO Point Number A4. Refer to Table 2-7.

Table 2-7. Discrete Output

Output voltage - ON	Battery voltage - 0.7 volts
Output voltage - OFF	0 volts
Output Current	0.3 amp maximum
Maximum voltage	22 volts maximum - clamping occurs

Refer to Section 2.5.11, Discrete Output Wiring, on page 2-41 for more information.

2.4.6 RTD Input

The GridBoss controller supports a direct input from a Resistance Temperature Detector (RTD) sensor. The terminals for the RTD wires are located at the bottom right of the Main Electronics Board and labeled “RTD.” Refer to Figure 2-4. The RTD input is converted through a 16-bit RTD converter chip.

The District Regulator controller sets the outlet pressure based on the actual ambient temperature and the stored time-of-day profile. During operation, the RTD is read once per second. The value from the RTD is linearized, and then it is sent to processing as Analog Input (AI) Point Number A3. The AI routine converts this value to engineering units, performs calibration corrections, and checks alarming. The board temperature is monitored by the RTD routine; if the temperature has changed by roughly 5° C or 9° F, the RTD circuitry is sent a command to recalibrate its reference. Refer to Section 2.5.9, RTD Wiring, on page 2-39.

2.4.7 Real-Time Clock

The real-time clock provides the controller with the time-of-day, month, year, and day of the week. The time chip automatically switches to backup power when the Main Electronics board loses primary input power. Backup power for the real-time clock is adequate for up to two weeks.

2.4.8 Automatic Self-Tests

The controller performs the following self-tests on a periodic basis:

- Battery low.
- Battery high.
- Software watchdog.
- Hardware watchdog.
- RTD automatic temperature compensation.
- Charging voltage for the super capacitor.
- Memory validity.

The controller operates with 8 to 15 volts of dc power. The LCD becomes active when an input voltage with the proper polarity and startup voltage of 10.8 volts or greater is applied to the POWER terminal block (provided the power input fusing/protection is operational). The battery low and high tests ensure that the controller has the correct voltage to operate in a safe mode.

The software watchdog is controlled by the Main Electronics Board. This watchdog checks the software for validity every 1.2 seconds. If necessary, the software is automatically reset. The hardware watchdog is controlled by the Main Electronics Board and monitors the power to the hardware. If this voltage drops below 4.75 volts, the controller is automatically shut down.

RTD automatic temperature compensation is tested at approximately every 5 degrees Celsius temperature change of the board temperature.

Voltage for charging the super capacitor is checked to ensure that it is continuously applied when the controller is powered.

A memory validity self-test is performed to ensure the integrity of memory.

2.4.8.1 Low Power Modes

The processor used in the controller is capable of low power operation under predetermined conditions. These features are available because of the Phase Lock Loop (PLL) used to control the speed of the system clock. The base crystal frequency is 3.6863 MHz and is raised by the PLL to 14.7 MHz for normal system operation. During the low power modes, the PLL and oscillator are in various states of shutdown. Two low power modes are supported: Standby and Doze.

- **Standby —** This mode is used during periods of inactivity. When the operating system cannot find a task to run, the controller enters Standby mode. Processor loading is calculated by using the amount of time spent in Standby mode. This mode keeps the clocks running and communications active with baud clocks running. A Periodic Interrupt Timer wakes up the controller and starts the normal operating mode.

Wake-up from Standby occurs when the controller receives a:

- ♦ Timed / Alarmed interrupt from the Real-Time Clock.
- ♦ Signal from the Operator Interface port – LOI.
- ♦ Signal from Connector P10 (built-in I/O) or I/O card.
- ♦ Signal Ring Indicator (RI) from a communications board – COM1.

♦ **Doze** — This mode is used if a low battery voltage is detected. The battery voltage is compared to the low-low alarm limit in the diagnostic analog input for the battery voltage. This value defaults to 10.6 volts. If the battery voltage is less than the low-low alarm limit (configured for Analog Input point E1), the unit:

1. Sets the Real-Time Clock alarm for 15 minutes from the present time if a charge voltage is greater than the battery voltage, or for 55 minutes if the charge voltage is less than the battery voltage.
2. Writes the message “Low Battery” to the LCD.
3. Enters the Doze mode.
4. Shuts down communications.
5. Wakes up from Doze mode by the Real-Time Clock alarm (set in step 1) and rechecks the voltage to see if operation is possible. If the voltage is greater than the low-low alarm limit for analog input point number E1, a normal restart sequence initiates.

2.5 CONNECTING THE CONTROLLER TO WIRING

The following paragraphs describe how to connect the GridBoss controller to power, ground, I/O devices, and communications devices. Use the recommendations and procedures described in the following paragraphs to avoid damage to equipment.

The field wiring terminations are accessed by opening the front door. The terminal wiring is arranged on the lower edge of the Main Electronics Board. The terminal designations are printed on the circuit board. Refer to Figure 2-4.

This section includes:

- ♦ Terminal Wiring Connections
- ♦ Connecting Ground Wiring
- ♦ Connecting Main Power Wiring
- ♦ Battery Connections
- ♦ Solar Panel Charge Connections
- ♦ AC Power Supply / Battery Charger
- ♦ Auxiliary Output Power
- ♦ Pressure Module Sensor Wiring
- ♦ Type 662 Kixcel Installation
- ♦ RTD Wiring
- ♦ Discrete Output Wiring
- ♦ Intrusion Switch Wiring
- ♦ Connecting Communications Wiring
- ♦ Operator Interface Port Wiring
- ♦ Host Port Wiring

CAUTION

Always turn the power to the GridBoss controller off before you attempt any type of wiring.

CAUTION

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

2.5.1 Terminal Wiring Connections

The Main Electronics Board connectors use compression terminals, the pulse input counter uses a removable connector that accommodate wiring up to #14 AWG (American Wire Gauge) in size. The connections are made by baring the end of a copper wire (¼ inch maximum), inserting the bared end into the clamp beneath the termination screw, and then securing the screw. The wire should be fully inserted with a minimum of bare wire exposed to prevent short circuits.

To make connections, unplug the left-hand connector from its socket, insert each bared wire end into the clamp beneath its termination screw, secure the screw, and then plug the connector back in. The inserted wires should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain on the circuit board and to provide enough clearance to unplug connectors or to allow the Main Electronics Board to swing out. This allows access to the batteries without tedious removal of the field wiring.

The terminations on the Main Electronics Board use removable connectors and accommodate wiring up to #14 AWG in size.

The following connectors are used on the Main Electronics Board:

- ♦ Battery Input – POWER BAT.
- ♦ Charge Input – POWER CHG.
- ♦ Auxiliary Radio Power – RADIO.
- ♦ Pressure Module – P/DP.
- ♦ Operator Interface port – LOI.
- ♦ Discrete Output – DO.
- ♦ Resistance Temperature Detector – RTD.
- ♦ Communications card connector – P3.

The input terminal wiring is arranged on the lower edge of the Main Electronics Board. The terminal designations are printed on the circuit board. Refer to Figure 2-4.

2.5.2 Connecting Ground Wiring

The GridBoss controller and related components must be connected to an earth ground. The National Electrical Code (NEC) governs the ground wiring requirements for all line-powered devices. Refer to Section 1 for further details.

There is a ground bar located inside the enclosure at the top right-hand side. This ground bus bar is electrically bonded to the enclosure and provides screw compression terminals to connect shields from I/O wiring, line-power earth ground, and other device earth grounds as needed.

An external lug on the bottom outside of the enclosure (refer to Figure 2-5) provides a place to connect an earth ground to the enclosure. Although this ground lug is electrically connected to the ground bar through the enclosure steel, it is recommended that a ground wire also be connected between the ground lug and the ground bar.

It is recommended that 14 AWG wire be used for the ground wiring. Make sure the installation has only one ground point to prevent creation of a ground loop circuit. A ground loop circuit could cause erratic operation of the system.

The Main Electronics Board is electrically connected to the ground lug and the ground bar through the enclosure with stand-offs. No earth ground connections to the board are required; however, the enclosure must be grounded from the ground lug.

CAUTION

Do not connect the earth ground to any terminal on the Main Electronics Board.

The recommended cable for I/O signal wiring is an insulated, shielded, twisted pair. The twisted pair and the shielding minimize signal errors caused by EMI (electromagnetic interference), RFI (radio frequency interference), and transients.

For line-powered installations, the grounding conductor must end at the service disconnect. The grounding conductor can be wire or metallic conduit, as long as the circuit provides a low-impedance ground path.

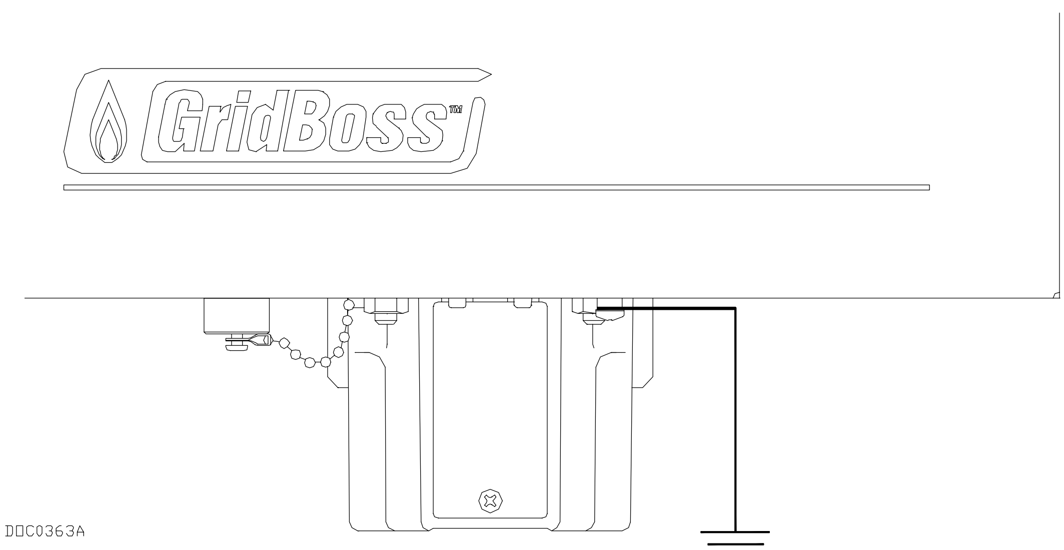


Figure 2-5. Earth Ground Connection

2.5.3 Connecting Main Power Wiring (Overview)

It is important that good wiring practice be used when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes. **The POWER terminal block can accommodate up to 14 AWG wire.** Input power is monitored by diagnostic Analog Input Point E2. Refer to Figure 2-6.

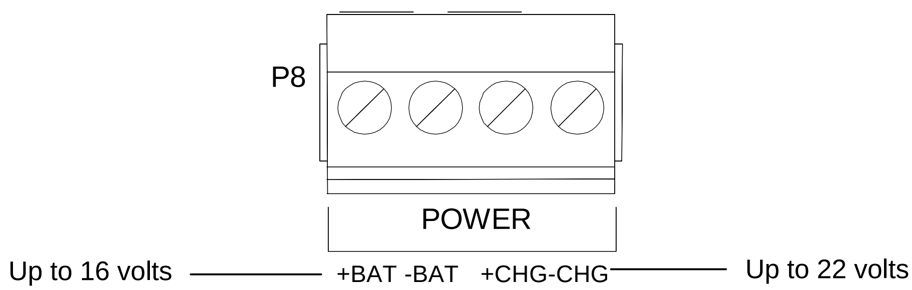


Figure 2-6. Power Input Terminal Connector

To make power connections:

1. Unplug the left-hand connector from its socket located at P8 on the Main Electronic Board.
2. Insert each bared wire end into the clamp beneath its termination screw.
3. Secure the screw.
4. Plug the connector back into the socket at P8.

As described in sections 2.5.4 and 2.5.5, connect the batteries (if used) to the "+BAT" and "BAT-" terminals. Connect the DC charging source (solar panels or AC power supply) to the "+CHG" and "CHG-" terminals. **Make sure the hook-up polarity is correct.**

NOTE

If you are connecting a solar panel that has its own regulator, connect the panel instead to the +BAT and BAT- terminals.

2.5.4 Battery Connections

The battery connections are made to the electronics board by the removable terminal block labeled POWER. These connections provide the input power for the controller electronics. As many as four 12-volt, sealed, lead-acid batteries wired in parallel are connected to these terminals, which are labeled "+BAT" for battery positive and "BAT-" for battery negative. Input power is monitored by diagnostic Analog Input Point E1.

CAUTION

The maximum voltage that can be applied to the "BAT" terminals without damage to the electronics is 16 volts dc.

The GridBoss enclosure can hold up to four sealed lead-acid batteries; see Section 1.7.5 for recommended battery types. The 12-volt batteries can be installed to give 7, 14, 21, or 28 amp-hours of backup capacity, or up to 21 amp-hours of backup capacity when used with an AC power supply.

The batteries are mounted behind the electronics swing-out circuit card panel and are retained by standoffs on the panel when the panel is secured. Refer to Figure 2-7. The AC power supply/battery charger mounts in place of one of the batteries. The batteries are connected to a harness that allows the batteries to be changed without removing power from the unit. Make sure that the black wires of the harness are connected to the negative terminals of the batteries and the red wires are connected to the positive terminals.

2.5.5 Solar Panel Charge Connections

The controller contains an internal battery charger circuit for charge control of the 12-volt batteries. The charger monitors the battery voltage, charge voltage, and the battery temperature, which is actually the board enclosure temperature. Based on these three conditions, a charge rate is determined and applied to the battery. Refer to Figure 2-7 for the proper wiring connections.

NOTE

The internal battery charger limits the current input to 1 amp, which is approximately the output of a 22-watt solar panel. Therefore, a bigger solar panel must have its own regulator and be connected to the +BAT and BAT- terminals.

NOTE

Keep in mind that a solar panel bigger than 11 watts will violate CSA Class I, Division 2, Group C and D ratings. Be sure to use approved connectors on the bottom of the GridBoss enclosure for routing the power wiring.

NOTE

If the solar panel contains its own regulator, connect it instead to the +BAT and BAT- terminals.

The power source (solar panels or line charger) provides power for the charging of the backup batteries. Overcharging is prevented by comparing the battery cell voltage to a maximum limit. If this limit is exceeded, the battery charge cycle is immediately terminated and cannot be re-initiated until the cell voltage has dropped below the maximum limit.

The charge connections are on the removable connector labeled Power. These connections provide the input voltage and power for the battery charging circuitry. A 12-volt solar panel or a line charger with regulated 14.5 to 16 volt output can be directly connected to these terminals. The charger circuitry provides reverse polarity protection and reverse discharge protection so no external circuitry is required. **The maximum voltage that can be applied to the charger terminals is 22 volts dc.** The terminals are labeled: CHG+ for charge input positive and CHG- for charge input negative. Refer to Figure 2-7.

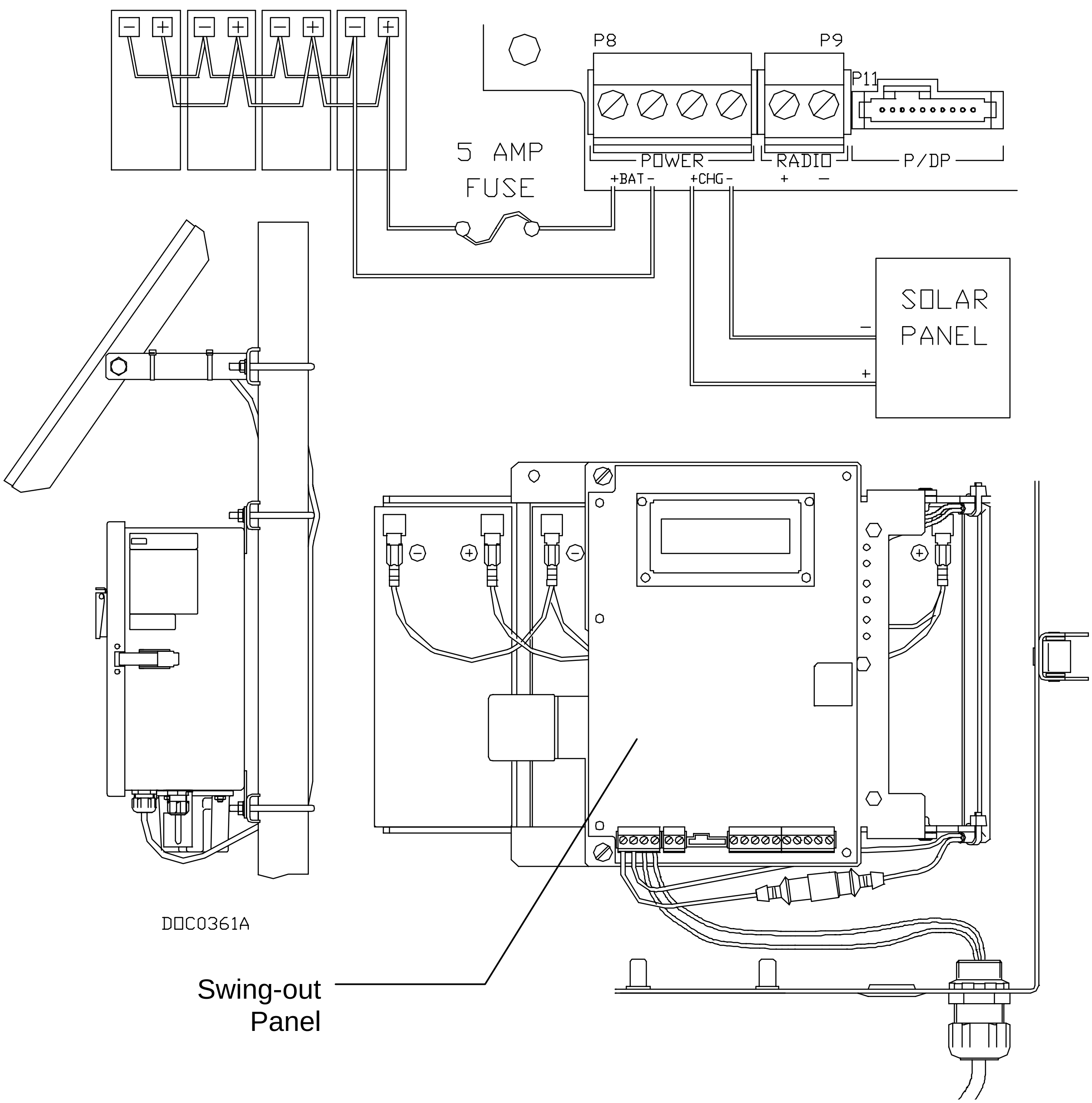


Figure 2-7. Battery and Solar Panel Connections

2.5.6 AC Power Supply / Battery Charger

The optional AC Power Supply is used as the primary source of power for the GB601 and GB602 in line-powered installations. The AC power supply is used to convert AC line power to DC power for use with the controller and its associated accessories. The unit is designed to be used either as a power supply only, or as a combination power supply and battery charger.

The AC power supply occupies the leftmost position in the battery compartment of the GridBoss controller (see Figure 2-8). When the AC power supply is installed, up to 21 amp-hours of battery backup capacity is available.

The internal AC power supply, which provides a nominal 12-volt DC output (14.5 to 16 volts dc at a maximum load of 1 amp), operates from either 115 or 230 volts AC line power, and has a hazardous approval rating. The power supply can be ordered as a 115 or 230 volt unit. By default, the power supply is set to 115 volts. To change the power supply voltage, remove the power supply from the controller. The AC voltage switch is located at S1 on the back of the power supply.

The installation and wiring of the AC voltages must meet local code and the requirements stated with the charger for compliance to Class I, Division 2 hazardous requirements.

In installations where battery backup is used, the AC power supply also functions as a battery charger. The unit provides a fully-regulated output that is protected from overcurrent conditions. When charging batteries, temperature compensation of the output voltage is also provided. Battery temperature is sensed by a thermistor (supplied) connected to terminals T1 and T2 on the power supply. For connection to the controller when battery backup is being used, refer to Figure 2-9. Note that batteries are connected to the +BAT and BAT- terminals, while the power supply is connected to the +CHG and CHG- terminals. The maximum voltage that can be applied to the charging terminals is 22 volts DC.

Through its DC monitor terminals, the AC power supply provides a means for monitoring its DC output remotely, allowing an alarm to be produced when power is interrupted.

The charger circuitry on the Main Electronics board provides reverse polarity protection and reverse discharge protection so no external circuitry is required to perform this function. The circuitry prevents overcharging by comparing the battery voltage to a maximum limit. If this limit is exceeded, the battery charge cycle is immediately terminated and cannot be re-initiated until the voltage has dropped below the maximum limit.

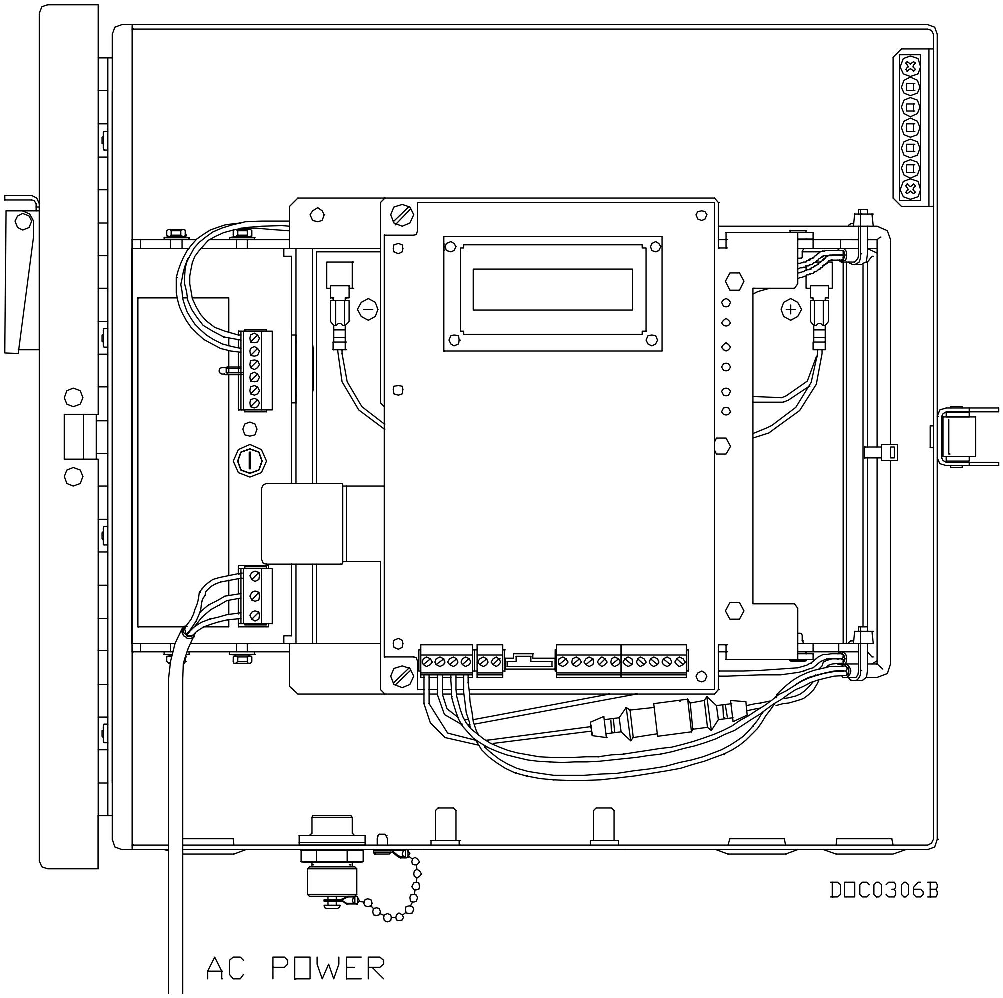


Figure 2-8. AC Power Supply Wiring

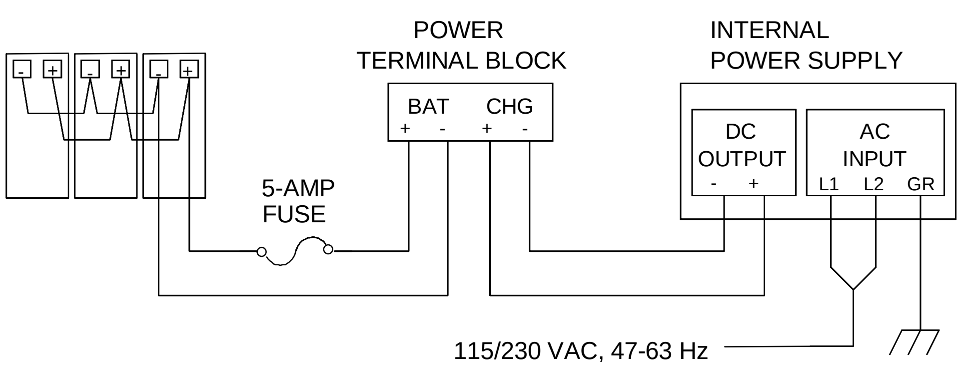


Figure 2-9. AC Power Supply Connections

2.5.7 Auxiliary Output Power

The auxiliary output power connections are on a fixed terminal block connector labeled RADIO. Refer to Figure 2-10. These terminals can supply power (pass through) to external devices such as a radio. The power for this connector originates at the battery connection terminal and is not fused or controlled on the Main Electronics Board. Fusing should be installed in the auxiliary output wiring and should not exceed the size of the fuse in the battery harness wiring. The terminals are labeled "+" for positive voltage and "-" for common.

If power to the radio or other device needs to be cycled to conserve power (recommended when batteries are used), use an EIA-232 communications card and connect wiring for switched radio power as described in Section 4. Configure radio power cycling/control as detailed in the *GRIDLINK Configuration Software User Manual (Form A6074)*.

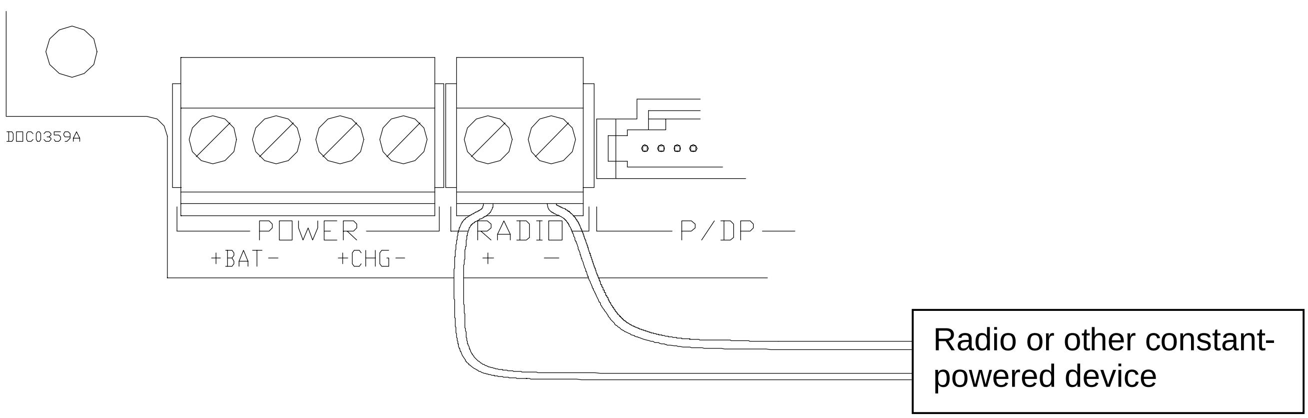


Figure 2-10. Auxiliary Power Terminals

2.5.8 Pressure Module Sensor Wiring

For information on Pressure Module wiring, refer to Section 3.

2.5.9 Type 662 Kixcel Installation

A Kixcel can receive input power as 120/240 Vac or optionally 24 to 36 Vdc, which is connected at terminal block TB1. An AC power selection switch is used to determine whether input power is 120 Vac or 240 Vac. It is important to check this switch and set it properly before applying power. For DC power, verify correct polarity of field wiring on the terminal block before applying power. Refer to the

Type 662 Kixcel Remote Control Pilot Drive Actuator Instruction Manual (Form 5419) or documentation specific to the type of device you are installing. Refer to Figure 2-11.

CAUTION

Before installing the Kixcel, make sure the actuator supplied is suitable for the intended application with respect to environmental conditions and the voltage and frequency of available line power. To avoid the possibility of personal injury caused by electrical shock, disconnect all power to the actuator before removing the cover.

NOTE

This wiring procedure only pertains to the Type 662 Kixcel. Please refer to your user documentation specific to the type of Kixcel, I/P, or servo valve you are actually installing.

2.5.9.1 Kixcel Setup

The Kixcel requires setup similar to the following procedure.

1. Connect the pilot regulator to an air supply.
2. Adjust the pilot for 0 pressure.
3. Count turns required to bring the pilot the outlet pressure to a maximum pressure for the utility application.
4. Adjust the pilot to 0 pressure and disconnect the air. Do **not** move the pressure adjustment on the pilot.
5. Configure the Kixcel dip switches.
    - ♦ **SW1** down for 4-20 mA command signal.
    - ♦ **SW2** up 4-12 mA command signal off.
    - ♦ **SW3** up 12-20 mA command signal off.
    - ♦ **SW4** up for current command signal.
    - ♦ **SW5** up is 0 to 10 volts and down is 0 to 5 volts. The command signal uses the current so position is not a factor.
    - ♦ **SW6** selects the shaft rotation direction for increasing the signal. The position varies with the type of gearbox used with the Kixcel. Select the position that increases the pilot regulator pressure as the input signal increases.
    - ♦ **SW7** down for Automatic operation.
    - ♦ **SW8** up to leave the Kixcel position locked in place if the input signal is lost.
6. Connect the power supply to the Kixcel.

7. Connect the 4-20 mA signal generator to the Kixcel input. Ensure that the wiring is shielded at the source.
8. Connect the meter to the 4-20 mA output of Kixcel.
9. Pull Kixcel jumpers, pin 1 and pin 2 located at TB2 and set the lower Setpoint potentiometer. The signal to the Kixcel is 4 mA.
10. Apply a 20 mA signal to the Kixcel, count the shaft turns and adjust the upper Setpoint potentiometer for the correct number of turns.
11. Apply a 4 mA signal to the Kixcel, allow it to travel and then turn off the power.
12. Mount the Kixcel to the Pilot regulator. Do not move the pressure adjustment on the regulator.
13. Connect the pilot to the air supply and monitor the output pressure.
14. Apply power to the Kixcel and send a 4 mA signal to the Kixcel.
15. Verify that the regulator is providing 0 pressure, adjust the lower Setpoint potentiometer if necessary.
16. Apply a 20 mA signal to the Kixcel and measure the full scale pressure, adjust the high Setpoint potentiometer if necessary.
17. Turn off the Kixcel power and reconnect the Kixcel jumpers pin 1 and pin 2 located at TB2.
18. Apply power to the Kixcel and set the end of travel limit potentiometers LS1 and LS2. These should be adjusted just outside the range of the low and high limits.
19. Make the span adjustments to the position signal from the Kixcel. A 4 mA input should return a 4 mA signal and a 20 mA signal should return a 20 mA signal.
20. Adjust the speed and the torque current limit potentiometers. Measure the voltage to ensure that the unit is not pulling too much power. The voltage is measured from the tab of the power amplifier on the TB3 side of the upper PC board and the accessible wire of R77 on the lower PC board. The voltage should be less than 2.75 volts. One end of R77 is soldered into the PC board close to the resistor. The resistor is perpendicular to the PC board and the accessible wire is bent back over and parallel to the resistor to solder into the PC board.
21. The Deadband potentiometer is usually not adjusted unless there is an oscillation as seen by the on and off action seen in the Green and Yellow LEDs on the lower PC board.

2.5.9.2 Kixcel Analog Output and Analog Input Wiring

The Kixcel, I/P, or servo valve receives a control signal (such as an Analog Output) from the GridBoss controller and converts the signal into an outlet pressure, adjusting the Setpoint at the DR. When an AO is used, an Analog Input (AI) can be sent back to the controller to indicate the position of the Kixcel and to ensure that it is approximately within the monitor Deadband. These signals are connected as shown in Figure 2-11. Make sure the scaling resistor is present on the AI terminal block of the I/O Card.

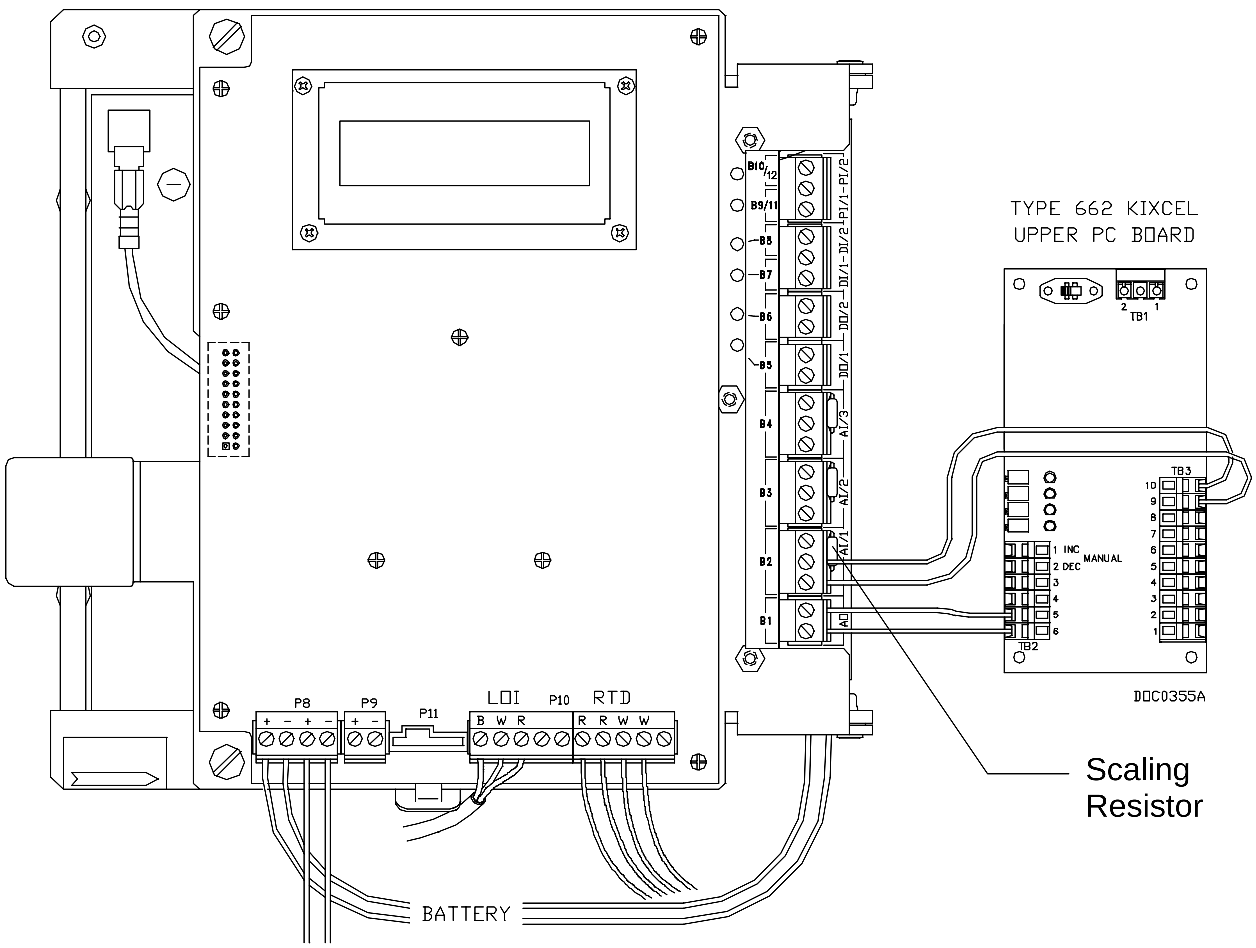


Figure 2-11. Kixcel AO/AI Wiring

2.5.10 RTD Wiring

The temperature for the GB601 is sensed by the factory-attached Resistance Temperature Detector (RTD) probe; this probe is factory-wired to the RTD input terminals on the Main Electronics Board. If you need to connect a 2-wire, 3-wire, or 4-wire RTD to the controller, refer to the wiring connections shown in Figure 2-12 and described below.

The GridBoss controller provides terminations for a four-wire 100-ohm platinum RTD with a DIN 43760 curve. The RTD has an alpha equal to 0.00385. A three-wire or two-wire RTD probe can be used instead of a four-wire probe; however, they may produce measurement errors due to signal loss on the wiring. Wiring between the RTD probe and the controller must be shielded wire, with the shield grounded only at one end to prevent ground loops. If an RTD sensor is mounted remote from the controller enclosure, the RTD wires should be protected either by a metal sheath or conduit connected to a liquid-tight conduit fitting on the bottom of the enclosure.

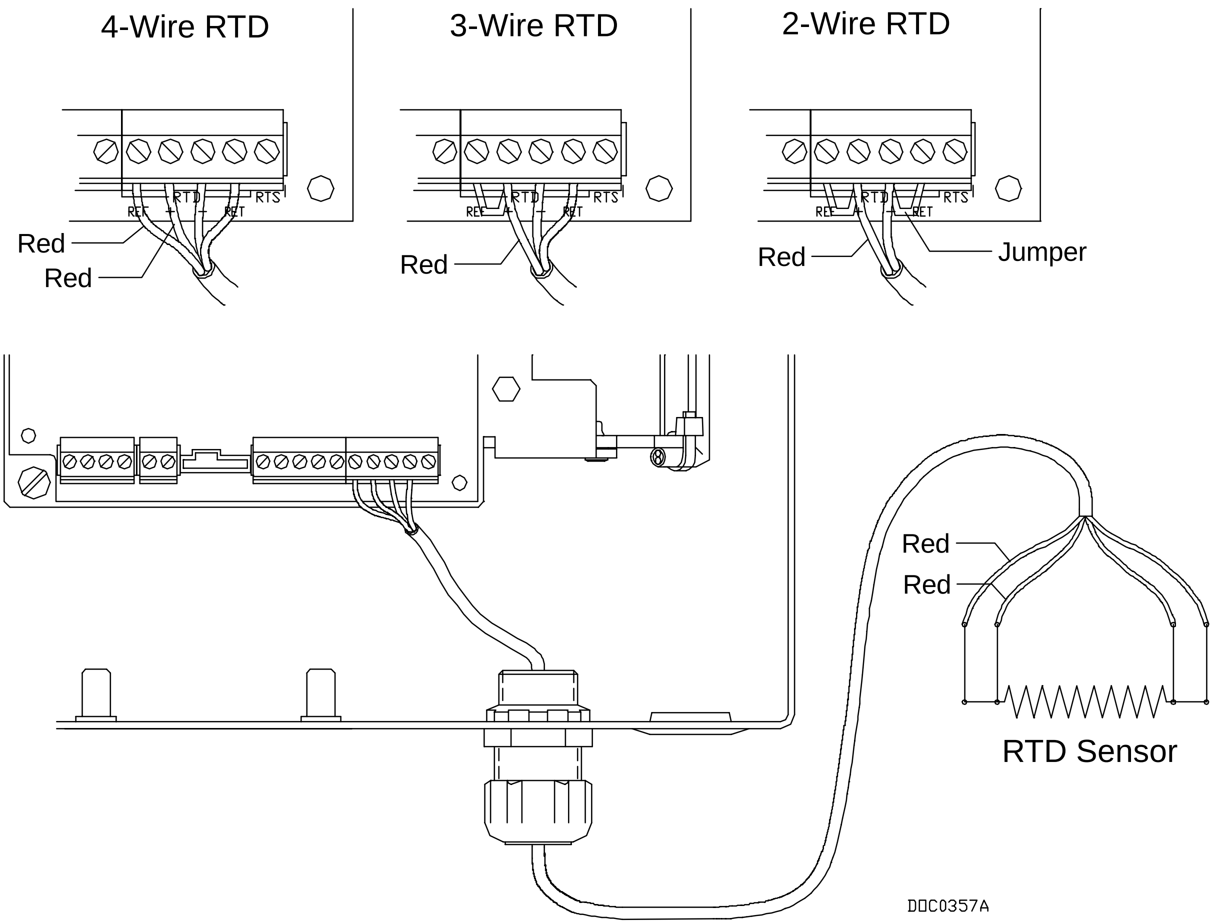


Figure 2-12. RTD Wiring Terminal Connections

The RTD terminals on the Main Electronics Board are designated and defined as follows:

- ♦ “REF” current source
- ♦ “+” signal positive input
- ♦ “–” signal negative input
- ♦ “RET” return (common)

As shown in Figure 2-12, the connections at the RTD terminals for the various RTD probes are:

Terminal	**4-Wire RTD**	**3-Wire RTD**	**2-Wire RTD**
REF	Red	Jumper to +	Jumper to +
+	Red	Red, Jumper to REF	Red, Jumper to REF
–	White	White	White, Jumper to RET
RET	White	White	Jumper to “–”

2.5.11 Discrete Output Wiring

A discrete output is provided on the Main Electronics Board at the I/O terminal blocks. Refer to Figure 2-13. One possible application for this output is to use it as one of a pair of DOs for controlling a Kixcel actuator. This discrete output channel is software configured as DO Point A4.

The DO channel uses a MOSFET to switch current-limited battery power to the positive terminal. The negative terminal is internally connected to battery negative. A blocking diode, a 22-volt transorb, and a back-EMF diode are included to protect the controller electronics.

Because the output is not isolated, care must be used to ensure that the load on it does not affect the operation of the controller. This may include installation of back-EMF diodes and MOVs on the load. The load should be connected as follows:

- ♦ DO + Positive load
- ♦ DO - Negative load

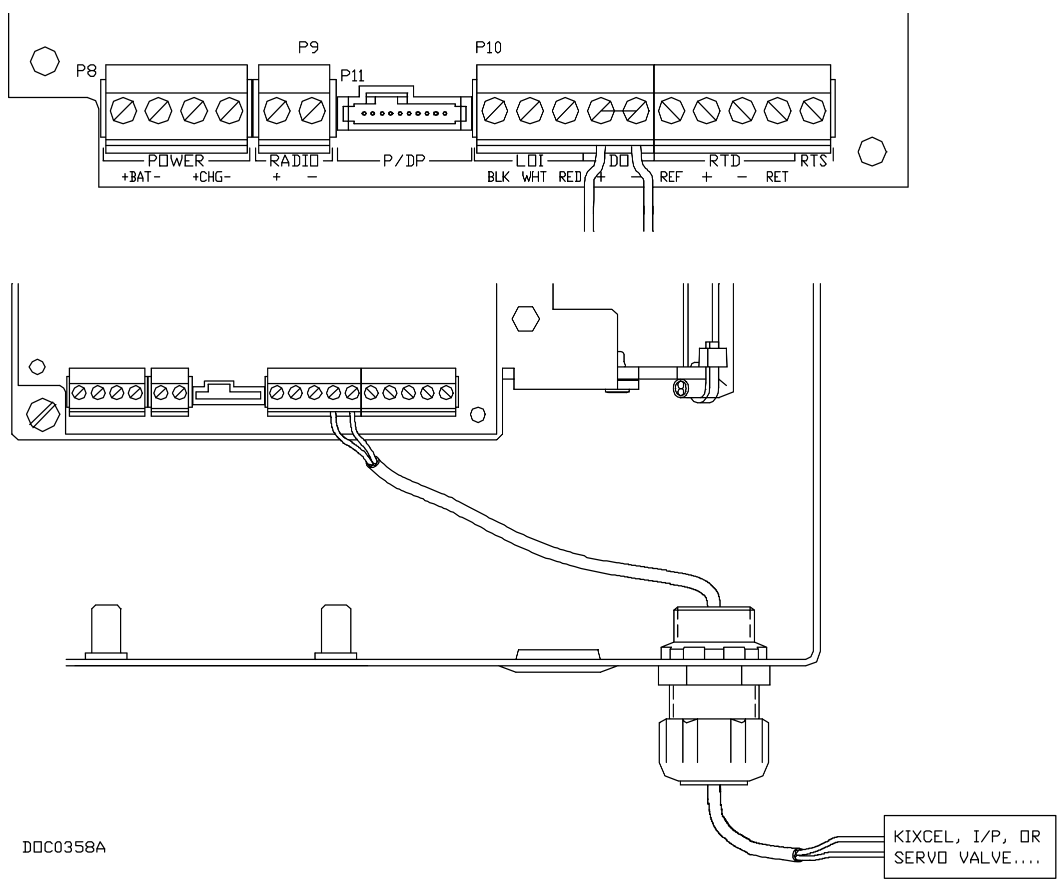


Figure 2-13. Discrete Output Terminal Wiring

2.5.12 Intrusion Switch Wiring

The intrusion switch is a momentary contact switch used to detect whether the door to the enclosure is open or closed. The switch, which has a normally closed contact, is designed to be mounted in the controller enclosure. When the normally-closed contacts are wired to a Discrete Input (DI) on the I/O Card of the controller (as shown in Figure 2-14), an "Off" status (contacts open) is detected when the door is closed and an "On" status (contacts closed) when the door is open. See Section 5 for more information about the DI channel.

Using GRIDLINK, the DI switch status can be configured to generate an alarm when the door is open.

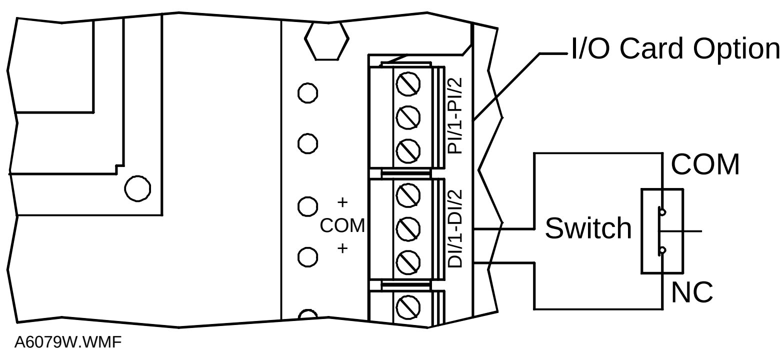


Figure 2-14. Intrusion Switch Wiring

2.5.13 Connecting Communications Wiring

The GridBoss controller has the flexibility to communicate to external devices using different protocols. Communications take place either through the operator interface port (LOI) or the Host port (COM1). A special 3-pin connector provides a port for an operator interface device. Wiring for the Host port is connected using screw terminals on the optional communications card.

2.5.13.1 Operator Interface Port Wiring

Figure 2-15 displays the operator interface (LOI) port, which is located on the bottom of the controller enclosure and factory-wired to a terminal block at the bottom of the Main Electronics Board. The LOI port provides connections for a built-in EIA-232 communications interface to a configuration and monitoring device. The configuration and monitoring device typically is an IBM-compatible computer. A prefabricated operator interface cable is available as an accessory from Fisher.

The LOI port is how the controller normally communicates with the GRIDLINK Configuration Software. This port is compatible with RS232 signals. An RTS terminal is provided on the Main Electronics Board (not routed to the cannon connector) and is intended for future applications. The following table shows the signal routing between the Main Electronics Board terminations and the cannon-style connector:

Main Board	Cannon Connector	Signal
BLK	1	Common
WHT	2	RXD
RED	3	TXD

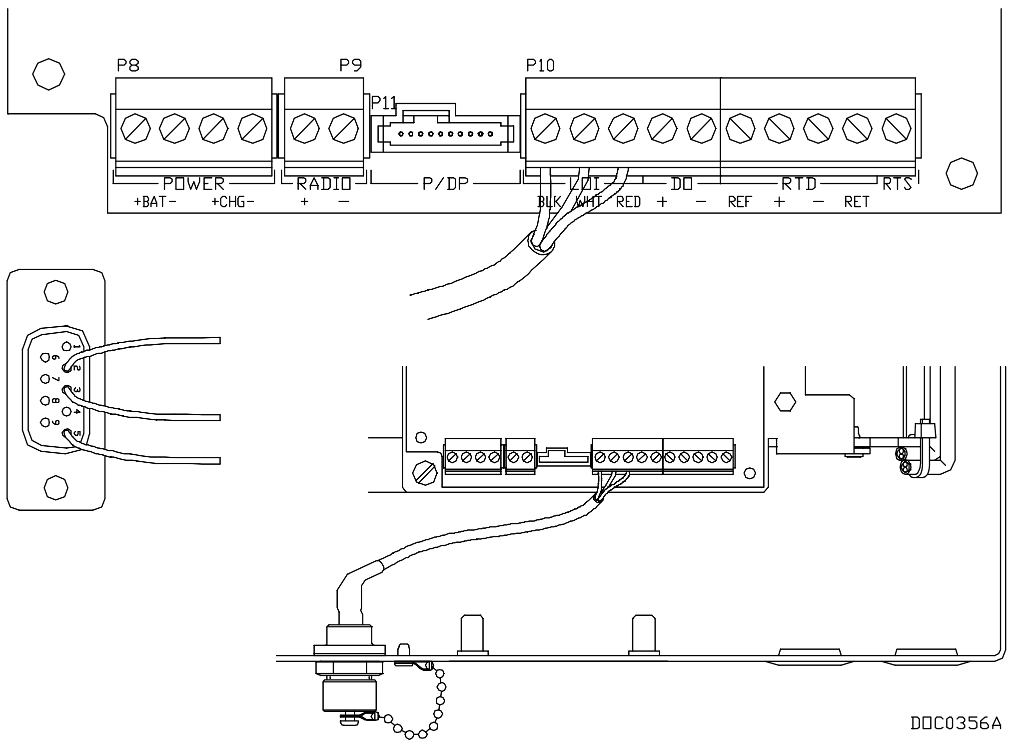


Figure 2-15. Operator Interface Wiring

2.5.13.2 Host Port Wiring

The Host port provides communications access to the controller through an optional communications card, which is plugged into the Main Electronics Board to provide COM1. Section 4 details the types of communications cards available for the GridBoss controller and how to make wiring connections to each type of card.

2.6 CALIBRATION

Analog Input calibration routines support 5-point calibration, with the three mid-points calibrated in any order. The low-end or zero reading (Set Zero) is calibrated first, followed by the high-end or full-scale reading (Set Span). The three mid-points can be calibrated next if desired. The diagnostic analog inputs — battery voltage (AI point number E1), input voltage (AI point number E2), and board temperature (AI point number E5) — are not designed to be calibrated.

The inputs that are supported with the 5-point calibration are:

- ♦ Inlet Line (static) pressure located at AI Point Number A1 – LPP and DR.
- ♦ Outlet Line (static) pressure located at AI Point Number A2 – DR only.
- ♦ Temperature located at AI Point Number A3 – DR only.

The calibration procedure for these inputs is described in Section 3. If you have an optional I/O card installed, then the Analog Inputs supplied by the card can likewise be calibrated using the GRIDLINK Configuration Software.

NOTE

Points represented by “A” are associated with the main electronics board and Pressure Module. Points represented by “B” are associated with the option I/O card.

Refer to the *GRIDLINK Configuration Software User Manual* for additional information.

2.7 TROUBLESHOOTING AND REPAIR

Troubleshooting and repair procedures are designed to help you identify and replace the Main Electronics Board and communications cards. Return faulty boards and cards to your Fisher Representative for repair or replacement. To troubleshoot communications cards, refer to Section 4.

The following tools are required for troubleshooting:

- ♦ IBM-compatible personal computer.
- ♦ GRIDLINK Configuration Software.
- ♦ Battery-powered digital multi-meter, Fluke 8060A or equivalent.

The GRIDLINK Configuration Software runs on the personal computer and is required for a majority of the troubleshooting performed on the controller. Refer to the *GRIDLINK Configuration Software User Manual* for additional information.

2.7.1 Backup Procedure Before Removing Power

Use the following backup procedure when removing or adding controller components. This procedure preserves the current controller configuration and data held in RAM.

Before removing power to the controller for repairs, troubleshooting, or enhancements, perform this backup procedure. The procedure assumes you are using Version 1.00 or later of the standard GRIDLINK Configuration Software.

CAUTION

There is a possibility of losing the configuration and historical data while performing the following procedure. As a precaution, save the current configuration and historical data to permanent memory as follows.

CAUTION

When installing units in a hazardous area, make sure installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous.

CAUTION

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Launch the **GRIDLINK** Configuration Software.
2. Select **Collect GridBoss Data** from the File menu.
3. Select **All** in the Collect GridBoss Data dialog box.
4. Enter a **File Name** and click **OK**.

2.7.2 Resetting the Controller

If you are experiencing problems with the GridBoss Controller that appear to be software related, try resetting the controller. As described in the following paragraphs, there are three ways to perform a reset:

- ♦ Warm Start
- ♦ Cold Start
- ♦ Jumper Reset

For example, if security was enabled on both communication ports of the controller, the settings were saved to permanent memory, and then the ID and/or Passwords were lost, communications with the controller will be locked out on both ports until a Jumper Reset is performed; then the Host port could be used, since its security is disabled by default.

If none of these methods seem to help, the controller may need to be returned to the factory for repair.

2.7.2.1 Warm Start

This re-initialization is performed by setting a parameter in the System Flags. The re-initialization includes the Tasks, Database, Communication Ports, and I/O. This does not change the current configuration of any parameters. Refer to Figure 2-16.

1. Launch the **GRIDLINK** Configuration Software.
2. Select **Flags** from the System menu option.
3. Set the **Warm Start** flag to **Yes**.
4. Press **(F8)Save**.

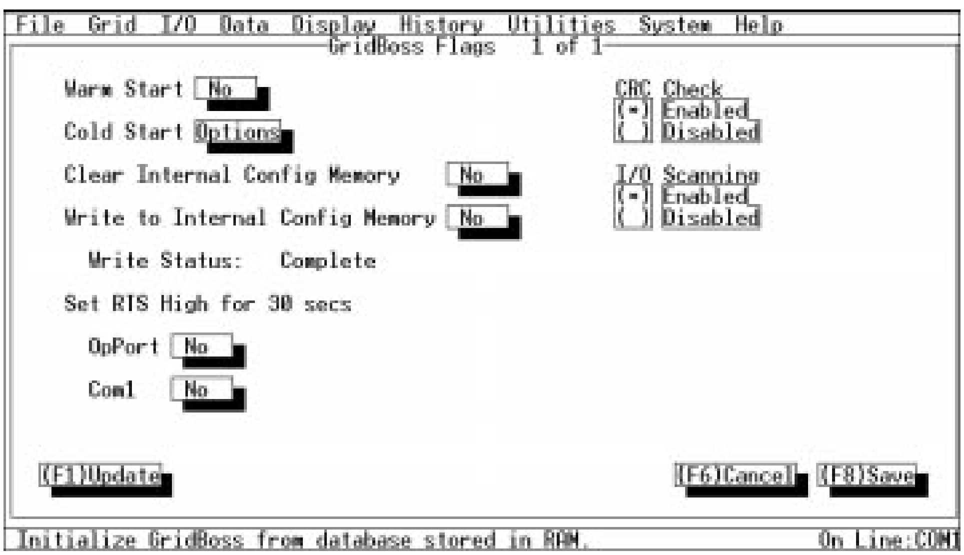


Figure 2-16. GridBoss System Flags

Alternately, you can perform a warm start by removing power from the controller and then restoring it. Make sure that jumper P1 on the Main Electronics Board is in the NORM position for a warm start to take place.

2.7.2.2 Cold Start

This re-initialization is performed by setting a parameter in the System Flags, called Cold Start Options. The re-initialization includes the Tasks, Database, Communication Ports, Pressure Module, I/O, and restoring the saved configuration if there is one. It also includes the following based upon the value entered in Figure 2-17.

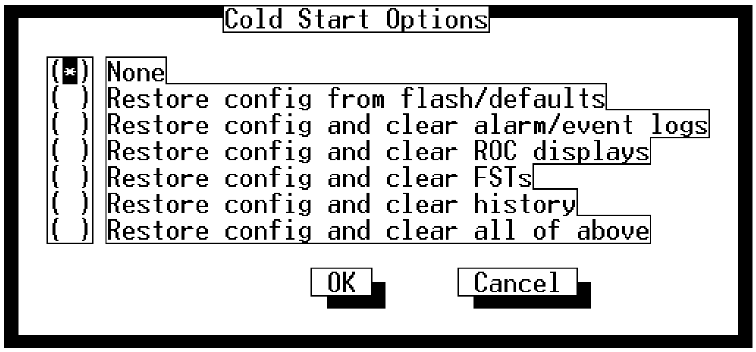


Figure 2-17. Cold Start Options

1. Launch the **GRIDLINK** Configuration Software.

2. Perform the **Backup Procedure** in Section 2.7.1.

3. Select **Flags** from the System menu option.

4. Click the **Cold Start** flag **Options**. Refer to Figure 2-16.

5. Select the type of **Cold Start** you desire. Select “Restore config and clear all of above” to reset all options.

6. Click **OK**.

7. Press **(F8)Save**.

2.7.2.3 Jumper Reset

The Main Electronics Board has a jumper located at P1 in the upper right-hand corner that can be used to perform a special type of cold start. Refer to Figure 2-18. This jumper permits a **power-up** reset to re-establish a known operating point. The includes reinitializing the Tasks, Database, Communication Ports, Pressure Module, and I/O and restoring the factory default configuration. This cold start does not include any of the clearing options available in a Cold Start performed by using GRIDLINK (see Section 2.7.2.2).

CAUTION

This type of reset restores the factory configuration defaults. Any user-entered configuration data will be lost; therefore, try to back up any required data before performing this reset.

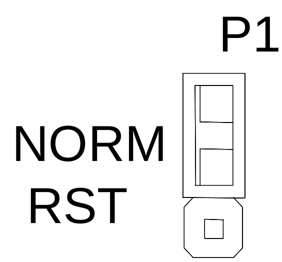


Figure 2-18. Reset Jumper Shown in Normal Position

1. Refer to Section 2.7.1 and perform the **Backup Procedure**.
2. **Disconnect** the **Power** terminal block to remove power.
3. Install the **P1** jumper in the reset (**RST**) position.

   To enact a reset, power up the unit with the jumper installed.
4. Apply power by plugging in the **Power** terminal block at P8.
5. Remove the **P1** jumper and install it in the normal (**NORM**) position.
6. Refer to Section 2.7.3 and perform the **After Installing Components**.

The reset action loads the factory default values into all configurable parameters.

2.7.3 After Installing Components

After removing power to the controller and installing components as needed, perform the following steps to start your controller and reconfigure your data.

CAUTION

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power.

CAUTION

When installing units in a hazardous area, make sure installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous.

CAUTION

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Reconnect power to the controller by inserting the **Power** terminal plug into the P8 Power connector.
2. Launch the **GRIDLINK** Configuration Software, **log in**, and **connect** to the controller.
3. Verify that the configuration is correct. If it is not, continue by configuring the needed items. If major portions or the entire configuration needs to be reloaded, perform the remaining steps.
4. Select **Download** from the File menu, and in the resultant sub-menu.
5. Select **Disk Config. to GridBoss**.
6. In the dialog box that appears (see Figure 2-19), select the **File Name** you entered in step 4 Section 2.7.1, Backup Procedure Before Removing Power, on page 2-45 and click OK.
7. **Select** the portions (see Figure 2-20) of the configuration you want to load or restore.
8. Press **(F8)Download** to restore the controller configuration.

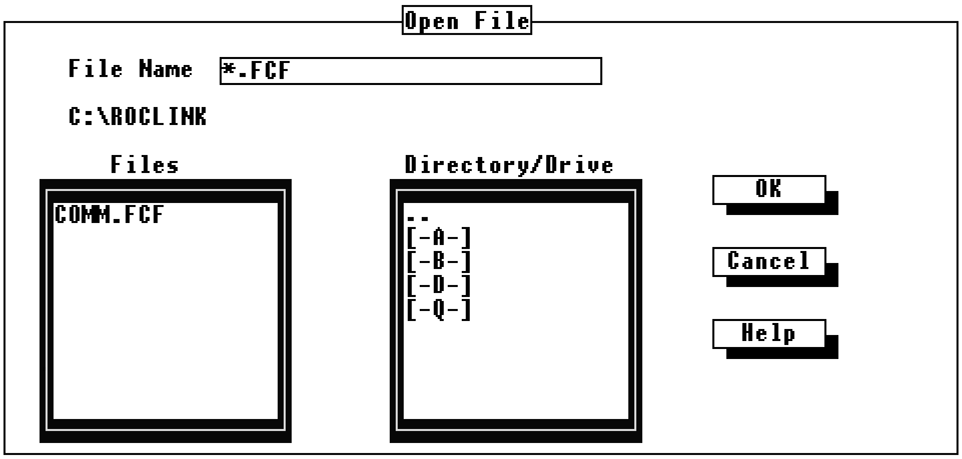


Figure 2-19. Open Configuration File

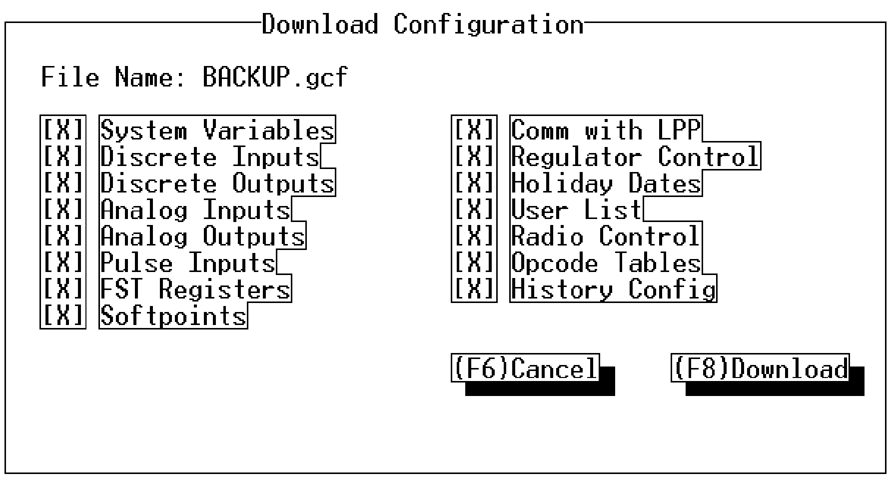


Figure 2-20. Download Configuration

2.7.4 Replacing the Main Electronics Board

Refer to Figure 2-4. Proceed as follows to replace the Main Electronics Board:

CAUTION

There is a possibility of losing the device configuration and historical data while performing the following procedure. As a precaution, save the current configuration and historical data to permanent memory as instructed in Section 2.7.1.

CAUTION

When installing units in a hazardous area, make sure installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Remove power from the area at the nearest electrical power switch box.

CAUTION

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

CAUTION

During this procedure, all power will be removed from the controller and any devices powered by it. Ensure that all connected input devices, output devices, and processes remain in a safe state when power is removed from the controller and also when power is restored.

1. Refer to Section 2.7.1 on page 2-45 for the **Backup Procedure Before Removing Power**.

2. **Disconnect** the **Power** input connector at P8 from the Main Electronics Board.

3. If a **communications card** is present, **remove** it by carefully pulling or prying the card loose from the lower compression stand-offs first, the upper compression stand-off next, and finish by unplugging the card from its mating connector. Disconnect wiring from the communications card as needed to clear the way for removing the Main Electronics Board.

4. **Remove** all **wiring** connected to the Main Electronics Board.

5. **Remove** the **Main Electronics Board** from the five compression stand-offs securing the card, and lift the board out of the case. You may need to pry the board off the stand-offs if you are unable to loosen the board by hand.

6. **Install** the new **Main Electronics Board** in the case. Firmly press the board over the compression stand-offs to secure the board to the case. The compression stand-offs "snap" into place when the card is secured.

7. **Install** the **communications card** if one was removed in Step 3.

8. Plug the Main Electronics Board **Power** wiring into socket P8.

9. Refer to Section 2.7.3, **After Installing Components**.

2.7.5 Pressure Module Replacement

Damaged or faulty Pressure Module units must be returned to the factory for repair. To maintain the approval rating of the controller, this replacement procedure should be performed only by a certified agent.

1. Refer to Section 2.7.1 on page 2-45 for the **Backup Procedure Before Removing Power**.
2. **Disconnect** the **Power** input connector at P8 from the Main Electronics Board.
3. **Disconnect** the **P/DP** input terminal connector from the Main Electronics Board.
4. **Remove** the two **bolts** holding the **Pressure Module** in place.
5. **Return** the **Pressure Module** to your Fisher Representative.
6. Position the new **Pressure Module** and **install** the four bolts to hold the new **Pressure Module** in place.
7. **Reconnect** the **P/DP** input terminal connector to the Main Electronics Board.
8. Refer to Section 2.7.3, **After Installing Components**.

2.8 SPECIFICATIONS

Refer to the following pages for specifications of the GB600-Series Controllers, the Sensor Module, and the Intrusion Switch. Refer to the *Type 662 Kixcel Remote Control Pilot Drive Actuator Instruction Manual (Form 5419)* concerning Kixcel specifications or to the documentation specific to the type of Kixcel, I/P, or servo valve that you are installing.

GB601 (DR) and GB602 (LPP) Specifications

PROCESSOR MEMORY

Motorola 32 bit, running at 14.7 MHz.

Program: 512 Kbyte flash ROM (electrically programmable) for firmware and configuration.

Data: 512 Kbyte SRAM, super capacitor-backed for up to 4 weeks.

Memory Reset: A reset jumper enables a cold start initialization when used during power-up.

TIME FUNCTIONS

Clock Type: 32 kHz crystal oscillator with regulated supply, super capacitor-backed. Year/Month/Day and Hour/Minute/Second, with Daylight Savings Time control.

Clock Accuracy: 0.01%.

Watchdog Timer: Hardware monitor expires after 1 second and resets the processor.

DIAGNOSTICS

These conditions are monitored and alarmed: SRAM validity/operation, PM and RTD point fail, battery and charging voltages, and enclosure internal temperature.

COMMUNICATIONS PORTS

Operator Interface: EIA-232 (RS-232D) format. Software configured; 1200 to 19.2K baud rate selectable. Screw-cap protected connector.

Host: Serial or modem interface, when optional communications card is installed.

POWER

Battery Input: 8 to 16 Vdc (normally 10.8 Vdc to start up). 0.2 W typical, excluding power for discrete output load, communications card, and I/O card (if present).

Charging Input: 14 to 22 Vdc. Charge current internally limited to 1.0 amp.

Optional Power Supply: 105 to 132 Vac or 207 to 264 Vac, 47 to 63 Hz.

Input Power: 10 to 14 Vdc at .020 amp maximum.

USER INTERFACE

2 line by 16 character LCD. Continually updates approximately every 3 seconds. See Environmental specification for operating temperature.

I/O CARD

See Specifications Sheet 3:IOB1.

RTD INPUT (BUILT-IN)

Quantity/Type: Single input for a 2, 3, or 4-wire RTD element (4-wire RTD sensor supplied for the GB601).

Terminals: "Ref" current source, "+" signal positive input, "-" signal negative input, and "Ret" return (common).

Sensing Range: -50 to 100° C (-58 to 212° F).

Accuracy (includes linearity, hysteresis, repeatability): ±0.56° C (1.0° F) over sensing range.

Ambient Temperature Effects per 28° C (50° F): ±0.50° C (.90° F) for process temperatures from -40 to 100° C (-40 to 212° F).

Filter: Band-pass hardware filter.

Resolution: 16 bits.

Conversion Time: 100 µsec.

Sample Period: 1 sec minimum.

DISCRETE OUTPUT (BUILT-IN)

Quantity/Type: 1 sourced, high-side switched output.

Terminals: "+" positive output, "-" negative (common).

Voltage: Same as applied to Battery Input minus 0.7 volts.

Frequency: 1.5 Hz maximum.

Sample Period: 200 milliseconds minimum.

Current Limit: 300 mA, automatic reset.

ENVIRONMENTAL

Operating Temperature: -40 to 75° C (-40 to 167° F), excluding LCD display, which is -25 to 70° C (-13 to 158° F).

Storage Temperature: -50 to 85° C (-58 to 185° F).

Operating Humidity: 5 to 95%, non-condensing.

Vibration: Meets SAMA PMC 31.1, Sec. 5.3, Condition 3.

ESD Susceptibility: Meets IEC 801-2, as required by EN50082-2.

EMI Susceptibility: Meets IEC 801-4, as required by EN50082-2.

RFI Susceptibility: No effect on operation of unit when tested properly mounted and door closed as required by EN50082.2.

Emissions: Meets CISPR22 and FCC part 15, Class A.

GB601 (DR) and GB602 (LPP) Specifications

DIMENSIONS

Overall: 16.56 in. H by 13.80 in. W by 7.25 in. D (420 mm by 350 mm by 184 mm). Height includes top mounting flange and SM.

Wall Mounting: 2.81 in. W by 13.80 in. H (72 mm by 350 mm) between mounting hole (0.38 in. diameter) centers.

Pipestand Mounting: Mounts on 2-inch pipe with U-bolt mounting kit (supplied).

WEIGHT

23 lb. (10.35 kg) nominal, including SM, but excluding batteries (not supplied). Power supply is 1.8 lb.

ENCLOSURE

Construction: Powder-coated 14-gauge carbon steel with lockable hasp and gasketed doors. Coating is ANSI 61 gray polyurethane paint. All unpainted hardware is stainless steel. Meets CSA Type 4 rating (NEMA 4 equivalent).

Wiring access: Three 0.88 in. holes punched in bottom.

APPROVALS

Approved as Model W40079 by CSA for hazardous locations Class I, Division 2, Groups A, B, C and D.

FCC Class A computing device.

Sensor Module (SM)

PULSE COUNTER INPUTS

Quantity and Type: 2 Voltage Sense inputs.
Field Wiring Terminals: S, +, COM
Source Power: Voltage is same as battery voltage; current is 1 mA max.
Range: Inactive, 0 to 1.4 Vdc; active, 2.1 Vdc minimum.

PRESSURE INPUTS

Up to two pressure sensors, selected from the ranges in the table below. Note that all are gauge pressure inputs, except for the 0 - 1000 PSI sensor.

CONSTRUCTION

Housing is 316 SST with Poron™ gasket between housing and controller enclosure.

PROCESS CONNECTIONS

1/4-18 NPT female on 1.56-inch center, located on bottom surface.

ENVIRONMENTAL

Compensated: 0 to 70° C (32 to 158° F).
Operating: -40 to 80° C (-4 to 176° F).
Storage: -40 to 80° C (-40 to 176° F).

Pressure Inputs Range	Accuracy % of Span	Proof Pressure	Burst Pressure
0 - 5 PSIG (0 - 0.35 bar)	± 0.2 %	20 PSIG	75 PSIG
0 - 30 PSIG (0 - 2.069 bar)	± 0.2 %	90 PSIG	150 PSIG
0 - 100 PSIG (0 - 6.895 bar)	± 0.2 %	300 PSIG	1250 PSIG
0 - 300 PSIG (0 - 20.65 bar)	± 0.2 %	600 PSIG	1250 PSIG
0 - 500 PSIG (0 - 34.473 bar)	± 0.2 %	850 PSIG	1000 PSIG
0 - 1000 PSIA (0 - 68.95 bar)	± 0.2 %	2000 PSIA	3000 PSIA

Intrusion Switch Specifications

Type: SPST, normally-closed, hermetically-sealed, spring-loaded plunger switch, with two terminals.

Maximum Contact Rating (Resistive Load): 100 mA at 100 Vdc.

Weight: 1 oz. (30 g) nominal.

Approvals: Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

SECTION 3 — SENSOR MODULE

3.1 SCOPE

This section describes the Sensor Module (SM), which provides static pressure inputs to the GridBoss Controller for the pressure calculation.

3.1.1 Section Contents

This section contains the following information:

3.2 DESCRIPTION

The primary function of the controller is to measure the pressure of natural gas using pressure metering in accordance with the American Petroleum Institute (API) and American Gas Association (AGA) standards. The GB601 measures the inlet and outlet pressure at the District Regulator and the GB602 measures the average pressure at the Low Pressure Point. The Sensor Module can be configured for Metric or English units. The Sensor Module senses static (line) pressures from direct process connections.

At the Low Pressure Point, the Sensor Module converts and reads the static (line) input pressure. The LPP calculates the inlet pressure average over a minute and compares it to the Setpoint Deadband. If the inlet average pressure is out of range of the Setpoint Deadband, a message containing the new calculated change in the Setpoint for the Inner Loop and the average pressure is sent to the DR.

At the District Regulator, the Sensor Module converts and reads the static (line) inlet pressure, converts and reads static outlet pressure, stores the values temporarily, and communicates the values on demand to the GB602. The inputs are used to determine the pressure output at the DR. The Sensor Module firmware has 128 Kbytes of program storage and 4 Kbytes of RAM storage for data.

The primary inputs used for pressure monitoring at the DR are static pressure and temperature. The primary input used for pressure monitoring at the LPP is static pressure. The inlet and outlet static pressure come from the Sensor Module (SM), and the temperature input is read using the RTD probe. The inputs are read at the following rates:

- ♦ Static pressure is sampled once per second.
- ♦ Temperature is sampled and linearized once per second. The RTD is internally re-calibrated for every 5° C temperature change as sensed by enclosure (battery) temperature.

The Sensor Module measures static pressure by converting the applied pressure to electrical signals. All readings from the sensor are made available to the Main Electronics Board via a factory-installed ribbon cable (see Figure 3-1) that plugs into the Main Electronics Board at P/DP. The readings from the Sensor Module are configured as two analog input points located at:

- ♦ Analog Input Point Number A1 – Inlet static pressure (DR and LPP)
- ♦ Analog Input Point Number A2 – Outlet static pressure (DR only)

Standard AI alarming is implemented. If the sensor fails to communicate, either during initialization or run time, the Point Fail bit in the Analog Input alarm code is set and if alarms are enabled, an alarm is entered in the Alarm Log.

The measurement in the Sensor Module for the static pressure inputs can be any combination of these ranges: 0 to 5 psig, 0 to 30 psig, 0 to 300 psig, or 0 to 1000 psia. Read the label on the Sensor Module to view the specific pressures ranges.

The Sensor Module informs the Main Electronics Board that it is ready for an update at least once per second. The controller converts this value and stores it in the proper analog input for access by other functions within the controller. If an update does not occur in the one-second interval, the sensor is re-initialized and a Point Fail alarm is set if the sensor does not respond to the initialization. Calibration is performed through the AI Calibration routine.

As described in Section 3.5, use the GRIDLINK Configuration Software to configure all analog input points required for pressure metering. Refer to the GRIDLINK User Manual.

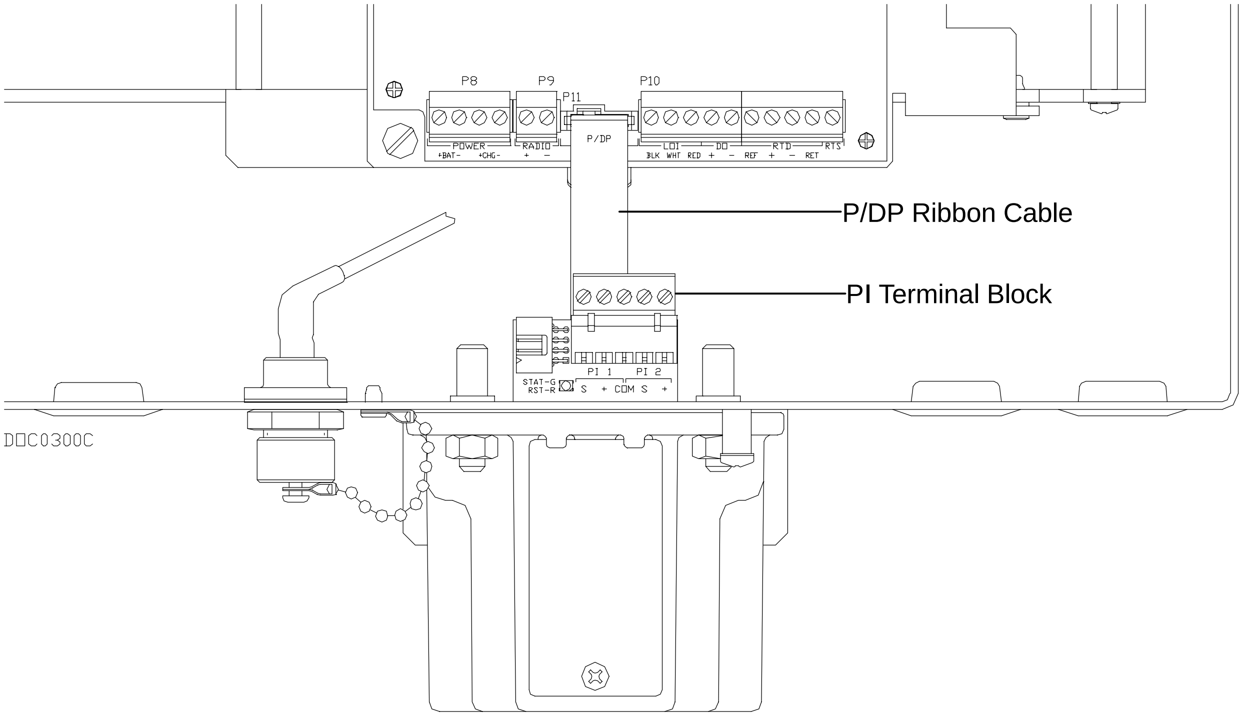


Figure 3-1. Sensor Module (Front View)

3.2.1 Analog Inputs

The static (line) pressure readings from the Sensor Module are configured as two analog input points in the DR controller and one analog input in the LPP controller. The pressure circuitry uses a 16-bit A/D converter. The 16-bit values are converted to 24-bit values (23 bits plus a sign bit) for transmitting to the MCU. The circuitry is designed to use as much range of the reference as possible. The sensors measure up to 300 psig or 1000 psia, depending on which was ordered. The AIs are located at:

- Analog Input Point Number A1 – Inlet static pressure (DR only)
- Analog Input Point Number A2 – Outlet static pressure (DR and LPP)

3.2.2 Pulse Inputs

Pulse Inputs (PI) are not used by the GridBoss System but are described in case you desire to use them for an alternative purpose. The Sensor Module is capable of handling two channels (points) for pulse inputs.

The pulse input circuitry is based upon a two-stage Schmidt trigger inverter. Also provided is a source voltage for open collector/drain turbines and for dry contacts. This source voltage is a nominal 12 volts open circuit; it provides approximately one milliamp in shorted or closed contact positions.

An external amplifier must be connected to the field terminations to provide gain for low-level turbine signals. The amplifier is powered by the source voltage terminals and the amplifier output is connected to the "+" input signal. The normal gain of the amplifier is 30. This allows 100 mV signals to be amplified to 3 volts (above the 2.5 volt threshold).

The pulses accumulate in a 32-bit register that rolls over when the 25^{th} bit is set. Only 24 bits are sent to the FloBoss for updates.

The Sensor Module accepts the signals, shapes and filters the signals, and sends the signals to the MCU. The pulse input connectors consist of a 5-pin removable terminal block with screw-type compression connectors.

Sensor module pulse inputs are configured at:

- ♦ Pulse Input Point A5
- ♦ Pulse Input Point A6

3.2.3 Sensor Module Connection

The connection between the Sensor Module and the main electronics board is achieved through a ribbon cable plugged in at the P/DP connector. Refer to Figure 3-1. In addition to all the signals, a 5-volt power supply from the controller is made available to the Sensor Module through the P/DP ribbon cable. The voltage of this power follows the battery voltage of the unit. This supply operates under very low currents with an efficiency of 60 to 90 percent, depending upon the current draw.

3.3 PROCESS CONNECTIONS

The process inputs are the static pressure connections, which are located on the bottom of the Sensor Module housing. Refer to Figure 3-2.

The inlet pressure connection is made to the front tap (labeled "1"), and the outlet pressure connection is made to the rear tap (labeled "2"). The LPP only uses the front tap. Both pressure connections are ¼-18 NPT.

CAUTION

Be sure to use a pipe thread compound suitable for stainless steel, or galling may occur.

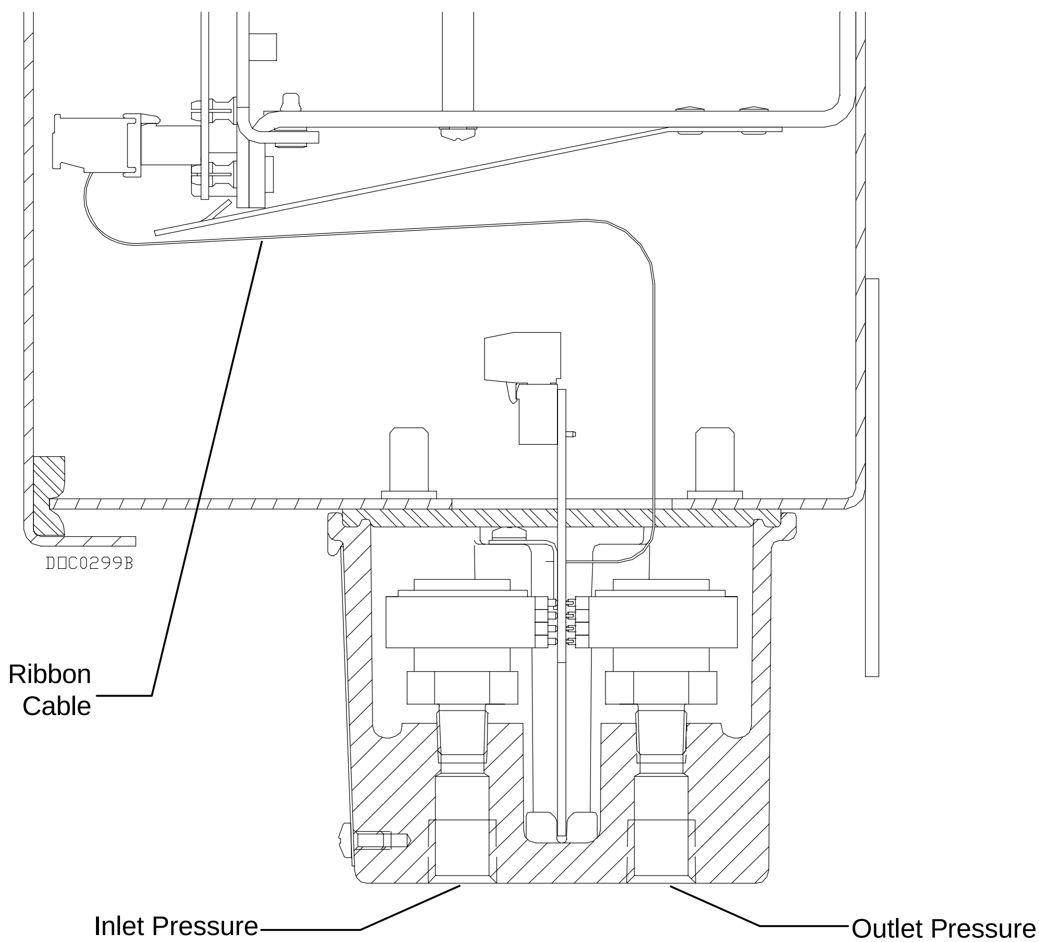


Figure 3-2. Side Cut-away View Showing Process Connections

3.4 WIRING THE SENSOR MODULE

Pulse Inputs (PI) are not used by the GridBoss System, but are described in case you desire to use them for an alternative purpose. The only field wiring connections to the Sensor Module are for the two pulse input channels. Like the standard field wiring, the wiring terminals for these inputs are accessed by opening the door of the GridBoss enclosure. The terminal designations (S, +, and COM) are printed on the circuit board directly below each terminal as shown in Figure 3-1. The pulse input (PI) terminals and their function are detailed in Table 3-1.

The first pulse input is on the left, and the second pulse input is located on the right.

CAUTION

Always turn the power to the controller off before you attempt any type of wiring.

CAUTION

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

Table 3-1. PI Connections on the Sensor Module

Terminal	Pulse Input #1 (Left Position)
DEVICE 1 (+)	The positive pulse input from the first device. This is the first pulse input (identified as PI point A5 when configuring).
SOURCE 1 (S)	First source voltage for open collector/drain or dry contacts.
COMMON (COM)	Power supply and circuit common.
Terminal	**Pulse Input #2 (Right Position)**
COMMON (COM)	Power supply and circuit common.
DEVICE 2 (+)	The positive pulse input from a second device. This is the second pulse input (identified as PI point A6 when configuring).
SOURCE 2 (S)	Second source voltage for open collector/drain or dry contacts.

The actual wiring connections for the pulse input counter depends on the application. See the following figures for typical hook-ups. Note that the power for the pulse device in Figure 3-3 could come from any suitable source other than the controller itself.

The field device in Figure 3-4 is assumed to be opening and closing an isolated switch of some type.

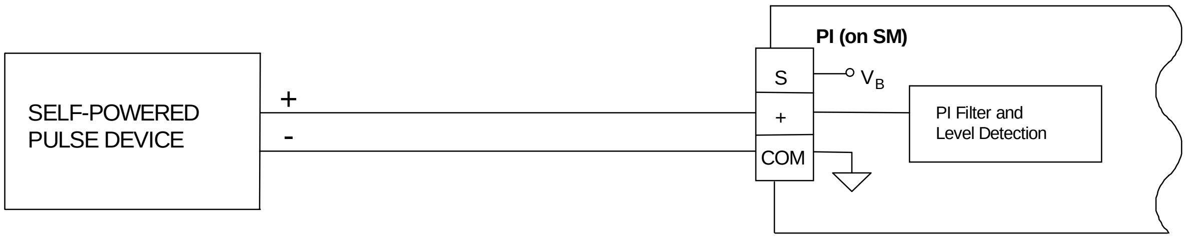


Figure 3-3. Pulse Input from Field-Powered Device

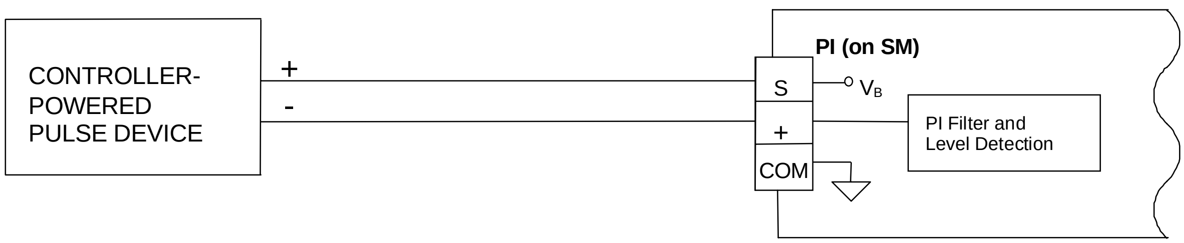
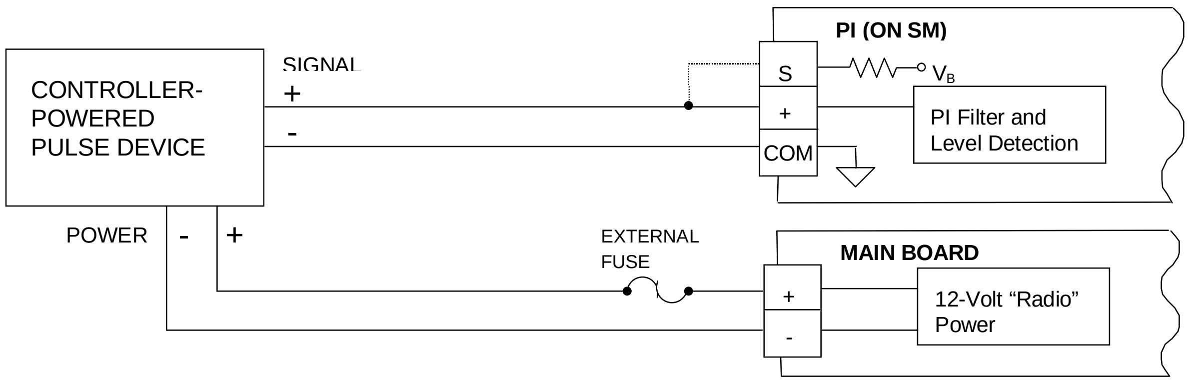


Figure 3-4. Pulse Input from SM-Powered Contact Closure

A controller-powered field device that uses a switch to ground (a “shorting” switch) can be accommodated by wiring the device between the “+” and COM terminals and also connecting the “S” and “+” terminals together. Note that the power for the pulse device in Figure 3-5 is shown coming from the Radio power terminals on the controller; however, another suitable 12-volt source could be used.



NOTES:
Connect this wire only for a contact closure from relay contacts or a solid-state relay with an open collector or open drain.
Locate fuse close to RADIO power connector.

Figure 3-5. Pulse Input from Controller-Powered Device

3.5 CONFIGURATION

Use the GRIDLINK Configuration Software, Version 1.0 or later, to configure the distribution system inputs and outputs associated with the Sensor Module. Refer to Section 2.3.2 concerning History Points.

3.5.1 Configuring Inputs

To configure parameters for the individual inputs associated with the Sensor Module and the pressure calculation, use the GRIDLINK I/O menu as described in Section 4 of the GRIDLINK user manual. The inputs and their point numbers are:

- ♦ The inlet pressure is configured at Analog Input point number A1. (DR and LPP)
- ♦ The outlet pressure is configured at Analog Input point number A2. (DR only)
- ♦ The RTD temperature (on the main electronics board) is configured at Analog Input point number A3. (DR only)

Points starting with “A” (such as A2) are associated with the main electronics board and the Sensor Module. Points starting with “B” are associated with the I/O card (optional on the GB602).

The initial pressures are read from the defaults contained within the sensor. The initial range of the static pressure depends upon the type of sensor installed. The ranges can be changed through the calibration routines. It is recommended that the turndown on the ranges not be greater than five.

3.5.2 Metric Units

The Sensor Module supports the conversion of values to Metric units. In Metric mode, both the static pressure and the auxiliary pressure are in kPa. To enter the Metric mode, using GRIDLINK Configuration Software:

1. Select the **System** menu.
2. From the pull-down menu, select **Information**.
3. On the system information display, enable the **Metric** field
4. Press **(F8) Save** to save the change to the GridBoss controller.

Refer to Figure 3-6.

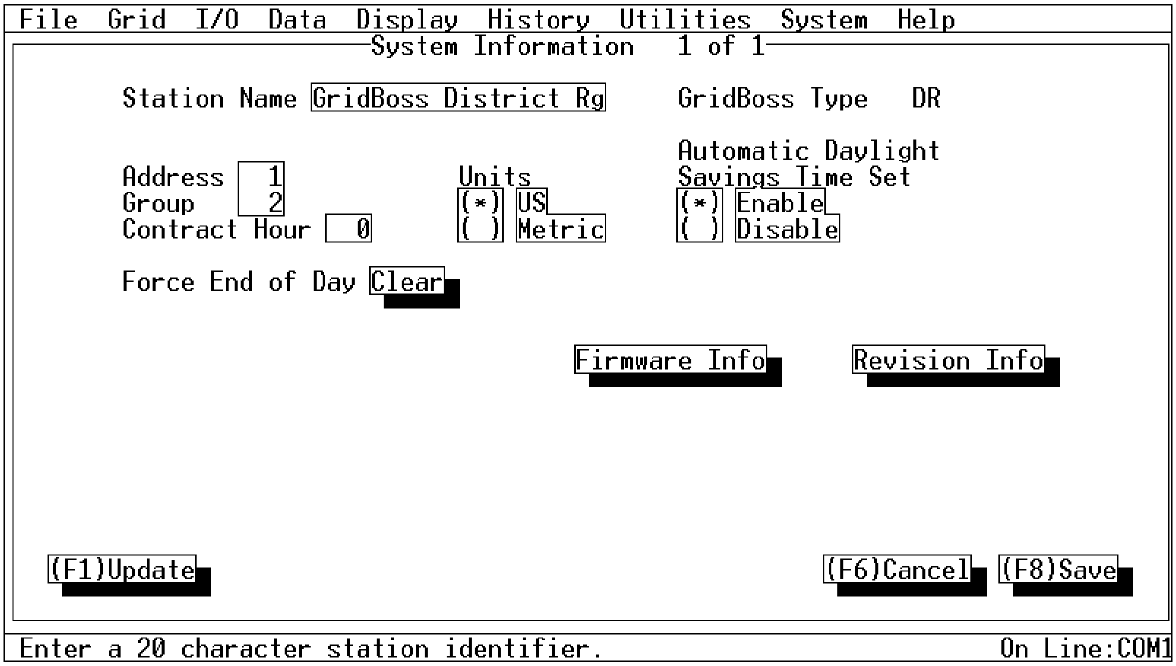


Figure 3-6. System Information

The controller automatically adjusts the units, ranges, alarm limits, and calibration factors of the static pressure, auxiliary pressure, RTD, and enclosure/battery temperature, to the metric mode for the entire distribution system. To return to US units, enable the US field and save this change to the controller. The controller adjusts the values to US units.

3.6 CALIBRATION

The calibration procedure is performed using the GRIDLINK Configuration Software, which allows you to perform a 5-point (minimum, maximum, and up to three intermediate points) calibration of the analog inputs associated with the calculation (static pressure and temperature).

The GRIDLINK Configuration Software is used to perform both initial calibration and re-calibration.

3.6.1 AI Calibration

The AI Calibration pushbutton allows you to calibrate the Analog Input displayed in this screen. Perform the following steps to calibrate an analog input:

CAUTION

During calibration, the controller will time-out and disconnect if it is left idle for extended amounts of time. Your calibration values will be lost and you will have to reconnect and begin calibration from the beginning.

1. Press the **AI Calibration** pushbutton. A dialog box displays as shown in Figure 3-7, and the analog input is automatically "frozen" at the value displayed in the dialog box.

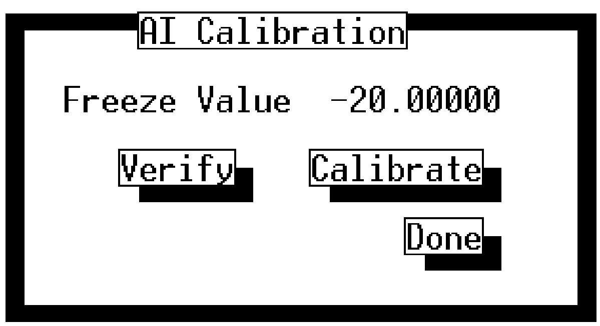


Figure 3-7. AI Calibration

2. If the input has been calibrated before, you can verify the calibration (this can also be done immediately after performing calibration). Press the **Verify** pushbutton to proceed with verification of an input's calibration. Refer to Figure 3-8 and to Section 3.3.3 for details. Otherwise, skip to Step 6 to begin calibration.

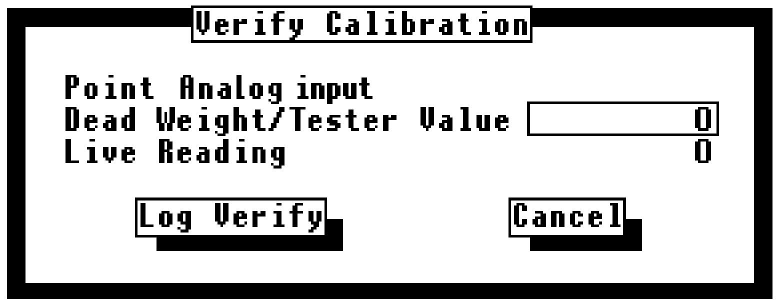


Figure 3-8. Verify AI Calibration

3. Enter the **Dead Weight/Tester Value**. This is the input desired for the test value and is the actual value expected by the test equipment being calibrated against. For example, when calibrating temperature for an RTD input, enter the degrees value associated with the resistance set up in the decade box.
4. Press the **Log Verify** pushbutton. Repeat Steps 3 and 4 for each value to be verified.
5. Press the **Cancel** pushbutton. If calibration is needed, proceed to Step 6; otherwise, press the Done pushbutton.
6. Press the **Calibrate** pushbutton. Refer to Figure 3-7 and to Section 3.3.4 for details.
7. Calibrate the zero value (0% of range) for the Analog Input. Enter the **Dead Weight/Tester Value** (in engineering units) and press the **Set Zero** pushbutton. Refer to Figure 3-9.

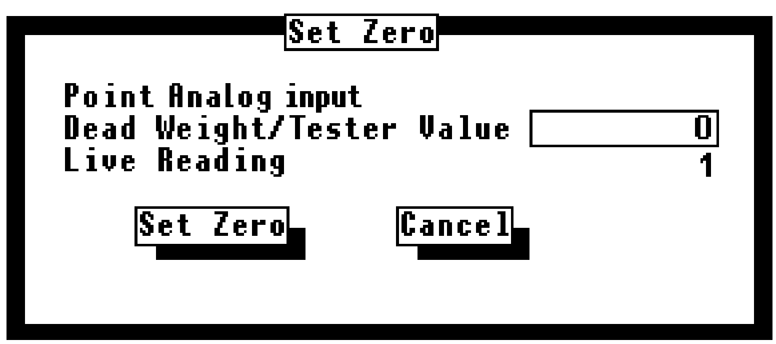


Figure 3-9. AI Set Zero

8. Calibrate the span value (100% of range) for the Analog Input. Enter the **Dead Weight/Tester Value** (in engineering units) and press the **Set Span** pushbutton. Refer to Figure 3-10.

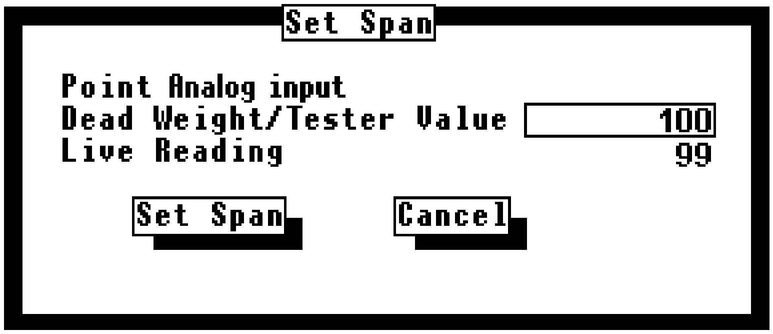


Figure 3-10. AI Set Span

9. If desired, calibrate Midpoint 1 (such as 25% of range) for the Analog Input. Enter the **Dead Weight/Tester Value** (in engineering units) and press the **Set Mid 1** pushbutton. Refer to Figure 3-11. Otherwise, use the **Done** pushbutton and proceed to Step 12.

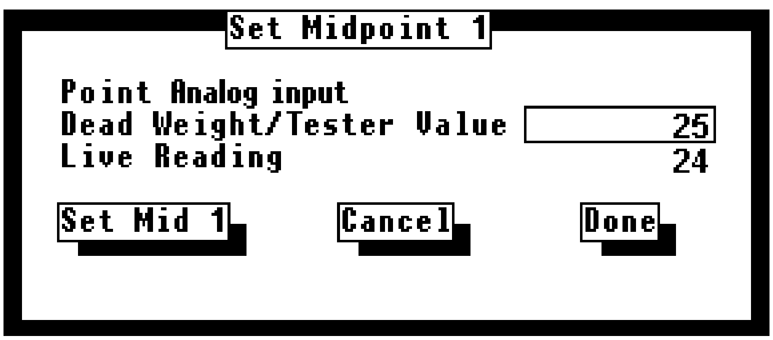


Figure 3-11. AI Set Midpoint 1

10. If desired, calibrate Midpoint 2 (such as 50% of range) for the Analog Input. Enter the **Dead Weight/Tester Value** (in engineering units) and press the **Set Mid 2** pushbutton. Refer to Figure 3-12. Otherwise, use the **Done** pushbutton and proceed to Step 12.

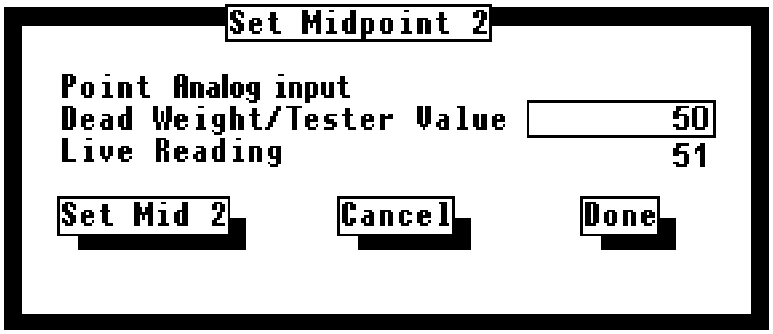


Figure 3-12. AI Set Midpoint 2

11. If desired, calibrate Midpoint 3 (such as 75% of range) for the Analog Input. Enter the **Dead Weight/Tester Value** (in engineering units) and press the **Set Mid 3** pushbutton. Refer to Figure 3-13. Otherwise, use the **Done** pushbutton and proceed to Step 12.

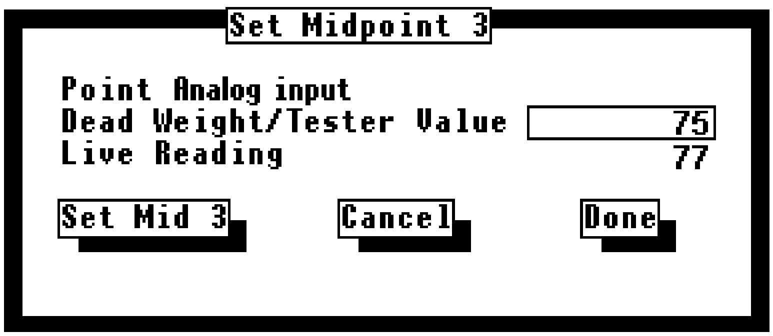


Figure 3-13. AI Set Midpoint 3

12. Press the **Done** pushbutton to close the main calibration window (Figure 3-7) and unfreeze the associated input.

3.7 TROUBLESHOOTING

There are no field repair or replacement parts associated with the Sensor Module. Return the Sensor Module to your Fisher Representative for repair or replacement. Refer to Section 3.1, LED Indicator, on page 3-15.

3.7.1 LED Indicator

The Sensor Module contains an LED indicator viewable when the enclosure case is open. Refer to Figure 3-1. The status of the Sensor Module is indicated by the LED. The Status LED indicator displays (after a power-up sequence):

- ♦ Normal Operation – flashing green.
- ♦ Communication Fail – solid green for 20 seconds, then alternating red (processor reset) and green.
- ♦ Power Fail – LED off.

If a failure is indicated, check the P/DP connector and restart the GridBoss controller.

3.8 SPECIFICATIONS

Refer to the Sensor Module Specifications given in Section 2.8.

SECTION 4 — COMMUNICATIONS CARDS

4.1 SCOPE

This section describes the communications cards used in the controllers of a GridBoss System.

Topics covered include:

- ♦ Product Descriptions
- ♦ Initial Installation and Setup
- ♦ Connecting the Communications Cards to Wiring
- ♦ Troubleshooting and Repair
- ♦ Specifications

4.2 SECTION CONTENTS

This section contains the following information:

4.3 PRODUCT DESCRIPTIONS

The communications cards provide communications between the GridBoss controller and a host system (such as GridManager) or external devices. The communications cards install directly onto the Main Electronics Board and activate the host port (COM1) when installed. COM1 is configured using the GRIDLINK Configuration Software.

The District Regulator (DR) Controller and Low Pressure Point (LPP) Controller have the ability to communicate with each other and the Host on the same communications port or on separate communications ports. If two communication ports are used, the LOI is used for peer-to-peer communications between the DR and LPP controllers, while COM1 is used for Host communications. If only one communications port is used, the LPP controller, DR controller, and Host all use COM1.

The DR controller timestamps (Last LPP Comm Time) the last time the LPP controller communicated with it. The DR controller only communicates with one LPP. An LPP controller can communicate with up to five DRs.

The following communications cards are available:

- EIA-232 Serial Communications Card.
- EIA-485 Serial Communications Card.
- Dial-up Modem Communications Card.

4.3.1 EIA-232 Serial Communications Card

The EIA-232 communications card meets all EIA-232 specifications for single-ended, RS-232 asynchronous data transmission over distances of up to 50 feet. Refer to Figure 4-1. The EIA-232 communications card provides transmit, receive, and modem control signals. Normally, not all of the control signals are used for any single application.

This is one of the optional interface cards for the host port of the GridBoss controllers. The EIA-232 communication card's P1 connector plugs into the Main Electronics Board at P3 and activates COM1.

The RTS and DTR control lines are supported. The EIA-232 communications card defaults are: 9600 baud rate, 8 data bits, 1 stop bit, no parity, 10 millisecond Key On Delay, and 10 millisecond Key Off Delay. The maximum baud rate is 19.2k.

The EIA-232 communications card includes LED indicators that display the status of the RXD, TXD, DTR, DCD, and RTS signal/control lines. LED indicators are detailed in Table 4-1.

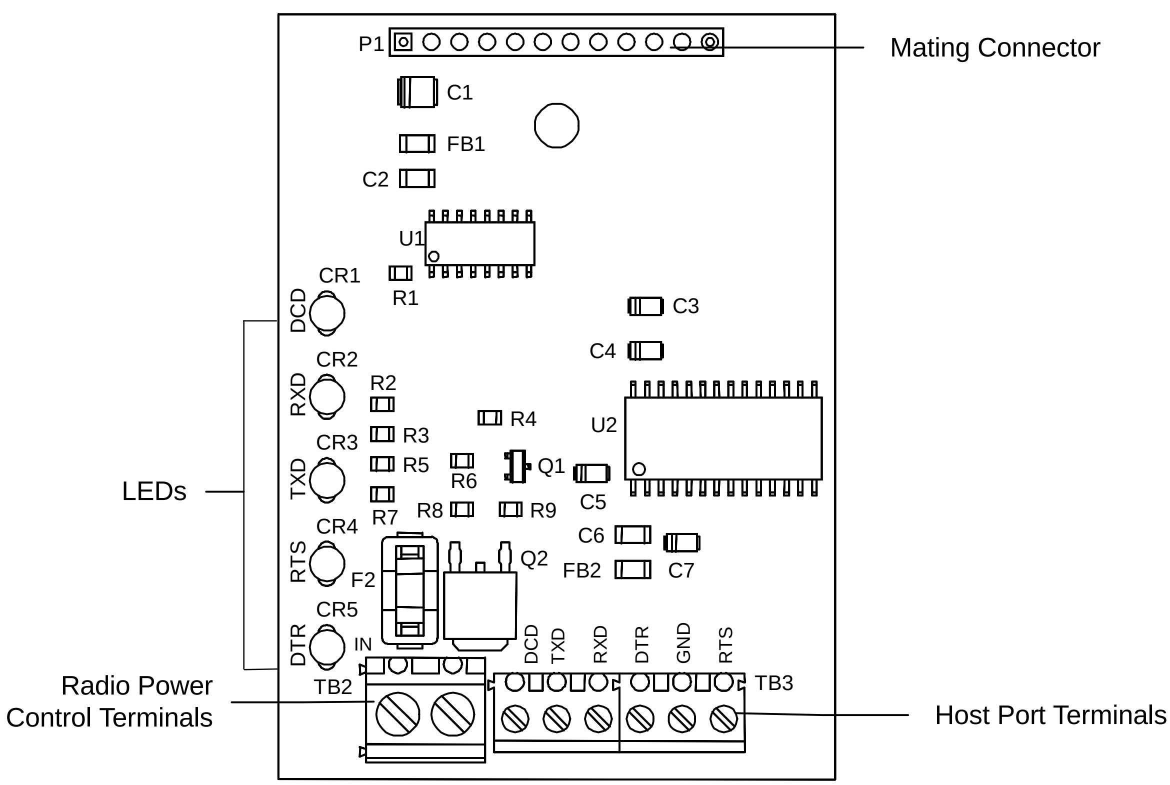


Figure 4-1. EIA-232 Serial Communications Card

Table 4-1. EIA-232 Communications Cards LED Indicators

LEDs	STATUS AND ACTIVITY
DCD	The DCD **data carrier detect** LED lights when a valid carrier is detected.
DTR	The DTR **data terminal ready** LED lights when a signal from the processor specifies the GridBoss controller is ready to answer an incoming message. When the DTR goes off, no communications occur through the COM1 port.
RTS	The RTS **ready to send** LED lights when a signal from the processor specifies the GridBoss controller is ready to transmit.
RXD	The RXD **receive data** LED blinks when the receive signal is being received from the communications card. The LED is on for a space and off for a mark.
TXD	The TXD **transmit data** LED blinks when transmit signal data is being received from the processor. The LED is on for a space and off for a mark.

4.3.1.1 Radio Power Cycling

This function is available with the EIA-232 communications card to provide power savings when using a radio for communications. Power cycling control for a radio is accomplished through the Data Terminal Ready (DTR) signal on the EIA-232 communications card. Connect wiring as described in Section 4.5.1. Configure the radio power cycling using the Radio Control feature as described in the GRIDLINK User Manual.

NOTE

If you require two radios, one for peer-to-peer and one for peer-to-host, one of the radios must be mounted outside of the GridBoss enclosure.

4.3.2 EIA-485 Serial Communications Card

The EIA-485 communications cards meet EIA-485 specifications for differential, RS-485 asynchronous transmission of data over distances of up to 4000 feet. Refer to Figure 4-2. The EIA-485 drivers are designed for true multi-point applications with multiple devices on a single bus.

This is an optional interface communications card for the host port, which activates COM1. The P1 connector on the EIA-485 communication card plugs into the Main Electronics Board at P3.

The interface lines of RTS are supported to control transmission. RTS must be active during TXD. The default values for the EIA-485 communications card are: 9600 Baud Rate, 8 Data Bits, 1 Stop Bit, No Parity, 10 millisecond Key On Delay, and 10 millisecond Key Off Delay. The maximum baud rate is 19.2k.

The EIA-485 communications card includes LED indicators that display the status of the RXD, TXD, and RTS control lines. LED indicators are detailed in Table 4-2.

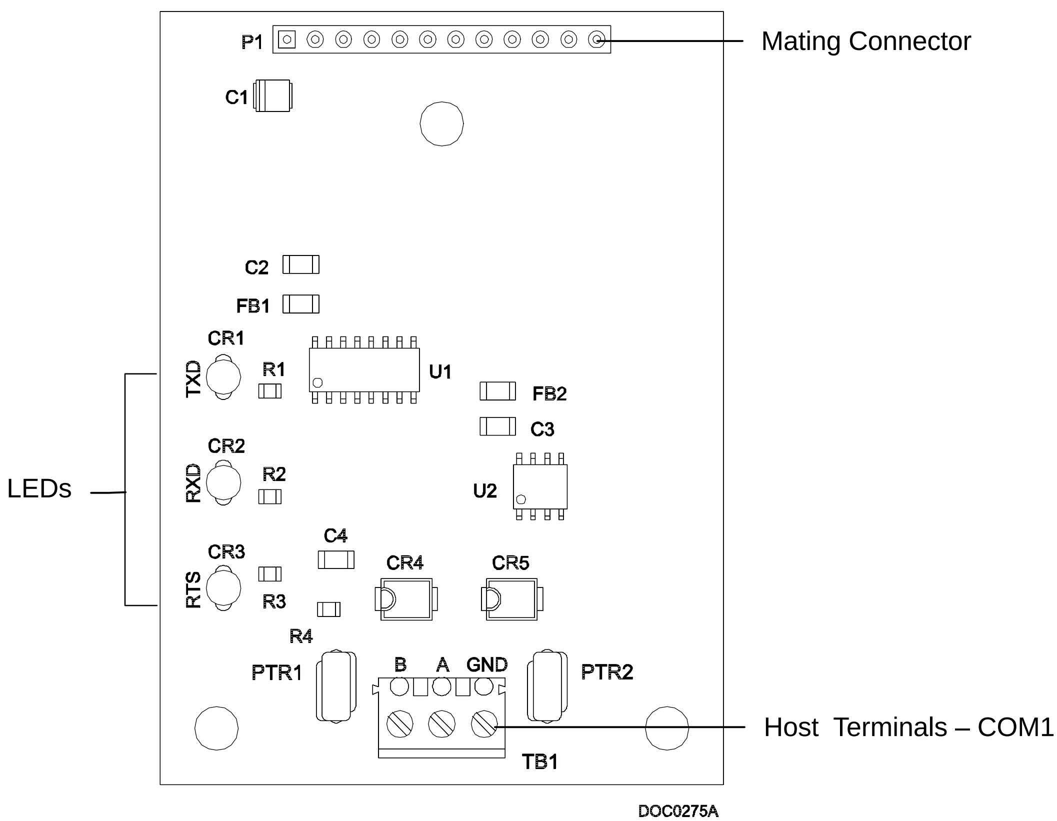


Figure 4-2. EIA-485 Serial Communications Card

Table 4-2. EIA-485 Communications Cards LED Indicators

LEDs	STATUS AND ACTIVITY
RTS	The RTS **ready to send** LED lights when a signal from the processor specifies the GridBoss controller is ready to transmit.
RXD	The RXD **receive data** LED blinks when the receive signal is being received from the communications card. The LED is on for a space and off for a mark.
TXD	The TXD **transmit data** LED blinks when transmit signal data is being received from the processor. The LED is on for a space and off for a mark.

4.3.3 Dial-up Modem Communications Card

The dial-up modem communications card supports V.22 bis/2400 baud communications with auto-answer/auto-dial features. Refer to Figure 4-3. The modem card is FCC part 68 approved for use with public-switched telephone networks (PSTNs). The FCC label on the card provides the FCC registration number and the ringer equivalent. The modem card has automatic adaptive and fixed compromise equalization.

This is an optional modem communications card for the host port activates COM1. The dial-up modem communications card's P1 connector plugs into the Main Electronics Board at P3.

The defaults for the dial-up modem communications card are: 2400 baud rate, 8 data bits, 1 stop bit, no parity, 10 millisecond Key On Delay, and 10 millisecond Key Off Delay. On power up, the modem must be set up for Auto Answer. Periodic checks are made to ensure that the modem is still in Auto Answer or that it is not left off the hook after a certain period of non-communication.

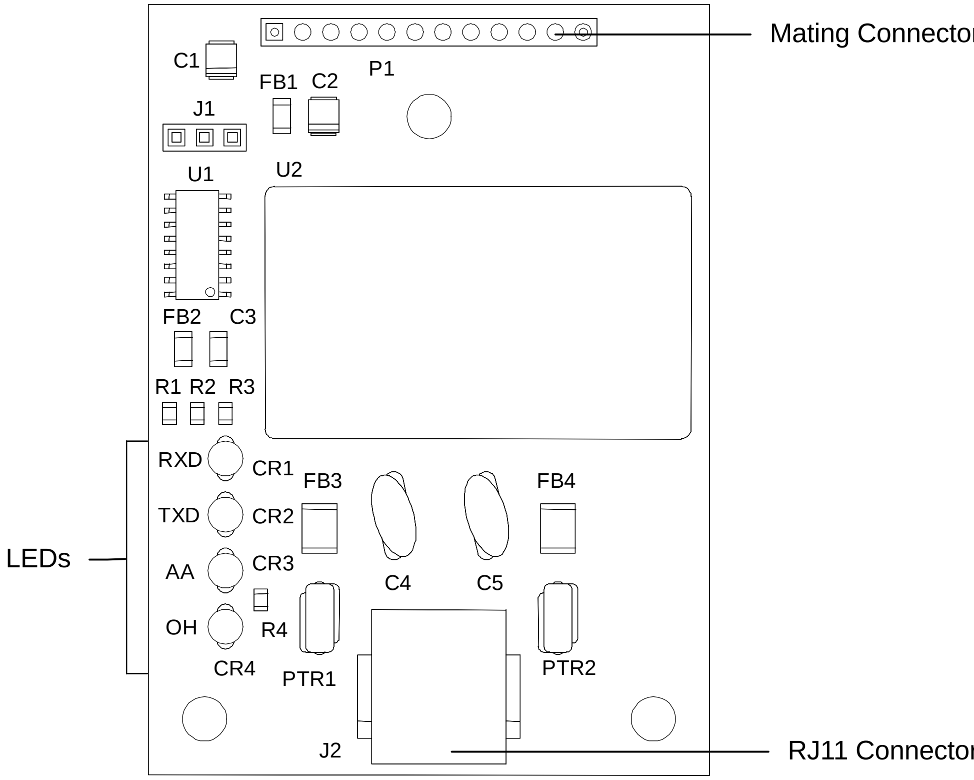


Figure 4-3. Dial-up Modem Communications Card

The modem card interfaces to two-wire, full-duplex telephone lines using asynchronous operation at data baud rates of 1200 and 2400. The card interfaces to a PSTN through an RJ11 jack located at the bottom of the communications card. The modem can be controlled using industry-standard AT command software. A 40-character command line is provided for the AT command set, which is compatible with EIA document TR302.2/88-08006.

LED indicators on the card show the status of the RXD, TXD, AA, and OH control lines. Refer to Table 4-3. The modem card also provides RS-232 level output signals (RXD and TXD) for an analyzer.

Table 4-3. Modem Card LED Indicators

LEDs	STATUS AND ACTIVITY
AA	The AA is the **automatic answer** indicator LED light. An incoming modem transmission lights this indicator.
OH	The OH is the **off hook** indicator LED light. A dial tone has been detected and the telephone line is in use by your modem when OH is lit.
RXD	The RXD **receive data** LED blinks when the receive signal is being received from the communications card. The LED is on for a space and off for a mark.
TXD	The TXD **transmit data** LED blinks when transmit signal data is being received from the processor. The LED is on for a space and off for a mark.

4.4 INITIAL INSTALLATION AND SETUP

Communications card installation is normally performed at the factory when the GridBoss controller is ordered. However, the modular design of the controller makes it easy to change hardware configurations in the field. The following procedures assume that this is a **first-time installation of a communications card in a controller and that the unit is currently not in service.** For units currently in service, refer to the procedures in Section 4-14, "Troubleshooting and Repair."

CAUTION

When installing units in a hazardous area, ensure that the components selected are labeled for use in such areas. Change components only in an area known to be non-hazardous.

CAUTION

Be sure to use proper electrostatic handling, such as wearing a grounded wrist strap, or components on the circuit cards may be damaged.

4.4.1 Installing Communications Cards

All communications cards install into the controller in the same manner.

1. Refer to Section 2.7.1 and perform the **Backup Procedure**.
2. Unplug the **Power** terminal block at P8 to remove power.
3. Plug the **communications card** connector into connector P3 on the Main Electronics Board. Figure 4-4 shows the card location. Gently press the connectors together until the card contacts a stand-off.
4. Ensuring that the three stand-off holes in the communications card line up with the compression **stand-offs** on the Main Electronics Board, firmly press the communications card onto the stand-offs.
5. Plug in the **Power** terminal block at P8 to restore power.
6. Perform the **After Installing Components** in Section 2.7.3.

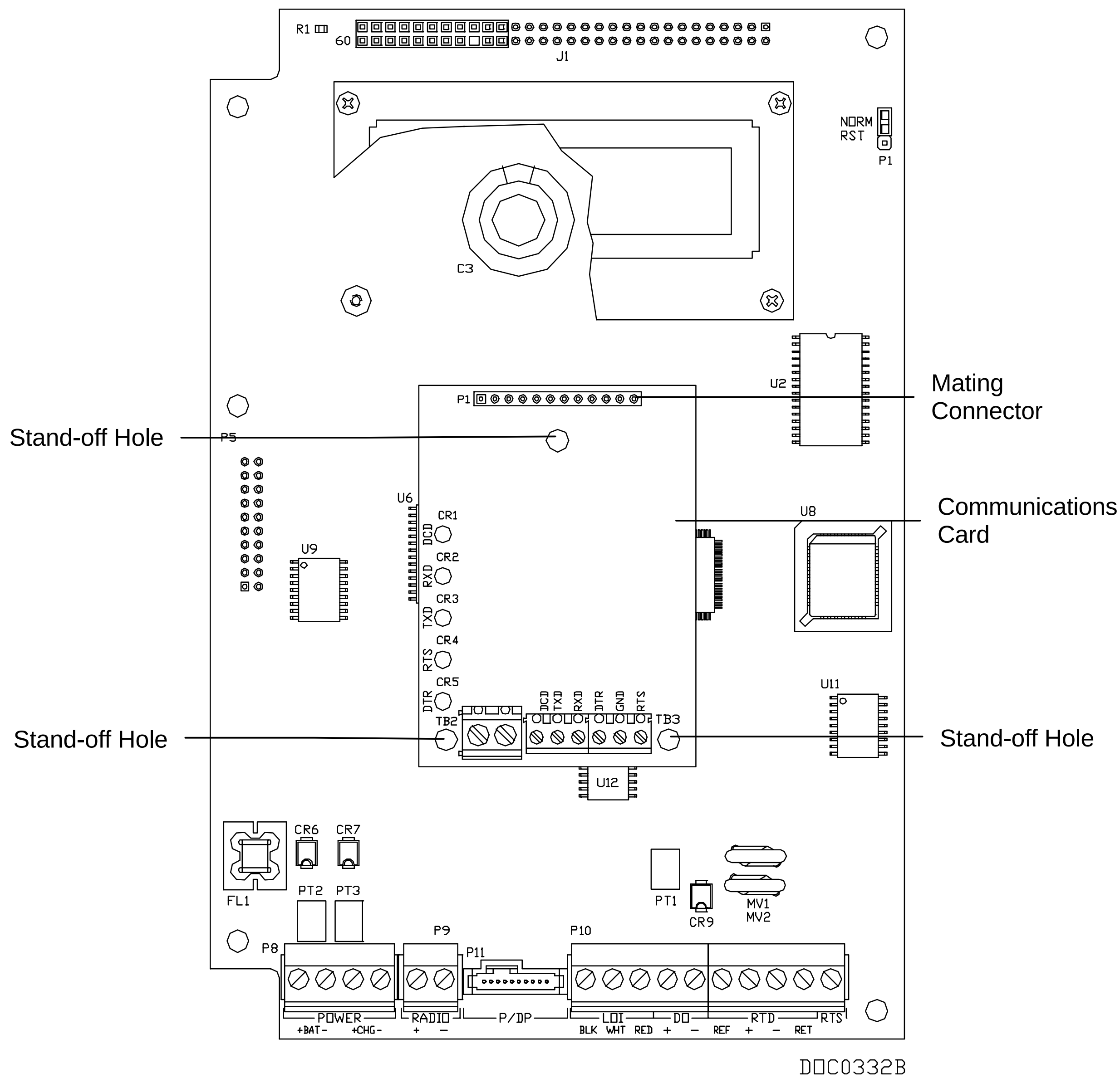


Figure 4-4. Communications Card Location

4.5 CONNECTING COMMUNICATIONS CARDS TO WIRING

Signal wiring connections to the communications cards are made through the terminal block located on the serial communications cards, or through the RJ11 TELCO connector supplied on the modem card.

4.5.1 EIA-232 Communications Card Wiring

The EIA-232 communications card provides for RS232 signals on the host port. This communications card also provides a means to switch external power to communication devices such as a radio to conserve power. LEDs are provided for diagnostic functions. The screw terminals and their functions are as follows:

Terminal	**Function**
RXD	Receive data
TXD	Transmit data
DTR	Data Terminal Ready
RTS	Ready to Send
DCD	Data Carrier Detect
GND	Ground
In	Power input
(Out)	Switched power output

4.5.1.1 Switched Auxiliary Power Wiring

Switched auxiliary power is used for radios that do not have a built-in sleep mode to automatically shut the radio off. Control of the radio power is set up by using the GRIDLINK software Radio Power Control function to achieve the required power cycling. The switched method involves wiring the radio power through the EIA-232 communications card as shown in Figure 4-5.

If the radio already has built-in sleep mode, or for some reason, you do not need to cycle the auxiliary radio power, wire it directly to the RADIO power terminals as described in Section 2, or to some other suitable source of power.

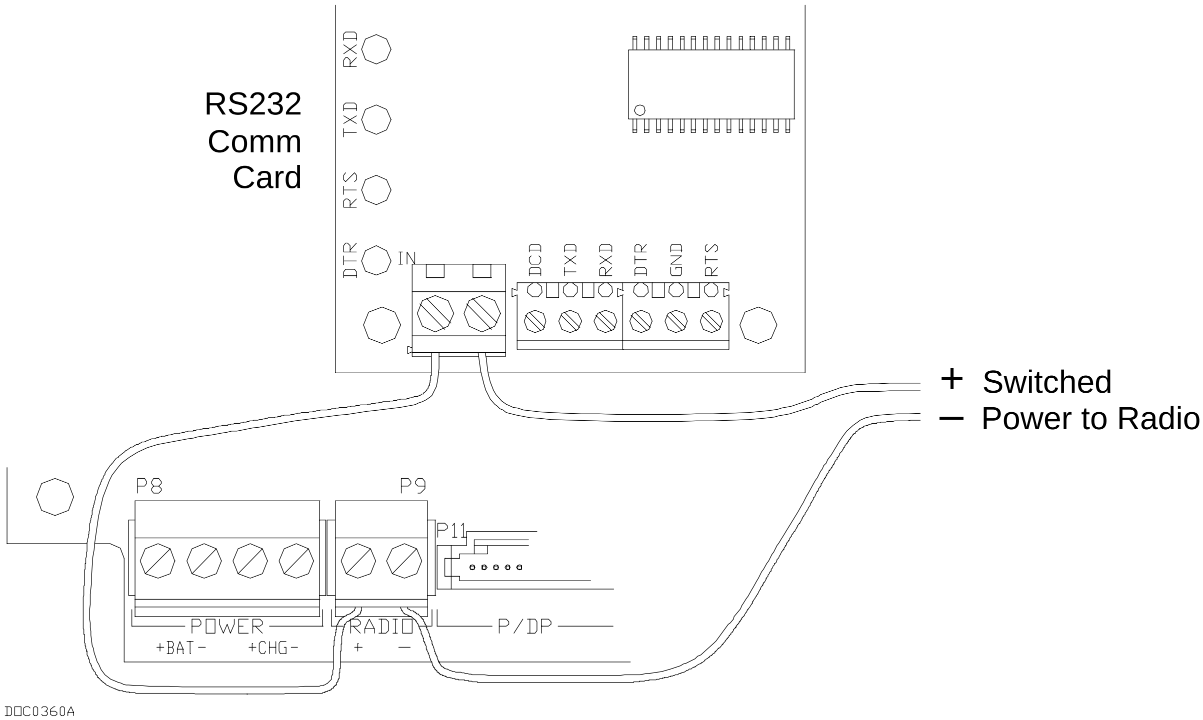


Figure 4-5. Wiring Switched Auxiliary Power

4.5.2 EIA-485 Communications Card Wiring

The EIA-485 communications card provides for RS-485 signals on the host port located at COM1. Wiring should be twisted-pair cable. This board also provides additional protection for the external wiring and the board circuitry. LEDs are provided for diagnostic functions. The terminals and their functions are as follows:

Terminal	**Function**
A	RS485 positive
B	RS485 negative
GND	Ground

4.5.3 Dial-Up Modem Communications Card Wiring

The dial-up modem card interfaces to a PSTN line through the RJ11 jack located at J2 with two wires. The dial-up modem card provides for a telephone interface on the host port that is capable of both answering and originating phone calls. The dial-up modem card also provides electronics that conserve power when the phone line is not in use. The dial-up modem card provides some protection from transients on the phone lines; however, if the potential for lightning damage is high, additional surge protection for the phone lines should be installed outside the GridBoss enclosure.

LEDs are provided for diagnostic functions. The dial-up modem card provides a modular phone (RJ11) jack that directly interfaces to phone line connections. The RJ11 connector signals and their functions are:

RJ11	Signal
1	
2	
3	Tip
4	Ring
5	
6	

4.6 TROUBLESHOOTING AND REPAIR

There are no user serviceable parts on the communications cards. If a card appears to be operating improperly, verify that the card is set up according to the information contained in Section 4-9, “Initial Installation and Setup.” If it still fails to operate properly, the recommended repair procedure is to remove and replace the card. The faulty card should be returned to your Fisher Representative for repair or replacement.

Follow the procedures below to help ensure data is not lost and equipment is not damaged during replacement of a communications card.

4.6.1 Replacing a Communications Card

If you are installing a communications card for the first time, refer to Section 4.4. To remove and replace a communications card on an in-service controller, perform the following procedure. Be sure to observe the cautions to avoid losing data and damaging equipment.

CAUTION

When repairing units in a hazardous area, ensure that the components selected are labeled for use in such areas. Change components only in an area known to be non-hazardous.

CAUTION

There is a possibility of losing the controller configuration and historical data while performing the following procedure. As a precaution, save the current configuration and historical data to permanent memory as instructed in Section 2.7.1, Backup Procedure.

CAUTION

Be sure to use proper electrostatic handling, such as wearing a grounded wrist strap, or components on the circuit cards may be damaged.

CAUTION

During this procedure, all power will be removed from the controller and devices powered by the controller. Ensure that all connected input devices, output devices, and processes will remain in a safe state when power is removed from the controller and also when power is restored to the controller.

1. Refer to Section 2.7.1 and perform the **RAM Backup Procedure**.

2. Remove the **Power** terminal block at P8 on the Main Electronics Board.

3. If the **communications card** is a modem card, unplug the RJ11 phone jack cable from the communications card connector J2.

4. Using a rocking motion, gently disengage the two **stand-off connectors** located at the bottom of the communications card.

5. Using a rocking motion, gently disengage the **stand-off connector** located at the top, middle of the communications card.

6. Using a rocking motion, gently disengage the **connectors at P1**, pull the card free from the Main Electronic Board at P3.

7. To reinstall a **communications card**, orient the card with the P1 connectors on the communications card mating with the connectors at P3 on the Main Electronics Board. Plug the card into its mating connectors and gently press until the connectors firmly seat.

8. Using a rocking motion, gently engage the three **stand-off connectors**.

9. For a **modem card**, connect the RJ11 phone jack cable to communications card connector J2.

10. Reconnect power by plugging in the **Power** terminal connector at P8 on the Main Electronic Board.

11. Check the **configuration** data and FSTs, and load or modify them as required.

12. **Verify** that the controller performs as required.

13. Perform the **After Installing Components** detailed in Section 2.73.

If you changed the configuration, save the configuration data to Flash ROM. If you changed the configuration, history database, or FSTs, save them to disk. See Section 2.7.1 for more information.

4.7 COMMUNICATION CARDS SPECIFICATIONS

The following subsections list the specifications for each communications card.

4.7.1 Serial Card Specifications

EIA-232D CARD

Meets EIA-232 standard for single-ended data transmission over distances of up to 50 feet (15 m).

Data Rate: Selectable from 1200 to 19.2k baud.

Format: Asynchronous, 7 or 8-bit (software selectable) with full handshaking.

Parity: None, odd, or even (software selectable).

EIA-485 CARD

Meets EIA-485 standard for differential data transmission over distances of up to 4000 feet (1220 meters) for multiple devices.

Data Rate: Software-selectable from 1200 to 19.2k baud.

Format: Asynchronous, 7 or 8-bit (software selectable).

Parity: None, odd, or even (software selectable).

LED INDICATORS

Individual LEDs for RXD, TXD, and RTS signals. EIA-232D card also has LEDs for DTR and DCD.

POWER REQUIREMENTS

4.75 to 5.25 Vdc, 0.03 W maximum, supplied by processor board.

ENVIRONMENTAL

Operating Temperature: -40 to 75° C (-40 to 167° F).

Storage Temperature: -50 to 85° C (-58 to 185° F).

Operating Humidity: To 95% relative, non-condensing.

WEIGHT

0.8 oz. (23 g) nominal.

DIMENSIONS

0.7 in. H by 2.0 in. W by 2.75 in. L (18 by 51 by 70 mm).

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups C and D.

4.7.2 Dial-up Modem Card Specifications

OPERATION

Mode: Full-duplex 2-wire for dial-up PSTN (Bell 212 compatible).

Data Rate: 300, 1200 or 2400 baud asynchronous (software selectable).

Parity: None, odd, or even (software selectable).

Format: 7 or 8 bits, including start, stop, and parity (software selectable).

Transmit Carrier Frequencies: Originate, 1200 Hz ± 0.1%; Answer, 2400 Hz ± 0.1%.

Receive Carrier Frequencies: Originate, 2400 Hz ± 7 Hz;
Answer, 1200 Hz ± 7 Hz.

Telephone Line Impedance:
600 ohm typical.

RTS to Transmission Delay: Configurable in 10 millisecond periods (software selectable).

Receiver Sensitivity: Off to On threshold, -33 dBm. On to Off threshold, -35 dBm.

Maximum Output Level: 0 dBm nominal into 600 ohms.

LED Indicators: TXD, RXD, AA, and OH.

Connector: RJ11 (6-pin).

Surge Protection: Conforms to FCC part 68.

Surge Isolation: 1000 Vac and 1500 volt peak.

Certification: FCC Part 68 approved.

POWER REQUIREMENTS

4.75 to 5.25 Vdc, 0.25 W maximum, supplied by processor board.

ENVIRONMENTAL

Operating Temperature: 0 to 70° C (32 to 158° F).

Storage Temperature: -25 to 85° C (-32 to 185° F).

Operating Humidity: To 95% relative, non-condensing.

DIMENSIONS

0.7 in. H by 2.0 in. W by 2.75 in. L (18 mm by 51 mm by 70 mm).

WEIGHT

1.3 oz. (36 g).

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups C and D.

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SECTION 5 — INPUT/OUTPUT CARD

5.1 SCOPE

This section describes the Input/Output (I/O) Card, which provides additional inputs and outputs, such as required by the GB601 District Regulator (DR) Controller. A discrete input (DI) on the I/O Card can be connected to the optional intrusion switch for both the GB601 and GB602 units. .

NOTE

Although the GridBoss System has extensive input and output requirements, not all of the capabilities of the I/O Card are used.

5.2 SECTION CONTENTS

This section contains the following information:

5.3 DESCRIPTION

The I/O Card, shown in Figure 5-1, provides additional inputs and outputs, some of which are used for adaptive predictive control. The I/O Card provides these types of additional I/O channels for the GridBoss controllers:

- ♦ Two Discrete Inputs / Pulse Inputs – DIs / PIs
- ♦ Three Analog Inputs – AIs
- ♦ Two Discrete Outputs – DOs
- ♦ One Analog Output – AO

The I/O Card uses a microprocessor for monitoring, control, and acquisition of data from external devices connected to the I/O channels. The information is then relayed to the controller. Six LEDs provide a visual indication as to the state of the discrete inputs, discrete outputs, and pulse inputs (refer to Section 5.6, I/O Card LEDs, on page 5-12).

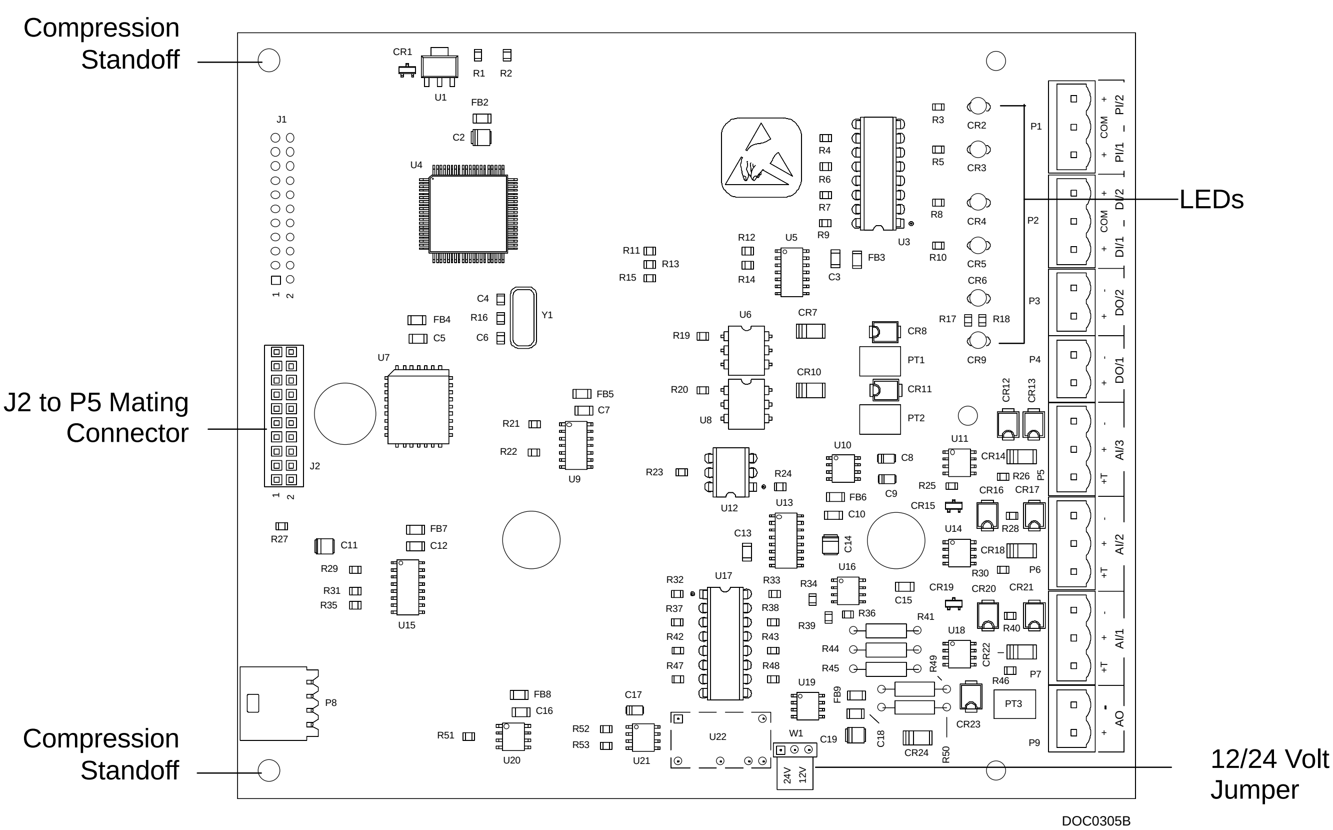

Figure 5-1. Input/Output Card

The I/O Card receives power for its processor and logic circuits from the Main Electronics Board. The I/O Card has a built-in DC/DC converter (with a jumper-selectable “+T” output of 12 or 24 volts—see Figure 5-1 location W1) to supply power for its field-I/O circuits. This converter helps isolate the field I/O from the processor.

The power converter produces enough current to support four current loops—three AIs and one AO—plus the power to run the analog-to-digital (A/D) and digital-to-analog (D/A) converters, as well as the discrete inputs. The power converter can turn off under processor control to reduce the load in low battery conditions.

Note that the pulse inputs can be wired as controller-powered pulse counters. The pulse circuitry is optically coupled to isolate the processor board from the input signal. The pulse inputs can also be configured as discrete inputs.

NOTE

Points represented by “A” (such as Analog Input point number A2) are associated with the main electronics board and Pressure Module. Points represented by “B” (such as Analog Input point number B2) are associated with the I/O Card.

5.4 I/O CARD INSTALLATION

The I/O Card is installed on a swing-out mounting panel in front of the battery compartment. The I/O Card mounts on two compression standoffs, a mating connector, and three #6-32 screws. Refer to Figure 5-1 and Figure 5-2.

CAUTION

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

CAUTION

Always turn the power to the controller off before you attempt any type of wiring.

1. Refer to Section 2.7.1 and perform the **Backup Procedure**.
2. Unplug the **Power** terminal block at P8 on the Master Controller Unit (MCU) board to remove power.
3. Disconnect the ribbon cable connected at P11 and any wiring that would restrict the panel from opening. Push down on the detent (see Figure 5-2) and open the swing-out panel.

4. Mate the **I/O Card** 20-pin position connector J2 with P5 on back of the main electronics board.

5. After mating the connector, press firmly to seat the board on the two **compression stand-offs**.

6. Install the three **#6 - 32 screws**.

7. Close the swing-out panel, and reconnect the ribbon cable and any other wiring.

8. Affix the supplied **label** to the front of the swing-out panel.

9. Plug in the **Power** terminal block at P8 to restore power to the controller.

10. Refer to Section 2.7.3, **After Installing Components**.

When power is applied to the controller, scanning of the I/O Card is automatically activated. Use the GRIDLINK Configuration Software to configure the I/O points and the history database as desired for the new points. Refer to the *GRIDLINK Configuration Software User Manual (Form A6074)*.

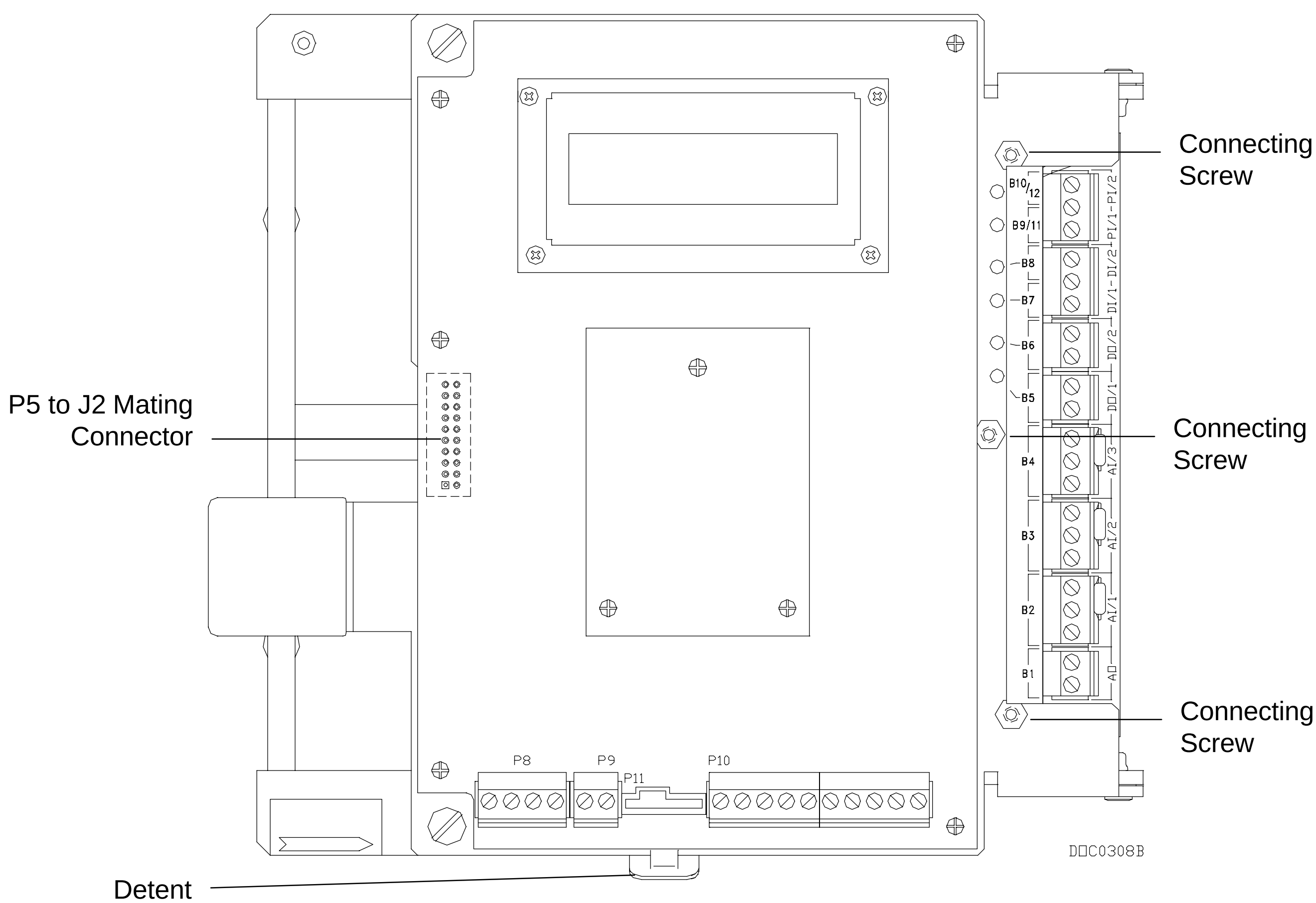

Figure 5-2. I/O Card Installation

5.5 I/O WIRING

The field terminals on the I/O Card are connected as explained in the following sections.

5.5.1 Discrete Inputs

Discrete inputs (DIs) monitor the status of relays, solid-state switches, or other two-state devices. DI functions support: discrete latched input and discrete status input. In the case of the GridBoss System, a DI is used with the optional intrusion switch.

The I/O Card discrete inputs acquire power from the 24-volt power supply. An LED indicator is included for each point on the field side. The signal from the field is coupled through an optical isolator providing 2500 Vdc isolation from the main electronics board.

The discrete inputs provided on the I/O Card are located at DI point number B7 through point number B10 and are connected as follows:

+	Positive Discrete Input
COM	Common

NOTE

The Discrete Inputs located at Point Number B9 and Point Number B10 are obtained by using the two Pulse Inputs on the I/O Card; see Section 5.5.2.1, Using Pulse Inputs as Discrete Inputs, on page 5-7.

The discrete input operates by providing a voltage across terminals "+" and "COM" (see Figure 5-3), which is derived from internal voltage source V_s. When a field device, such as a relay contact is connected across "+" and "COM," the closing of the contacts completes the circuit which causes a flow of current between V_s and ground at terminal "COM." This current flow activates the LED and is sensed in the DI circuitry, which in turn, signals the controller electronics that the relay contacts have closed. When the contacts open, current flow is interrupted and the DI circuit signals the controller electronics that the relay contacts have opened.

CAUTION

The discrete input is designed to operate only with non-powered discrete devices such as "dry" relay contacts or isolated solid state switches. Use of the DI channel with powered devices may cause improper operation or damage to occur.

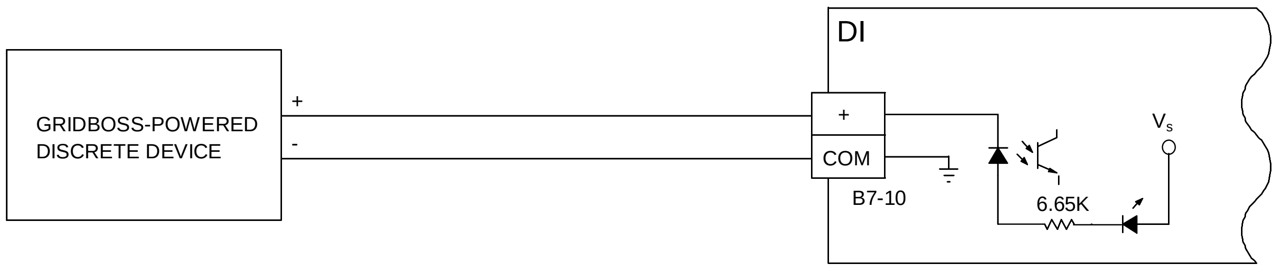

Figure 5-3. Discrete Input Wiring

5.5.2 Pulse Inputs

Pulse Inputs are not required by the GridBoss System. Pulse Inputs (PIs) are used for counting pulses from pulse-generating devices. The I/O Card pulse input circuits are physically the same as the discrete inputs. The pulse input, after the isolation, is routed to a pulse accumulator, where the pulses are counted and accumulated.

The pulse inputs provided on the I/O Card are located at Point Number B11 and B12. The pulse input at Point Number B11 can operate at up to 50 Hz, with a maximum 50% duty cycle. The pulse input at Point Number B12 can operate at up to 10 kHz, with a maximum 50% duty cycle.

NOTE

The Pulse Inputs (located at Point Numbers B11 and B12) can also be used as Discrete Inputs at Point Numbers B9 and B10, respectively. See Section 5.5.2.1, Using Pulse Inputs as Discrete Inputs, on page 5-7.

The PI channel has two field terminals. One terminal is a positive source voltage; the other is the signal return. The terminals are designated as follows:

+	Positive Pulse Input (Sourced)
COM	Common

To use the channel as a pulse input (shown in Figure 5-4), connect the “+” and “-” field wires to terminals “PI/1+” or “PI/2+” and “COM” on the I/O Card pulse input channel. When the field device completes the circuit between “+” and “COM” terminals, the PI indicator LED on the termination board lights to show an active circuit, and the optical circuitry is triggered, producing a signal to the controller unit.

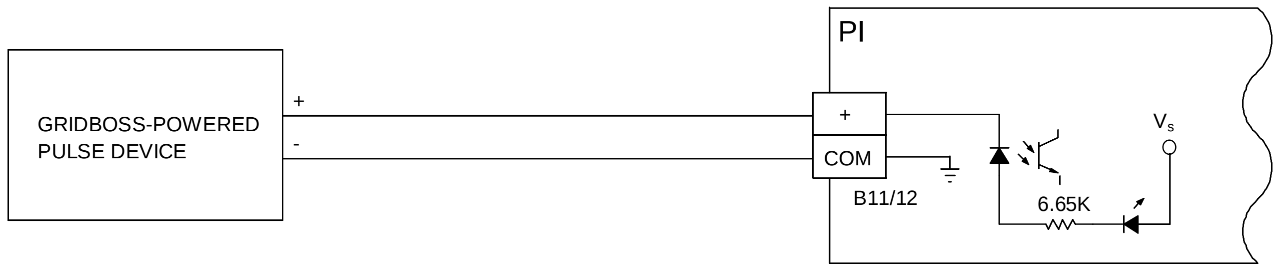

Figure 5-4. Pulse Input Wiring

5.5.2.1 Using Pulse Inputs as Discrete Inputs

The two PI channels can be configured as both pulse inputs (see Section 5.5.2), both discrete inputs, or one of each in either order. As PIs, the two channels are designated Point Number B11 and Point Number B12. As DIs, the two channels are designated Point Number B9 and Point Number B10. The Point Number designation can be seen when using the GRIDLINK configuration software (see Figure 5-5); in addition, these point numbers appear on a label to the left of the terminals on the I/O Card.

To use a Pulse Input as a Discrete Input:

1. **Ensure** the I/O Card is installed correctly. Refer to Section 5.4 on page 5-3.
2. **Attach** a PC to the LOI port on the controller and **launch** GRIDLINK.
3. In GRIDLINK, **Connect** to the GridBoss controller.
4. Select **DI** from the I/O menu.
5. Press **(F3)Next** until you display **B9** (to use PI/1 as a DI) or **B10** (to use PI/2 as a DI) in the **Point Number** field. Refer to Figure 5-5.
6. Type a name in the Tag field and **Configure** the rest of the Discrete Input as detailed in the *GRIDLINK Configuration Software User Manual*.
7. Wire the channel for the Discrete Input the same as described in Section 5.5.1.

NOTE

There is no jumper or software switch to set to change a PI into a DI or back again. Both software points (such as B9 and B11) always exist for the same channel (in this case, PI/1). Just ensure that the PI or DI point is configured for the channel's intended use.

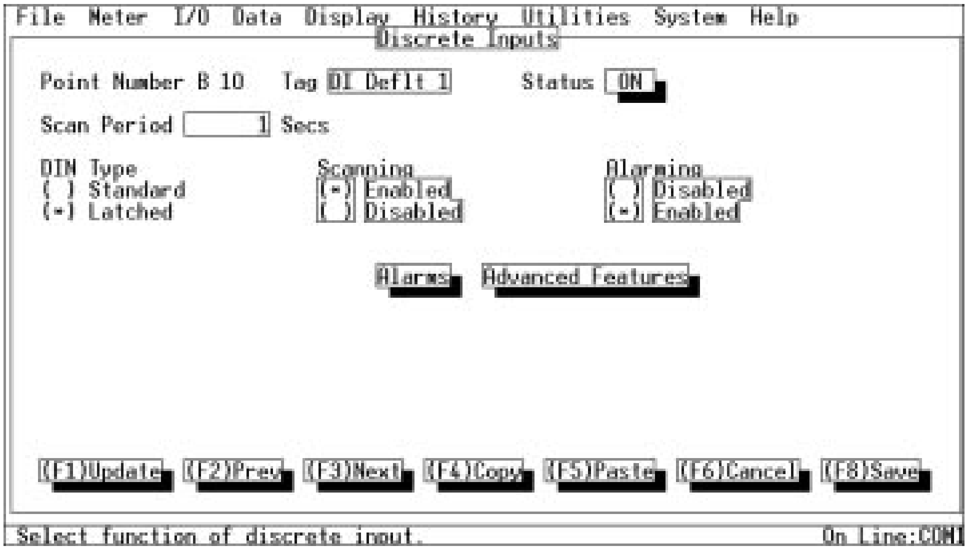

Figure 5-5. Pulse Input PI/1 used as a Discrete Input

5.5.3 Analog Inputs

Analog inputs (AIs) monitor current loop and voltage input devices. The I/O Card analog inputs each consist of a 12 or 24 volt current source (switch dependent) and a multiplexed A/D converter. The power for the A/D is from the isolated power supply. The A/D signal input range is from 1 to 5 volts with 12-bit resolution. Current inputs of 4 to 20 milliamps can be used with the addition of a 250-ohm resistor across the input terminals.

In the GridBoss System, an Analog Input (AI) can be used to communicate the position of the Kixcel to the GB601 DR Controller when an Analog Output (AO) is used to send the Setpoint to the Kixcel. The AI is compared to the AO to ensure that the Kixcel is approximately within the Deadband.

The analog inputs provided on the I/O Card are designated Point Number B2, B3, and B4. The terminals for connecting wiring are as follows:

+T	Current-limited positive battery voltage for transmitter power
+	Positive Input
-	Negative Input (Common)

The analog inputs have three field terminals per channel. The “+T” terminal provides power for loop-powered devices at either 12 or 24 volts, depending on the position of jumper W1. See Figure 5-1; the jumper is actually found on the non-component side of the board. Each channel has a current regulator in series with the “+T” terminal to provide short-circuit protection. A 250-ohm scaling resistor is supplied for use between the “+” and “-” analog input terminals.

The "+" terminal is the positive signal input and the "-" terminal is the signal common. These terminals accept a voltage signal in the 1 to 5 volt range. Since the "-" terminal is internally connected to common, the analog input channels function as single-ended inputs only.

When wiring a 4 to 20 milliamp current signal, leave the 250-ohm resistor installed between the "+" and "-" terminals. Wire the current loop device "+" lead to the "+T" terminal and the device "-" lead to the AI "+" terminal. Figure 5-6 shows the wiring for a typical current signal.

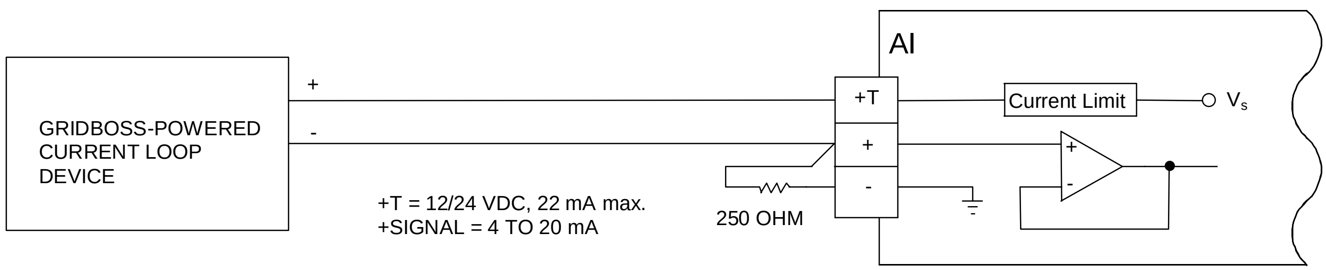

Figure 5-6. Current Signal on I/O Card Analog Input

When connecting the analog input channel to a voltage device, remove the 250-ohm resistor from the analog input terminal block.

Figure 5-7 shows typical wiring for a voltage signal analog input.

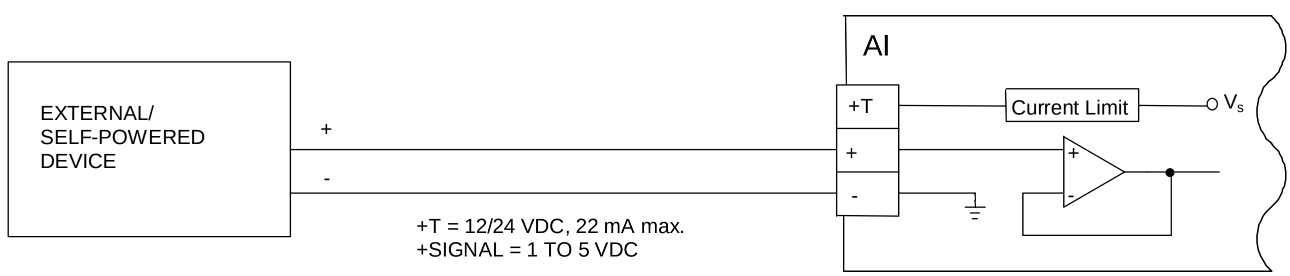

Figure 5-7. Voltage Signal on I/O Card Analog Input

5.5.4 Discrete Outputs

Discrete outputs (DOs) provide a solid-state switch to control relays and power small electrical loads. DO functions supported are:

- ♦ Sustained discrete outputs
- ♦ Momentary discrete outputs
- ♦ Slow pulse-train outputs

The I/O Card provides two discrete output channels. The discrete output channel is a normally-open, single-pole, single-throw switch. An LED turns on to show when the switch is closed. The discrete outputs are solid-state switches enabled by individual signals from the processor I/O lines. The solid-state switches are capable of handling 24 Vdc at 300 mA.

For use as the control output for a District Regulator Controller, the Discrete Outputs may be configured as standard DOs. A pair of Discrete Outputs acting as a Timed Duration Output for open/close control can be used to control the Kixcel instead of an AO.

The discrete output on the I/O Card can be used in a toggle mode, a latched mode, and a timed duration output (TDO) mode.

The discrete outputs provided on the I/O Card are designated DO Point Number B5 and B6. They are connected as follows:

+ Positive load
- Negative load

Figure 5-8 shows a typical discrete output wiring diagram.

Figure 5-8. Discrete Outputs

5.5.5 Analog Output

Analog outputs (AOs) provide a current output for powering analog devices.

The I/O Card analog output is a 4-20 mA loop signal with a maximum voltage of 24 Vdc from the isolated power supply. The analog output uses a 12-bit D/A converter and a volt to current converter.

One 4-20mA analog output is provided on the I/O Card. It is designated AO Point Number B1 and is connected as follows:

+ Positive load
- Negative load

At the District Regulator, if an Analog Output (AO) is used to send the Setpoint signal to the Kixcel, an Analog Input (AI) can be used to verify the position of the Kixcel. The AI is compared to the AO to ensure that the Kixcel is approximately within the set Deadband.

A schematic representation of the field wiring connections to the analog output channel is shown in Figure 5-9. The AO can provide loop current to non-powered field devices. The analog output provides a 0 to 22 milliamp current source output at terminal "+". Terminal "-" is isolated from the controller common.

Figure 5-9 shows wiring for a controller-powered current loop device.

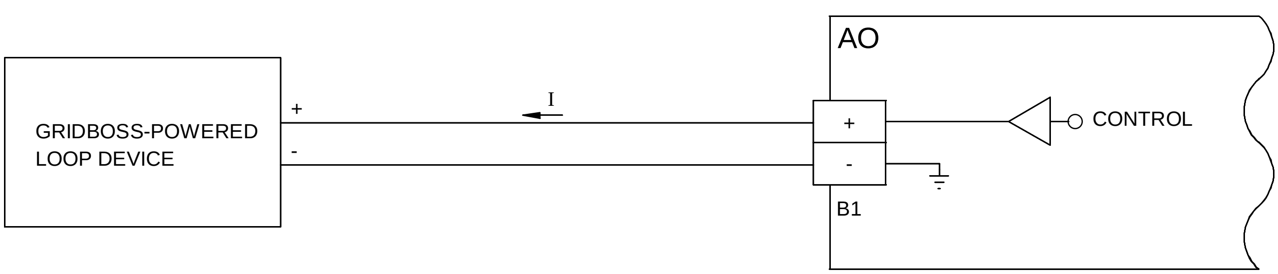

Figure 5-9. Analog Output Field Wiring for Current Loop Devices

5.6 I/O CARD LEDS

Six LED indicators are located on the I/O Card; when a specific PI, DI, or DO is active, then the corresponding LED lights:

- LED CR2 – Pulse/Discrete Input #1
- LED CR3 – Pulse/Discrete Input #2
- LED CR4 – Discrete Input #1
- LED CR5 – Discrete Input #2
- LED CR6 – Discrete Output #1
- LED CR9 – Discrete Output #2

5.7 TROUBLESHOOTING

To troubleshoot an I/O channel, first check to see how the channel is configured using the GRIDLINK Configuration Software. If the configuration looks correct, then simulate an input (within the range of the input) or force an output to be produced by using GRIDLINK. If an input channel is in question, you may be able to use one of the outputs on the I/O Card (known to be in working order) to simulate the needed input. Likewise, if an output channel is in question, you may able to connect it to a working input channel and check the results.

There are no field repair or replacement parts associated with the I/O Card. If the card appears to be faulty, return it to your Fisher Representative for repair or replacement.

5.8 SPECIFICATIONS

I/O Card Specifications

POWER

Input: 8 to 15 Vdc (supplied by main processor card), 78 mW typical, excluding power for DO and AO load.

AI Loop: 12 or 24 Vdc nominal, 4 to 20 mA provided for transmitter loop power from internal power converter. Available at "+T" terminal on each analog input channel.

FIELD I/O ISOLATION

1000 Vdc minimum.

DISCRETE INPUTS

Quantity/Type: 2 contact-sense discrete inputs. Two additional DIs are available when pulse inputs are so configured (see Pulse Inputs).

Terminals: "+" positive input; "COM" negative input (common).

Signal Current: 0.5 to 3.5 mA in the active (on) state, 0 to 0.2 mA in the inactive (off) state.

Isolation: 2500 Vdc from processor.

Frequency: 50 Hz maximum.

Sample Period: 10 ms minimum.

PULSE INPUTS

Quantity/Type: 2 sourced pulse counter inputs, one medium-speed and one high-speed. Both are also software-configurable as discrete inputs.

Terminals: "+" positive input, "COM" negative input (common).

Isolation: 2500 Vdc.

Frequency: Medium-speed input is 50 Hz maximum; high-speed input is 10 kHz maximum.

ANALOG INPUTS

Quantity/Type: 3 single-ended, voltage-sense analog inputs (current loop if scaling resistor is used).

Terminals: "+T" loop power, "+" positive input, "-" negative input (common).

Signal: 1 to 5 Vdc, software configurable. 4 to 20 mA, with 250Ω resistor (supplied) installed across "+" and "-" terminals.

Accuracy: 0.1% over –40 to 65 °C (-40 to 149 °F) range.

Isolation: 2500 Vdc from processor.

Input Impedance: One MΩ.

Filter: Double-pole, low-pass.

Resolution: 12 bits.

Conversion Time: 200 µs.

Sample Period: 50 ms minimum.

I/O Card Specifications (Continued)

DISCRETE OUTPUTS

Quantity/Type: 2 dry-contact, solid-state relay outputs.

Terminals: "+" normally-open contact; "-" common.

Contact Rating: 120 Vdc, 0.3 A maximum.

Isolation: 3000 volts.

Frequency: 5 Hz maximum.

ANALOG OUTPUT

Quantity/Type: One 4-20 mA loop signal output.

Terminals: "+" positive output and "-" common.

Range: 4 to 20 mA with 0 to 22 mA overranging.

Resolution: 12 bits.

Accuracy: 0.1% of full-scale output.

Settling Time: 100 µs maximum.

Reset Action: Output goes to zero percent output or last value (software configurable) on power-up (warm start) or on watchdog time-out.

DIMENSIONS

0.8 in. H by 5.4 in. W by 6.3 in. L (21 mm by 137 mm by 160mm)

WEIGHT

0.9 lb. (0.1 kg) nominal.

ENVIRONMENTAL

Meets the Environmental specifications of the controller in which the card is installed, including Temperature and Voltage Surge specifications.

CLASSIFICATION

FCC Class A and CISPR 22 computing device.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups C and D.

APPENDIX A — LIGHTNING PROTECTION MODULE

A.1 SCOPE

This appendix describes the Lightning Protection Module (LPM) used with the GridBoss System. Topics covered include:

- Product Description
- Initial Installation
- Connecting the Module to Wiring
- Troubleshooting and Repair
- Specifications

A.2 SECTION CONTENTS

This section contains the following information:

A.3 PRODUCT DESCRIPTION

In lightning-prone areas, it is recommended an LPM (or some other device) be used to protect the circuitry for each field input or output possible.

The LPM is designed to prevent damage to I/O card circuitry by augmenting protection from high-voltage transients that may occur in field wiring. The LPMs plug into the Analog Input termination sockets located on the I/O Card. To provide protection for other I/O channels on the I/O Card, on the main board, or on the Sensor Module, use a separate protective device.

Figure A-1 shows a front and side view of the module. The LPM provides screw terminals for connecting to field wiring. The LPM has sockets for plugging in a range (scaling) resistor. The module also provides a ground wire for connection to the enclosure ground bar.

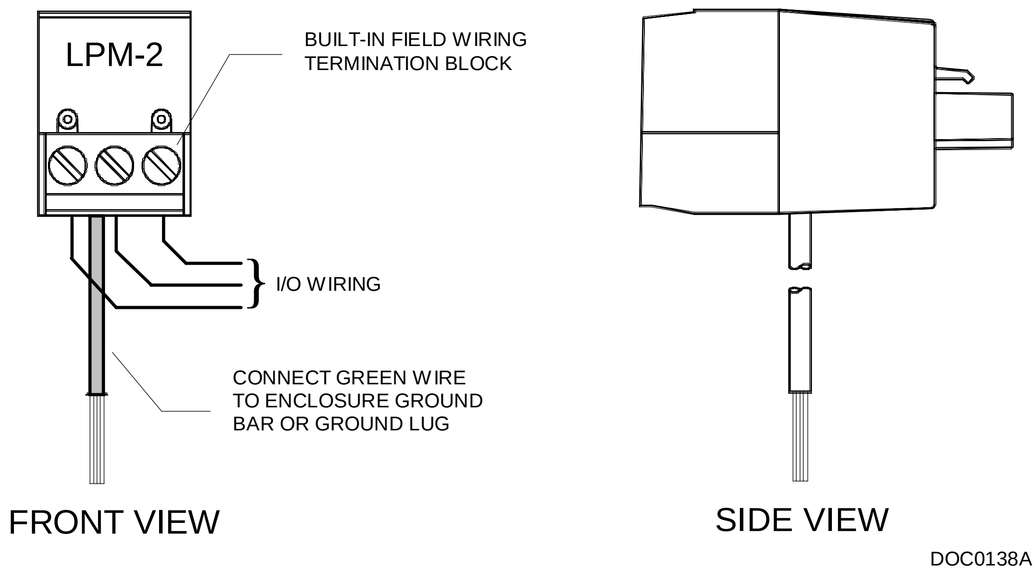

Figure A-1. Lightning Protection Module

A.4 INITIAL INSTALLATION

The LPM plugs into any of the 3-position field terminal block sockets used to wire I/Os. Refer to Figure A-2.

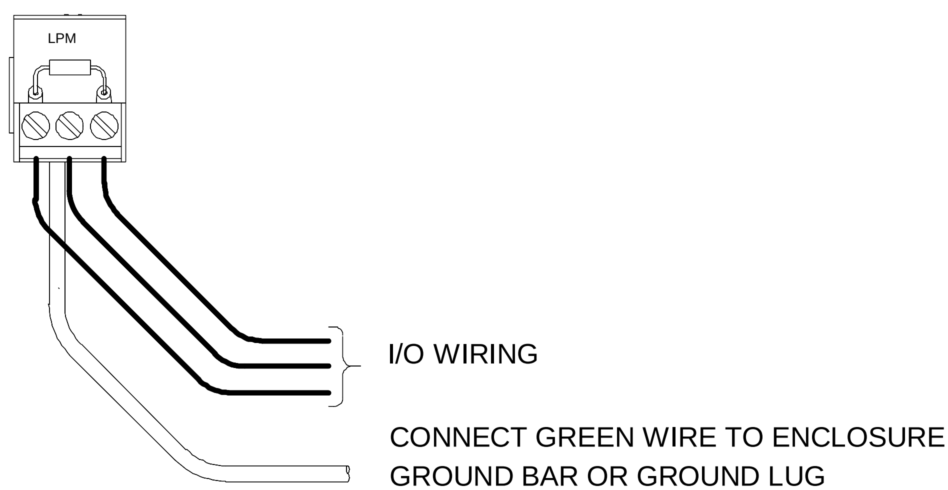

Figure A-2. Lighting Protection Module Installation

To add an LPM to protect an I/O card, perform the following steps.

CAUTION

If you are installing an LPM on a controller currently in service, and there is a field device connected to the I/O channel that receives the LPM, make sure the field device will not be left in an undesirable state when it is disconnected from the controller.

CAUTION

When installing units in a hazardous area, ensure that the components selected are labeled for use in such areas. Change components only in an area known to be non-hazardous.

CAUTION

Be sure to use proper electrostatic handling, such as wearing a grounded wrist strap, or components on the circuit cards may be damaged.

1. **Unplug** the field wiring **termination block** from the channel for which the LPM is going to be installed.
2. **Plug** the **LPM** into the field wiring terminal block socket located in step 1.
3. **Connect** the **LPM** ground wire to the ground bus bar. This ground bar must in turn be connected to a good earth ground. Do not use the power system ground for this connection.
4. **Transfer** any **field wiring** from the unplugged termination block to the built-in termination block on the LPM.

A.5 CONNECTING THE LPM TO WIRING

There is a one-to-one correspondence between the LPM terminals and the terminals of the I/O channel being protected. If you are connecting field wiring to the LPM, refer to the I/O wiring information in this instruction manual.

NOTE

The LPM module provides sockets for a plug-in range (scaling) resistor. These sockets, which are internally connected to the module's middle and right-most screw terminals, must be used when installing a range resistor.

The LPM module provides a ground wire for connection to the enclosure ground bar or ground lug. The enclosure ground bar or ground lug must in turn be connected to a good earth ground. Do not use the power system ground for this connection.

A.6 TROUBLESHOOTING AND REPAIR

The lightning protection modules function by shunting the high voltage transients through gas discharge tubes to the ground lead. In the event of an I/O signal failure, verify the signal is not interrupted by the LPM. Proceed to the troubleshooting and repair procedures for I/O in previous sections of this manual.

Before removing an LPM, make sure all devices and processes remain in a safe state. Remove the LPM and disconnect the field wiring. Remove any range resistors from the LPM. With a digital multimeter, verify continuity through each connector socket to the corresponding field wiring terminal. If there is no continuity, replace the LPM.

With a digital multimeter, check each of the input terminals for continuity to the ground lead. If the test shows continuity to the ground lead, replace the LPM.

A.7 SPECIFICATIONS

Lightning Protection Module Specifications

ELECTRICAL

Series Resistance: 10 ohms from input to output, each terminal.

DC Clamping Voltage: 72 to 108 volts.

100 V/ms Impulse Clamping Voltage: 500 volts maximum.

Clamping Release Voltage: 52 volts minimum.

10 KV/microsecond Impulse Clamping Voltage: 900 volts maximum.

Surge Life: Module can withstand 300 surges of 10 to 1000 microseconds duration at 500 amps minimum.

Insulation Resistance: 10,000 megohm minimum.

Capacitance: 1.0 picofarad maximum @ 1 MHz, each terminal.

SURGE WITHSTAND

Meets surge requirements CCITT K17-K20.

CASE

Material: ABS polycarbonate thermoplastic.

Dimensions: 0.65 in. H by 0.84 in. W by 1.58 in. D (17 mm by 21 mm by 40 mm).

Length of Ground Wire: 48 inches (1.2 m) nominal.

ENVIRONMENTAL

Operating Temperature: -40 to 75 °C (-40 to 167 °F).

Storage Temperature: -60 to 100 °C (-76 to 212 °F).

Operating Humidity: To 95% relative, non-condensing.

WEIGHT

1.2 ounces (34 grams).

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

GLOSSARY OF TERMS

A

AGA — American Gas Association.

AI — Analog Input.

AO — Analog Output.

Analog — Analog data is represented by a continuous variable, such as a electrical current signal.

AP — Absolute Pressure.

APC — Adaptive Predictive Control.

ASCII — American (National) Standard Code for Information Interchange.

B

Built-in I/O — I/O channels that are fabricated into the ROC, FloBoss, and GridBoss controller; they do not require a separate module. Also called “on-board” I/O.

C

COM1 — Port on the ROC364, FloBoss 500-series, and GB600-series that may be used for host communications, depending on the installed communications card. On the FloBoss 407, this port is built-in and dedicated to RS-232 serial communications.

Configuration — Typically, the software setup of a device, such as a ROC, FloBoss, or GridBoss controller that can often be defined and changed by the user. Can also mean the hardware assembly scheme.

CSA — Canadian Standards Association.

D

DB — Database.

dB — Decibel. A unit that gives the ratio of the magnitudes of two signals on a logarithmic scale.

DCD — Carrier Detect communications signal.

DI — Discrete Input.

Discrete — Input or output that is non-continuous, typically representing two levels such as on/off.

DO — Discrete Output.

DMM — Digital multimeter.

DP — Differential Pressure.

DR — District Regulator.

DTR — Data Terminal Ready modem communications signal.

Duty Cycle — Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, etc.

DVM — Digital voltmeter.

E

EEPROM — Electrically Erasable Programmable ROM, a form of permanent memory.

EIA-232 — Serial Communications Protocol using three or more signal lines, intended for short distances.

EIA-422 — Serial Communications Protocol using four signal lines.

EIA-485 — Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion.

EMF — Electro-motive force.

EMI — Electro-magnetic interference.

ESD — Electronic Static Discharge.

EU — Engineering Units.

F

Firmware — Internal software that is factory-loaded into a form of ROM. In the ROC, FloBoss, or GridBoss controller, the firmware supplies the software used for gathering input data, converting raw input data calculated values, storing values, and providing control signals.

Flash ROM — A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory (needs no backup power).

FM — Factory Mutual.

FSK — Frequency shift keyed.

FST — Function Sequence Table, a type of program that can be written by the user in a high-level language designed by Fisher Controls.

G, H

GB601 — District Regulator Controller, Fisher Control’s microprocessor-based unit that provides remote pressure monitoring and control in a GridBoss system.

GB602 — Low Pressure Point Controller, Fisher Control’s microprocessor-based unit that provides remote pressure monitoring and control in a GridBoss system.

GFA — Ground fault analysis.

GND — Electrical ground, such as used by the ROC, FloBoss, or GridBoss controller power supply.

GP — Gauge Pressure.

GRIDLINK — Configuration software used to configure GridBoss controllers to gather data, as well as most other functions.

I, J

I/O — Input/Output.

IEC — Industrial Electrical Code.

K

Kbytes — Kilobytes.

kHz — Kilohertz.

Kixcel — An actuator that receives a control signal (Analog Output or Discrete Output pair) from the GB601 and converts the signal into an outlet pressure to adjust the Setpoint at the DR.

L

LCD — Liquid Crystal Display. Display only device used for reading data.

LED — Light-emitting diode.

LOI — Local Operator Interface. Refers to the serial (RS-232) port on the ROC, FloBoss, or GridBoss controller through which local communications are established, typically for configuration software running on a PC.

LPM — Lighting Protection Module. Use this module to provide lightning and power surge protection for ROC, FloBoss, and GridBoss units that use I/O.

M

mA — Milliamp(s); one thousandth of an ampere.

MCU — Master Controller Unit.

MPU — Micro-processor Unit.

mW — Milliwatts, or 0.001 watt.

mV — Millivolts, or 0.001 volt.

N

NEC — National Electrical Code.

NEMA — National Electrical Manufacturer's Association.

O

OH — Off-Hook modem communications signal.

Off-line — Accomplished while the target device is not connected (by a communications link). For example, off-line configuration is configuring a ROC, a FloBoss, or a GridBoss controller in a electronic file that is later loaded into the units.

Ohms — Units of electrical resistance.

On-line — Accomplished while connected (by a communications link) to the target device. For example, on-line configuration is configuring a ROC while connected to it, so that current parameter values are viewed and new values can be loaded immediately.

OP — Operator Port; see LOI.

Opcode — Type of message protocol used by the ROC, FloBoss, or GridBoss controller to communicate with the ROCLINK, GRIDLINK, or GV101 software, as well as host computers with ROC driver software.

P, Q

Parameter — A property of a point that typically can be configured or set by the user. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.

PC — Personal computer.

PI — Pulse Input.

PID — Proportional, Integral, and Derivative control.

Point — Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.

Point Number — The rack and number of an I/O point as installed in the ROC, FloBoss, or GridBoss controller.

PSTN — Public switched telephone network.

PT — Process Temperature.

PTT — Push-to-talk signal.

Pulse — Transient variation of a signal whose value is normally constant.

PV — Process variable.

R

RAM — Random Access Memory. In a ROC, it is used to store history, data, most user programs, and additional configuration data.

RBX — Report-by-exception. In a ROC, it always refers to spontaneous RBX in which the ROC contacts the host to report an alarm condition.

RFI — Radio frequency interference.

RI — Ring Indicator modem communications signal.

ROM — Read-only memory. Typically used to store firmware.

RTD — Resistance Temperature Detector.

RTS — Ready to Send modem communications signal.

RTV — Room Temperature Vulcanizing, typically a sealant or caulk like silicone rubber.

RXD — Received Data communications signal.

S

SAMA — Scientific Apparatus Maker's Association.

Sensor Module — The SM provides static pressure inputs to the GridBoss Controller for the pressure calculation.

Soft Points — A type of ROC, FloBoss, or GridBoss point with generic parameters that can be configured to hold data as desired by the user.

SP — Setpoint, or Static Pressure.

SPI — Slow Pulse Input

SRAM — Static Random Access Memory. Stores data as long as power is applied; typically backed up by a lithium battery or supercapacitor.

T-Z

TDO — Timed Discrete Output, or Timed Duration Output.

TLP — Type (of point), Logical (or point) number, and Parameter number.

TXD — Transmitted Data communications signal.

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If you have comments or questions regarding this manual, please direct them to your Fisher Representative or contact:

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