Released

WOODWARD

Product Manual 35166
(Revision -, 10/2020)
Original Instructions

Atlas-II™ Digital Control Without LON Interface

Installation and Operation Manual

General Precautions	**Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.** **Practice all plant and safety instructions and precautions.** **Failure to follow instructions can cause personal injury and/or property damage.**

Revisions	**This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:** **http://www.woodward.com/** **The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.**

Proper Use	**Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.**

Translated Publications	**If the cover of this publication states "Translation of the Original Instructions" please note:** **The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Contents

⚠WARNING

IOLOCK. When a CPU or I/O module fails, watchdog logic drives it into an IOLOCK condition where all output circuits and signals are driven to a known de-energized state as described below. The System MUST be designed such that IOLOCK and power OFF states will result in a SAFE condition of the controlled device.

- **CPU and I/O module failures will drive the module into an IOLOCK state.**
- **CPU failure will assert an IOLOCK signal to all modules and drive them into an IOLOCK state.**
- **Discrete outputs / relay drivers will be non-active and de-energized.**
- **Analog and actuator outputs will be non-active and de-energized with zero voltage or zero current.**

The IOLOCK state is asserted under various conditions including:

- **CPU and I/O module watchdog failures**
- **PowerUp and PowerDown conditions**
- **System reset and hardware/software initialization**
- **Entering configuration mode**

NOTE: Additional watchdog details and any exceptions to these failure states are specified in the related CPU or I/O module section of the manual.

The following are trademarks of Woodward, Inc.:
Atlas-II
AtlasPC
DSLC
GAP
Woodward

The following are trademarks of their respective companies:
Beldfoil (Belden Inc.)
DeviceNet (Open DeviceNet Vendor Association, Inc. [ODVA])
Modbus (Schneider Automation Inc.)
VxWorks (Wind River Systems, Inc.)

Illustrations and Tables

Warnings and Notices

Important Definitions

This is the safety alert symbol used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER** - Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
- **WARNING** - Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
- **CAUTION** - Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
- **NOTICE** - Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT** - Designates an operating tip or maintenance suggestion.

WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

Electrostatic Discharge Awareness

NOTICE	
Electrostatic Precautions	**Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:** • **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).** • **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.** • **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.** **To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.**

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

IMPORTANT	**External wiring connections for reverse-acting controls are identical to those for direct-acting controls.**

Regulatory Compliance

European Compliance for CE Marking:
These listings are limited only to those units bearing the CE Marking.

EMC Directive: Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility. (EMC)

ATEX – Potentially Explosive Atmospheres Directive: Directive 2014/34/EU on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.

RoHS Directive: Restriction of Hazardous Substances 2011/65/EU:
This product is intended to be sold and used only as equipment which is specifically designed, and is to be installed, as part of another type of equipment that is excluded or does not fall within the scope of this Directive, which can fulfil its function only if it is part of that equipment, and which can be replaced only by the same specifically designed equipment and therefore fulfills the requirements stated in Art.2.4(c) and as such is excluded from the scope of the Directive

North American Compliance:
These listings are limited only to those units bearing the UL identification.

UL: UL Listed for Class I, Division 2, Groups A, B, C, & D, T3C at 70°C surrounding air temperature. For use in Canada and the United States.
UL File E156028
The 16-channel relay interface modules are suitable for ordinary or non-hazardous locations only.

Marine Compliance

American Bureau of Shipping: Rules for Conditions of Classification, Part 1 - 2020 Steel Vessels Rules 1-1-4/7.7,1-1-A3, 1-1-A4, which covers the following: 2020 Steel Vessels Rules: 4-2-1/7.3, 4-2-1/7.5.1, 4-9-3/11.9, 4-9-5/17, 4-9-6/23, & 4-9-8/13 Table 1 & 2 (as appropriate)

Det Norske Veritas: DNV GL Rules for Classification - Ships and Offshore Units
DNV GL Rules for Classification - High-Speed and Light Craft
Temperature Class B, Humidity Class B, Vibration Class A, and EMC Class A per the Applicable tests according to Class Guideline DNVGL-CG-0339, December 2019

Lloyd's Register of Shipping: LR Type Approval Test Specification No. 1, March 2019 for Environmental Categories ENV1, ENV2, and ENV3

Special Conditions for Safe Use:
This Equipment is Suitable for Use in Class I, Division 2, Groups A, B, C, D or Non-Hazardous Locations Only.

This equipment is suitable for use in European Zone 2, Group IIC environments.

This equipment is intended to be installed in a metal cabinet or enclosure to provide protection against the entry of dust or water and to protect against mechanical impact. For ATEX compliance, a minimum ingress protection rating of IP54 is required for the enclosure.

For ATEX compliance, this equipment must be protected externally against transient disturbances. Provisions shall be made to prevent the power input from being exceeded by transient disturbances of more than 40% of the rated voltage

Wiring must be in accordance with North American Class I, Division 2, or European Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.

A fixed wiring installation is required and a switch or circuit breaker shall be included in the building installation that is in close proximity to the equipment and within easy reach of the operator and that is clearly marked as the disconnecting device for the equipment. The switch or circuit breaker shall not interrupt the protective earth conductor.

Do not connect more than one main power supply to any one fuse or circuit breaker.

Protective Earth Grounding is required by the input PE terminal (see Chapter 2, Installation).

Ground leakage current exceeds 3.5 mA.

For Communications wires, use wires with a temperature rating of at least 5 °C above surrounding ambient. All others use wires with a temperature rating of at least 10 °C above surrounding ambient.

The Atlas-II A5200 board contains a single cell primary battery. This battery is not to be charged and is not customer replaceable.

Control is suitable for installation in pollution degree 2 environments.

Unmarked inputs are classified as permanently connected IEC measurement Category I. To avoid the danger of electric shock, do not use inputs to make measurements within measurement categories II, III, or IV. See individual inputs for additional information on transient overvoltage input ratings.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 applications.

⚠AVERTISSEMENT

RISQUE D’EXPLOSION—Ne pas raccorder ni débrancher tant que l’installation est sous tension, sauf en cas l’ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2.

IMPORTANT

The Atlas-II is designed for installation in a standard metal cabinet. If the cabinet door is open or Atlas-II is not installed in a metal cabinet, some degraded performance can occur on RTD and thermocouple inputs in the presence of radio wave energy. Radio wave energy may be from transmitters such as cell phones or push to talk radios.

This degraded performance is in the form of a slight change in the accuracy of the RTD and thermocouple input measured temperature. It is recommended that operation of such radio wave devices be kept more than 3 m (10 ft) from the Atlas-II control. This will prevent performance degradation. Installation of the Atlas-II control in a metal enclosure, as intended, will also prevent performance degradation.

IMPORTANT

The Atlas-II Actuator and Analog outputs are intended to drive loads that are isolated from protective earth, like actuators and meters.

NOTICE

The Atlas-II is protected from indirect lighting strikes. However, during a lighting strike to protective earth (PE), or similar transient events, if the Actuator or Analog outputs are connected to earth-referenced devices, the device may significantly reduce performance of the Atlas-II.

Protective earth connections separated by a significant distance (>30 m) can see a large voltage difference due to transient surge events. The non-isolated device may cause a ground fault with significant current flow through the analog signal lines, causing signal input measurement errors beyond Analog I/O to occur.

Adding an isolator between the Atlas-II and its analog loads will solve this issue. Alternatively adding clamping circuitry, like Metal Oxide Varistors (MOV) or Transient Voltage Suppression (TVS) diodes, from chassis to signal lines at both ends will also solve this issue. (See the appropriate sections for more details.)

Chapter 1.
General Information

Information

This manual describes the Woodward Atlas-II Digital Control. It provides a variety of useful information for the user ranging from simple basic descriptions to detailed information on wiring, specifications, and functionality. Included are:

- General information on the Atlas-II platform and available versions
- A physical description of the control hardware
- A description of all Atlas-II modules
- A listing of accessories that may be used with the platform
- Information on Atlas-II communications and distributed I/O interfaces
- Installation and maintenance
- Troubleshooting information
- For information on programming, networking, and communication protocols, refer to the software manual provided with the control.

Atlas-II Control Description

The Atlas-II digital control platform fits a wide range of prime mover applications. These include small mechanical-drive units with a minimum of complexity on up to large two-shaft gas turbine generator sets that require unit sequencing and load control. The Atlas-II control is programmed to the specific needs of the prime mover and its driven load.

At the heart of the Atlas-II control is a 32-bit microprocessor that runs a powerful Real Time Operating System. This operating system is specifically designed to control the proper timing of all application code so that dynamic performance of the final control system is absolutely guaranteed. Each piece of the application code is “scheduled” under a Rate Group structure that ensures execution of the code at a predetermined time.

Application programming is accomplished via Woodward’s GAP Graphical Application Program. GAP is a pictures-to-code system that provides a high-level programming environment for users who have control expertise but do not have specific programming skills. Once the application program has been generated and loaded into the Atlas-II control, the user can view variables and tune the control with a variety of Woodward service tools. Connection to other devices, such as an HMI, is accomplished by means of serial Modbus or Ethernet ports on the control. The desired information flow is programmed into the control via GAP.

The hardware platform is based on the industry-standard PC/104 bus structure. In the Atlas-II control, the backplane is the SmartCore board. The PC/104 modules are “stacked” onto the SmartCore board in order to add I/O or other functionality. Each of the stacked modules has an on-board DIP switch that is positioned to the unique address of that particular module. The Atlas-II control uses a second stack called the Power Bus Stack. This stack is used primarily for power-related I/O. The control runs on low-voltage DC power (18–32 Vdc). Atlas-II field wiring is accomplished via terminal blocks that plug into the control modules.

Control Versions

The Atlas-II control provides a flexible platform that can be structured into a wide variety of configurations of I/O and communications. The required number of I/O modules and the types of communication modules that are required will depend entirely on the specific application scenario. Table 1-1 shows the various modules that are available.

Table 1-1. Atlas-II Modules

Atlas-II Module List

- Power Supply
- SmartCore CPU A5200
- PowerSense
- Analog Combo I/O

Table 1-2. VxWorks Atlas-II Item Numbers

Atlas-II Item Number	Operating System	Atlas-II A5200	Power-Sense	Analog Combo	DLE Com	Profibus	Cooling Fan	Description
8273-555	VxWorks	1		3			X	ATLAS II, 2 X 4, A5200, LV, 3 COMBO
8273-546	VxWorks	1	1	1				ATLAS-II, 3 X 4, A5200, LV, PSENSE, 1 COMBO
8273-567	VxWorks	1	1	2			X	ATLAS-II, 3X4 A5200, PSENSE, LV, 2 COMBO
8273-565	VxWorks	1		1				ATLAS-II, 2 X 2, A5200, LV, 1 COMBO
8273-571	VxWorks	1		2				ATLAS-II, 2 X 4, A5200, LV, 2 COMBO
8273-584	VxWorks	1						ATLAS II, 2 X 2, A5200, LV
8273-585	VxWorks	1	1					ATLAS-II, 3 X 2, A5200, LV, PSENSE
8273-701	VxWorks	1	1	1				ATLAS-II, 3 X 2, A5200, LV, PSENSE

Note: Depending on the configuration, the control may or may not contain a fan. See Table 1-2 above.

Figure 1-1 shows diagrammatically the physical arrangement of the modules in the Atlas-II control hardware. The hardware uses two stacked-bus arrangements to provide the required structure. The Power Bus Stack is used for the power-related I/O as well as the discrete output drivers. The PC/104 Stack is used primarily for the signal I/O, the main processor, and communications modules. All configurations contain a SmartCore CPU A5200 module that spans both the Power Bus Stack and the PC/104 Stack. If real power sensing is required in the application, a PowerSense module is stacked above the SmartCore module and also spans both bus stacks. If a PowerSense module is not specified, then an additional Analog I/O module can be substituted. Figure 1-1 shows a “maximum” example configuration (5 levels high).

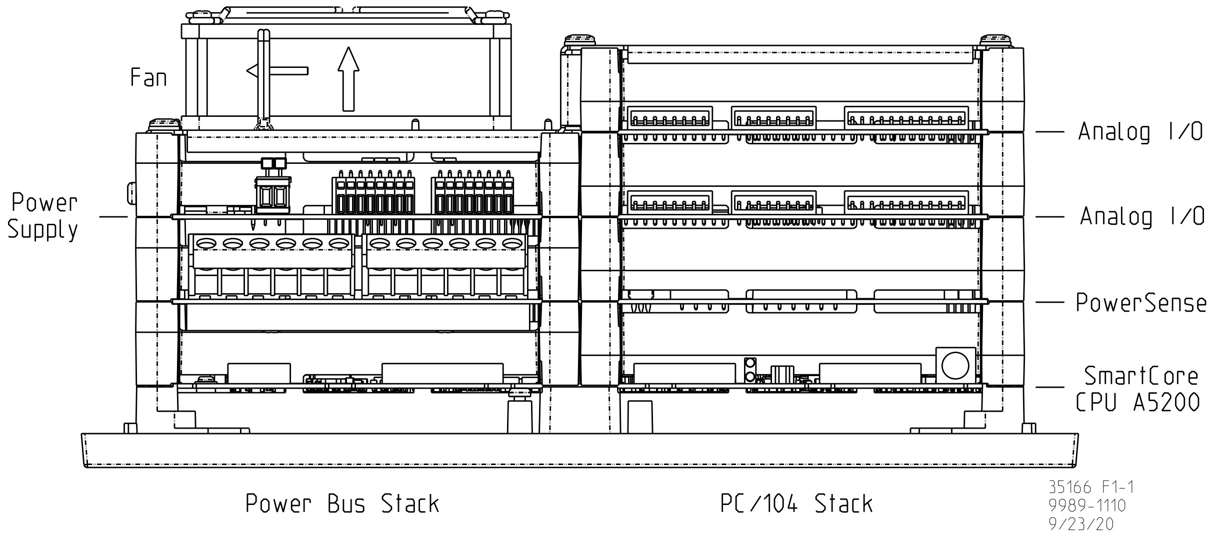


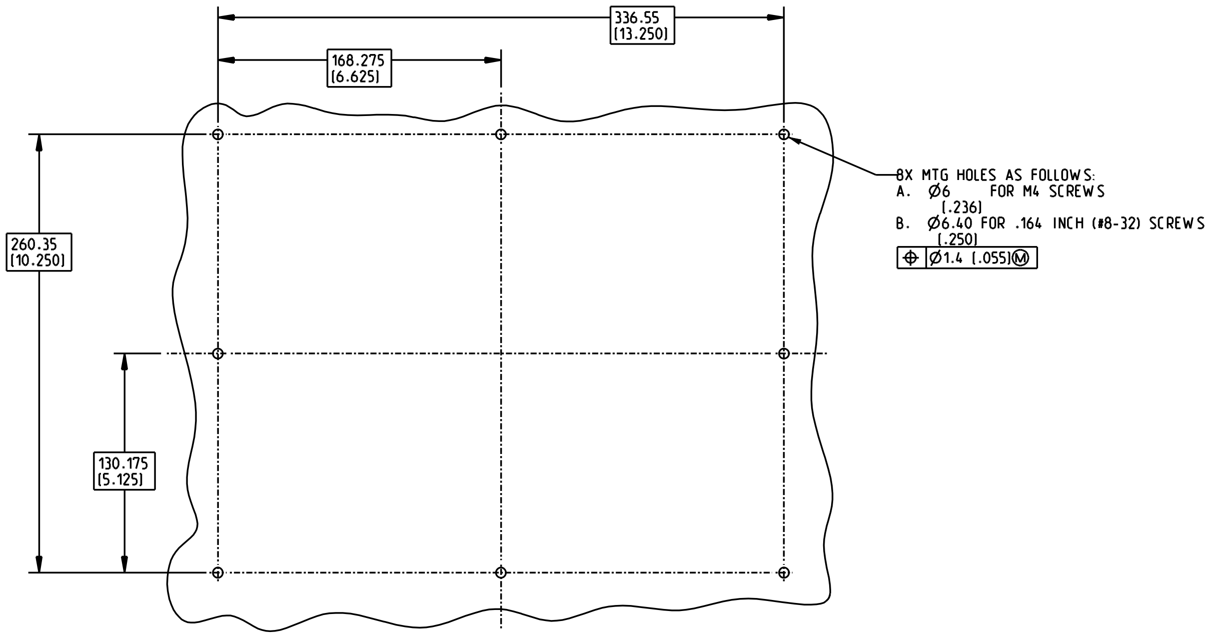
Figure 1-1. Atlas-II, Example Module Layout

NOTES:

1. ALLOW A MINIMUM OF 1.00 INCH AIRSPACE AROUND ALL 4 SIDES AND TOP OF ENCLOSURE.
2. FAN MAY OR MAY NOT BE PART OF ASSEMBLY. SEE BOM FOR CLARIFICATION.
3. STAINLESS STEEL INTERNAL TOOTH LOCK WASHER RECOMMENDED BETWEEN THE MOUNTING FLANGE AND THE MOUNTING SCREW HEADS.
4. DIMENSIONS ARE SHOWN AS: [MM / INCH]

2

CHASSIS SIZE # LEVELS OF SIDE "A" X # LEVELS OF SIDE "B"	"A" MAX.	"B" MAX.	"C" MAX.
2 X 2	100.1 [3.94]	100.1 [3.94]	142.2 [5.60]
2 X 4	100.1 [3.94]	160.8 [6.33]	142.2 [5.60]
3 X 2	130.6 [5.14]	100.1 [3.94]	172.7 [6.80]
3 X 4	130.6 [5.14]	160.8 [6.33]	172.7 [6.80]



MOUNTING HOLE DETAIL

35166 F1-2a
9989-1110
9/23/20

Figure 1-2a. Physical Dimensions

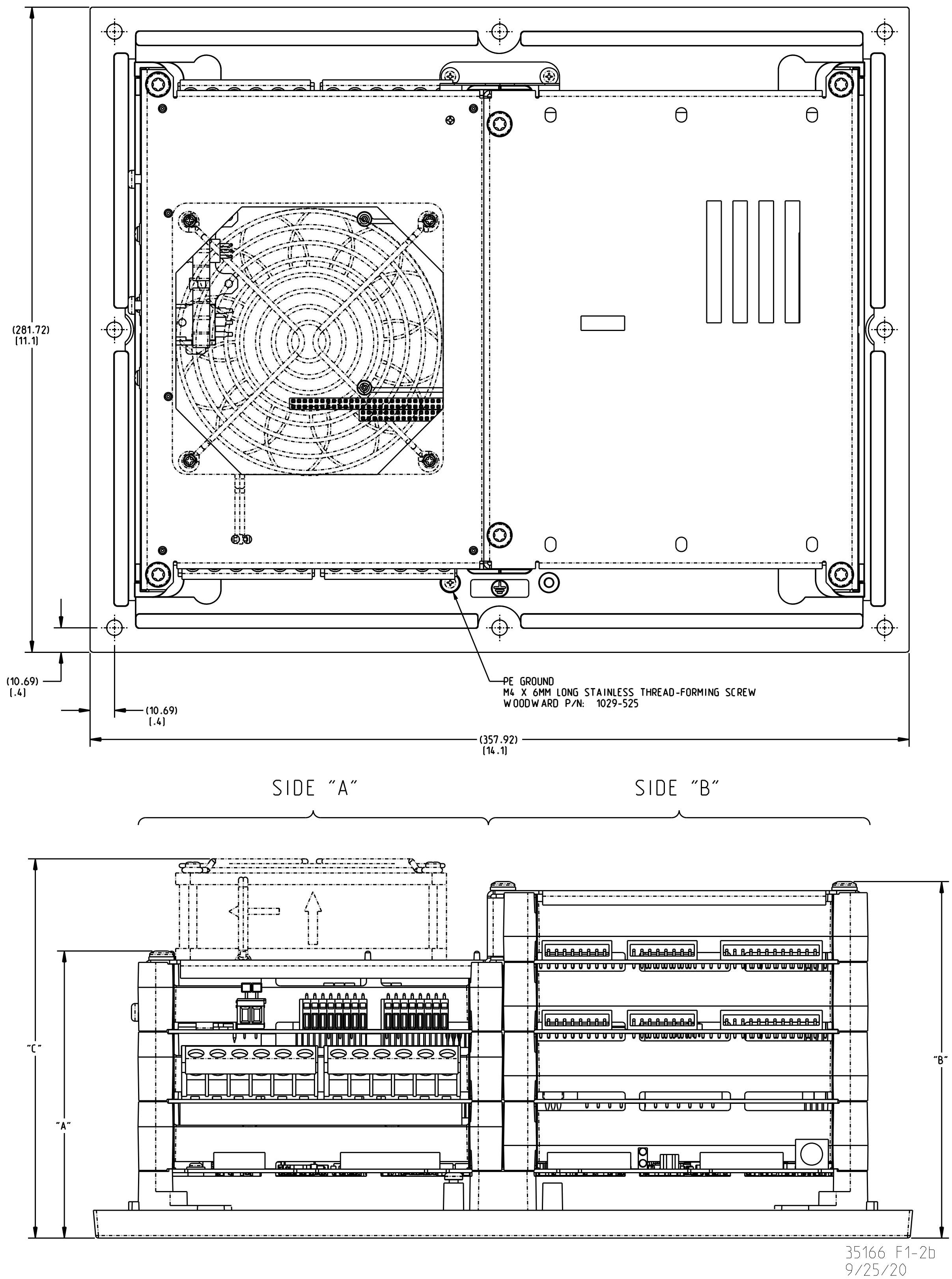


Figure 1-2b. Physical Dimensions

Control Accessories

The Atlas-II digital control platform is designed to interface with several Woodward service tools and commercial software products. Available tools are listed below with a brief description of their functionality:

- **Monitor GAP**—An Ethernet connection to the control allows on-line GAP monitoring, debug, and tunable configuration.
- **Watch Window**—Provides an Ethernet or serial connection to the control to allow 1) initial configuration of the unit; 2) monitoring and tuning of system variables; and 3) management of configuration and setpoints.
- **Control Assistant**—Ethernet connection to the control for Tunable Management, viewing of high-speed data captures, and other useful utilities.
- **Application Manager**—Ethernet access to the control for program loading, network configuration and support, and system diagnostics.
- **HMI (Human Machine Interface)**—Commercially available HMI programs interface to the Atlas-II control through Ethernet or serial connections to provide operator access and control of the application machinery.

Chapter 2.
Installation

Introduction

This chapter provides the general information for mounting location selection, installation, and wiring of the Atlas-II control. Hardware dimensions, ratings, and requirements are given for mounting and wiring the control in a specific application.

General Installation

When selecting a location for mounting the Atlas-II control, consider the following:

- Protect the unit from direct exposure to water or to a condensation-prone environment.
- The control is designed for installation in a protective metal enclosure such as a standard cabinet with ingress protection rating of IP54.
- A standard "EMC" cabinet is required when installing into a Marine Type Approval applications.
- Provide an ESD strap inside the cabinet for handling the equipment and plugging/unplugging the connectors.
- The operating range of the Atlas-II control is –40 to +70 °C (–40 to +158 °F). See the Environmental Specifications for more details.
- Provide adequate ventilation for cooling. Shield the unit from radiant heat sources.
- Do not install the unit or its connecting wires near inductive, high-voltage, or high-current devices. If this is not possible, shield both the system connecting wires and the interfering devices or wires.
- Allow adequate space around the unit for servicing and wiring.
- Do not install where objects can be dropped on the terminals.
- Ground the chassis for proper safety and shielding.
- When installing on a generator set package, provide vibration isolation.

Shipping Carton

Before unpacking the control, refer to the inside front cover and page 5 of this manual for WARNINGS and CAUTIONS. Be careful when unpacking the control. Check for signs of damage such as bent or dented panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

The Atlas-II control was shipped from the factory in an anti-static foam lined carton. This carton should always be used for transport of the control or for storage when the control is not installed.

Mounting

Figure 1-2 shows the Atlas-II control layout and mounting pattern. The Atlas-II digital control is to be mounted in an appropriate enclosure for the installed environment. This equipment is designed for installation within a control room panel or cabinet.

⚠WARNING	**This equipment is intended to be installed in a metal cabinet or enclosure to provide protection against the entry of dust or water and to protect against mechanical impact. For ATEX compliance, a minimum ingress protection rating of IP54 is required for the enclosure.**

The standard Atlas-II package must be mounted to allow sufficient room for wiring access. Eight front panel mounting holes permit secure mounting. Depending on its configuration, the Atlas-II weighs between 3.4 and 4.5 kg (7.5 and 10 pounds). A minimum of 25 mm (1 inch) of clear space around the outer surfaces of the Atlas-II is adequate for ventilation, however approximately 75 mm (3 inches) of space may be required for wiring, depending on wire size.

Environmental Specifications

Operating Temperature

The Atlas-II Control Platform operates in a specified ambient temperature of –40 to +70 °C (–4 to +158 °F) with forced convection cooling.

NOTICE	**Continuous operation with insufficient airflow or higher operating temperatures will lead to reduced reliability and possible damage to the control.**

Storage Temperature

The Atlas-II Control Platform is designed to be stored without applied power at the temperature range of –40 to +85 °C (–40 to +185 °F).

Component life is adversely affected by high-temperature, high-humidity environments. Room temperature storage is recommended for long life. If the unit is to be stored for a long period of time, operating power must be applied at least for one hour every 18 to 24 months.

Shock

The Atlas-II Control Platform was designed to meet the shock requirements specified by MIL-STD-810C procedure 516.2, procedure 1 (30g, 11 millisecond half sine pulse). During Shock, relay bounce shall be limited to less than 100 ms.

Vibration (Sinusoidal)

The Atlas-II Control Platform was designed and tested to meet Lloyd's Test Specification No. 1, 2002, Vibration Test 1. The Vibration test profile includes 3–16 Hz, ±1 mm and 16–150 Hz, ±1.0g.

Audible Noise Emission

The Atlas-II Control Platform does not emit an audible noise above 70 dBA as measured 1 meter away, with or without a fan.

Enclosure Protection

In order to meet Zone 2 European Group IIC, the Atlas-II Control must be mounted in an enclosure that meets or exceeds IP 54.

Altitude

The Atlas-II Control Platform is designed to operate up to 3000m / 9800 feet.

Electrical Connections

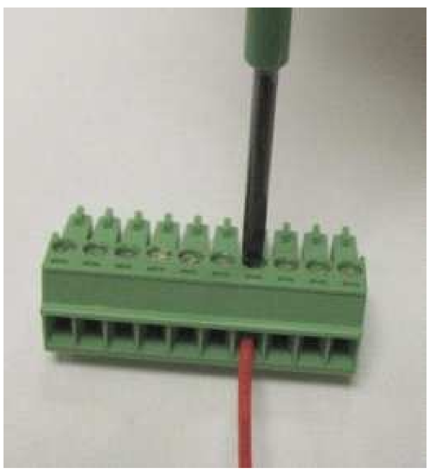
IMPORTANT

Most of the Atlas-II control's terminal blocks are designed to be removed by hand. The Atlas-II Control uses two different styles of pluggable terminal blocks: Screw Connection (limited to the A5200 SmartCore board) and "CageClamp".

The pluggable terminal blocks on the SmartCore CPU A5200 board all utilize the Screw Connection style terminal blocks (see Figure 2-1 for torque and screwdriver requirements). The Screw Connection terminal blocks accept wires from 0.08–1.5 mm² (28–16 AWG). Two 0.8 mm² (18 AWG) wires or three 0.3 mm² (22 AWG) wires can be easily installed in each terminal.

The pluggable terminal blocks on the modules (other than the A5200 SmartCore) are screwless, CageClamp style blocks. The spring clamp can be actuated by using a standard 2.5 mm (3/32 inch) flat bladed screwdriver (see Figure 2-2). These terminal blocks accept wires from 0.08–1.1 mm² (28–18 AWG). Two 0.5 mm² (20 AWG) wires or three 0.3 mm² (22 AWG) wires can be easily installed in each terminal.

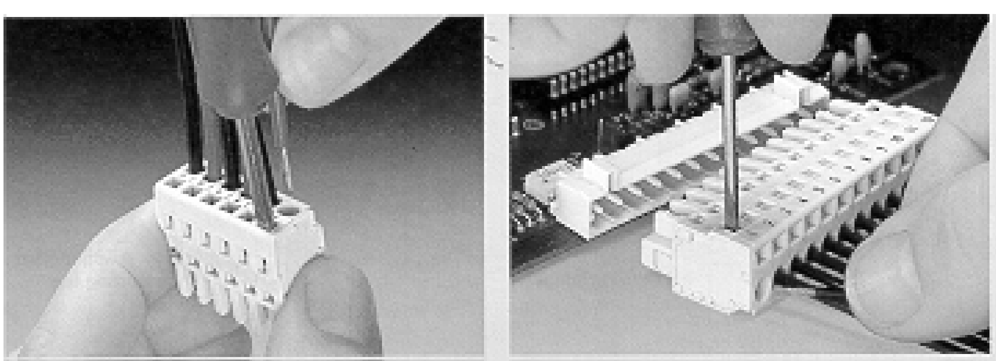
Most of the Atlas-II control's terminal blocks are designed to be removed by hand. After Atlas-II input power is disconnected, the terminal blocks can be removed one at a time by pulling them straight out. Be careful not to pull the plug out at an angle, as this will fracture the end terminal. Wires for the all the pluggable I/O terminal blocks should be stripped at 8 mm (0.3 inch).



Torque range for screws of Screw Connection Terminal Blocks:
0.22–0.25 N·m (1.95–2.21 lb-in).

Screwdriver blade: 0.4 X 2.5 mm (0.016 X 0.10 inch)
Screwdriver available as Woodward PN 8992-005

Figure 2-1. Screw Connection Terminal Block Used on A5200 SmartCore Board



Method #1
Free Hand (holds spring open)

Method #2
Bench (momentarily opens spring while force is applied)

Figure 2-2. Spring Clamp Terminal Block

The Atlas-II fixed terminal blocks used for the power supply input accept wires from 0.08–1.1 mm² (28–18 AWG). Two 0.5 mm² (20 AWG) wires or three 0.3 mm² (22 AWG) wires can be easily installed in each terminal. Wires for the fixed mounted power terminals should be stripped 5 mm (0.2 inch).

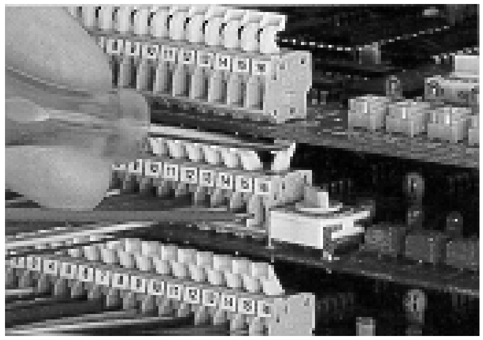


Figure 2-3. Wiring Fixed Terminal

IMPORTANT

<u>Do not</u> tin (solder) the wires that terminate at the Atlas-II terminal blocks. The spring-loaded CageClamp terminal blocks are designed to flatten stranded wire, and if those strands are tinned together, the connection loses surface area and is degraded.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

All AC wiring for voltages and currents is done with fixed screw barrier blocks rather than pluggable terminal blocks. The fixed screw barrier blocks accept wires terminated into terminal lugs for #6 screws.

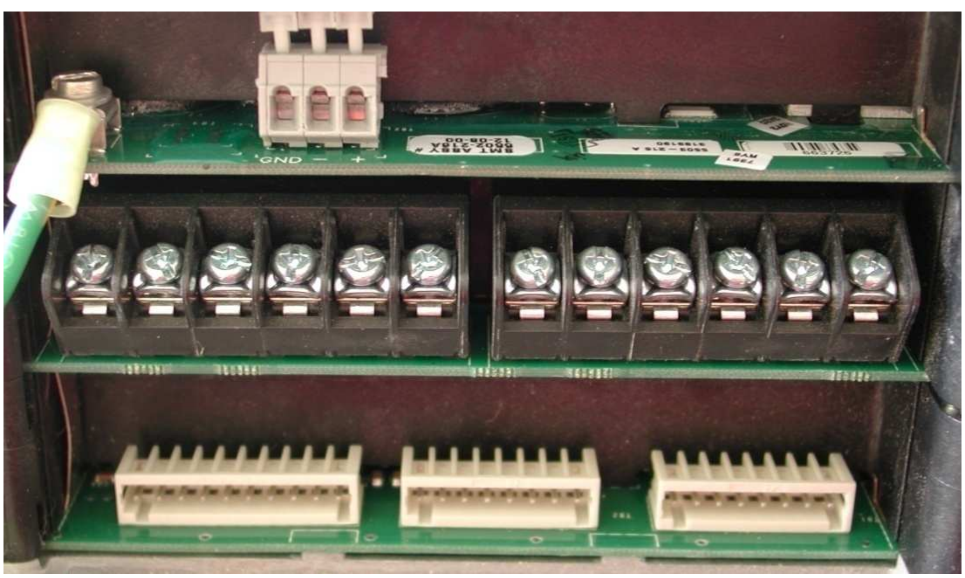


Figure 2-4. Fixed Terminals

Grounding

Protective Earth (PE) must be connected to the termination point on the backside of the unit next to the label with the symbol ⏚ to reduce the risk of electric shock. This connection will be made using a thread-forming screw (M4 x 6 mm). The conductor providing the connection shall have a properly sized ring lug and wire larger than or equal to 3.3 mm² (12 AWG).

The unit also needs low impedance grounding to earth, e.g. the cabinet or enclosure used. The low impedance ground can be accomplished by one or more of the following:

- A short 15 cm (6 inch) protective earth wire
- A 1.3 cm (0.5 inch) wide flat hollow braid less than 1 m long
- A 1.3 cm (0.5 inch) wide flat tin or lead/tin plated copper strap less than 1 m long
- The use of the eight mounting bolts and paint breaking washers.

⚠WARNING

Do not connect chassis ground or PE ground to signal common.

Safety Ground Wire Installation

- Safety wires must be routed against the grounded cabinet structure. Locate safety ground wire 150 mm (6 inches) from unshielded cabling and 75 mm (3 inches) from shielded cabling inside the cabinet, and 150 mm (6 inches) from any I/O cabling exiting the cabinet.

Recommended Grounding Practices

Providing the proper ground for the Atlas-II control is important. Improper connection of the control chassis to the protective earth / building ground plane may lead to stray currents between the reference point for the AC signal sources (current and voltage transformers), and the reference point for the sensing inputs on the Atlas-II control. Differences in potential between these two points results in equalizing current flow which then produces unacceptably high common mode voltages. Common mode voltages may result in improper readings for the sensed AC inputs, or even damage to the Atlas-II control in extreme cases. To minimize this problem, it is necessary to provide a low resistance path between the AC signal reference point, and the chassis of the Atlas-II control. Typically this point is the designated ground for the generator set and related instrument transformers.

Shields and Grounding

All signal lines except PT/CT, relay outputs, contact inputs, and power supply wiring should be shielded to prevent picking up stray signals from adjacent equipment.

IMPORTANT

Shielding of PT/CT, relay outputs, contact inputs, and power supply wires inside the metal enclosure is required for Marine Type Approval installation applications. Relay outputs, contact inputs, and power supply wiring do not normally require shielding for other installations, but may be shielded if desired.

All shielded cable must be twisted conductor pairs. The Atlas-II control is designed with shield terminations to earth ground at the control. An individual shield termination to earth is provided at the terminal block for each of the signals requiring shielding. Do not tin (solder) or attempt to tin the braided shield for connection into the terminal block. Wire exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches).

If intervening terminal blocks are used in routing a signal, the shield should be continued through the terminal block. If shield grounding is desired at the terminal block, it should be AC coupled to earth. All shield terminations not at the Atlas-II or entry into its metal enclosure should be AC coupled to earth through a capacitor. (A 1000 pF, 500 V capacitor is typically sufficient. The intent is to provide a low impedance path to earth for the shield at frequencies of 150 kHz and higher.)

Multiple, spread out, direct or high capacitance connections of a shield to earth should be avoided. Multiple connections risks high levels of low frequency ground current, like 50/60 Hz, flowing within the shield.

Shield termination can be a deterministic process. AC shield connections (capacitors) may be dictated at the control, instead of the direct earth connection provided. Typically, shields at signal inputs are connected directly to earth, and shields at signal outputs are AC-coupled to earth or floating. See Woodward application notes 50532, *Interference Control in Electronic Governing Systems*, and 51204, *Grounding and Shield Termination,* for more information.

Shielded Wire Preparation

Where shielded cable is required, cut the cable to the desired length and prepare the cable as instructed below.

1. Strip outer insulation from both ends, exposing the braided or spiral wrapped shield. Do not cut the shield or nick the wire inside the shield.
2. Using a sharply pointed tool, carefully spread the strands of the braided shield to form a hole.
3. Pull inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.
4. Remove 6 mm (1/4 inch) of insulation from the inner conductors.
5. Connect wiring and shield as shown in plant wiring diagram.
6. If a shield connection is not required or desired, fold back and secure or remove the excess shield as needed.

General Wiring Guidance

For noise suppression reasons, it is recommend that all low-current wires be separated from all high-current wires and high-voltage be separated from low-voltage.

Input power ground terminal, not power return, should also be wired to earth ground.

Installations with severe electromagnetic interference (EMI) may require additional shielding precautions, such as wire run in conduit or double shielding. Contact Woodward for more information.

Shields from the control to its loads or inputs can be directly grounded to earth at both ends, if the cable length is sufficiently short to prevent ground loop current in the shield (e.g. within a single cabinet).

Enclosure Installations: If the control is installed in a metal enclosure, as intended, shielded I/O must be AC or DC terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as at the control shield pins.

Specifics are provided in each individual installation section.

Non-Marine Enclosure Application Information

Cabinet Structural Grounding

- The cabinet needs to be a six-sided metal enclosure.
  - ✓ Do not use cabinet doors with windows—doors should be solid metal.
- The enclosure floor and/or top panels must provide holes for cable entry.
- Top and bottom cable entry areas must be restricted in size. Cable entry aperture sizes should be minimized to the extent possible, the largest dimension of any aperture (hole) is no greater than 152 mm (6 inches). This is particularly important when RF transmitters, like push to talk radios or cell phones, can be located near the cable access areas.
- An enclosed metal cable area or cable way joining to the cabinet may be thought of as part of the enclosure; If it has no holes larger than 152 mm (6 inches) and no RF transmitters can be present with in it. This allows larger holes in the enclosure cable access plate. The enclosed cableway effectively becomes part of the enclosure.
- The cabinet enclosure frame and device mounting areas must be bonded (grounded) together.
- The frame shall be electrically connected at each structural interface (<2.5 mΩ).

- Mounting plates shall be electrically connected to structural frame (<2.5 mΩ).
  - ✓ 4 corners minimum—4 corners + 2 mid-points preferred.
- Doors must be electrically connected to the main structural frame (<2.5 mΩ).
  - ✓ 1 place minimum, 3 places preferred, use of 25 mm (1 inch) wide bond straps is preferred.
  - ✓ Optimally install bond straps at the locations that cables cross the door hinge. If no cables cross the hinge point, locate straps to break up the size of gaps or openings in the metal structure to door interface.
- Cover panels shall be electrically connected to structural frame (<10 mΩ).
  - ✓ 1 place minimum, 2 places preferred (placed at opposite corners).
- Floor and top panels must be electrically connected to structural frame (<2.5 mΩ).
  - ✓ 1 place minimum, 4 places at the corners is preferred.
- DIN rails must be electrically connected to structural frame (<2.5 mΩ).
  - ✓ Once every 12”, use a minimum of 2 screws to bond a DIN rail to cabinet frame or mounting panel.
- The cabinet must provide a shield termination point for cables as they enter the enclosure. Shielded I/O must be AC or DC terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as to the Atlas-II shield pins.

IMPORTANT	**The grounding section covers how to create shield terminations and when to ground shields: directly to earth or indirectly to earth through a capacitor. There must be one earth ground.**

Marine Enclosure Application Information

Cabinet Structural Grounding

- The cabinet needs to be a six-sided EMI shielded metal enclosure. The interior surfaces must be conductive and coated with corrosion protection treatments.
  - ✓ Do not use cabinet doors with windows—doors should be solid metal.
- The enclosure floor and/or top panels must provide holes for cable entry.
- Top and bottom cable entry areas must be restricted in size. Cable entry aperture sizes should be minimized to the extent possible, the largest dimension of any aperture (hole) is no greater than 152 mm (6 inches). This is particularly important when RF transmitters, like push to talk radios or cell phones, can be located near the cable access areas.
- The cabinet/enclosure frame and device mounting areas must be bonded (grounded) together.
- The frame shall be electrically connected at each structural interface (<2.5 mΩ).
- Mounting plates shall be electrically connected to structural frame (<2.5 mΩ).
  - ✓ 4 corners minimum, 4 corners + 2 mid-points preferred.
- Doors must be electrically connected to the main structural frame (<2.5 mΩ) and must be mounted to contact an EMI gasket all the way around the perimeter when the door is closed.
  - ✓ Bond strap 1 place minimum, 3 places preferred, use of 25 mm (1 inch) wide bond straps is preferred.
  - ✓ Optimally, install bond straps at the locations that cables cross the door hinge. If no cables cross the hinge point, locate straps to break up the size of gaps or openings in the metal structure.
- Cover panels shall be electrically connected to structural frame (<10 mΩ) and must be mounted to contact an EMI gasket all the way around the perimeter when the panel is mounted.
  - ✓ Bond strap 1 place minimum, 2 places (placed at opposite corners) preferred.
- Floor and top panels must be electrically connected to structural frame (<2.5 mΩ) and must be mounted to contact an EMI gasket all the way around the perimeter when the panel is mounted.
  - ✓ Bond strap 1 place minimum, 4 places preferred.
- DIN rails must be electrically connected to structural frame (<2.5 mΩ).
  - ✓ Once every 12”, use a minimum of 2 screws to bond a DIN rail to cabinet frame or mounting panel.
- The cabinet must provide a shield termination point for cables as they enter the enclosure. Shielded I/O must be AC or DC terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as at the Atlas-II shield pins.

- All cables that have sections going outside the cabinet must be shielded from the cabinet entry/exit point to the cable end point inside the cabinet. Cables normally unshielded may limit the shield to just the section inside the cabinet, with shield terminations to the cabinet at each end.

IMPORTANT	**The grounding section covers how to create shield terminations and when to ground shields: directly to earth or indirectly to earth through a capacitor. There must be one earth ground.**

General Enclosure Application Information

Cable Entry Locations

- Cable shield termination hardware must be installed at cable entry points.
- Cable shield terminations must be electrically connected to structural frame and shall allow direct grounding (<2.5 mΩ) or AC grounding of cable shields as specified.
- Route each of the shielded cable types separately, by type. A minimum of 5 cm (2 inches) between types should be maintained.
- Maintain unshielded cables within 0-10 mm (0.0-0.4 inches) of the enclosure metal mounting panels, frame rails, etc., until they get close to the Atlas-II. Approximately 152-203 mm (6-8 inches) near the Atlas-II may be moved away from the enclosure ground by as much as needed to get to the connector.
- The cable shielding of shielded cables performs better if the shielded cables follow the same routing instructions given for unshielded cables, however this is not required.
- Atlas-II cable shields termination pins, except for CAN shield, are designed connected directly to chassis. If this direct connection is used, cables at the cabinet's cable entry point should also be directly connected to the cabinet.
- All signal lines going outside the cabinet must be shielded while inside the cabinet to prevent picking up stray signals.

IMPORTANT	**Shielding of PT/CT, relay outputs, contact inputs, and power supply wires inside the metal enclosure is required for Marine Type Approval installation applications. Relay outputs, contact inputs, and power supply wiring do not normally require shielding for other installations, but may be shielded if desired.**

IMPORTANT	**The grounding section covers how to create shield terminations and when to ground shields: directly to earth or indirectly to earth through a capacitor. There must be one earth ground.**

Equipment Zoning (Segregation)

Separate the equipment types inside the enclosure/cabinet, as possible:

- Analog equipment area
- Discrete I/O equipment areas
- Shielded I/O area
- Un-shielded I/O area
- Power
- AC mains PT & CT monitoring area
- Light Industrial EMC compliant equipment area
- Monitor/keyboard/pointing device (HMI if applicable)
- Other equipment area
- Maintain a minimum or 6" of separation between equipment type areas

IMPORTANT

Light Industrial equipment is defined as equipment that is designed and tested to comply with European Union (EU) directives (e.g. EN61000-6-1 and EN61000-6-3) for Light Industrial environments. Industrial compliant equipment is designed and tested for the EU directives for Heavy Industrial environments (e.g., EN61000-6-2 and EN61000-6-4).

Third Party Hardware Located Inside the Cabinet

- Use only CE Compliant or Marine Type Approved devices

  CE Compliant to Light Industrial Levels
  - ✓ Locate cables (to and from Light Industrial) away from all I/O cables that enter or exit the cabinet by 305 mm (12 inches)
  - ✓ Locate cables (to and from Light Industrial) away from all other cables not going outside the cabinet, separated by greater than 150 mm (6 inches).

  CE Complaint to Industrial Levels
  - ✓ Locate based on zoning restrictions

  Installation of Other Equipment, Fans, Meters, etc.
  Shield Termination Schemes
  - ✓ Follow general guidance above and see Application Note 51204 for this information.

Input Power Routing and Filtering

- Input power coming inside the cabinet from outside it or going outside the cabinet from inside it must be routed separately from all other circuits as it enters the cabinet and while inside the cabinet.
- If input power feeding the Atlas-II is ever outside the cabinet, it must be routed separately from all other circuits as it enters the cabinet and while inside the cabinet. Marine Type Approval applications also require input power that leaves the cabinet to be shielded while inside the cabinet. Shield termination at the cabinet entry point and just before the device input.
- Route Atlas-II power coming from outside the cabinet along the left side of middle, at the back of the cabinet. Route it directly against the mounting panel. All other I/O and internal cabling must be kept more than 152 mm (6 inches) away.
- Input power must route directly to controls that are “Industrial” compliant.
- Input power that must route to controls that are “Light Industrial” compliant must be filtered with a minimum of 20 dB filtering.
- Input power that must be routed near other cabling will be filtered prior to the point the cables follow a common path. Filter with a 20 dB filter.

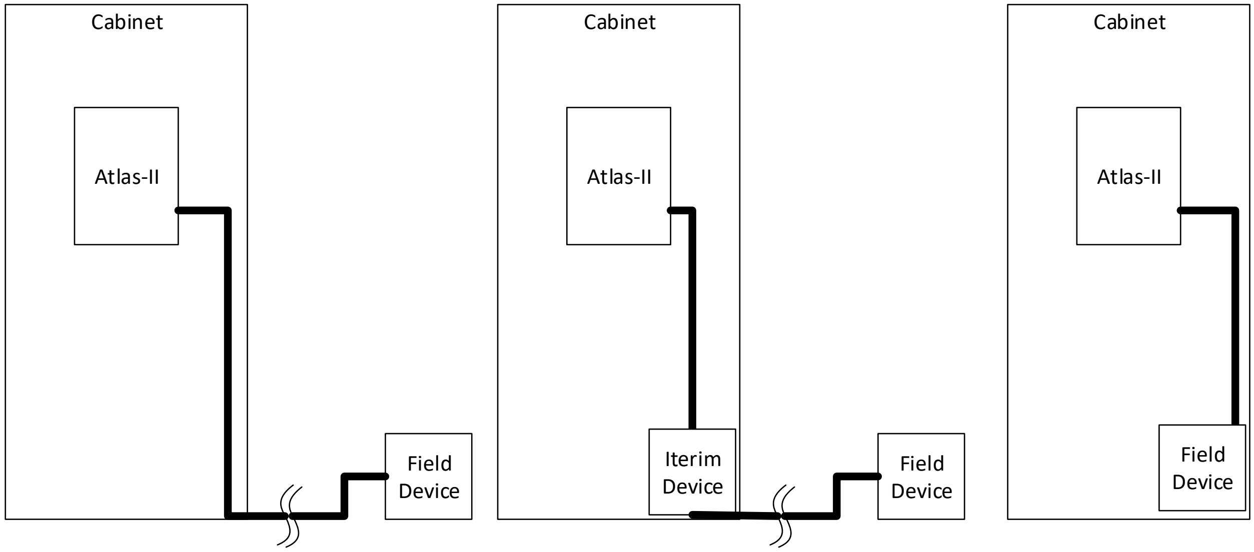


Figure 2-5. Descriptions of Main Cabinet Cabling Options

Shielded Cable Routing & Shield Termination

⚠WARNING	**Do not connect chassis ground or PE ground to signal common.**

Field Device not in Cabinet, No Interim Device (Figure 2-5)

- Use shielded cable from Atlas-II to field device (Isolator, FTM, Analog Driver, indicator meter, etc).
- Route the cable from Atlas-II to the cabinet exit point with the cable against cabinet metal structure.
- AC or DC ground the cable shield at entry point to cabinet and at the Atlas-II shield termination pin.
- If the I/O cable is AC grounded or floated at the field device end of the cable, it must be directly ground at the cabinet and Atlas-II shield termination pin.
- If the I/O cable is directly grounded (DC coupled) at the field device end of the cable, it should be ground with a capacitor (AC ground) at the cabinet. AC ground it both at the Atlas-II shield pin and at the cable entry point into the cabinet.
- Two separate I/O cable shields:
  - ✓ If over braided (two shields), directly ground over braid shield to cabinet and shield pin—directly connect inner braids at field device termination point. The inner braid must have at least one point directly grounded to earth.

Field Device not in Cabinet, with Interim Device in the Cabinet (Figure 2-5)

- Locate interim device away from unshielded discrete areas > 152 mm (6 inches).
- Use shielded cable from Atlas-II to field device (Isolator, FTM, Analog Driver, indicator meter, etc.)
- Route the cable from Atlas-II to the interim device with the cable against cabinet metal structure.
- The interim device must have one AC shield and one DC shield connection. The following are the shield termination combinations, starting from outside the cabinet and working to the Atlas-II.

Table 2-1. Shield Termination Combinations

Field Device	Cabinet Entry	Interim Device Out	Interim Device In	Atlas-II	Status
DC	AC	AC	DC	DC	Allowed / Preferred
AC	AC	AC	DC	DC	Allowed
AC	AC	AC	DC	AC	Allowed / Not Preferred
AC	DC	DC	AC	DC	Allowed / Not Preferred
AC	DC	DC	AC	AC	Allowed / Not Preferred
DC	AC or DC	DC	AC	AC or DC	Not allowed
DC	DC	DC	AC	AC or DC	Not allowed

- Two separate I/O cable shields:
  - ✓ If over braided (two shields), directly ground over braid shield to cabinet & shield pin—directly connect inner braids at field device termination point. The inner braid must still have at least one point directly grounded to earth.

Field Device in Cabinet, No Interim Device (Figure 2-5)

- Locate field device away from unshielded discrete areas > 152 mm (6 inches).
- Use shielded cable from Atlas-II to field device (Isolator, FTM, Analog Driver, indicator meter, etc.)
- Locate field device as close to I/O cable entry point as possible.
- Route the I/O cable against cabinet metal wall from entry point to field device.
- Ground the I/O cable shield directly at both ends.
  - ✓ If over braided (two shields), directly ground over braid shield to cabinet—directly connect inner braids at field device termination point. The inner braid must have at least one point directly grounded to earth.
  - ✓ If single shield, ground the shield to the cabinet and/or shield pin at both ends.
  - ✓

Unshielded Cable Routing & Termination

Field Device not in Cabinet, No Interim Device (Figure 2-5)

- Route the I/O cable against the metal cabinet wall, from cabinet entry point to the Atlas-II.
- Limit the length of unshielded I/O cable inside the cabinet. Lengths over 915 mm (36 inches) are too long.
- If lengths greater than 915 mm (36 inches) are required, special considerations should be used to separate this unshielded wiring from other circuits and minimize electromagnetic coupling into or from the cable.
- Do not let other cables within 305 mm (12 inches) of unshielded cables if they are parallel for greater than 610 mm (24 inches).
- Do not let other cables within 150 mm (6 inches) of unshielded cables if they are parallel for less than 610 mm (24 inches).

Field Device not in Cabinet, with Interim Device in the Cabinet (Figure 2-5)

- Locate unshielded field devices > 152 mm (6 inches) away from other field devices.
- Locate field device as close to I/O cable entry point as possible.
- Route the I/O cable against the metal cabinet wall, from cabinet entry point to the interim device.
- Route the I/O cable against the metal cabinet wall, from the interim device to the Atlas-II.
- Limit the length of unshielded I/O cable inside the cabinet. Lengths over 915 mm (36 inches) are too long.
- If lengths greater than 915 mm (36 inches) are required, special considerations should be used to separate this unshielded wiring from other circuits and minimize electromagnetic minimize electromagnetic coupling into or from the cable.
- Do not let other cables within 305 mm (12 inches) of unshielded cables if they are parallel for greater than 610 mm (24 inches).
- Do not let other cables within 150 mm (6 inches) of unshielded cables if they are parallel for less than 610 mm (24 inches).

Field Device in Cabinet, No Interim Device (Figure 2-5)

- Locate field device as close to I/O cable entry point as possible.
- Route the I/O cable against the metal cabinet wall, from cabinet entry point to the Atlas-II.
- Limit the length of unshielded I/O cable inside the cabinet. Length over 915 mm (36 inches) is too long and may couple.
- If lengths greater than 915 mm (36 inches) are required, special considerations should be used to separate this unshielded wiring from other circuits and minimize electromagnetic minimize electromagnetic coupling into or from the cable.
- Do not let other cables within 305 mm (12 inches) of unshielded cables if they are parallel for greater than 610 mm (24 inches).
- Do not let other cables within 150 mm (6 inches) of unshielded cables if they are parallel for less than 610 mm (24 inches).

Input Power

The Atlas-II control requires a nominal voltage source of 18 to 32 Vdc. Input power requirements vary depending on the control version. Table 2-1 contains information for the maximum configuration.

⚠WARNING	**Power must be applied to the Atlas-II control at least 60 seconds prior to expected use. The control must have time to do its power up diagnostics to become operational. Failure of the diagnostics will disable control function.**

⚠WARNING	**The Atlas-II power supply board must have the input power removed before installing or removing.** **This Equipment is Suitable For Use in Class I, Division 2, Groups A, B, C, D or Non-Hazardous Locations Only.** **This equipment is suitable for use in European Zone 2, Group IIC environments.** **Wiring must be in accordance with North American Class I, Division 2, or European Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.** **Do not connect more than one main power supply to any one fuse or circuit breaker.** **For Communication wires, use wires with a temperature rating of at least 5°C above surrounding ambient. All others use wires with a temperature rating of at least 10°C above surrounding ambient.**

⚠WARNING	**For ATEX compliance, this equipment must be protected externally against transient disturbances. Provisions shall be made to prevent the power input from being exceeded by transient disturbances of more than 40% of the rated voltage.**

The power supply output supplying the Atlas-II must be of a low impedance type for proper operation of the control. DO NOT power a control from a high voltage source containing dropping resistors and zener diodes. If batteries are used for operating power, an alternator or other battery-charging device is necessary to maintain a stable supply voltage.

NOTICE	**To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.**

IMPORTANT	**If an alternator is used to charge batteries supplying the Atlas-II power, the alternator must be a suppressed/clamped type or have external load dump transient suppression. The Atlas-II does not have sufficient energy handling capability to suppress a full alternator load dump.**

Significant inrush currents are possible when current is applied to the Atlas-II control. The magnitude of the inrush current depends on the power source impedance, so Woodward cannot specify the maximum inrush current. Time-delay fuses or circuit breakers must be used to avoid nuisance trips.

(PE) must be connected to the chassis at the termination point on the unit labeled ⏚ . The power supply grounding terminals should also be connected to earth to ensure grounding of the power supply printed circuit boards. The grounding conductor must be the same size as the main supply conductors or the combined PT wires, whichever is larger.

⚠WARNING	**The control's power supplies are not equipped with input power switches. For this reason, a fixed wiring installation is required and a switch or circuit breaker shall be included in the building installation that is in close proximity to the equipment and within easy reach of the operator and that is clearly marked as the disconnecting device for the equipment. The switch or circuit breaker shall not interrupt the protective earth conductor.**

It is expected that the installation of this equipment will include over current protection between the power source and the Atlas-II control. This over current protection may be accomplished by series connection of properly rated fuses or circuit breakers. Branch circuit protection of no more than 250% of the maximum Atlas-II power supply input current rating must be provided. See Table 2-1 for maximum recommended fuse ratings. This value meets the 250% UL listing requirements. The use of properly sized UL class CC, J, T, G, RK1, or RK5 fuses meet the requirements for branch circuit protection. Do not connect more than one Atlas-II control to any one fuse. Use only the wire size specified in Table 2-1 or equivalent metric size which meets local code requirements. Time delay fuses should be used to prevent nuisance trips.

Table 2-1 provides the power supply holdup time specification; which is the time the supply will continue to operate within specification after its input power is interrupted. This information may be useful in specifying uninterruptible power supply (UPS) systems.

Table 2-1. Power Supply Requirements

Input Voltage Range	Fuse (Current Rating)	Fuse (I^2t Rating)	Wire Size* **	Holdup Time
18–32 Vdc**	9 A	>800	2/4 mm² 12/14 AWG	8 ms

IMPORTANT

*** 4 mm² (12 AWG) is the largest wire gauge size that may be connected to the control power input terminal blocks.**

**** The minimum input voltage allowed is 18 V at the power input of the control. The length, size of wire, and load current will determine the minimum supply output voltage. The minimum supply voltage measured at the source should always be greater than 18 V. Example: two (source and return) 20 foot (6 m) lengths of 14 AWG (2 mm²) wire carrying 1.2 A (maximum rated current) will result in a voltage drop from source output to control power input of approx. 0.16 volts. The resulting supply voltage from the example must be greater than 18.16 volts.**

***** A fuse or circuit breaker shall not interrupt the protective earth conductor.**

Input Power Wiring Diagram

The power supply and ground connections are located on the power supply board (see also Recommended Grounding Practices).

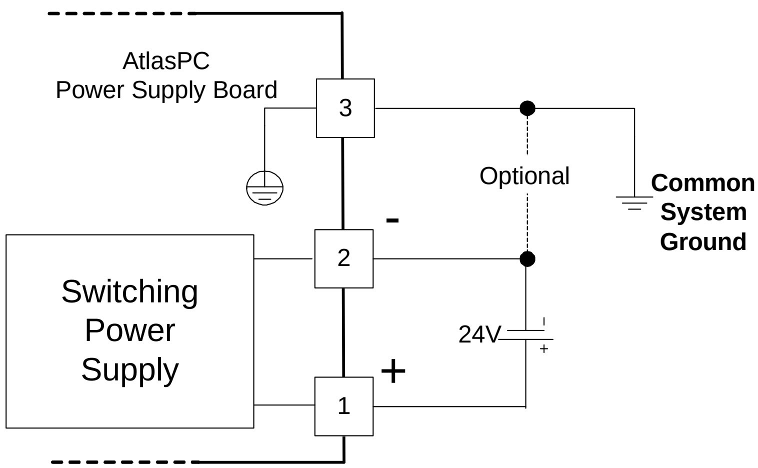


Figure 2-6. Input Power Wiring Diagram

Maintenance

The only part of the Atlas-II control system that may require user maintenance is the cooling fan (Woodward part number 1886-439). In the event that the fan must be replaced, please use the following procedure to remove a faulty fan from the chassis:

- Use a #2 Phillips screwdriver
- Power down the control to avoid overheating or other hazards.
- Disconnect fan wires from terminal block. Cut the tie-wrap supporting the wires to the cover.
- Remove, the four retaining screws holding the fan and guard to the cover.
- Remove fan and guard from unit.
- Remove guard from faulty fan
- Install new fan of same size and flow rate.
- Reinstall fan (flow arrows should point "OUT")
- Reinstall fan guard with the 4 screws. Torque screws to 0.1 N·m (1 lb-in) max to avoid damage to the flange of fan.
- Trim leads to a reasonable length.
- Connect RED wire to the + fan terminal and BLACK wire to - fan terminal.
- If desired strain relief leads to cover with a new tie-wrap.

Application Guidelines

The following items are general guidelines intended to educate the system integrator on potential installation and application issues that might arise when the Atlas-II controller is applied.

IMPORTANT **The Atlas-II platform must use Coder 4.05 or higher.**

Analog Inputs

The readback output on the AO_420_ATL block can be used to detect a fault condition associated with the analog output. The readback output is available on all analog output channels associated with the Atlas-II main board (A5200). The readback fault output can also be used to monitor the analog outputs. It is intended to detect a gross fault in the actual current versus current setpoint. Note that the readback output does not have the same specifications as the analog output. The readback function is intended as a gross check only. It is also recommended that application software have filtering to use multiple rate groups for readback indication before enunciating a fault.

Two of the connectors used for the analog inputs are identical. It is possible for the end user to connect the wrong connector to the wrong input. The terminals are numbered to minimize the chance of this happening however it is possible. The system integrator should take precautions to ensure that it is easy to view the terminal labels or design other methods to allow the user to easily identify the correct cable for each connector.

Analog Input cables are shielded, and shields should be terminated directly at the Atlas-II end and the cabinet entry/exit point.

Actuator Outputs

The actuator outputs on the Atlas-II main board have readback monitoring on both the source side of the current driver circuit and the return side of the circuit. The readback outputs can fault. These outputs can be used to monitor the current loop associated with the actuator for open circuit conditions. These monitoring inputs are intended to be used to detect a gross error in the actuator driver current loop. It is also recommended that application software have filtering to use multiple rate groups for readback indication before enunciating a fault.

Analog Output cables are shielded, and shields may be terminated directly (preferred) or via AC coupling at the Atlas-II end and the cabinet entry/exit point.

Discrete Inputs

Two of the connectors used for the discrete input connections are identical. It is possible for the end user to connect the wrong connector to the wrong input. The terminals are numbered to minimize the chance of this happening however it is possible. The system integrator should take precautions to ensure that it is easy to view the terminal labels or design other methods to allow the user to easily identify the correct cable for each connector.

Discrete Input cables are only required to be shielded for Marine Type Approval applications, and shielding may be limited to the cabinet interior. Cable shields should be terminated directly at the Atlas-II end and the cabinet entry/exit point.

CAN Network

The connectors used for the CAN network connections are identical. It is possible for the end user to connect the wrong connector to the wrong input. The terminals are numbered to minimize the chance of this happening however it is possible. The system integrator should take precautions to ensure that it is easy to view the terminal labels or design other methods to allow the user to easily identify the correct cable for each connector.

The CAN Network's cables are shielded, and the shield should only be directly terminated to earth at one point. The Atlas-II's CAN shield pins are AC coupled to earth and the shield may be direct connected (preferred) or AC coupled at the Atlas-II end and the cabinet entry/exit point depending on the rest of the network.

Serial Ports

The connectors used for the serial port connections are identical. It is possible for the end user to connect the wrong connector to the wrong input. The terminals are numbered to minimize the chance of this happening however it is possible. The system integrator should take precautions to ensure that it is easy to view the terminal labels or design other methods to allow the user to easily identify the correct cable for each connector.
Serial port cables are shielded and should be terminated directly at the Atlas-II end and the cabinet entry/exit point. Take care with the shield termination at the field device end.

Ethernet Connectors

The Atlas-II has four Ethernet connectors that are arranged in one connector. The physical spacing between connectors is limited. This can create the situation where it is easy to connect the wrong cable to the connector. Another consideration is that the Ethernet cables are located on the side of the controller which was not used for connections on the original Atlas PC. In certain installations, the space to access these connectors may be limited.

To mitigate the risk the system integrator should implement an Ethernet cable labeling process to allow the user to easily identify which Ethernet cable connects to each Ethernet port. The Atlas-II also has application level checks that the system integrator should be aware of when designing a system.

At the GAP application level there are functions available to monitor the Ethernet ports. The following functions can be implemented depending on the application requirements.

Ethernet Status Block (ENET_STAT)

- Monitors the number of packets received and transmitted by each physical Ethernet port.
- Provides diagnostic information about the low level Ethernet interface.

Modbus Communications

- Each Modbus interface block has a link error output that should be monitored in the GAP application and appropriate action taken when a link error occurs.
- The link error will not go FALSE unless the cables are connected properly.

EGD Communications

- The EGD interface block has a link error output that should be monitored in the GAP application and appropriate action taken when a link error timeout is detected.
- The link error will not go FALSE unless the cables are connected properly.

Ethernet Based Distributed IO

- Distributed IO interfaces will have a timeout diagnostic similar to the link error function on the communication blocks. The application programmer must ensure that the timeouts and action taken, when a timeout is detected, is appropriate for the application requirements.

Woodward Service Tools

- Woodward service tools will only work when the laptop is connected to Port1.

Ethernet port cables are shielded. Cable shields are terminated directly at the Atlas-II end and the cabinet entry/exit point. An Ethernet Field Termination Module (FTM), available from Woodward, may be used to break the shield path between the field device and the Atlas-II.

Speed Sensor Ports

Speed Sensor port cables are shielded. Cable shields are terminated directly at the Atlas-II end and the cabinet entry/exit point. Refer to the SmartCore CPU A5200 module for additional information and wiring requirements.

Installation Functional Check Guidelines

In general all IO points should be functionally tested prior to starting the prime mover. The IO points should be checked for ground loops and other possible sources of noise as well as isolation from other power sources that are not related to the specific IO circuit. These installation guidelines are given as general guidelines only. The system integrator / end user are responsible for understanding the application and defining a field checkout procedure that addresses the requirements of the system being installed.

IMPORTANT **When performing IO checkout, appropriate safety precautions must be taken to ensure that the devices being tested are properly locked out or that a safety issue is not created.**

Analog Inputs

- The field signal should be validated to ensure that the correct field signal is connected to the correct analog input channel. It is recommended that this validation is done by viewing the field signal in the GAP application.
  - ✓ Example: If the analog input comes from a pressure transducer then a pressure tester could be used to vary the analog output that is being input to the Atlas. This signal can then be verified to be correct in the GAP application.

Analog Outputs

- Analog output values should be forced from the Atlas-II controller and verified at the receiving device. Outputs should be checked at min and max current values (4 – 20 ma).
  - ✓ Example: If the analog output is used to drive an indicator then the output should be forced to several values and the indicator should be monitored to ensure that the indicator is connected to the correct analog output as defined by the GAP application.
- Verify that the total loop resistance is less than the specification limit defined in the hardware manual.

Discrete Inputs

- The field contacts should be operated to ensure that the correct field device is connected to the correct discrete input on the Atlas-II.
  - ✓ Example: If the discrete input tells the Atlas-II that a certain motor is running then the motor should be operated and the input should be viewed in the GAP software to ensure that software "sees" the change of state.
- Verify that only the 24Vdc wetting voltage is connected to the discrete inputs.
  - ✓ Check for AC by measuring all inputs from the input terminals to chassis ground.
  - ✓ Check the discrete input common with respect to other power supply commons to ensure that the discrete inputs are isolated from other power supplies that are not used with the discrete inputs.

Discrete Outputs

- The discrete outputs should be forced and the resulting signal should be confirmed at the field device.
  - ✓ Example: If the discrete output is input to another PLC then the output should be forced from the GAP logic and verified in the PLC logic. If the output drives a field device such as a motor starter then the output should be forced and verified at the motor starter. Note: Before forcing outputs to field devices verify that all necessary safety precautions are in place.

Ethernet Connections

- The Ethernet connections should be removed one at a time and expected faults should be verified in the Atlas-II software and also in the other device.
  - ✓ Example: If port 2 is connected to an HMI using the Modbus TCP protocol then removing the Ethernet cable connected to port 2 should cause a Link Error in the GAP application and a comm. fault in the HMI application.
  - ✓ Note: Due to the identical design of the Ethernet ports and the potential for similar cables, labeling is important to ensure that the user can easily identify which cable goes to each connector.

CAN Connections

- The CAN network connections should be verified to ensure that the correct networks are connected to the correct connector.
- Note: Due to the identical design of the two CAN ports and the potential for similar cables, labeling is important to ensure that the user can easily identify which network is connected to the CAN connectors.

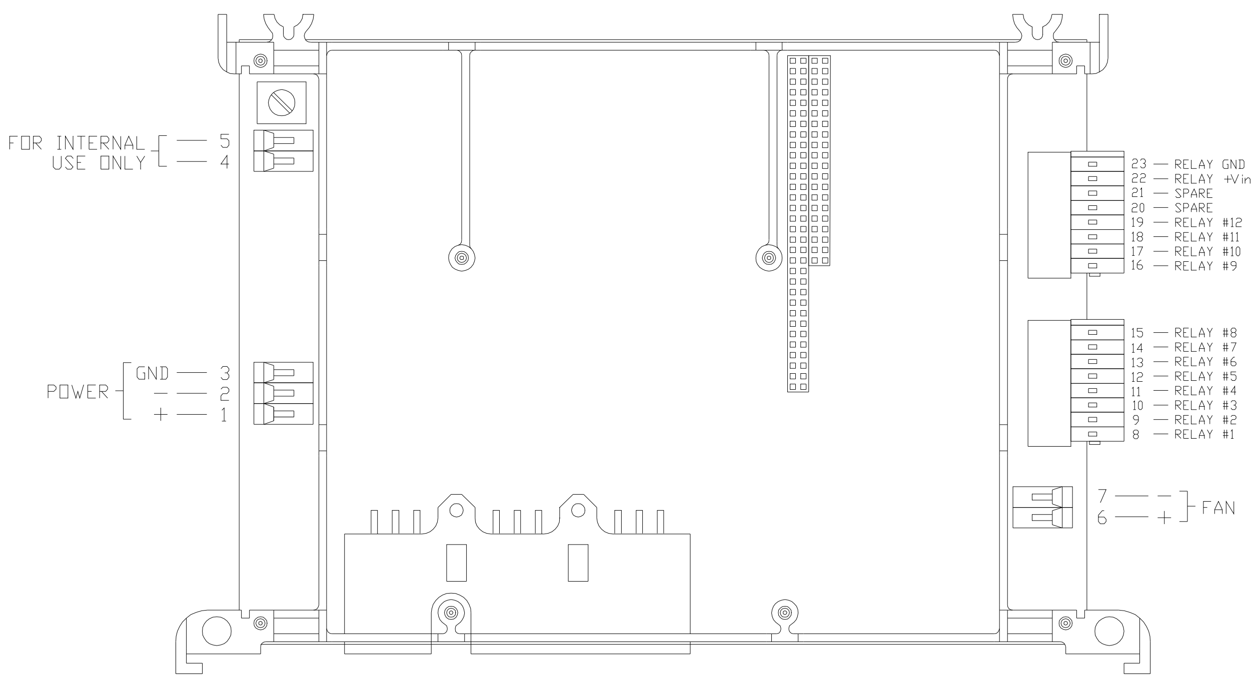
Chapter 3.
Power Supply Board

General Description

The Atlas-II power supply contains the power supply and twelve discrete output driver channels. The discrete outputs are low-side drivers having short circuit and thermal shutdown protection. The discrete output drivers are not isolated from each other, and are powered by an external +12 Vdc or +24 Vdc. They are isolated from the internal power supplies of the Atlas-II Control platform.

Input power connections are made to the power supply through terminals on the front of the power supply.

⚠WARNING	**The Atlas-II power supply board must have the input power removed before installing or removing.** **This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, and D, Zone 2, Group IIC, or non-hazardous locations only.** **Wiring must be in accordance with Class I, Division 2 or Zone 2 wiring methods and in accordance with the authority having jurisdiction.**



855-741B
02-11-21

Figure 3-1. Atlas-II Power Supply Board (601-1008)

Table 3-1. Specifications

Power Supply Input (Power Supply Board)	
Range:	18–32 Vdc
Input Current:	2.7 A @ 24 Vdc 3.61 A @ 18 Vdc
Input Power:	less than 65 W at 70 °C
Interrupt Time Holdup:	8 ms @ >/= 24 V
Efficiency	70% minimum over operating input voltage range
Reverse Polarity Protection	56 V
Input Wiring Constraints	The Atlas-II control platform must be wired such that no other device receives power from the wiring between the Atlas-II Control Platform and the power supply source.
Discrete Output Drivers (Power Supply Board)	
Number of channels:	12
Type:	Low-side driver with short circuit and overvoltage protection
Current Drive Rating:	200 mA
Discrete Output Supply Voltage:	9–32 V
Power Supply Monitoring Circuit (Power Supply Board)	
LVdc Maximum voltage measured:	35 Vdc
Resolution in Volts:	0.15 Vdc
Maximum Error due to temperature change:	1.0 Vdc
Maximum Error due to load change:	1.0 Vdc
Total maximum error at 25 °C (over 15 to 35 V range):	1.2 Vdc

Electric Shock

The Atlas-II control platform shall not present an electrical shock hazard to the operator or maintenance personnel when used in a normal manner per the National Electrical Code Handbook, ANSI/NFPA 70 HANDBOOK-1990. Safety is ensured by certification through the safety agencies specified in the “Regulatory Compliance” section of this document.

Troubleshooting Guide

Power Supply Checks

The following is a troubleshooting guide for checking areas, which may present difficulties. If these checks are made prior to contacting Woodward for technical assistance, system problems can be more quickly and accurately assessed.

- Is the input voltage within the control’s specified input voltage range (measured at control power supply input)?
- Is the input power free of switching noise or transient spikes?
- Is the power circuit dedicated to the Atlas-II control only?

Discrete Output Checks

The Atlas-II power supply contains twelve discrete output driver channels. The discrete outputs are low-side drivers having short circuit and thermal shutdown protection. The discrete output drivers are not isolated from each other, and are powered by an external +12 Vdc or +24 Vdc. They are isolated from the internal power supplies of the Atlas-II Control platform.

- Is the input power within the range of 9–32 V?
- Is the input free of switching noise or transient spikes?
- Is the power circuit dedicated to the control only?
- Are the individual discrete output lines current limited by external series connected components (example: relay coils) to <200 mA?

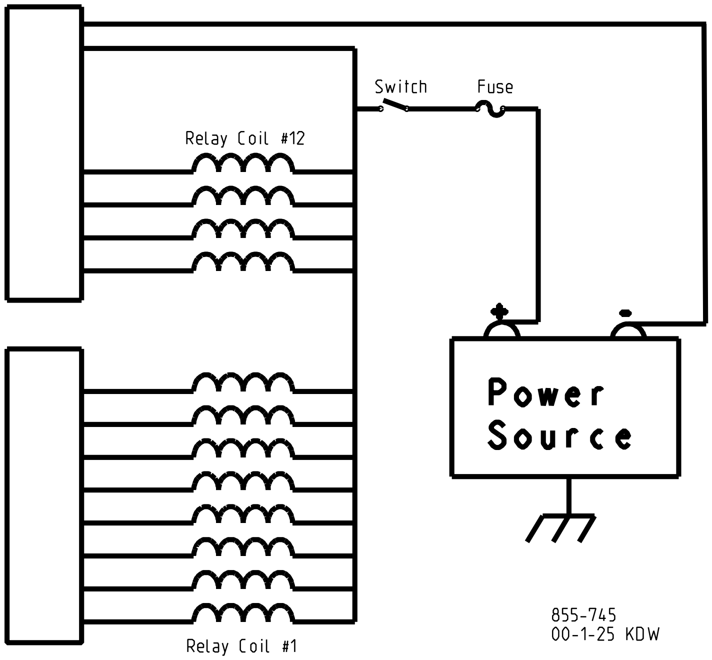


Figure 3-2. Discrete Output Wiring Example
(Discrete Output Interface Wiring to the Power Supply Board)

⚠WARNING	**When used in a Class I, Div. 2 or ATEX application the Power Supply used to provide the +12/24Vdc Relay Driver Input Voltage must be listed to the appropriate Hazardous Location or ATEX standard. The power input must be isolated from the Chassis and a minimum of 500Vac as shown in Figure 3.2.**

Configuration Notes

- Refer to Figure 3-2 for discrete output wiring.
- Discrete outputs are not normally shielded, however may be shielded and are required to be shielded for Marine Type Approval applications.
  - When shielding cables, shield at least from the Atlas-II to the cabinet entry/exit point. Terminate the shield directly to the cabinet at the entry/exit point and Atlas-II.
- The discrete output commons are tied together, so each power supply board accepts only one voltage source.
- Power for the discrete outputs must be externally supplied, the external supply must be capable of supplying a voltage between 9–32 V while supplying up to 2.5 A. As specified in the Input Power Wiring Section, branch circuit protection of no more than 250% of the maximum rated current of the load (Discrete Output power input current plus 12 times the maximum Discrete Output channel current) shall be provided. Fuse current rating should not exceed 6.25 A (time delay fuses are recommended).
- Chapter 7 contains a relay module that can be used with these discrete outputs.

IMPORTANT	**Shielding of relay (discrete) output wires inside the metal enclosure is required for Marine Type Approval installation applications. Relay outputs do not normally require shielding for other installations, but may be shielded if desired.**

Chapter 4.
SmartCore CPU A5200 Board

General Description

The SmartCore CPU A5200 board contains 4 Ethernet communication ports as well as circuitry for 2 speed sensor inputs, 6 analog inputs, 4 analog outputs, 2 proportional actuator drivers, 2 CAN communication ports, 2 isolated serial ports, 1 debug serial port (isolated), and 24 discrete inputs. Each speed sensor input may be either from a magnetic pick-up or a proximity probe. Analog input and output circuits are 4–20 mA. The actuator driver outputs may be configured as either 4–20 mA or 20–220 mA. The user serial ports are configurable as RS-232, RS-422, or RS-485.

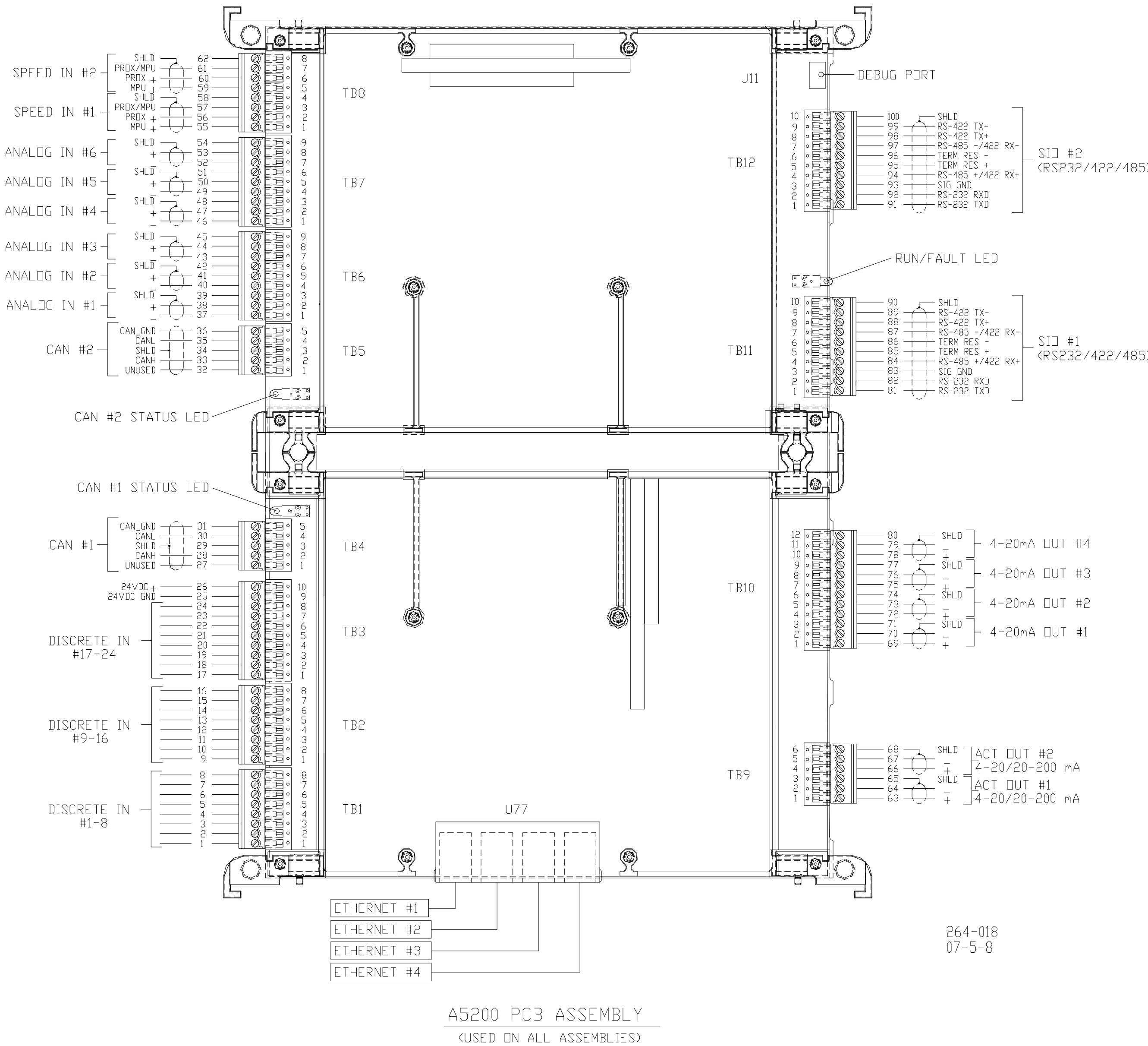


Figure 4-1. SmartCore CPU A5200 board, Connectors

Features

- 5 ms update rate
- On-board processor for automatic calibration of the I/O channels
- PowerPC 5200, low power version
- 64 MB DDR-266 MHz, DRAM
- 8/16 bit PC/104 Interface (ISA bus)

Communications

- (4) RJ45 10/100 Base-TX Ethernet
- (2) isolated CAN ports
- (2) isolated and configurable RS-232 / RS-422 / RS485 Serial ports, 115.2K baud max
- (1) isolated RS-232 Debug Service Port

Hardware I/O

- (24) Discrete inputs
- (2) Speed Sensor Inputs (MPU / Proximity), 16 bit minimum resolution
- (6) Analog inputs have 16 bit resolution
- (4) Analog outputs have 15 bit resolution
- (2) Actuator outputs with 15 bit resolution

Block Diagram

The Atlas-II boards connect to each other through either the PC/104 bus connectors or the power bus connectors. All of the boards are held together and to the chassis, by bolts. The SmartCore CPU A5200 board is the size of two analog boards.

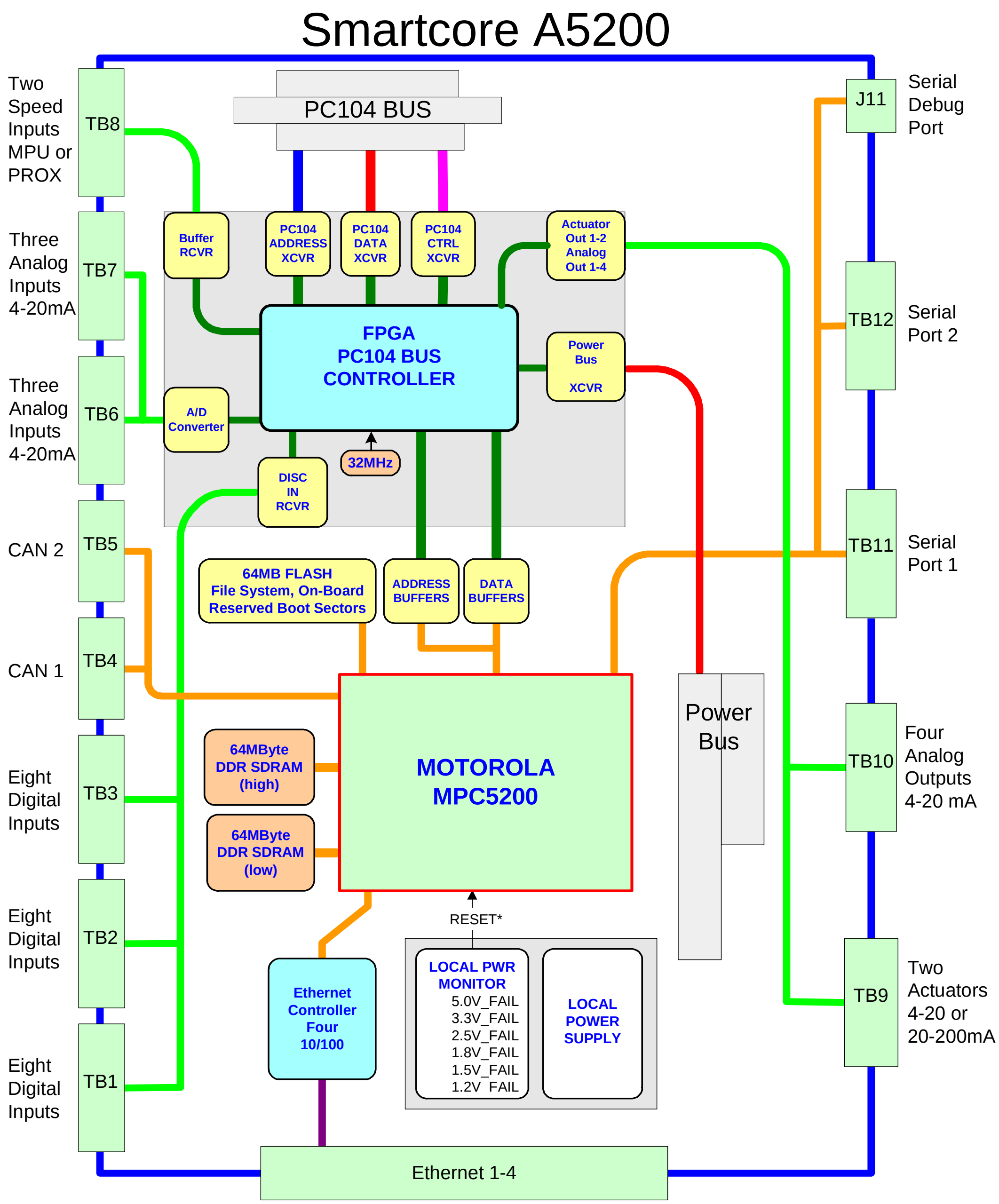


Figure 4-2. Block Diagram—Atlas-II SmartCore CPU A5200 Board

Module Configuration

Hardware Configuration. This module is factory configured as module 1 of the Atlas platform. No user hardware configuration is necessary.

Network Configuration. Ethernet port #1 can be re-configured for the customer network as desired. See the on-site Network Administrator to define an appropriate I/P address configuration for port #1. Please note that each Ethernet port is required to be on a separate domain.

IMPORTANT

This module has been factory configured with fixed Ethernet IP addresses of:

- **Ethernet #1 = 172.16.100.20, Subnet Mask = 255.255.0.0**
- **Ethernet #2 = 192.168.128.20, Subnet Mask = 255.255.255.0**
- **Ethernet #3 = 192.168.129.21, Subnet Mask = 255.255.255.0**
- **Ethernet #4 = 192.168.130.22, Subnet Mask = 255.255.255.0**

Network Configuration Utility (AppManager)

Woodward's *AppManager* software can be used to load GAP Control software, monitor diagnostic faults, and configure Network settings. The *AppManager* utility can be downloaded from **www.woodward.com/software**. A PC to Atlas-II connection must be made using an Ethernet cable and Ethernet port #1.

- Locate the Atlas-II ControlName on the chassis and highlight it using *AppManager*.
- To VIEW the IP address configuration, select menu option CONTROL - CONTROL INFORMATION. Look for the Ethernet adapter addresses under the Footprint Description.
- To CHANGE the IP address configuration, select menu option CONTROL - CHANGE NETWORK SETTINGS.

Module Indicators (LEDs)

The SmartCore CPU A5200 module has the following LEDs.

Table 4-1. SmartCore CPU A5200 LED Names and Descriptions

LED	Name	Description
RD FAULT GR RUN	FAULT	CPU FAULT (RED)—Active upon reset and flashes CPU fault codes as necessary.
	RUN	RUN (GREEN)—Active GREEN after the CPU Operating system is loaded and running.
ETH G LINK Y TX/RX	LINK	LINK ACTIVE (GREEN)—A valid Ethernet connection to another device exists
	TX/RX	TX/RX (YELLOW)—Active YELLOW when data is transmitted or received.
CAN LED's GR RD	CAN #1, #2	CAN #1, #2 (GREEN/RED)—Active GREEN or RED when data is transmitted or received through CAN port #1 or #2.

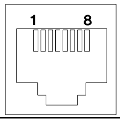
10/100 BaseT Ethernet Ports

There are four 10/100 BaseT Ethernet Ports (RJ45) available to the application software. These ports are full duplex, auto switching, and do not require the use of an Ethernet shield box.

IMPORTANT

Max cable length is 30 meters. Double shielded, Cat 5 Ethernet cables (SSTP) are required for customer installations.

Table 4-2. Ethernet Port Pinout

Connector	Signal Mnemonic
RJ45F 	Shielded RJ45 female receptacle
1	RX+
2	RX-
3	TX+
4	--
5	--
6	TX-
7	--
8	--
Shield	Chassis EARTH

RS-232/422/485 Serial Ports

Two isolated, pluggable RS-232 / 422 / 485 serial ports (SIO1, SIO2) are available for customer use and can be configured by the GAP software application. The baud rate is selectable from 300 baud to 115.2 kBaud. Shielded cable is required when connecting to the CPU module's serial port. Using shielded cable will help ensure the robustness of the serial communications.

Pin 1 – RS-232 Transmit
Pin 2 – RS-232 Receive
Pin 3 – Signal Ground
Pin 4 – RS-485/422 Receive (+)
Pin 5 – Termination Resistor (+)
Pin 6 – Termination Resistor (–)
Pin 7 – RS-485/422 Receive (–)
Pin 8 – RS-422 Transmit (+)
Pin 9 – RS-422 Transmit (–)
Pin 10 – Chassis EARTH

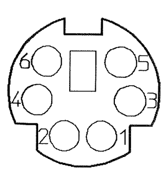
Figure 4-3. SmartCore CPU A5200 Communications Ports (SIO1, SIO2)

RS-232 Service Port

An isolated RS-232 service port is located near one corner of the A5200 CPU module. This port is for VxWorks operating system use only and cannot be configured for application software use. The communication settings are fixed at 38.4 kBaud, 8 data bits, no parity, 1 stop-bit, and no flow control.

For debug use, a null-modem cable and 5450-1065 Serial Adapter cable (PS2M to DB9F) is required to attach this port to a PC. This port is to be used by trained Field Service personnel only!

Shielded cable is required when connecting to the Service Port. Using shielded cable will help ensure the robustness of the serial communications.



Pin 1 – RS-232 Receive
Pin 2 – RS-232 Transmit
Pin 3 – Signal Ground
Pin 4 – Not Used
Pin 5 – Signal Ground
Pin 6 – Not Used
Connector Shell – Chassis EARTH

Figure 4-4. CPU Service Port (mini-DIN6F)

CAN Communication Ports

Two CAN ports (5 pin pluggable connectors, screw down) are available for communication with Woodward Valves and other CAN devices. A maximum of 15 Woodward valves configured for operation in the 10 ms rate group may be used.

Pin 1 – not used
Pin 2 – CAN High (white)
Pin 3 – CAN Shield (14Meg + AC coupled to EARTH)
Pin 4 – CAN Low (blue)
Pin 5 – CAN Signal Ground (black)

Figure 4-5. CAN Communication Ports

CAN networks must include 120Ω terminations at each end of the trunk line. Drop cables connecting a device to the trunk line should be as short as possible and less than six meters. It is recommended to design the network to be less than 100 meters with a max cumulative drop length of less than 39 meters.

Table 4-3. CAN Network Cable Specifications

Network Speed	Max Trunk Length (Thick cable)	Max Trunk Length (Thin cable)	Max Drop Length	Max Cumulative Drop Length
500 Kbps	100 m	100 m	6 m	39 m
250 Kbps	250 m	100 m	6 m	78 m
125 Kbps	500 m	100 m	6 m	156 m

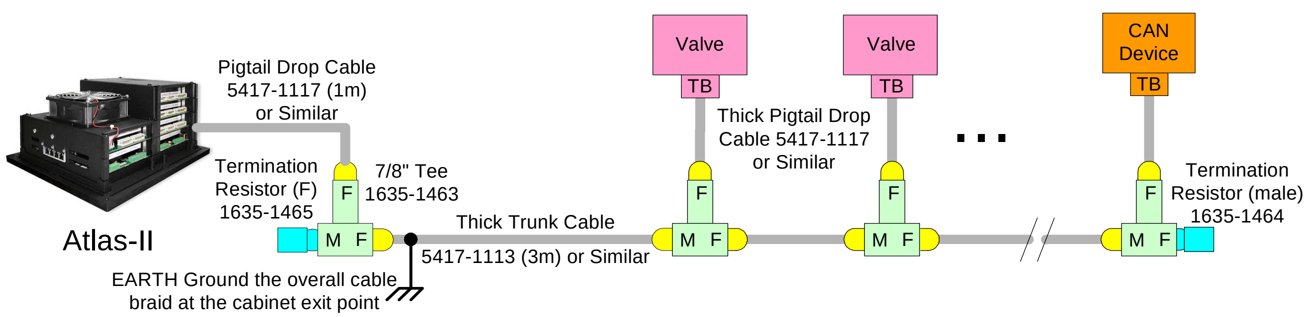
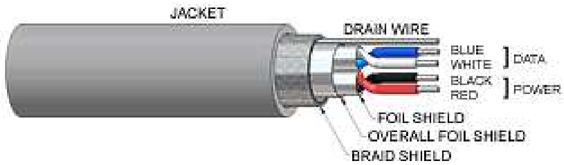


Figure 4-6. CAN Network Multidrop

CAN Cable Specification

Thick cable is preferred and recommended for all uses. Most CAN / DeviceNet cable is not rated for temperatures above 80 °C so be careful during installation to avoid hot routing areas. Always use shielded cables for improved communications in industrial environments.

Table 4-4. CAN Cable Specification



Impedance:	120Ω ±10% at 1MHz
DC resistance:	< 7ohms per 1000 ft.
Cable capacitance:	12 pF/ft at 1kHz
Propagation delay	1.36 ns/ft (maximum)
Data Pair:	19 strands, 1.0 mm² corresponds to 18 AWG, individually tinned, 3 twists/foot
Power Pair:	19 strands, 1.5 mm² corresponds to 15 AWG, individually tinned, 3 twists/foot
Drain / Shield Wire:	19 strands Tinned Copper shielding braid or shielding braid and foil
Cable type:	Twisted pair cable. 2x2 lines
Bend Radius:	20x diameter during installation or 7x diameter fixed position
Signal attenuation:	0.13 dB/100 ft @ 125 kHz (maximum) 0.25 dB/100 ft @ 500 kHz (maximum) 0.40 dB/100 ft @ 1000 kHz (maximum)

Recommended Bulk Cable

Cable manufacturer Turck and Belden are widely available in North America. Turck, Lumberg, and Lapp Cable products are available in Europe. All cables below are suitable for DeviceNet trunk and drop cabling. Be aware that cable vendors may not use the same wire colors on individual conductors.

Table 4-5. Recommended Bulk Cable Manufactures and Part Numbers

Manufacturer	Part Number	Website
Belden	3082A DeviceNet Thick Cable–Grey	www.belden.com
Belden	3083A DeviceNet Thick Cable–Yellow	www.belden.com
Lapp Cable	2710-250 Unitronic DeviceNet Thick	www.lappcable.com
Lumberg	STL 613	www.lumbergusa.com
Turck	Type 575, DeviceNet Thick Cable – Grey	www.turck.com

***Note:** Turck and Lumberg can also provide custom length cordsets with connectors.

Hardware Specifications

Table 4-6. Digital Speed Sensor Inputs

Number of channels	2, selectable as MPU or proximity probe, by terminal block wiring and correct software switches
Input frequency	100–25 000 Hz (MPU), 0.5-25 000 Hz (Prox) (25 kHz is the max reading available using the TSS_ATL GAP block)
Input frequency (max)	25 000 Hz
Resolution	Dependent on frequency, 16 bit minimum at maximum speed
Accuracy	Less than ±0.08% full scale from –40 to +85 °C internal temperature

Shielded cable is required when connecting to the Digital Speed Sensor Inputs.

Table 4-7. MPU Inputs

Input magnitude (min)	See Figure 4-6
Input magnitude (max)	See Figure 4-7
Input impedance (typ)	See Figure 4-8
Input impedance (min)	1450 Ohm at 1 Vrms and 100 to 25 000 Hz input
Input impedance (min)	450 Ohm at 14.6 Vrms and 100 to 300 Hz input
Input impedance (min)	1450 Ohm at 14.6 Vrms and 301 to 25 000 Hz input
Isolation voltage	500 Vac minimum, each channel is isolated from all other channels and from the Atlas-II platform

IMPORTANT **When choosing to wire either a MPU or proximity speed input, make sure the unused MPU/PROX(+) terminal block input is shorted to MPU/PROX (–).**

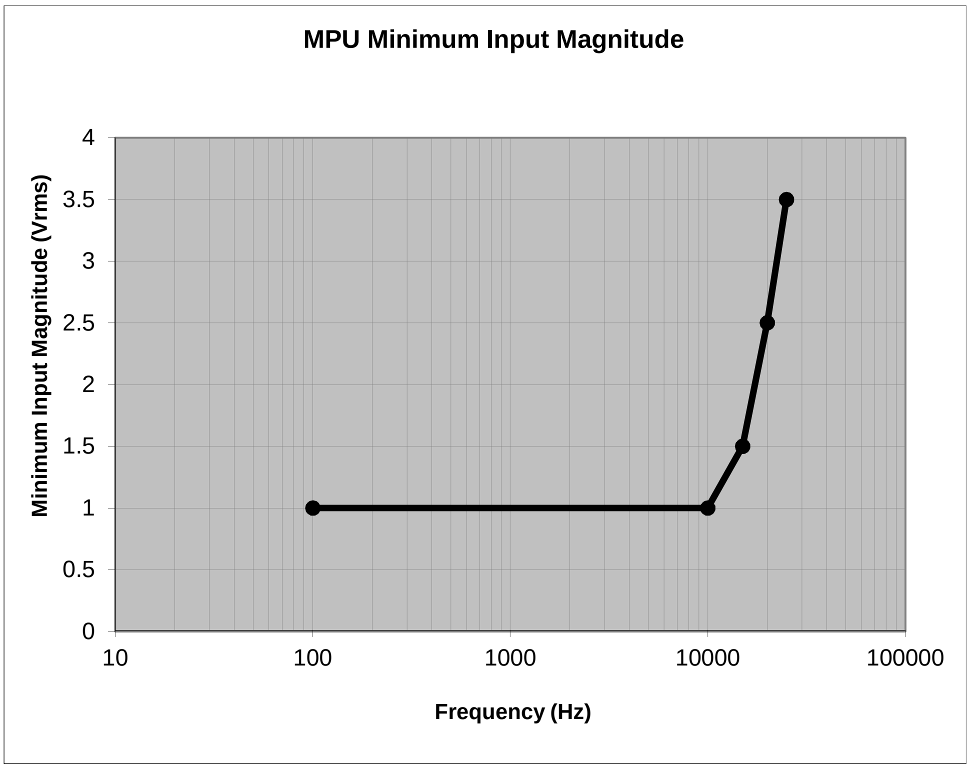


Figure 4-7. MPU Minimum Input Magnitude in Vrms
To convert to V peak to peak, multiply by 2.828.

Released

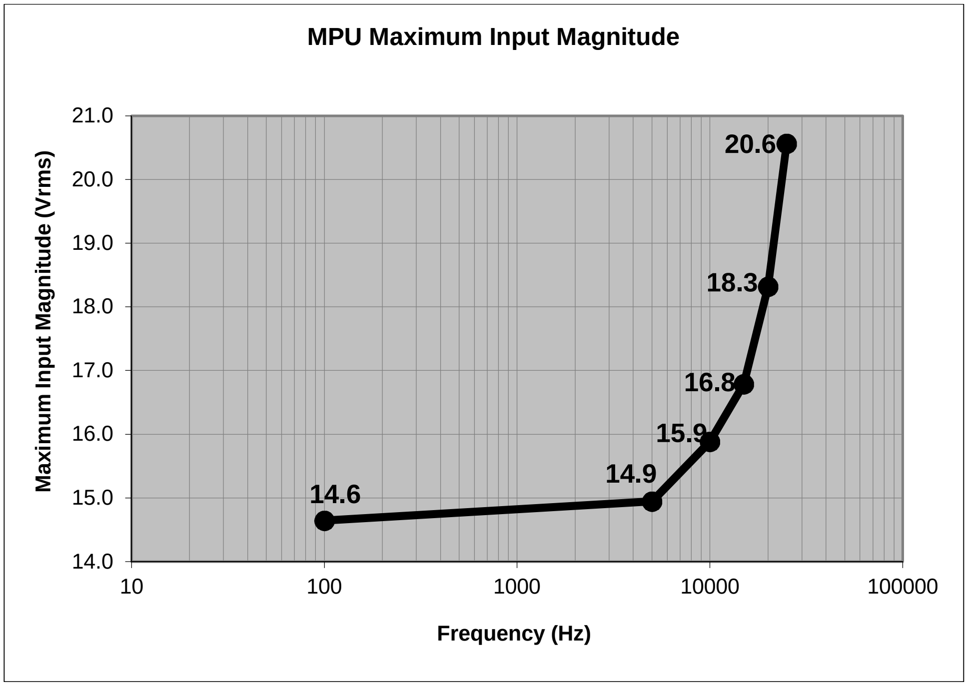


Figure 4-8. MPU Maximum Input Magnitude in Vrms
To convert to V peak to peak, multiply by 2.828.

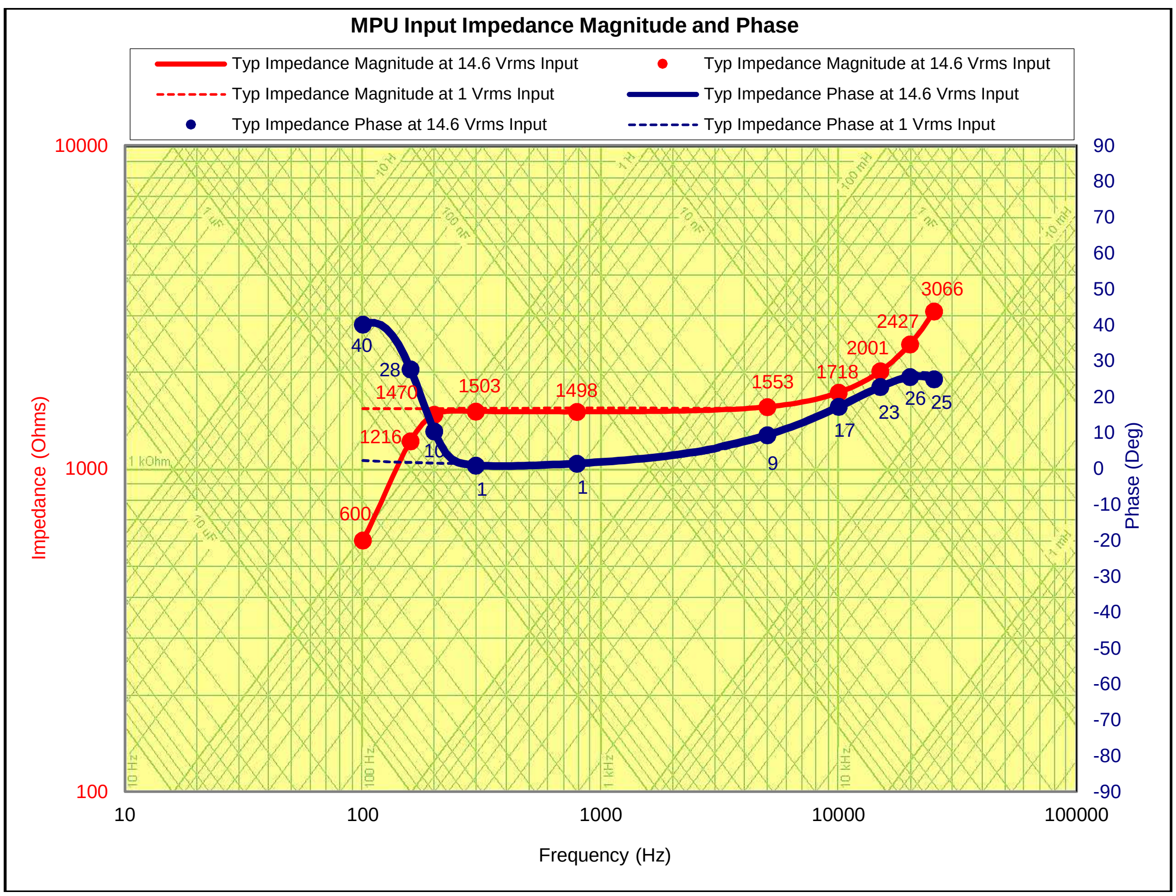


Figure 4-9. MPU Typical Input Impedance Magnitude and Phase

Table 4-8. Proximity Probe Inputs

Voltage threshold /duty cycle at 5 kHz	at 16 Vin, duty cycle = 3.5–96.5% at 24 Vin, duty cycle = 3.5–96.5% at 28 Vin, duty cycle = 3.5–96.5%
Voltage threshold /duty cycle at 25 kHz	at 16 Vin, duty cycle = 17.5-82.5% at 24 Vin, duty cycle = 17.5-82.5% at 28 Vin, duty cycle = 17.5-82.5%
Input threshold (V low)	< 8 Vdc
Input threshold (V high)	> 16 Vdc
Input voltage (V high range)	16–28 Vdc
Minimum Input Resistance (Ohm) @ 8V	37730
Minimum Input Resistance (Ohm) @ 16V	7160
Minimum Input Resistance (Ohm) @ 28V	4190
Available power	none
Isolation	500 Vac minimum, each channel is isolated from all other channels and from the Atlas-II platform
Input frequency	0.5–25 000 Hz

- A derivative output is provided to the application software. Generally, the derivative error increases with frequency input. The typical six-sigma performance with input frequencies < 5000 Hz is better than 8 Hz/s. The typical six-sigma performance with input frequencies > 5000 Hz is better than 24 Hz/s.
  Note: Field wiring may introduce additional signal error due to cable length, cable routing, and other sources.
- No proximity probe power is provided.

IMPORTANT — **When choosing to wire either a MPU or proximity speed input, make sure the unused MPU/PROX(+) terminal block input is shorted to MPU/PROX (–).**

Table 4-9. Analog Inputs

Number of channels	6
Input type	4–20 mA , (full scale = 24 mA)
Max. input current	> 23 mA
Max. input voltage	24V @ 25 °C
Common mode rejection	80 dB minimum
Input common mode range	±40 V minimum
Safe input common mode volt	±40 V minimum
Input impedance	211 Ω (±1.3%)
Anti-aliasing filter (ch1-4)	2 poles at 10 ms
Anti-aliasing filter (ch5-6)	2 poles at 5 ms
Resolution	Greater than 16 bits
Accuracy @ 25 °C	less than ±0.1% of full scale
Temp Drift	171 ppm/°C, maximum (1.1% of full scale, 0.275 mA) 30 ppm/°C, typical (0.20% of full scale, 0.05 mA)
I/O Latency	1 ms

Shielded cable is required when connecting to the Analog Inputs.

- Loop power for the analog inputs is NOT available.
- Only 4–20 mA inputs are supported. This is a change from the previous SmartCore module that allowed both current and voltage inputs.

IMPORTANT **External loop powered transducers must be individually protected with a 100 mA fuse on each channel.**

Table 4-10. Analog Outputs

Number of channels	4
Output type	4–20 mA outputs, non-isolated, (full scale = 25mA)
Common Mode Voltage	15 Vdc ±10%
Max current output	25 mA ±5%
Min. load resistance	0 Ω
Max load resistance	300 Ω at 22 mA
Resolution	15 bits of full scale
Accuracy @ 25 °C	less than ±0.1% of full scale
Readback Accuracy @ 25 °C	±1% of full scale
Temperature Drift	140 PPM/°C, maximum (±0.23 mA) 70 ppm/°C, typical (±0.45% of full scale, 0.1125 mA)

Shielded cable is required when connecting to the Analog Outputs.

Table 4-11. Actuator Outputs

Number of channels	2	
Actuator Type	Proportional, non-isolated,	
Output Type	4-20 or 20-200 mA, software selectable (full scale = 31 mA or 233 mA)	
Isolation	None	
Max current output	27 mA +10% 218 mA +10%	(20-200 mA range) (4-20 mA range)
Min. load resistance	10 Ω	
Max load resistance	300 Ω at 22 mA 40 Ω at 200 mA	(20-200 mA range) (4-20 mA range)
Resolution	15 bits of full scale	
Accuracy @ 25 °C	less than ±0.1% of full scale 0.029 mA 0.220 mA	 (20-200 mA range) (4-20 mA range)
Readback Accuracy @ 25 °C	±1.0 % of full scale	
Temperature Drift	140 PPM/°C maximum 0.26 mA maximum 2.00 mA maximum 70 ppm/°C typical 0.13 mA 1.00 mA	 (4-20 mA range) (20-200 mA range) 0.45% of full scale, (4-20 mA range) (20-200 mA range)
Readbacks	Actuator source and return currents	
Dither Current	25 Hz, fixed duty cycle, software variable amplitude	

Shielded cable is required when connecting to the Actuator Outputs.

Table 4-12. Discrete Inputs

Number of channels	24
Input type	Optically isolated discrete input
Input thresholds	< 8 Vdc = "OFF" > 16 Vdc = "ON"
Input current	3 mA @ 24 Vdc
Contact voltage	24 Vdc isolated output (100 mA max, internally protected)
Max input voltage	28 Vdc
Isolation voltage	500 Vac, all channels are isolated from the Atlas-II platform

Shielded cable is only required when connecting to the Discrete Inputs and it is a Marine Type Approval installation.

- For EMC compliance, the on-board, isolated, +24 Vdc supply is recommended for use as power to contacts, 100 mA maximum.
- All channels are common to each other. Isolation is with respect to the Atlas-II platform and other I/O types.

Table 4-13. Serial I/O

Number of channels	3 isolated ports, 115.2K max
Channel configuration	1 - RS-232 Debug Port (PS2 style, mini-DIN6F connector) 2 - RS-232/RS-485/RS-422 software configurable, terminal block connections
Termination Resistor	Located on the board and are accessible via field wiring. Termination resistors are provided for RS-485 and RS-422 Receive.
Isolation Voltage	500 Vdc

Shielded cable is required when connecting to the Serial I/O.

SmartCore CPU A5200 Board Operation

This board includes no potentiometers and requires no field calibration.

Speed Sensor Inputs

The MPU and proximity probe inputs are read and the speed is provided to the application program. A derivative output is also provided. The speed sensor inputs are filtered by the SmartCore CPU A5200 board with the filter time constant being selectable in GAP software between 5 and 160 ms. Eight milliseconds should be acceptable for most turbine applications, while 16 milliseconds may be necessary for very slow speed applications. The speed range is selected in the application software and determines the maximum speed that the board will detect. The control output of the software will detect a minimum speed of one fiftieth of the speed range. This allows detection of failed speed sensors to help prevent overspeed due to slow update times at very low speeds. The monitor output of the GAP block will read down to 0.5 Hz, regardless of the speed range. An application may use any combination of accepted MPU and proximity probes, and any combination of speed ranges.

The SmartCore CPU A5200 board uses speed sensing probes mounted on a gear connected or coupled to the turbine's rotor to sense turbine rotor speed. Either of the A5200 board's speed channels accept passive magnetic pickup units (MPUs) or proximity probes.

It is not recommended that gears mounted on an auxiliary shaft coupled to the rotor be used to sense speed. Auxiliary shafts tend to turn more slowly than the rotor (reducing speed sensing resolution) and have coupling gear backlash, resulting in less than optimum speed control. For safety purposes, it is also not recommended that the speed sensing device sense speed from a gear coupled to a generator or mechanical drive side of a system's rotor coupling.

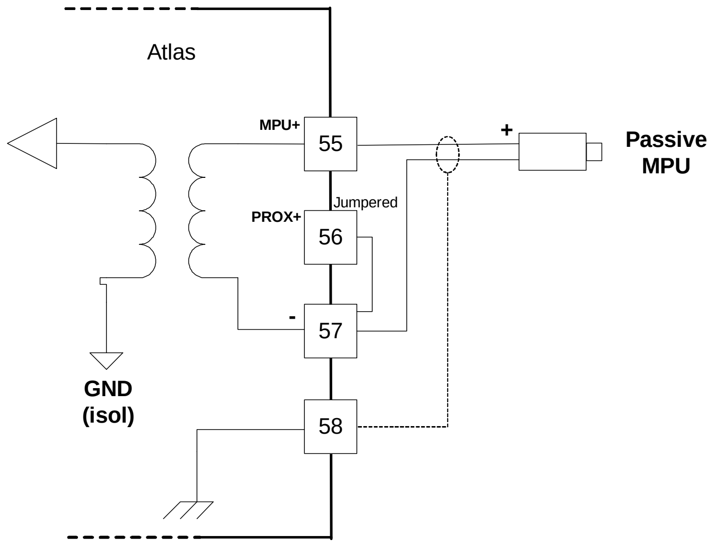


Figure 4-10. Wiring Example–MPU Interface to the SmartCore Board

A proximity probe may be used to sense very low speeds. With a proximity probe, speed can be sensed down to 0.5 Hz. When interfacing to open collector type proximity probes, a pull-up resistor is required between the supplied proximity probe voltage and the proximity probe input to the SmartCore CPU A5200 board.

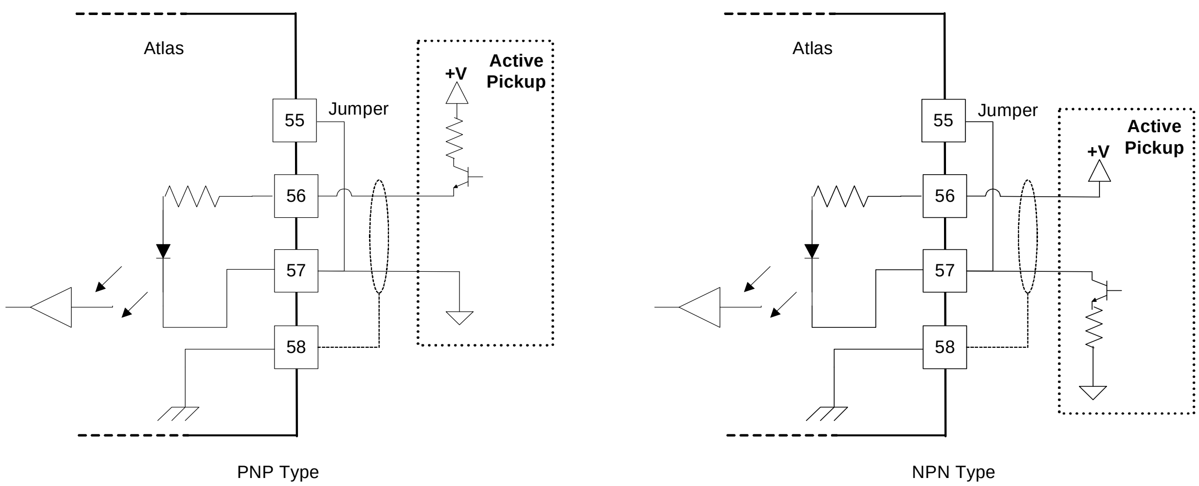


Figure 4-11. Wiring Example–Open Collector Proximity Probe to the SmartCore CPU A5200 Board

Configuration Notes

- Refer to Figures 4-9 and 4-10 for speed sensor wiring.
- Each speed input channel can only accept one MPU or one proximity probe.
- Proximity probe power is not provided.
- Proximity probes only—External pull-up resistors are required when interfacing to open collector type proximity probes.
- If the proximity probe inputs are used, the corresponding MPU inputs must be jumpered as shown.

Speed Sensor Input Software Configuration Limitations

- (TxMxR)/60 must be < 25 000 Hz
  T = gear teeth
  M = (overspeed test limit setting x 1.2)
  R = gear ratio

Analog Inputs

The analog inputs accepts a 4-20 mA current signal and may be used with two-wire ungrounded (loop powered) transducers or isolated (self-powered) transducers. All Analog inputs have greater than 40 Vdc of common mode rejection. If interfacing to a non-isolated device, which may have the potential of reaching over 40 Vdc with respect to the control's common, the use of a loop isolator is recommended to break any return current paths, which could produce erroneous readings.

For a 4–20 mA input signal, the SmartCore CPU A5200 board uses a 211 Ω resistor across the input.

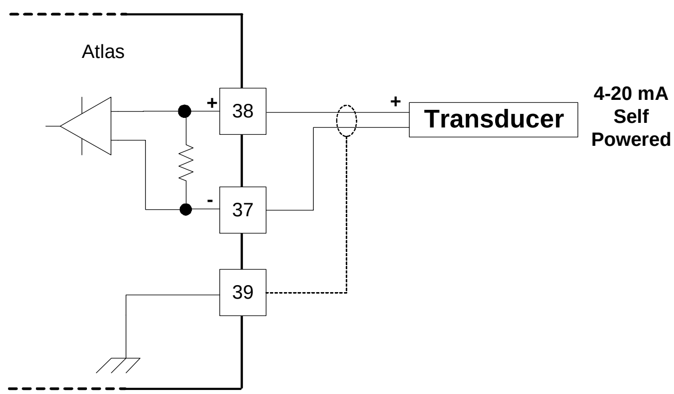


Figure 4-12a. Wiring Example–4–20 mA Input Interface to the SmartCore CPU A5200 Board

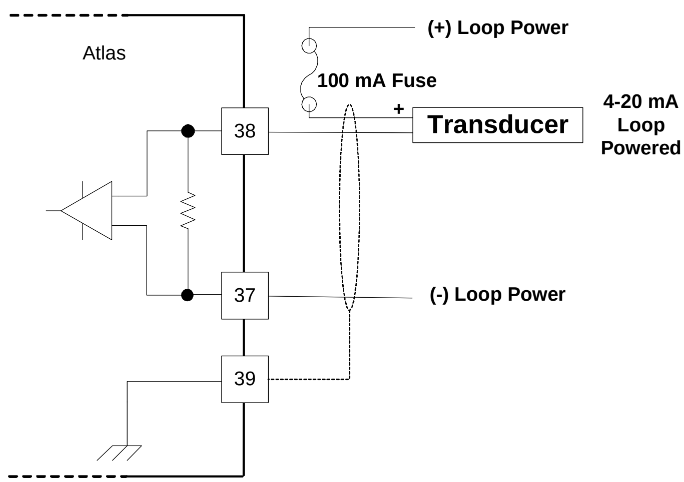


Figure 4-12b. Wiring Example–4–20 mA Input Interface using External Loop Power

Configuration Notes

- Refer to Figures 4-11a, b for analog input wiring.
- All 4-20 mA inputs have an input impedance of 211 Ω.
- Loop power is NOT provided by the Atlas control, it must be sourced externally.

IMPORTANT	**External loop powered transducers must be individually protected with a 100 mA fuse on each channel.**

Analog Outputs

The analog outputs are 4–20 mA with a full scale range of 0–25 mA. The SmartCore CPU A5200 board has four analog outputs.

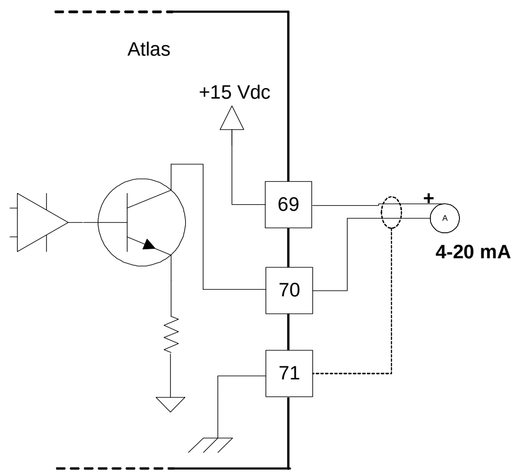


Figure 4-13. Wiring Example–Analog Output Interface to the SmartCore CPU A5200 Board

Configuration Notes

- Refer to Figure 4-12 for analog output wiring.
- Only 4–20 mA signals are output.
- See the specifications section for the maximum analog output load.
- Care should be taken to prevent ground loops and other faults when interfacing to non-isolated devices.
- Each output provides readback capability that can be used to detect field wiring or device faults as needed.
- The analog outputs have a 15 V common mode voltage, with respect to Atlas-II control common.

NOTICE

Avoid misconnection of the Analog Output (+) to the Actuator Output (–). This will damage internal components, making the control inoperable.

NOTICE

Signal Isolators should be used when connecting to non-isolated field devices greater than 30 meters away.

Beware of Analog and Actuator output connections to non-isolated field devices that are located greater than 30 meters away from the Atlas-II Control. Ground potentials between different locations can be severe enough under certain EMC/Surge events to cause control malfunction.

Actuator Outputs

The (2) proportional actuator driver outputs are software configurable as either 4-20 mA or 20-200 mA with a full scale range of 0–31 mA or 0-233 mA. Each driver output provides both current source and return readbacks that can assist in troubleshooting and detection of field wiring or device failures.

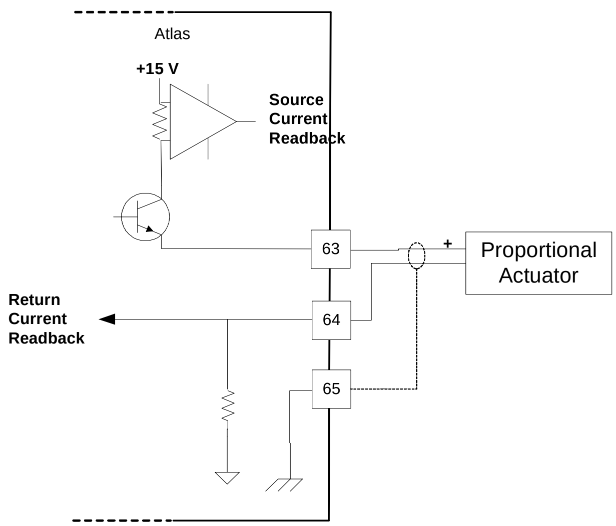


Figure 4-14. Wiring Example–Actuator Output Interface to the SmartCore CPU A5200 Board

Configuration Notes

- Refer to Figure 4-13 for actuator output wiring.
- 4–20 mA or 20-200 mA signals are output.
- See the specifications section for the maximum actuator output load.
- Care should be taken to prevent ground loops and other faults when interfacing to non-isolated devices.
- Application software selects the actuator type, the output range, and the dither amount.
- Each output provides readback capability that can be used to detect field wiring or device faults as needed.

NOTICE

Avoid misconnection of the Analog Output (+) to the Actuator Output (–). This will damage internal components, making the control inoperable.

NOTICE

Signal Isolators should be used when connecting to non-isolated field devices greater than 30 meters away.

Beware of Analog and Actuator output connections to non-isolated field devices that are located greater than 30 meters away from the Atlas-II Control. Ground potentials between different locations can be severe enough under certain EMC/Surge events to cause control malfunction.

Discrete Inputs

The SmartCore CPU A5200 board accepts 24 discrete inputs. Contact wetting voltage may be supplied by the SmartCore CPU A5200 card. Optionally, an external 18–28 Vdc power source can be used to source the circuit wetting voltage.

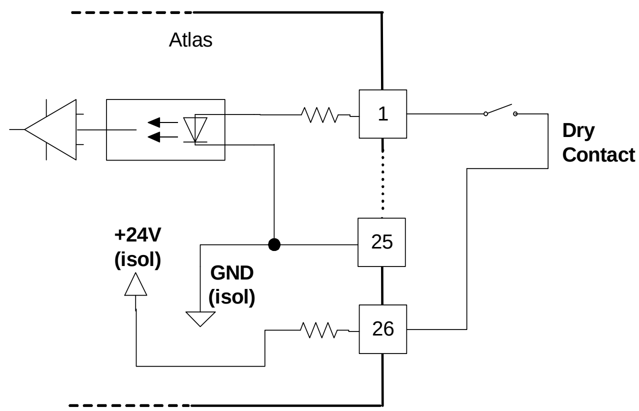


Figure 4-15. Wiring Example–Discrete Input Interface to the SmartCore CPU A5200 Board

Configuration Notes

- Refer to Figure 4-15 for discrete input wiring.
- The discrete input commons are tied together, so each SmartCore CPU A5200 board accepts only one voltage source, which can be internally or externally supplied.
- All contact inputs accept dry contacts.
- If an external power supply is used, it must be rated to 28 Vdc max from Class 2 type source for North America (SELV type source for applications outside North America). Power supply outputs must be fused with appropriately sized fuses (a maximum, current rating of 100 ÷ V, where V is the supply's rated voltage, or 5 A, whichever is less).
- The 24 V isolated contact power is protected by a 0.3 A poly switch that is rated for 0.1A continuous use. This may not prevent interruption in control operation due to a short in the field wiring, but should protect the control from damage. The poly switch will reset itself when the short condition is resolved.
- If unused (floated) Discrete Inputs have an extended cable length attached for future use, they must be ignored in software. Events such as large transient pulses near the unused cable can cause them to momentarily toggle.
- Marine Type Approval installations require Discrete Input cabling inside the cabinet to be shielded if it leaves the cabinet.

Serial I/O

The SmartCore CPU A5200 accepts (2) user serial I/O connections. Both isolated ports are configurable for RS-232, RS-422, or RS-485. RS-232 is specified to 50 feet (15 m) while RS-485 and RS-422 are specified to 4000 feet (1219 m).

Serial #1 - RS-232

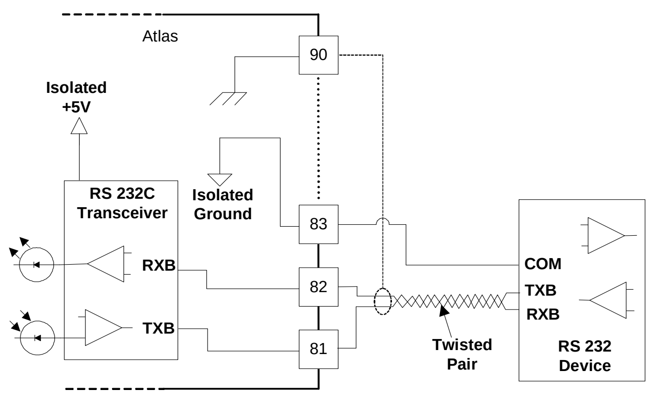


Figure 4-16. Serial #1–RS-232 Pinouts

Serial #1 - RS-422

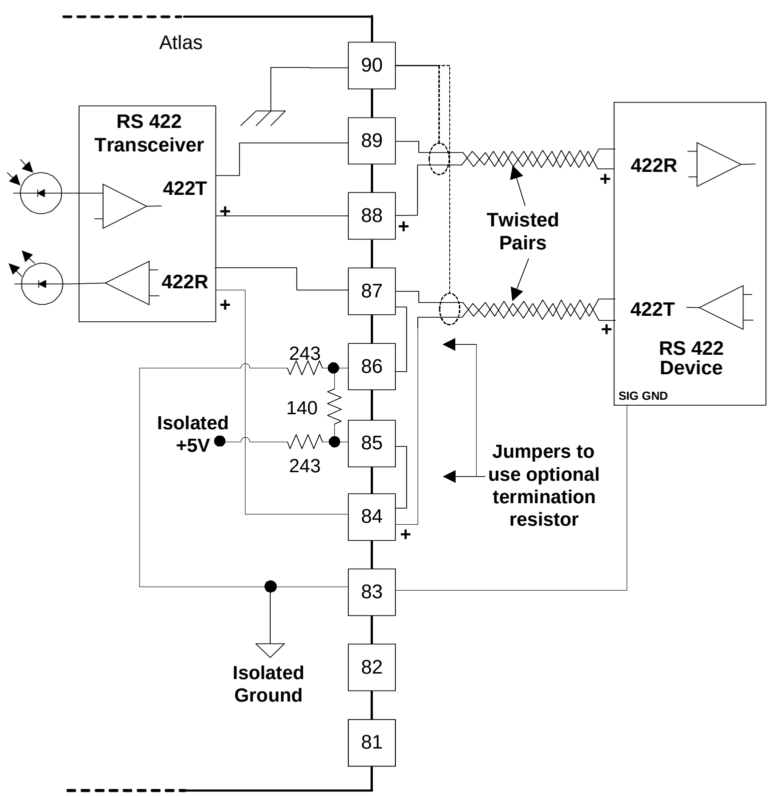


Figure 4-17. Serial #1–RS-422 Pinouts

Serial #1 - RS-485

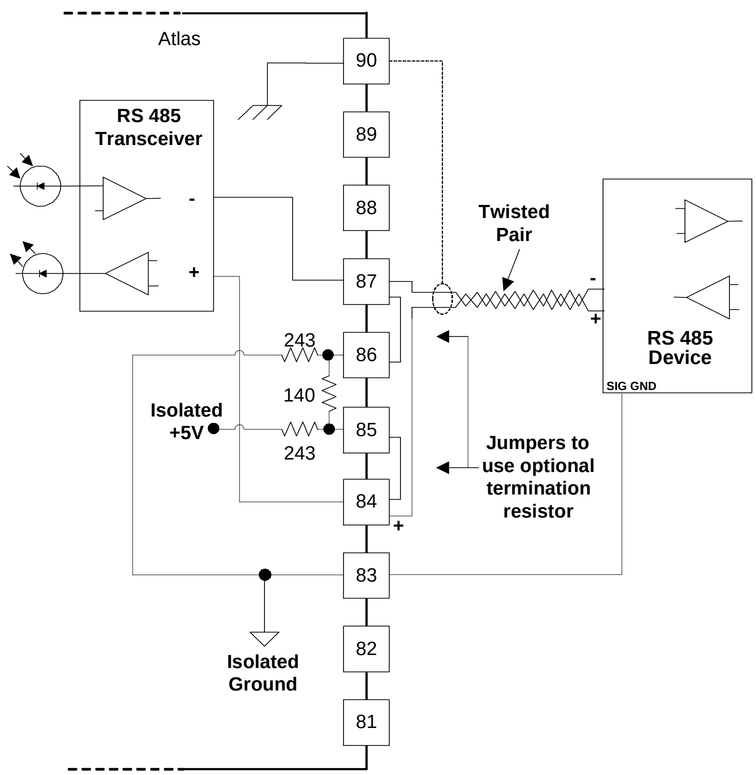


Figure 4-18. Serial #1–RS-485 Pinouts

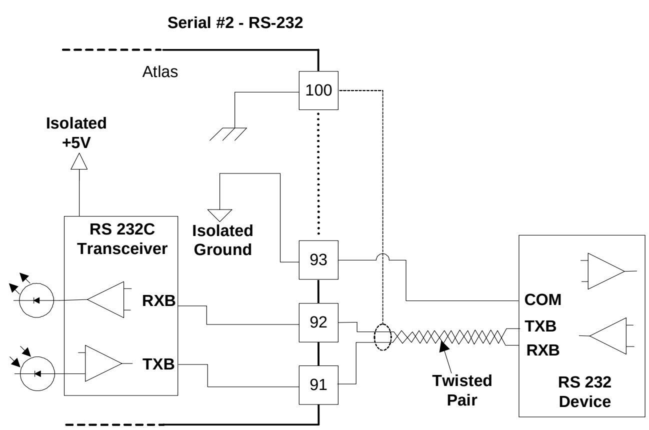


Figure 4-19. Serial #2–RS-232 Pinouts

Serial #2 - RS-422

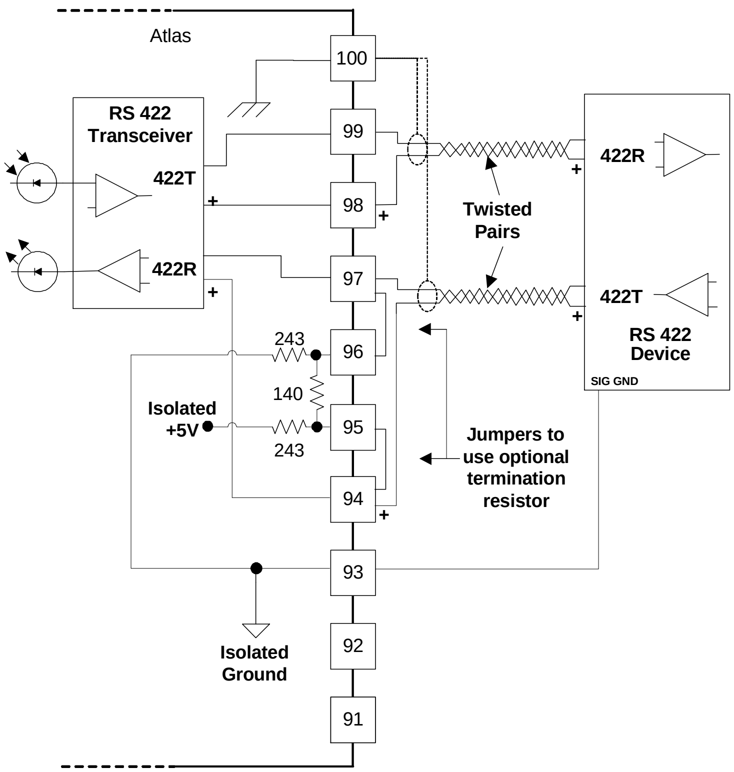


Figure 4-20. Serial #2–RS-422 Pinouts

Serial #2 - RS-485

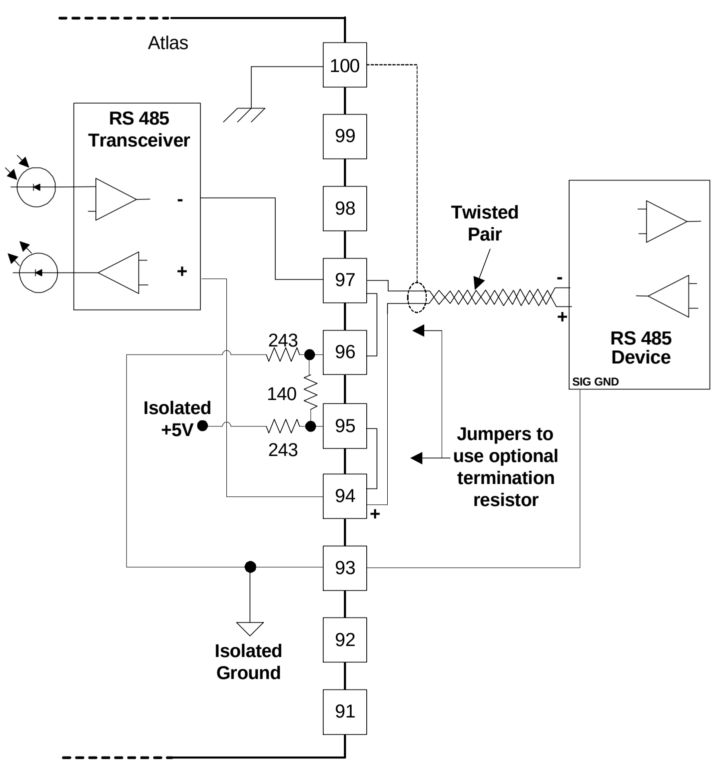


Figure 4-21. Serial #2–RS-485 Pinouts

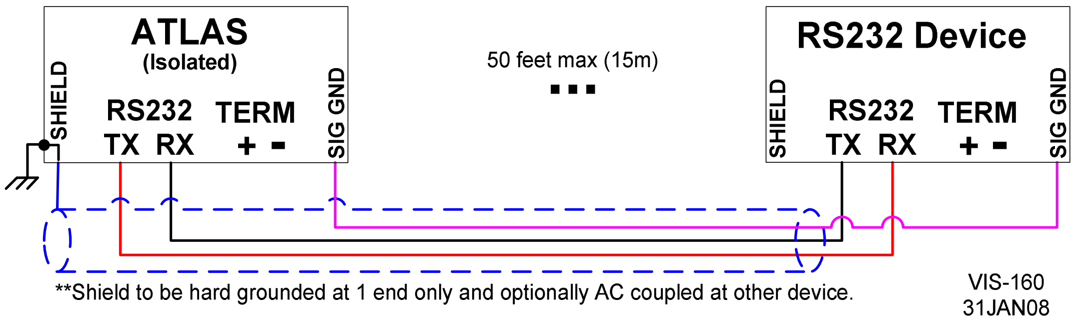


Figure 4-22. Wiring Example–RS-232 Interface to the SmartCore CPU A5200 Board

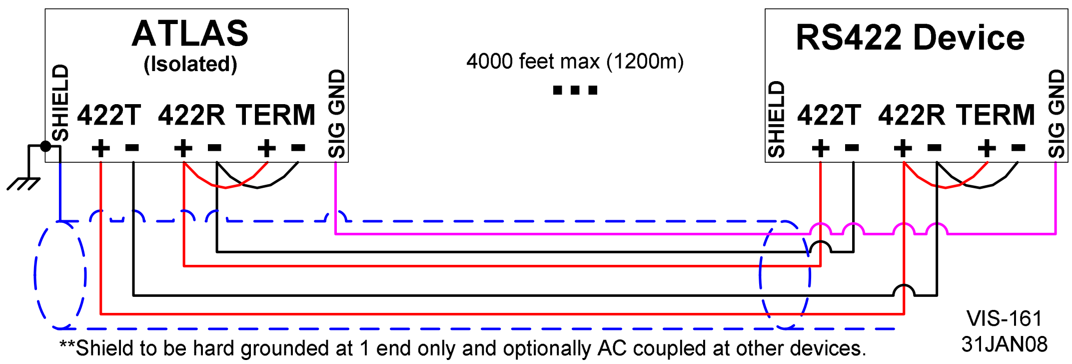


Figure 4-23. Wiring Example–RS-422 Interface to the SmartCore CPU A5200 Board

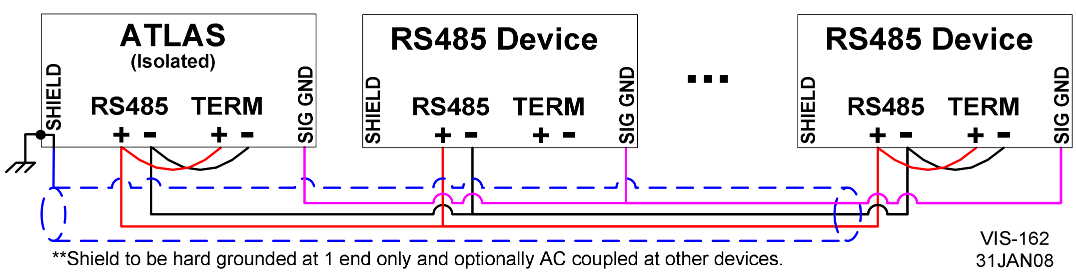


Figure 4-24. Wiring Example–RS-485 Interface to the SmartCore CPU A5200 Board

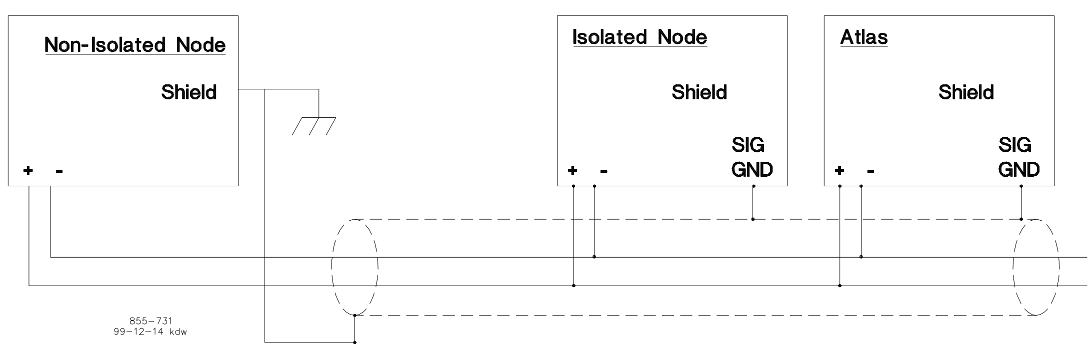


Figure 4-25. Wiring Example–Alternate Multipoint Wiring
(without a separate signal ground wire for the SmartCore CPU A5200 board)

Configuration Notes

- **RS-232.** Refer to Figure 4-21 for RS-232 wiring. The transmit data (TXD), receive data (RXD), and signal ground (SIG GND) must be properly connected as shown. In addition the shield (SHLD) should be connected in at least one location.
- **RS-422.** Refer to Figure 4-22 for RS-422 wiring. The transmit data pairs (422T+ and 422T-), receive data pairs (422R+ and 422R-), and signal ground (SIG GND) must be properly connected as shown. In addition, the shield (SHLD) should be connected in at least one location. Only the receiver at each end of the network should be terminated with a resistor.
- **RS-485.** Refer to Figure 4-23 for RS-485 wiring. The data lines (485+ and 485–) and signal ground (SIG GND) must be properly connected as shown. In addition, the shield (SHLD) should be connected in at least one location. The unit at each end of the network should be terminated with a resistor.
- **Termination Resistors.** The Atlas-II has termination resistors (TERM RES) built into the SmartCore CPU A5200 board that can be jumpered-in as required for RS422 and RS485 communication networks.
- The serial ports must be properly configured in the application software for the appropriate communication parameters.

Reference Grounds

- The serial ports are individually isolated from each other, and from the rest of the Atlas-II control. The RS-422 and RS-485 specifications state that a ground wire is needed if there is no other ground path between units. The preferred method for isolated ports is to include a separate wire in the ground cable that connects the circuit grounds together.
- Non-isolated nodes may not have a signal ground available. If signal ground is not available, use the alternate wiring scheme of connecting all circuit grounds of isolated nodes to the shield, and connecting the shield to earth ground at a non-isolated node.

Troubleshooting and Tuning

The SmartCore CPU A5200 module runs off-line and on-line diagnostics that display troubleshooting messages through the debug Service Port and AppManager. Off-line diagnostics run automatically on power-up and upon reset. On-line diagnostics run during normal Control System operation when the GAP application is active. More information on diagnostics tests, subsequent LED flash codes, and serial port messages is contained in the VxWorks manual.

Fault Detection (Board Hardware)

Each SmartCore CPU A5200 board has a red fault LED that is turned on when the system is reset. During initialization of a board, which occurs after every CPU reset, the CPU turns the Fault LED on. The CPU then tests the board using diagnostic routines built into the software. If the diagnostic test is not passed, the LED remains on or blinks. If the test is successful, the LED goes off. If the fault LED on a board is illuminated after the diagnostics and initialization have been completed, the SmartCore CPU A5200 board may be faulty.

A table of the CPU fault LED flash codes is shown below:

Table 4-14. SmartCore CPU A5200 Failure Codes

Failure	Flash Code
RAM Test Failure	1, 4
Real Time Clock Test Failure	2, 2
Floating Point Unit Test Failure	2, 3
Flash Test Failure	2, 4
HD1 Flash Test Failure	2, 5
I2C Bus Test Failure	2, 6
Module Installed in wrong slot	2, 7
Main Chassis CPU switch must be set to 0	3,5
Remote RTN Rate Group 5 Slip	3, 7
Remote RTN Rate Group 10 Slip	3, 8
Remote RTN Rate Group 20 Slip	3, 9
Remote RTN Rate Group 40 Slip	3, 10
Remote RTN Rate Group 80 Slip	3, 11
Remote RTN Rate Group 160 Slip	3, 12

Fault Detection (I/O)

In addition to detecting board hardware faults, the application program may detect I/O faults.

- Analog Input Faults—The application software may set a high and low latch set point to detect input faults.
- Speed Sensor Input Faults—The application software may set a high and low latch set point to detect input faults.
- Serial Port Faults—The system monitors the serial communications on the serial ports for various communication errors.
- Microcontroller Faults—The system monitors a software watchdog, a hardware watchdog, and a software watchdog on the PC/104 bus communications. All outputs are shutdown in the event of a microcontroller fault.

Troubleshooting Guide

Speed Sensor Inputs

MPUs—If a magnetic pickup input is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Measure the input voltage on the terminal block. It should be greater than 1 Vrms.
- Verify that the signal waveform is clean and void of double zero crossings.
- Verify that no signal return to ground connections exist and that the 60 Hz signal resulting from ground loops is absent.
- Measure the frequency. Frequency should be in the range of 100 Hz to 25 kHz.
- Check the wiring. Look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Check the software configuration to ensure that the input is configured properly.

After verifying all of the above, the Atlas-II should be returned for service.

Proximity Probes—If a proximity probe input is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Measure the input voltage on the terminal block. It should be in the range of 16–28 V peak, and the duty cycle should be within the specified range for the input voltage.
- Verify that the signal waveform is clean and void of double zero crossings.
- Verify that no signal return to ground connections exist and that the 60 Hz signal resulting from ground loops is absent.
- Measure the frequency. Frequency should be in the range of 0.5 Hz to 3 kHz.
- Check the wiring. Look for a loose connection at the terminal blocks and disconnected or misconnected cables. If an open collector probe is used, check to ensure that the pull-up resistor is installed properly.
- Check the software configuration to ensure that the input is configured properly.
- Verify that the corresponding MPU input is jumpered.

After verifying all of the above, the Atlas-II should be returned for service.

Analog Inputs

If an Analog input is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Measure the input voltage on the terminal block. It should be in the range of 0–5 V.
- Verify that there are no or minimal AC components to the analog input signal. AC components can be caused by improper shielding or grounding.
- Check the wiring. If the inputs are reading 0 or the engineering units that correspond to 0 mA, look for a loose connection at the terminal blocks and disconnected or misconnected cables. If the unit is a 4–20 mA input, check for proper jumper installation on the terminal block.
- If all of the inputs are reading high, check that the power is not connected across the input directly.
- Check the software configuration to ensure that the input is configured properly.
- If the input is loop powered, ensure that power is provided externally, the Atlas control does not provide this power.

After verifying all of the above, the Atlas-II should be returned for service.

Analog Outputs

If an Analog output is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Check the load resistance, ensure that it is less than the specification limit for the output current.
- Check to ensure that the load wiring is isolated.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Disconnect the field wiring and connect a resistor across the output. If the output is correct across the resistor, there is a problem with the field wiring.
- Check the software configuration to ensure that the output is configured properly.

After verifying all of the above, the Atlas-II should be returned for service.

Proportional Actuator Outputs

If an Actuator output is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Check the load resistance, ensure that it is less than the specification limit for the output current.
- Check to ensure that the load wiring is isolated.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.

- Disconnect the field wiring and connect a resistor across the output. If the output is correct across the resistor, there is a problem with the field wiring.
- Check the software configuration to ensure that the output is configured properly.

After verifying all of the above, the Atlas-II should be returned for service.

Discrete Inputs

If a discrete input is not functioning properly, verify the following:

- Measure the input voltage on the terminal block. It should be in the range of 18–28 Vdc.
- If an external wetting voltage source is used, check the voltage source is referenced to the A5200 wetting voltages common.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Check the software configuration to ensure that the input is configured properly.

After verifying all of the above, the Atlas-II should be returned for service.

Serial I/O

If a serial port is not functioning properly, verify the following:

- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Check to be sure that termination resistors are properly installed where needed on the network.
- Check the software configuration to ensure that the input is configured properly.
- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.

After verifying all of the above, the Atlas-II should be returned for service.

Chapter 5.
Analog Combo Board

General Description

Each Analog Combo board contains circuitry for two speed sensor inputs, fifteen analog inputs, one cold junction, and two Analog outputs. The first eleven analog inputs may be 4–20 mA inputs or thermocouple inputs, and the remaining four analog inputs may be 4–20 mA inputs or RTD inputs.

Features

- 5 ms update rate
- On-board processor for automatic calibration of the I/O channels
- Analog inputs have 15 bit resolution
- Analog outputs have 12 bit resolution
- First 11 analog inputs are software configurable 4–20 mA or thermocouple (in pairs)
- Last 4 analog inputs are software configurable 4–20 mA or RTD (individually)
- First 11 analog inputs are isolated as a group, from the other inputs, and from control common
- Last 4 analog inputs are isolated as a group, from the other inputs, and from control common
- A cold junction measurement is provided on the board

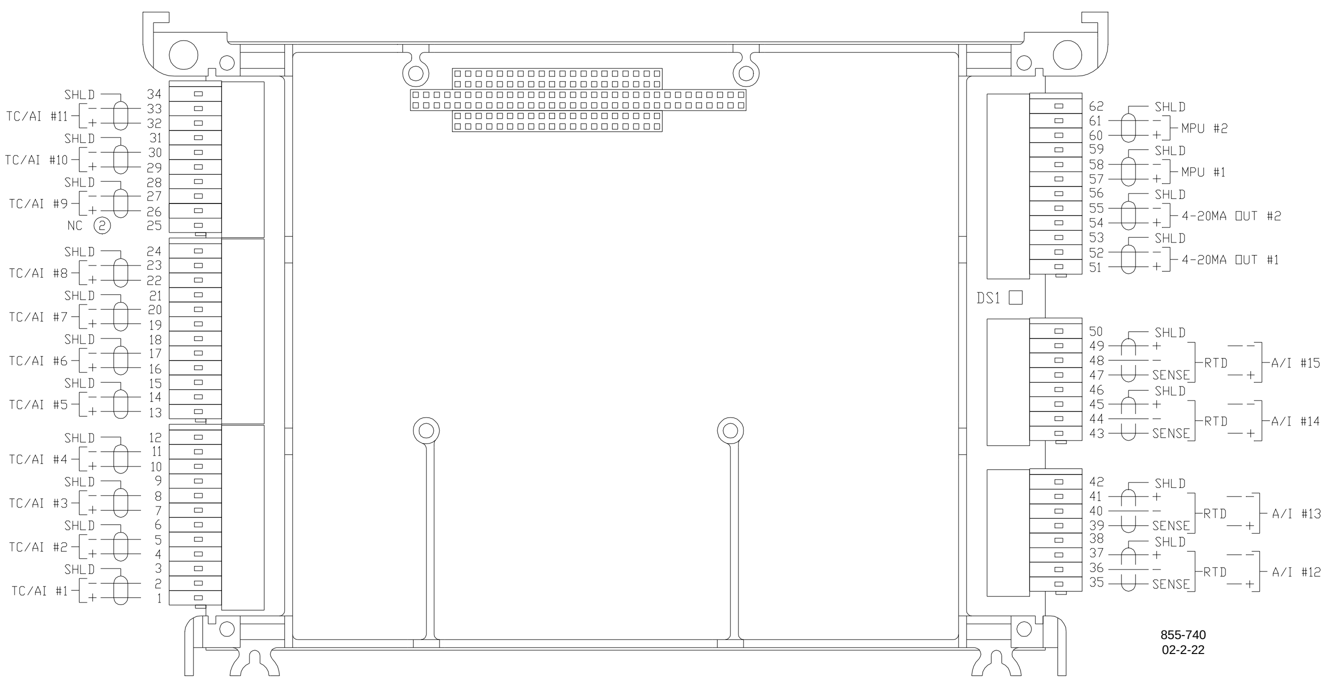


Figure 5-1. Atlas-II Analog Combo Board Connections

Physical

The Atlas-II Analog Combo board connects to the CPU board through the PC/104 bus. It does not connect to the Atlas-II power bus directly, it requires a SmartCore CPU A5200 board for this purpose.

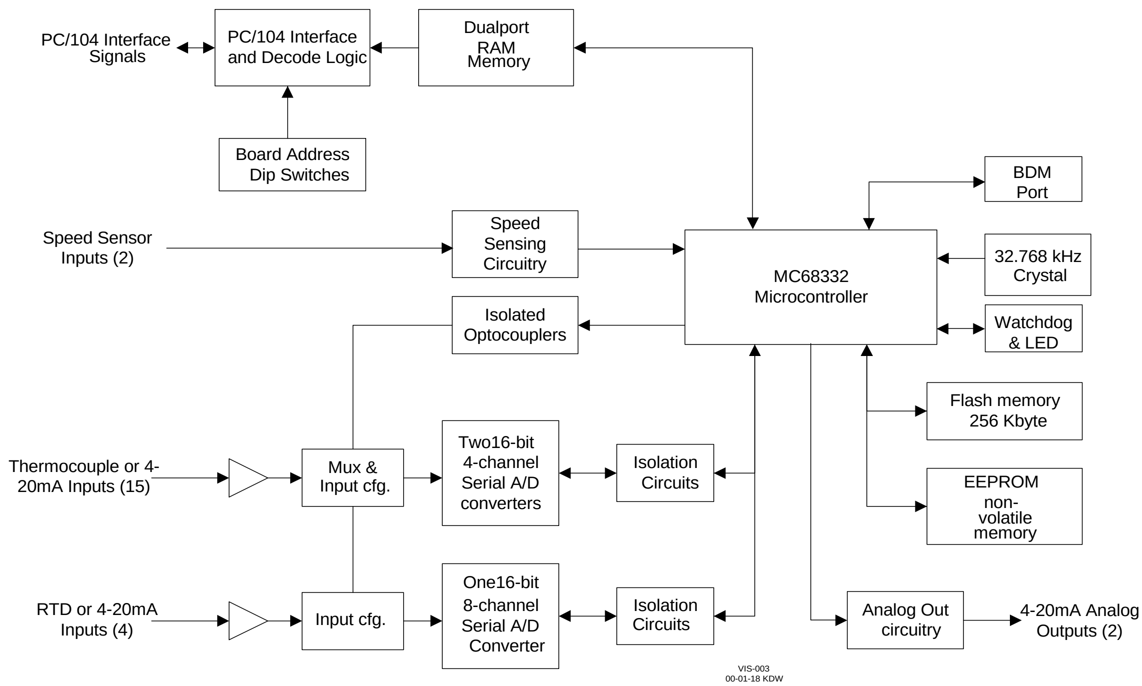


Figure 5-2. Atlas-II Analog Combo Board Block Diagram

Specifications

Thermocouple/4–20 mA Analog Inputs

Number of channels:	11
Input type:	4–20 mA, type J or type K, thermocouple (required)
Max. input current:	24 mA if configured for 4–20 mA
Max. input voltage:	±72.8 mV for thermocouples inputs
Thermocouple Range:	Type E:–9.83 mV (–267.68 °C/–449.82 °F) to 72.8 mV (952.60 °C/1746.68 °F) Type J:–8.09 mV (–209.72 °C/–345.50 °F) to 69.55 mV (1199.94 °C/2191.89 °F) Type K:–6.45 mV (–263.95 °C/–443.11 °F) to 54.88 mV (1371.81 °C/2501.26 °F) Type N:–4.34 mV (–263.14 °C/–441.65 °F) to 47.51 mV (1299.92 °C/2371.86 °F) Type R:–0.22 mV (–48.27 °C/–54.89 °F) to 21.10 mV (1767.88 °C/3214.18 °F) Type S:–0.23 mV (–48.60 °C/–55.48 °F) to 18.69 mV (1767.76 °C/3213.97 °F) Type T:–6.25 mV (–265.71 °C/–446.28 °F) to 20.87 mV (399.97 °C/751.95 °F)
Common mode rejection:	–80 dB minimum for analog inputs –96 dB typical for analog inputs –110 dB minimum for thermocouple inputs –120 dB typical for thermocouple inputs
Input common mode range:	±11 V minimum
Safe input common mode volt:	±40 V minimum
Input impedance:	103 Ω (±1%) for 4–20 mA inputs

Anti-aliasing filter:	2 poles at 10 ms (channel 11 has 2 poles at 5 ms)
Resolution:	15 bits
Accuracy:	

Thermocouple Input Accuracy @ 25°C (%)								
T/C type	Range							
	< 25 °C		> 25 °C		< 300 °C		> 300 °C	
	Typ	Max	Typ	Max	Typ	Max	Typ	Max
E or K	0.15	0.45	0.075	0.25				
J	0.10	0.30	0.05	0.20				
N	0.15	0.60	0.10	0.30				
R or S					0.15	0.50	0.10	0.30
T	0.50	1.50	0.15	0.60				

IMPORTANT

Terminal block wiring must use multi-stranded wires to provide best results. Due to the clamping action of the spring-loaded terminal blocks, lower level signals (like TC and RTD inputs) are susceptible to glitches when using single "solid-core" wiring.

IMPORTANT

The Atlas may experience degraded performance of the thermocouple (TC) inputs of the Analog Combo cards from ~900 MHz to 1.1 GHz at field strengths greater than 10 V/m. Fields of 10–20 V/m degrade the steady-state performance from a 0.25% tolerance to a 1.2% tolerance. Installation of the Atlas in a metal cabinet will minimize this degradation.

4–20 mA Input Accuracy @ 25°C (%)		
Input type	**Typ**	**Max**
4–20 mA	0.05	0.10

IMPORTANT

The Atlas may experience degraded performance of these 4–20 mA inputs of the Analog Combo cards from 410 MHz to 450 MHz at field strengths greater than 10 V/m. Fields of 10–20 V/m degrade the steady-state performance from a 0.1% tolerance to a 0.36% tolerance. Installation of the Atlas in a metal cabinet will minimize this degradation.

Temperature Drift				
Input Type	**Full Scale**	**Max Drift Degree C/C**	**Max Drift µa/°C)**	**Max % Error over 25 °C Delta (% of full scale)**
E	999.4 °C	0.22472989		0.56
J	1200 °C	0.29615393		0.62
K	1370 °C	0.43528413		0.79
N	1300 °C	0.46956505		0.90
R	1760 °C	1.43793547		2.04
S	1756 °C	1.62240259		2.31
T	399 °C	0.32912099		2.06
4–20 mA	25 mA		4 µA	0.40

IMPORTANT

For thermocouple inputs, the Max % Error example is calculated for a 25 °C delta using the full scale for the corresponding thermocouple type. For the 4–20 mA inputs, the Max % Error example is calculated for a 25 °C delta using the 25 mA full scale.

CJ Update Time:	5 ms
Latency:	1 ms for odd channels and 3 ms for even numbered channels
Failure detection	Open wire detection provided for thermocouples
Isolation	All input channels are isolated from the rest of the Atlas-II platform to 500 Vac, however they are not isolated from each other. The inputs are differential, with a high impedance between channels.

CJ Accuracy	±3 °C worst case at 25 °C, (±1 °C typical at 25 °C) uncalibrated ±1 °C worst case at 25 °C, (±0.5 °C typical at 25 °C) calibrated ±4 °C over the full temperature range (–40 to +85 °C) uncalibrated ±2 °C over the full temperature range (–40 to +85 °C) calibrated

- Loop power for the analog inputs must be supplied by an external supply, if needed.
- 4–20 mA, or type J or K T/C is selected in the GAP block software, for each input. GAP configuration sets input gain via software.
- Maximum wire size, one 16 AWG (1.5 mm²), or two 20 AWG (0.5 mm²) wires. Wires must be shielded.
- Channels 1–10 must be configured in pairs, that is, channels 1 and 2, 3 and 4, etc., must both be configured as 4–20 mA inputs or must both be configured as thermocouple inputs.
- Any “unused” channel of a pair, Channels 1–10, must have its input shorted to prevent measurement errors on the “in-use” channel of the pair.

IMPORTANT **External loop powered transducers must be individually protected with a 100 mA fuse on each channel.**

RTD/4–20 mA Analog Inputs

Number of Channels:	4
Input type:	100 or 200 Ω 3-wire
Max. Input Current:	24 mA, if configured for 4–20 mA
Max. Input Resistance:	781 Ω, if configured for RTD
RTD Range:	European Curve (Type 385): 100 Ω RTD: 18.49 Ω (–200 °C/–328 °F) to 390.48 Ω (850 °C/1562 °F) 200 Ω RTD: 37.04 Ω (–200 °C/–328 °F) to 533.10 Ω (457 °C/854.6 °F) American Curve (Type 392): 100 Ω RTD: 59.57 Ω (–100 °C/–148 °F) to 269.35 Ω (457 °C/854.6 °F) 200 Ω RTD: 119.14 Ω (–100 °C/–148 °F) to 538.70 Ω (457 °C/854.6 °F)
Common Mode Rejection:	–80 dB minimum for analog inputs –96 dB typical for analog inputs –96 dB minimum for RTD inputs –115 dB typical for RTD inputs
Input common mode range:	±11 V minimum
Safe input common mode volt:	±40 V minimum
Input impedance:	103 Ω (±1%) for 4–20 mA inputs
Anti-aliasing filter:	2 poles at 10 ms
Resolution:	15 bits
Accuracy:	see table below

RTD and 4–20 mA Input Accuracy @ 25 °C (%)

Input type	Typ	Max
100 Ω American and European, 200 Ω American	0.05	0.10
200 Ω European	0.10	0.20
4–20 mA	0.05	0.10

Temp Drift

Input Type	Typ (ppm/°C)	Typ error (%)	Max (ppm/°C)	Max error (%)
100 Ω European Curve	30	0.20	290	1.89
100 Ω American Curve	50	0.33	290	1.89
200 Ω European Curve	20	0.13	290	1.89
200 Ω American Curve	20	0.13	290	1.89
4–20 mA	105	0.68	160	1.04

IMPORTANT **Terminal block wiring must use multi-stranded wires to provide best results. Due to the clamping action of the spring-loaded terminal blocks, lower level signals (like TC and RTD inputs) are susceptible to glitches when using single “solid-core” wiring.**

IMPORTANT **For RTD inputs, percent error is for full scale for 65 degree delta (25 to –40 °C). For 4–20 mA inputs, percent error is for 25 mA full scale input for 65 degree delta (25 to –40 °C).**

Update time:	5 ms
I/O Latency:	1 ms
Isolation:	All input channels are isolated from the rest of the Atlas-II platform to 500 Vdc, however inputs are not isolated from each other.

- Loop power for the Analog inputs must be supplied by an external supply if needed.
- 4–20 mA, or RTD is selected in the GAP block software, for each input. GAP configuration sets input gain via software.
- Maximum wire size, one 16 AWG (1.5 mm²), or two 20 AWG (0.5 mm²) wires. Wires must be shielded.

IMPORTANT **External loop powered transducers must be individually protected with a 100 mA fuse on each channel.**

Digital Speed Sensor Inputs

Number of channels:	2, MPU only
MPU Inputs:	
Input frequency:	100—24 950 Hz
Minimum input amplitude:	See Figure 5-3
Maximum input amplitude:	70 V peak-to-peak
Input impedance:	>550 Ω
Isolation voltage	500 Vac, each channel is isolated from all other channels, and from the Atlas-II platform
Resolution	dependent on frequency, 13 bit minimum at maximum speed
Accuracy	less than ±0.08% of full scale from –40 to +85 °C internal temperature

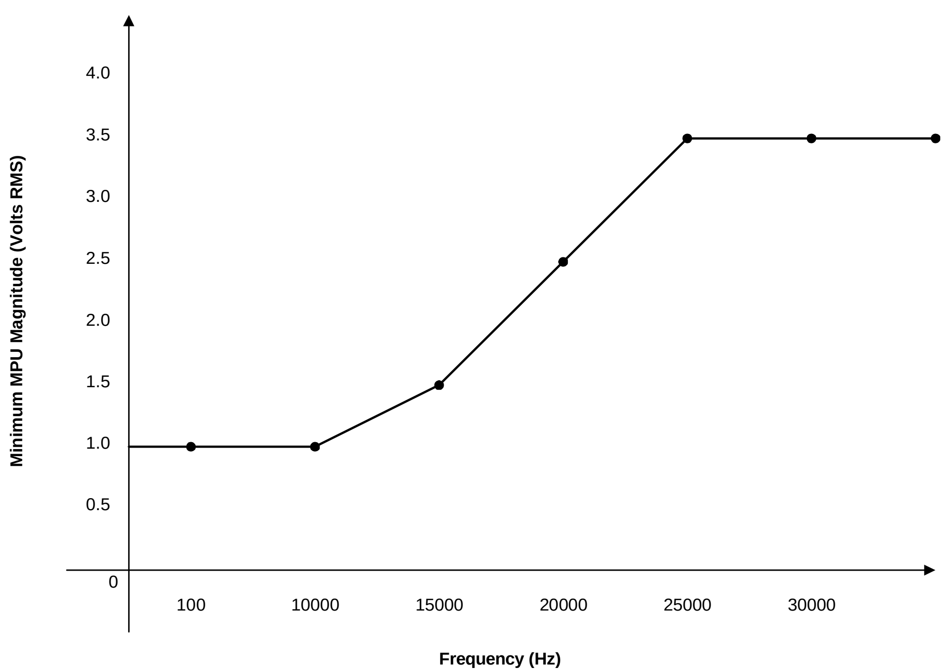


Figure 5-3. Minimum MPU Voltage

- A derivative output is provided. The inherent noise on this output, due to resolution, increases with frequency. At 1000 Hz, it can be as much as 2.5 Hz/s. At 5000 Hz, it can be as much as 12.5 Hz/s. At 10 kHz, it can be as much as 25 Hz/s. At 20 kHz, it can be as much as 80 Hz/s. Typically, at 3600 Hz, noise on the MPU signal due to wiring runs, will make the noise contribution due to resolution, insignificant.
- Maximum wire size, one 16 AWG (1.5 mm²), or two 20 AWG (0.5 mm²) wires. Wires must be shielded and the shield terminated to the shield pin and cabinet entry/exit point.

Analog Outputs	
Number of channels	2
Output type	4–20 mA outputs, non-isolated
Current output	4–20 mA
Max current output	25mA ±5%
Isolation	0 Vdc
Min. load resistance	0 Ω
Max load resistance	300 Ω at 22 mA
Resolution	12 bits
Accuracy	less than ±0.1% of full scale at 25 °C (after software calibration)
Temperature drift	140 ppm/°C, maximum, =0.23 mA 70 ppm/°C, typical (0.45% of full scale), =0.11375 mA

- 0–1 mA OUTPUTS ARE NOT SUPPORTED, WITHOUT A GREATER THAN 4 BIT LOSS OF RESOLUTION. RESULTING RESOLUTION WOULD BE 7 BITS.
- Common mode voltage is 15 Vdc.
- Maximum wire size, one 16 AWG (1.5 mm²), or two 20 AWG (0.5 mm²) wires. Wires must be shielded.
- When interfacing to non-isolated devices, an isolator should be used between the Atlas-II and the device.

Analog Combo Board Operation

This board includes no potentiometers and requires no field calibration.

Speed Sensor Inputs

The MPU inputs are read and the speed is provided to the application program. A derivative output is also provided. The speed sensor inputs are filtered by the Analog Combo board, and the filter time constant is selectable at 8 milliseconds or 16 milliseconds. Eight milliseconds should be acceptable for most turbine applications, sixteen milliseconds may be necessary for very slow speed applications. The speed range is selected in the application software and determines the maximum speed that the board will detect. The control output of the software will detect a minimum speed of one fiftieth of the speed range. This allows detection of failed speed sensors to help prevent overspeed due to slow update times at very low speeds. The monitor output of the GAP block will read down to .5 Hz, irrespective of the speed range. An application may use any combination of accepted MPUs, and any combination of speed ranges.

The Analog Combo board uses speed sensing probes mounted on a gear connected or coupled to the turbine's rotor to sense turbine rotor speed. Any of the board's speed channels accept passive magnetic pickup units (MPUs) or proximity probes. It is not recommended that gears mounted on an auxiliary shaft coupled to the rotor be used to sense speed. Auxiliary shafts tend to turn more slowly than the rotor (reducing speed sensing resolution) and have coupling gear backlash, resulting in less than optimum speed control. For safety purposes, it is also not recommended that the speed sensing device sense speed from a gear coupled to a generator or mechanical drive side of a system's rotor coupling.

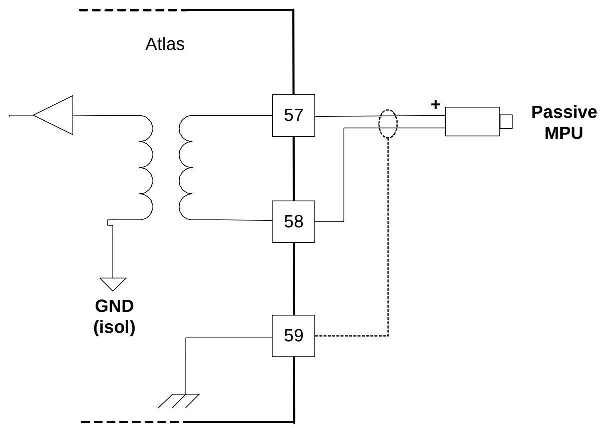


Figure 5-4. Wiring Example–MPU Interface to the Analog Combo Board

Configuration Notes

- Refer to Figure 5-4 for speed sensor wiring.

Speed Sensor Input Software Configuration Limitations

(TxMxR)/60 must be < 25 000 Hz
T = gear teeth
M = (overspeed test limit setting x 1.2)
R = gear ratio

Analog Inputs

The Analog inputs may be current or temperature inputs. The first 11 inputs can be thermocouple inputs, and the other 4 inputs can be RTD inputs. The software must be configured for the correct input type. This allows the Analog Combo card to use the applicable hardware calibration values, and to configure the appropriate hardware gains. The first 10 inputs must be configured in pairs, that is, channels 1 and 2 must both be thermocouples or must both be 4–20 mA inputs. Channels 11–15 may be configured individually.

All 4–20 mA inputs may be used with two-wire ungrounded (loop powered) transducers or isolated (self-powered) transducers. All Analog inputs have 11 Vdc of common mode rejection. If interfacing to a non-isolated device, which may have the potential of reaching over 11 Vdc with respect to the control's common, the use of a loop isolator is recommended to break any return current paths, which could produce erroneous readings.

RTD inputs must be configured to use either the European or American curve. 200 Ω RTDs are limited to the maximum temperature on the American curve, even when the European curve is used. The RTD source current is 2 ma, and the RTD sense input should be tied to the negative side of the RTD, at the RTD.

See the specifications section for supported thermocouple types. The cold junction sensor is provided on the Atlas-II Analog Combo board. If the actual cold junction in the field wiring occurs elsewhere, the temperature of that junction must be brought into the control as a thermocouple, RTD, or 4–20 mA input, and the application software must be configured to use the appropriate cold junction temperature.

The first 11 analog inputs are isolated as a group from control common, earth ground, and the other 4 analog inputs. The last 4 analog inputs are also isolated as a group from control common, earth ground, and the first 11 analog inputs.
For a 4–20 mA input signal, the Analog Combo board uses a 100 Ω resistor across the input.

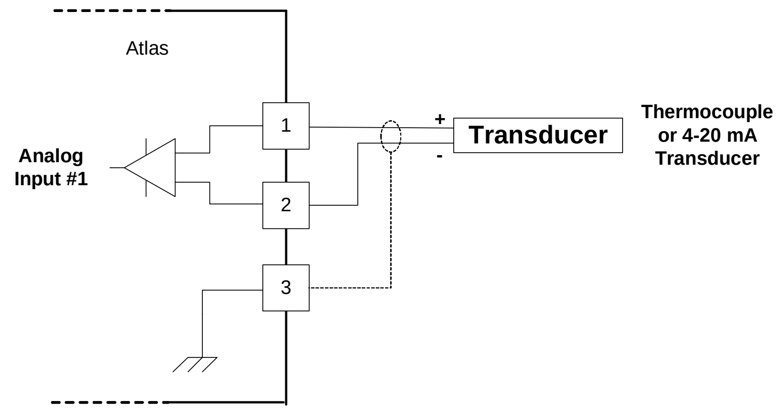


Figure 5-5a. Wiring Example–Analog Input Interface
(to the Analog Combo Board for 4–20 mA
and thermocouple inputs on inputs 1–11)

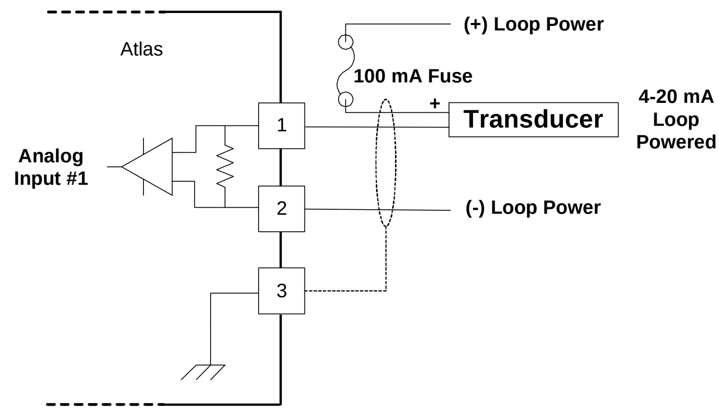


Figure 5-5b. Wiring Example–Analog Input Interface with External Loop Power

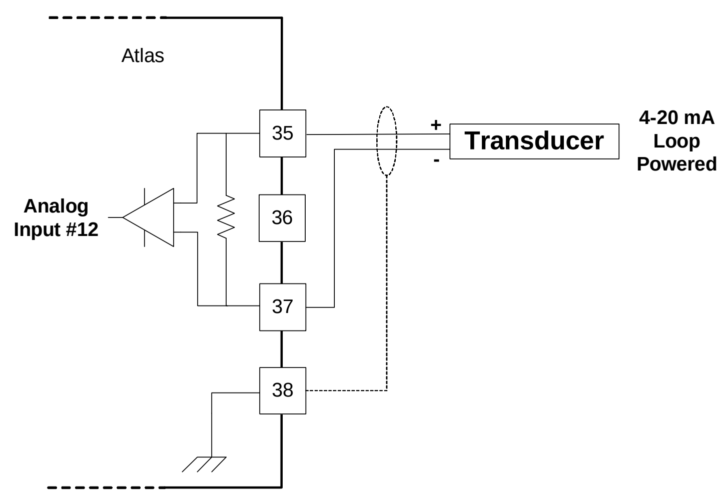


Figure 5-6. Wiring Example–4–20 mA Input Interface
(to the Analog Combo Board for inputs 12–15)

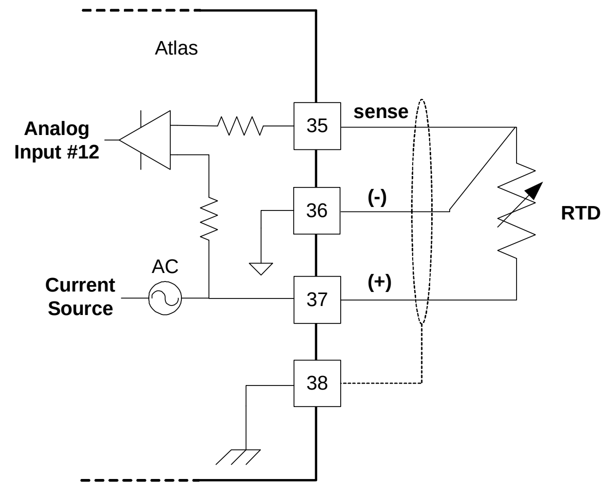


Figure 5-7. Wiring Example–RTD Input Interface
(to the Analog Combo Board for inputs 12–15)

Configuration Notes

- Refer to Figures 5-5, 5-6, and 5-7 for analog input wiring.
- 4–20 mA inputs are supported, 0–5 V inputs are not.
- The application software must be configured to match the input type used, that is, 4–20 mA, 100 Ω RTD, k-type thermocouple, etc.

IMPORTANT	**External loop powered transducers must be individually protected with a 100 mA fuse on each channel.**

RTDs

- Only 100 and 200 Ω RTDs are supported.
- RTD inputs can use the European or American curve. 200 Ω RTDs are limited to the maximum temperature on the American curve, even when the European curve is used.
- The RTD source current is 2 mA.
- The RTD sense input should be tied to the negative side of the RTD, at the RTD.

Thermocouples

- See the specifications section for supported thermocouple types.
- The cold junction sensor is provided on the Atlas-II Analog Combo board. If the actual cold junction in the field wiring occurs elsewhere, the temperature of that junction must be brought into the control as a thermocouple, RTD, or 4–20 mA input, and the application software must be configured to use the appropriate cold junction temperature.
- The thermocouple and cold junction input units (°C or °F) should be consistent in the application software.

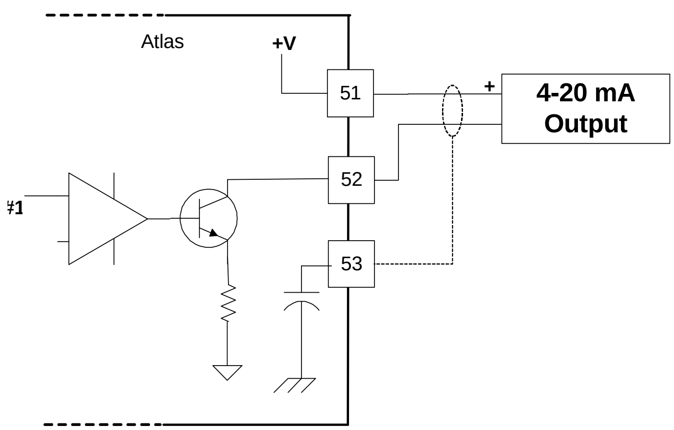
4–20 mA Inputs

- All 4–20 mA inputs have an impedance of 100 Ω.
- No loop power is provided.

IMPORTANT	**External loop powered transducers must be individually protected with a 100 mA fuse on each channel.**

Analog Outputs

The Analog outputs are 4–20 mA with a full scale range of 0–24 mA. The Analog Combo board has four Analog outputs.



IMPORTANT

On earlier versions of the Analog Combo board, the cable shield termination went directly to earth.

Figure 5-8. Wiring Example–Analog Output Interface
(to the Analog Combo Board)

Configuration Notes

- Refer to Figure 5-8 for analog output wiring.
- Only 4–20 mA signals are output.
- See the specifications section for the maximum analog output load.
- Care should be taken to prevent ground loops and other faults when interfacing to non-isolated devices.
- The output does not contain fault detection. If it is necessary to detect failures, then the device that is driven by the Analog output, for example an actuator driver, must contain reference failure detection.
- The Analog outputs have a 15 V common mode voltage, with respect to Atlas-II control common.
- +V is 15 V

NOTICE

Avoid misconnection of the Analog Output (+) to the Actuator Output (–). This will damage internal components, making the control inoperable. This applies only when a SmartCore CPU A5200 board is installed in the control.

Fault Detection (Board Hardware)

Each Analog Combo board has a red fault LED that is turned on when the system is reset. During initialization of a board, which occurs after every CPU reset, the CPU turns the Fault LED on. The CPU then tests the board using diagnostic routines built into the software. If the diagnostic test is not passed, the LED remains on or blinks. If the test is successful, the LED goes off. If the fault LED on a board is illuminated after the diagnostics and initialization have been completed, the Analog Combo board may be faulty or may have the address DIP switches configured incorrectly. The DIP switch setting must match the module address set in the GAP application program.

Table 5-1 Analog Combo Failure

Number of LED Flashes	Failure
1	Microprocessor failure
2	Bus, address, any unexpected exception error
5	Failure during EE test or erasing
7	Kernel software Watchdog count error
12	Failure during CPU Internal RAM test
13	Dual port RAM error

Fault Detection (I/O)

In addition to detecting board hardware faults, the application program may detect I/O faults.

- Analog Input Faults—The application software may set a high and low latch set point to detect input faults. For thermocouple inputs, open wire detection is provided.
- Speed Sensor Input Faults—The application software may set a high and low latch set point to detect input faults.
- Microcontroller Faults—The system monitors a software watchdog, a hardware watchdog, and a software watchdog on the PC/104 bus communications. All outputs are shutdown in the event of a microcontroller fault.

Troubleshooting Guide

Speed Sensor Inputs

If a magnetic pickup input is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Measure the input voltage on the terminal block. It should be greater than that shown in Figure 5-3.
- Verify that the signal waveform is clean and void of double zero crossings.
- Verify that no signal return to ground connections exist and that the 60 Hz signal resulting from ground loops is absent.
- Measure the frequency. Frequency should be in the range of 100 Hz - 25 kHz.
- Check the wiring. Look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Check the software configuration to ensure that the input is configured properly; check the hertz to rpm ratio, and the maximum speed.

After verifying all of the above, the Atlas-II should be returned for service.

Analog Inputs

If an Analog input is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Measure the input voltage on the terminal block. It should be in the range of 0–5 V for 4–20 mA inputs. RTD inputs have a 2 mA current source. Thermocouple inputs should have the appropriate millivolt signal.
- Verify that there are no or minimal AC components to the Analog Input signal. AC components can be caused by improper shielding or grounding. Thermocouple inputs are extremely sensitive to signal fluctuations.
- Check the wiring. For a 4–20 mA input if the input is reading 0 or the engineering units that correspond to 0 mA, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- For RTD inputs, check for proper connection of the sense line.
- For thermocouple inputs, check for proper cold junction location.
- If the input is reading high, check that the power is not connected across the input directly.
- Check the software configuration to ensure that the input is configured properly. Ensure that the proper RTD or thermocouple type is selected, if applicable.

After verifying all of the above, the Atlas-II should be returned for service.

Analog Outputs

If an Analog output is not functioning properly, verify the following:

- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Check the load resistance, ensure that it is less than the specification limit for the output current.
- Check to ensure that the load wiring is isolated.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Disconnect the field wiring and connect a resistor across the output. If the output is correct across the resistor, there is a problem with the field wiring.
- Check the software configuration to ensure that the input is configured properly.

After verifying all of the above, the Atlas-II should be returned for service.

Chapter 6. PowerSense Board

General Description

Each PowerSense board contains the circuitry for two sets of three phase AC voltage (PT) and AC current (CT) inputs, as well as a speed bias output and a voltage bias output.

Features

- On-board processor for automatic calibration of the I/O channels
- PT and CT inputs provide fundamental as well as harmonic information
- PT and CT inputs are sampled at high speed, then the RMS value is updated every 50 ms (which is 3 cycles at 60 Hz)
- PT and CT inputs and bias outputs have 12 bit resolution
- PT inputs are software configurable for 70 V, 120 V, or 240 V ranges
- Each set of PT and CT inputs is isolated from the rest of the board and chassis
- 5 ms update rate for speed and voltage bias outputs
- Speed bias output is software configurable for 4–20 mA, 0–5 V, PWM, or ±3 V output
- Speed Bias output is isolated from the rest of the board
- Voltage Bias output is software configurable for 4–20 mA, ±1 V, ±3 V, and ±9 V
- Voltage bias output is isolated from the rest of the board

Physical

The Atlas-II PowerSense board connects to the CPU board through the PC/104 bus. It connects to the power supply, through the Atlas-II power bus. It requires a SmartCore CPU A5200 board or a Pentium CPU board as a master controller. The master controller is responsible for all application level tasks such as protective relaying, load share, and controlling the voltage and speed bias outputs.

Hazardous Live

The following circuits are classified as Hazardous Live because they carry potential shock hazardous voltages during normal operation or under single fault conditions:

- potential transformer (PT) inputs
- current transformer (CT) inputs
- voltage bias outputs

⚠WARNING	**HIGH VOLTAGE—Do not contact the above inputs and outputs during system operation when such circuits are live. Possible serious personal injury or death could result.**

⚠WARNING	**HIGH VOLTAGE—Before disconnecting the secondary terminals of the current transformer or the connections of the current transformer at the control, ensure that the transformer is short-circuited.**

⚠WARNING **HIGH VOLTAGE—To prevent risk of electric shock, make sure that the terminal block covers are installed on the above inputs before operation (see Figure 6-1).**

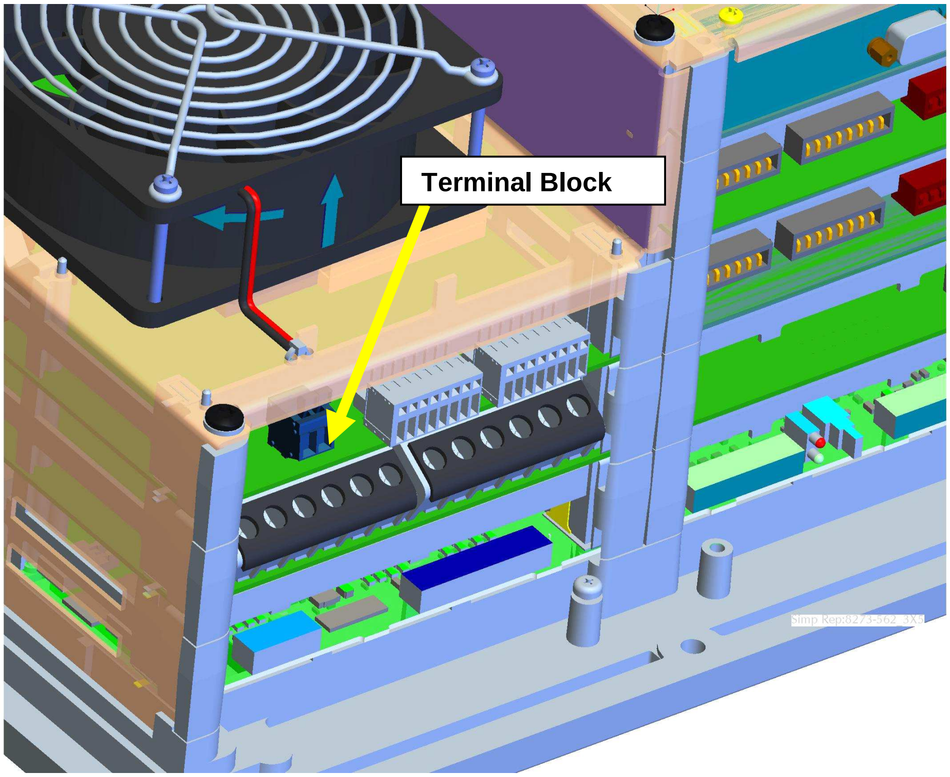


Figure 6-1. Terminal Block Covers

These inputs and outputs are provided with 500 V of dielectric isolation from chassis ground. In addition, these inputs/outputs are isolated from safety extra-low voltage (SELV) circuits (such as serial communication, PC/104 circuits) by optoisolators or transformers provided with double insulation and 3 kVac of dielectric isolation.

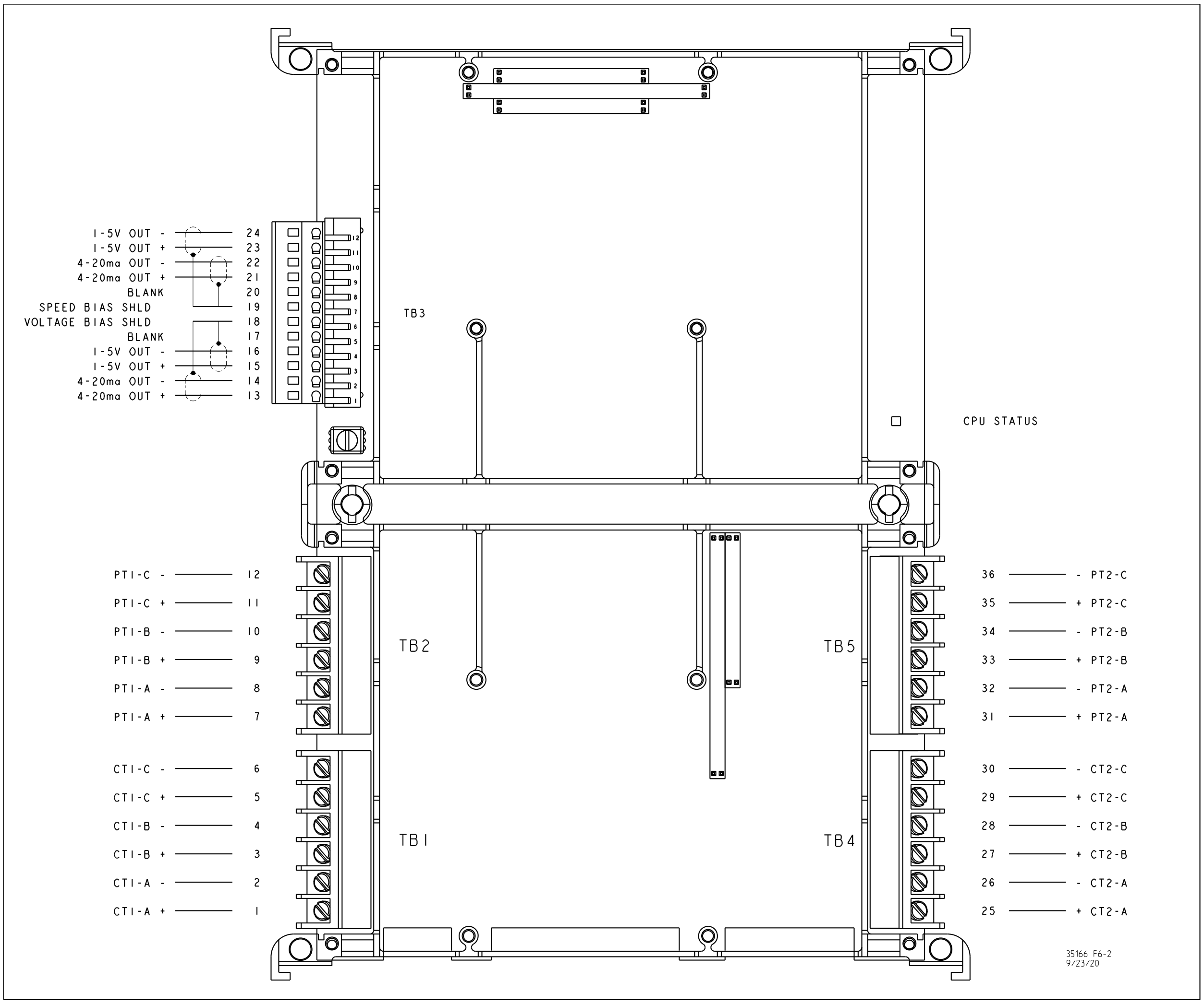


Figure 6-2. PowerSense Board Connections

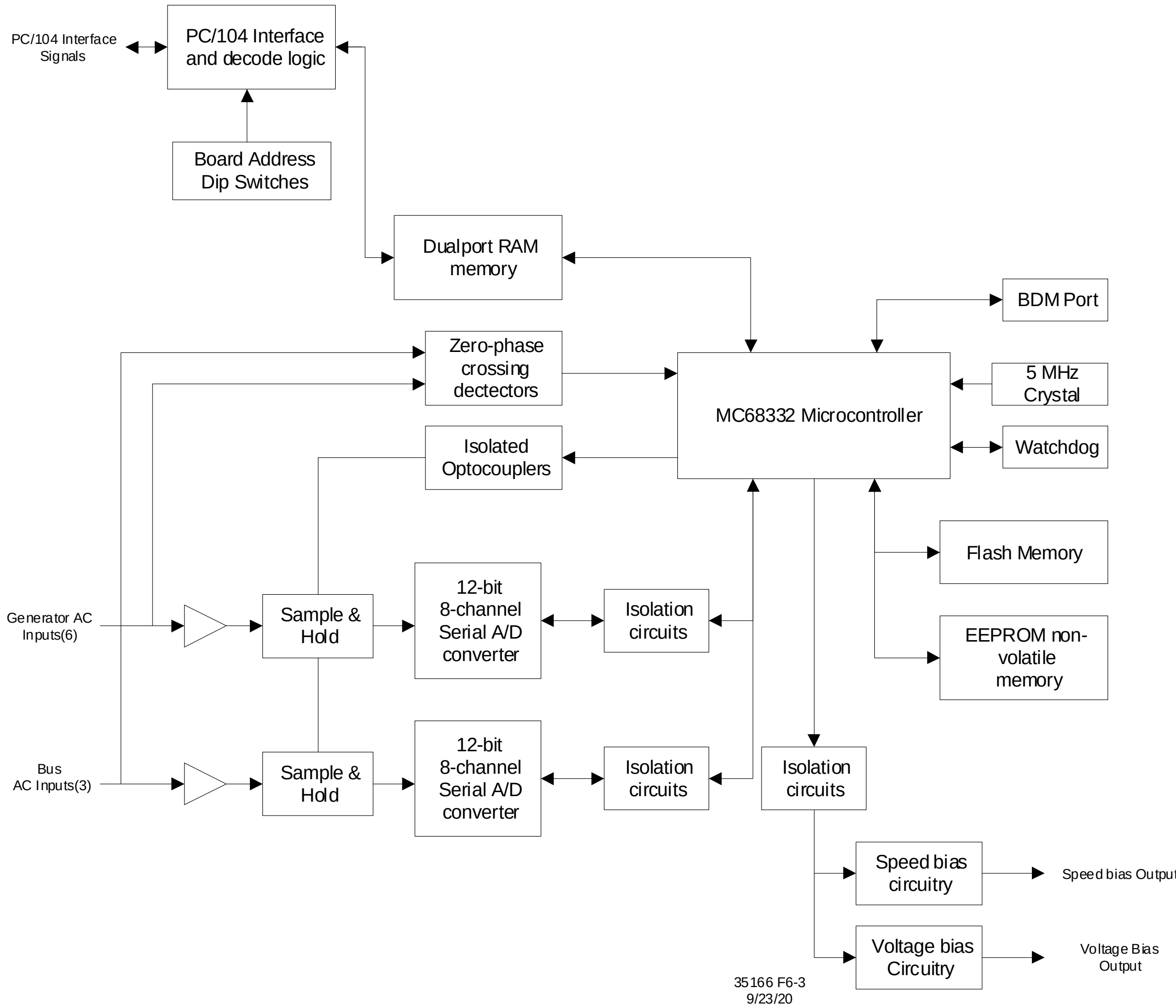


Figure 6-3. PowerSense Board Block Diagram

Table 6-1. Specifications

Utility and Generator PT Voltage Inputs			
Input Voltage (Typical)	77, 120, 240/277 Vac, transducers externally powered		
Max. Input Voltage	300 Vac		
Input Current	3 mA maximum		
Input Frequency	45—70 Hz		
Common Mode Voltage	±450 Vdc minimum		
Common Mode Rejection Ratio	–63 dB minimum		
Measurement Category	CAT III		
PT Temp Drift	**(Vrange = 70/120/240 Vrms)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.4 % of Vrange	< 0.3% of Vrange
		0.28V, 70V scale	0.21V, 70V scale
		0.48V, 120V scale	0.36V, 120V scale
		0.96V, 240V scale	0.72V, 240V scale
	Max (3σ):	< 1.2 % of Vrange	< 0.8% of Vrange
		0.84V, 70V scale	0.56V, 70V scale
		1.44V, 120V scale	0.96V, 120V scale
		2.88V, 240V scale	1.92V, 240V scale
Input Impedance	400 kΩ or greater		
Isolation	see HAZARDOUS LIVE section above		
Utility and Generator CT Current Inputs			
Input Current	5 A rms full scale		
Max Transient Input Current	7.07 A rms		
Input Frequency	45—70 Hz		
Common Mode Voltage	±250 Vdc minimum		
Common Mode Rejection Ratio	–63 dB minimum		
Measurement Category	CAT III		
Accuracy	see PT/CT Accuracy Table		
CT Temp Drift	**(FullScale = 5 Arms)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.4% or 20.0 mA	< 0.3% or 15.0 mA
	Max (3σ):	< 1.2% or 60.0 mA	< 0.8% or 40.0 mA
Input Impedance	0.030 Ω		
Isolation	see HAZARDOUS LIVE section above		
Speed Bias Output			
Number of Channels	1		
Current Output Option	4–20 mA selected by software switch and wiring		
Max current output	25mA ±5%		
Voltage Output Options	0–5 V (5 V max ±5%), ±3 V (±3V limit ±5%), 500 Hz PWM, selected by software switch and wiring		
Isolation	500 Vac		
Max load resistance	300 Ω at 24 mA for 4–20 mA output, infinite for V outputs		
Min load resistance	0 Ω for current output, 450 Ω for ±3 V output, 1kΩ for 0–5 V output, PWM output		
Resolution	11 bits, except for PWM output		
Accuracy	less than ±0.1% of full scale @ 25 °C or ±0.006 V for ±3 V output ±0.005 V for 0–5 V output ±0.025 mA for 4–20 mA output		
TempDrift	**(±3V range)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.3% or 18.0 mV	< 0.2% or 12.0 mV
	Max (3σ):	< 0.7% or 42.0 mV	< 0.5% or 30.0 mV
TempDrift	**(0–5 V range and PWM)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.1% or 5.0 mV	< 0.1% or 5.0 mV
	Max (3σ):	< 0.2% or 10.0 mV	< 0.2% or 10.0 mV

- Options: 4–20 mA, 0–5 V, ±3V, PWM- 5V- 500 Hz. Both the GAP block field and the wiring must be changed to switch between current and voltage outputs. Only the GAP block field must be changed to switch between the voltage outputs.

Voltage Bias Output			
Number of channels	1		
Current output option	4–20 mA selected by software switch and wiring		
Max current	25mA ±5%		
Voltage output options	±1, ±3, ±9 V selected by software switch and wiring		
Max Voltage	±9V ±5%		
Isolation	see HAZARDOUS LIVE section above		
Max load resistance	300 Ω at 24 mA for 4–20 mA output, infinite for V output		
Min load resistance	7kΩ for ±9V output, 0 Ω for 4–20 mA output		
Resolution	11 bits for ±9V, >9 bits for ±3V, >7 bits for ±1V		
Accuracy	less than ±0.1% of full scale @ 25 °C or ±0.018V for ±1V, ±3V, ±9V output ±0.025 mA for 4–20 mA output		
TempDrift	**(4–20 mA, FS = 25 mA)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.5% or 0.125 mA	< 0.3% or 0.075 mA
	Max (3σ):	< 1.2% or 0.30 mA	< 0.8% or 0.20 mA
TempDrift	**(±9V range)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.3% or 54.0 mV	< 0.3% or 54.0 mV
	Max (3σ):	< 0.6% or 108.0 mV	< 0.5% or 90.0 mV
TempDrift	**(±3V range)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 0.9% or 54.0 mV	< 0.9% or 54.0 mV
	Max (3σ):	< 1.8% or 108.0 mV	< 1.5% or 90.0 mV
TempDrift	**(±1V range)**	**–40 to +85 °C**	**Any 40 °C change**
	Typical (1σ):	< 2.7% or 54.0 mV	< 2.7 % or 54.0 mV
	Max (3σ):	< 5.4% or 108.0 mV	< 4.5% or 90.0 mV

- Options: 4–20 mA, ±1V, ±3V, ±9V; software and wiring selectable. Both the GAP block field and the wiring must be changed to switch between current and voltage outputs. Only the GAP block field must be changed to switch between the voltage outputs.

Table 6-2. PT/CT Accuracy Table

Metering Item	**Accuracy with Default Filter Values of 0.67**
Voltage	0.25% or 0.175 V, 70 Vac scale
	0.25% or 0.3 V, 120 Vac scale
	0.25% or 0.6 V 240 Vac scale
Current	0.25% or 12.5 mA
Power	0.5% or 1.75 VA, 70 V scale
	0.5% or 3.0 VA, 120 V scale
	0.5% or 6.0 VA, 240 V scale
Power Factor	±0.003 PF Across entire range of 0.5 lead to 0.5 lag
Frequency	0.08% of 60 Hz or ±0.048 Hz
Synchronizing	0.25% or ±0.00157 rad or ±0.9°
Harmonics 2-7	1% or 50 mA for current
	1% or 0.7 V, 70 Vac scale
	1% or 1.2 V, 120 Vac scale
	1% or 2.4 V, 240 Vac scale
Harmonics 9, 11, 13	2% or 100 mA for current
	2% or 1.4 V, 70 Vac scale
	2% or 2.4 V, 120 Vac scale
	2% or 4.8 V, 240 Vac scale
Negative Phase Sequence Voltage or Current	0.5% or 25 mA for current
	0.5% or 0.35 V, 70 Vac scale
	0.5% or 0.6 V, 120 Vac scale
	0.5% or 1.2 V, 240 Vac scale
Typical Temperature Drift for voltage inputs	<0.4% of Vrange for any 40 °C change
Typical Temperature Drift for current inputs	<0.4% or 20.0 mA for any 40 °C change

* Accuracy values at 25 °C with no harmonics

PowerSense Board Operation

This board includes no potentiometers and requires no field calibration.

A PowerSense board may be replaced with another board of the same part number without any physical adjustment.

NOTICE

When the PowerSense card is used for synchronizing, the GAP application must be configured so that the timing is correct for the characteristics of the PTCT_ATL and SYNCHRO blocks.

1) The rate group for both blocks must be set to "10".
2) Disable the synchronizer and verify that the SYNCHRO.SYNC_DIS is <TRUE>.
3) Enable the PTCT_ATL.SMPL_TYPE by tuning to <TRUE>.
4) Delay 200 ms.
5) After the 200 ms delay, tune the SYNCHRO.SYNC_DIS to <FALSE>.

Please see the GAP help for further details on the remaining functionality of these blocks.

PT Voltage Inputs

The PT inputs are designed to sense three phase voltage. All features of the three phase voltage for the generator are exactly duplicated for the mains inputs. The ‘A’ phase voltage inputs of each set (generator and mains) are used for frequency measurement and synchronizing. The fundamental magnitude and phase information is calculated, in addition to the magnitude and phase of each harmonic. All harmonics are calculated, up to the 7th harmonic, as well as the 9th, 11th, and 13th harmonics. In addition the PT voltage inputs are used in conjunction with the CT current inputs for power calculation purposes. All voltage calculations are performed using algorithms in accordance with IEEE 1459-2000.

Individual fundamental and harmonic voltage inputs are provided. A negative phase sequence voltage input, and a THD voltage input are also provided.

Three hardware ranges are provided and are selected by the application software. The nominal inputs for these ranges are 70 V, 120 V, and 240 V. Using the 70 V range, the lowest voltage that will be sensed it 26.67 V, using the 120 V range the lowest voltage is 40 V, and using the 240 V range the lowest voltage is 80 V.

PT ratio and gain inputs are provided, to allow field configuration of the PT scaling. The PT ratio will scale all three PT inputs by the same ratio. There is a separate gain input provided for each PT input (3 for the generator and 3 for the mains) that is provided to allow for compensation of potential transformer turns ratio inaccuracies.

The PT inputs, have adjustable software filters. All PT inputs are updated every 3 cycles. With an input of 60 Hz, this equates to 50 ms.

The hardware does not require three phases for voltage calculations, the application can configure the module for single phase, and all functionality will be modified accordingly. The single phase input that must be provided is the A phase. The application can also configure the module for a “Y” or “delta” line configuration, and the calculations will compensate appropriately. If the physical connections are to a wye connected generator or load, the input to PowerSense should also be wye connected (line-to-neutral). If the physical connections are to a Delta connected generator or load (no neutral present), the input to PowerSense should also be Delta connected (line-to-line).). The “Y” or “delta” configuration applies to the entire set of PT and CTs, it is not possible to configure the PTs for “Y”, and the CTs for “delta”, or vice versa. However, the configuration may differ between PT/CT 1 and PT/CT 2 (or gen and mains in a typical configuration).

Configuration Notes

- Refer to Figures 6-4 through 6-8 for PT wiring.
- When using the 3 different PT ranges, 70 V, 120 V, and 240 V, the physical input must be the correct voltage AND the application software must configure the PT/CT block for the correct voltage range.
- When using a single phase input, the PT input used must be phase A, and the application software must configure the PT/CT block for “single phase” operation.
- The application software must configure the PT/CT block for the correct system frequency 50Hz or 60 Hz, as well as for the correct rotation, clockwise or counterclockwise.
- See the GAP help, for information on application software configuration variables.
- The terminal block screws should be torqued to 8 – 10 lb-in (0.9038782 - 1.129848 N·m).
- Marine Type Approval installations require cabling to be shielded if it leaves the cabinet. PT wires may be shielded as a single group and the shield may be conduit or similar.

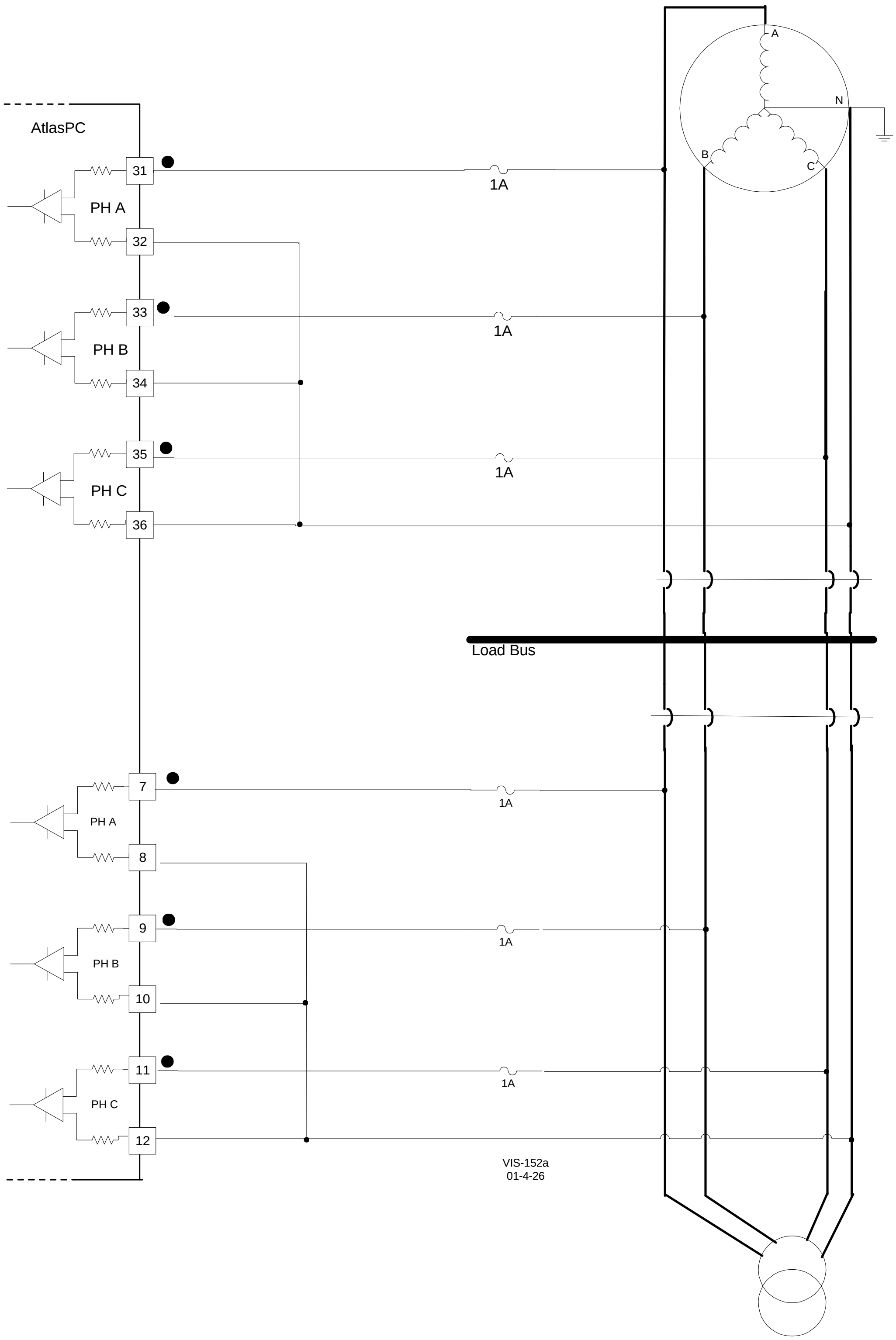


Figure 6-4. Wiring Example–Wye Connected System
(PT Interface wired L-N to the PowerSense Board)

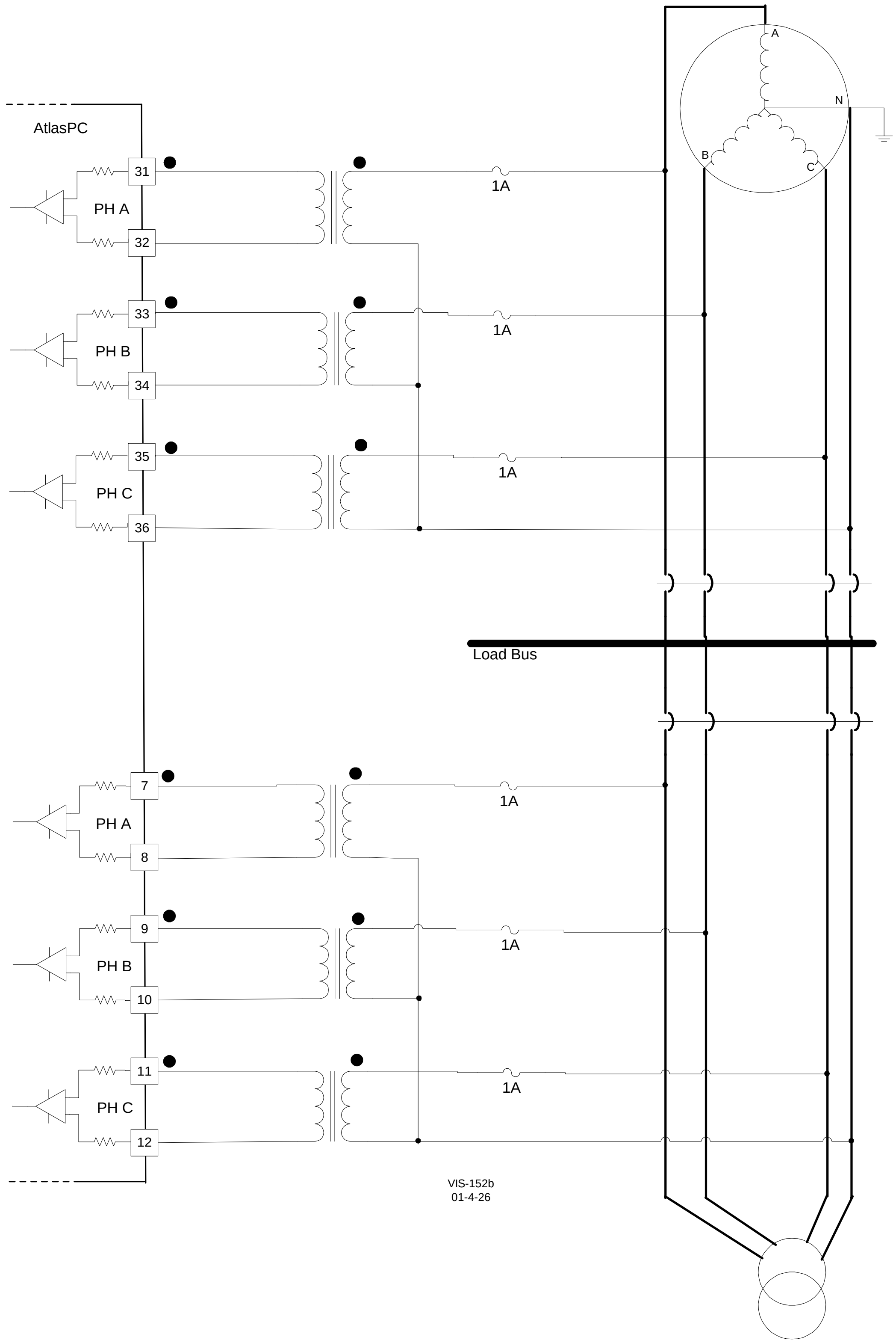


Figure 6-5. Wiring Example–Wye Connected System
(Wired L-N to PowerSense with potential transformers used to step the voltage down to a level within the capability of the PowerSense inputs)

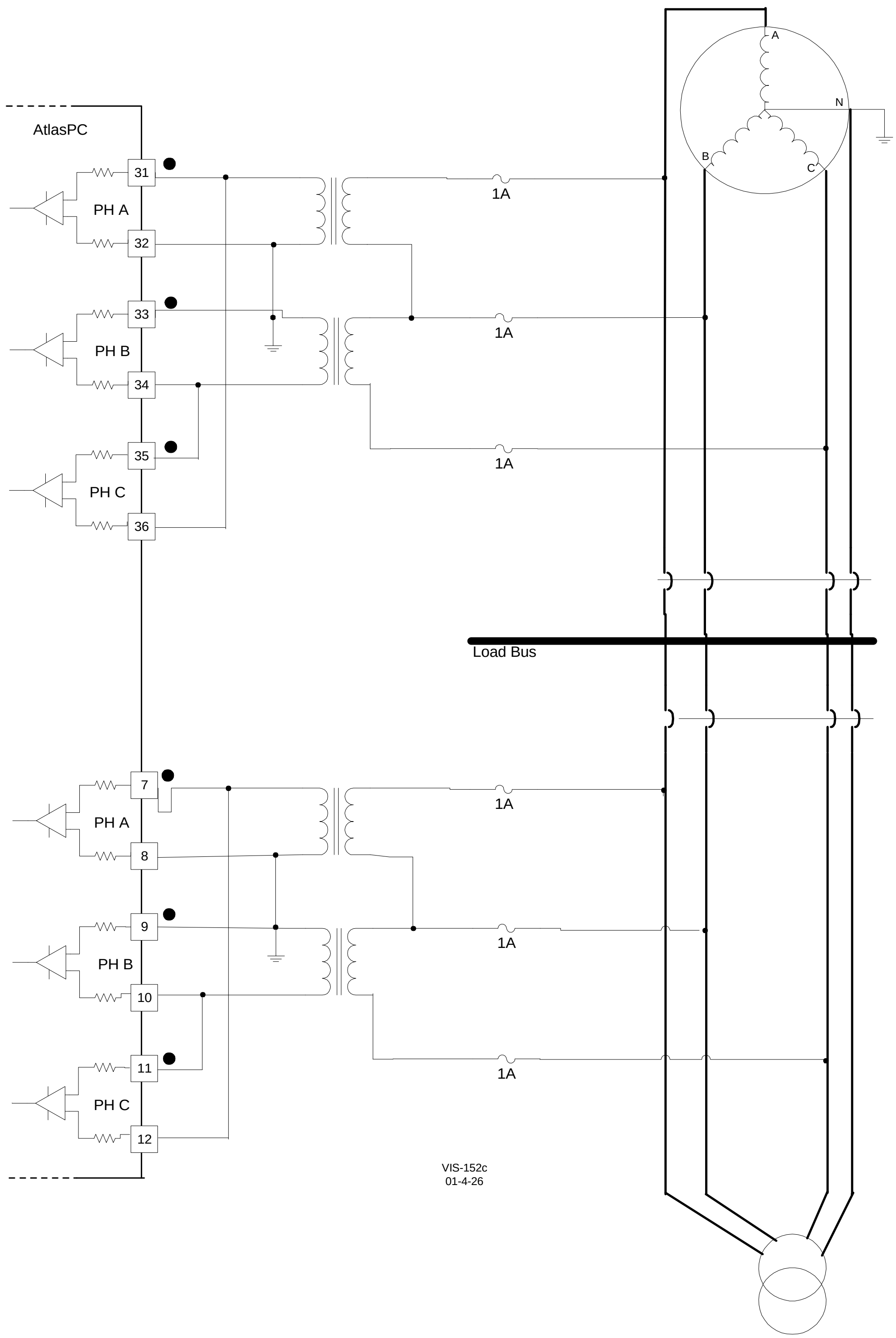


Figure 6-6. Example Wiring–Wye Connected System
(Wired L-L to PowerSense with potential transformers used to step the voltage down to a level within the capability of the PowerSense inputs; the ground on the b-phase input is optional.)

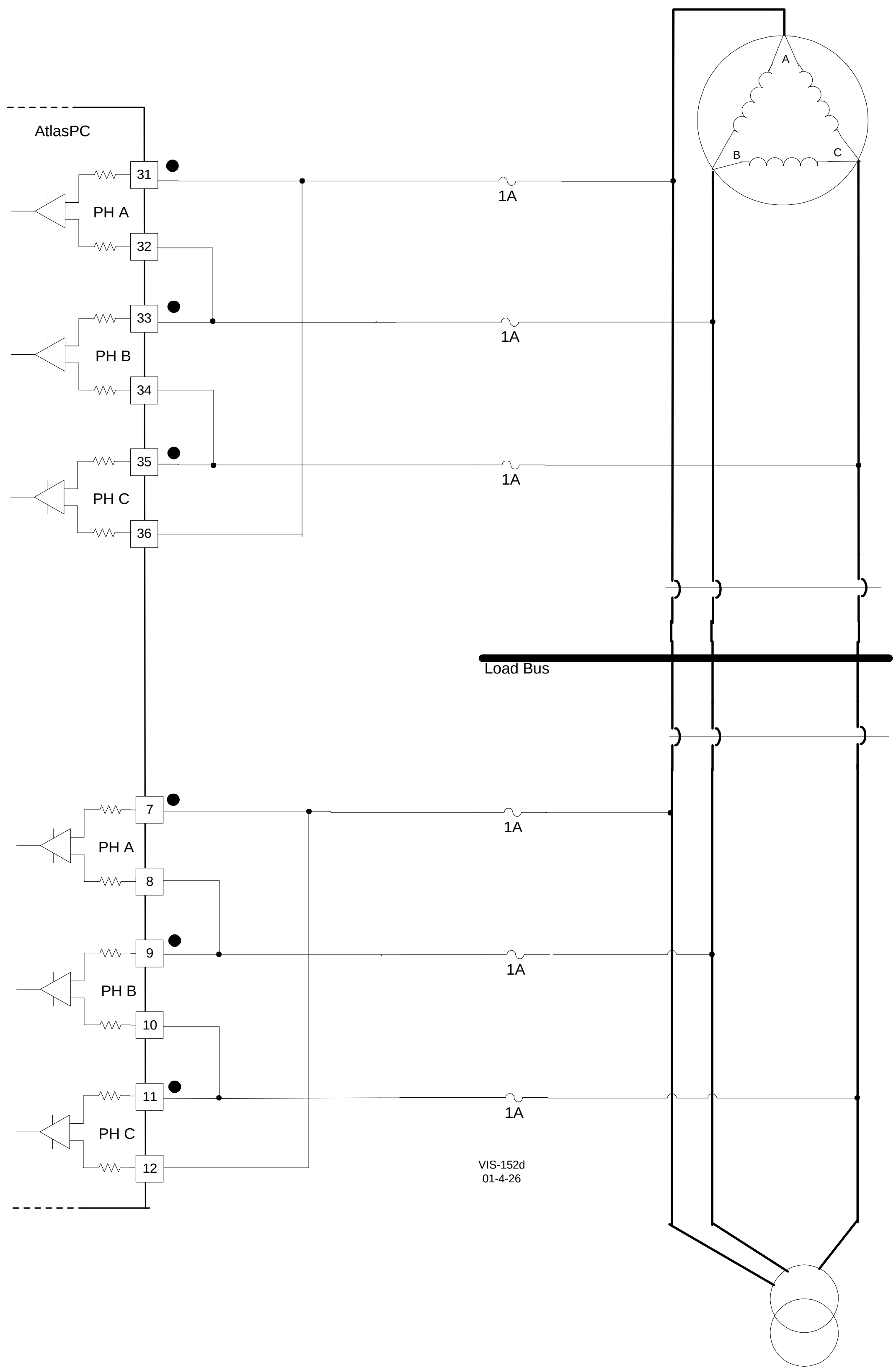


Figure 6-7. Wiring Example–Delta Connected System
(PT Interface wired L-L to the PowerSense Board)

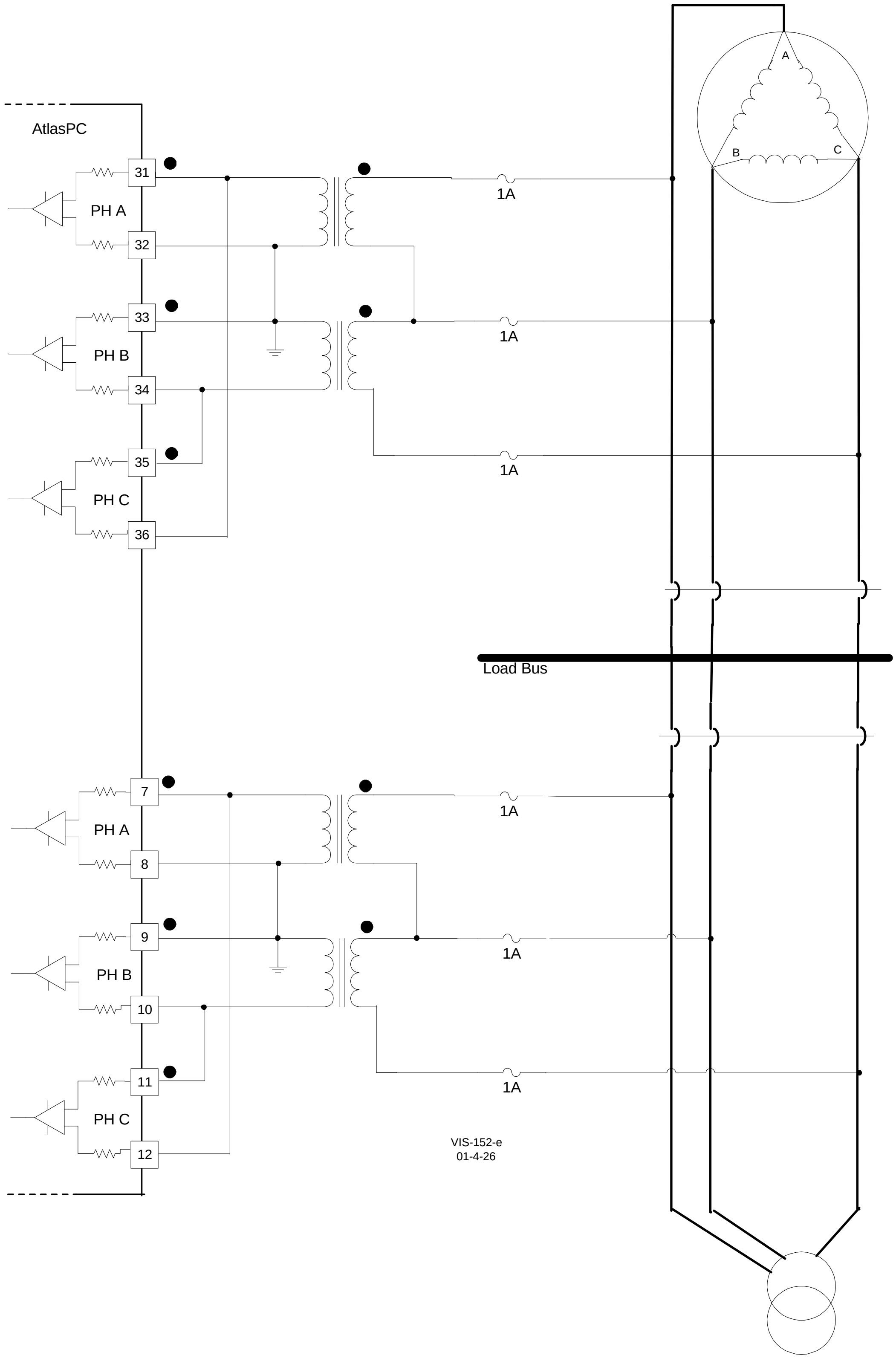


Figure 6-8. Wiring Example–Delta Connected System
(Wired L-L to PowerSense with potential transformers used to step the voltage down to a level within the capability of the PowerSense inputs; the ground on the B-phase input is optional.)

Generator Current Inputs

The CT inputs are designed to sense three phase current inputs. The ‘A’ phase current inputs of each set are used for phase calculations. The fundamental magnitude and phase information is calculated, in addition to the magnitude and phase of each harmonic. All harmonics are calculated, up to the 7th harmonic, as well as the 9th, 11th, and 13th harmonics. In addition the CT current inputs are used in conjunction with the PT voltage inputs for load calculation purposes. All current calculations implement algorithms in accordance with IEEE 1459-2000.

Individual fundamental and harmonic CT inputs are provided. A negative phase sequence current input and a THD current input are also provided.

The CT inputs are rated at 5A and function down to 50 mA. For optimum accuracy in the usable range, it is recommended to use 5 A secondary CTs with PowerSense (not 1A secondary CTs). Take care to avoid secondary currents greater than 7 Arms, as this will cause damage.

CT ratio and gain inputs are provided, to allow field configuration of the CT scaling. The CT ratio will scale all three CT inputs by the same ratio. There is a separate gain input provided for each CT input (3 for the generator and 3 for the mains) that is provided to allow for compensation of current transformer turns ratio inaccuracies.

The CT inputs have adjustable software filters. All CT inputs are updated every 3 cycles. With an input of 60 Hz, this equates to 50 ms.

The hardware does not require three phases for current calculations, the application can configure the module for single phase, and all functionality will be modified accordingly. The single phase input that must be provided is the A phase. The application can also configure the module for a “Y” or “delta” line configuration, and the calculations will compensate appropriately. If the physical connections are to a wye connected generator or load, the input to PowerSense should also be wye connected (line-to-neutral). If the physical connections are to a Delta connected generator or load (no neutral present), the input to PowerSense should also be Delta connected (line-to-line).). The “Y” or “delta” configuration applies to the entire set of PT and CTs, it is not possible to configure the PTs for “Y”, and the CTs for “delta”, or vice versa. However, the configuration (line type and single or three-phase) may differ between PT/CT 1 and PT/CT 2 (gen and mains in most systems).

⚠WARNING	**HIGH VOLTAGE—Before disconnecting the secondary terminals of the current transformer or the connections of the current transformer at the control, ensure that the transformer is short-circuited.**

Configuration Notes

- Refer to Figures 6-9 and 6-10 for CT wiring.
- When using only one CT, rather than 3, the CT must be phase A, and the application software must configure the PT/CT block for “single phase” operation.
- The application software must configure the PT/CT block for the correct system frequency 50 Hz, or 60 Hz, as well as for the correct rotation, clockwise or counterclockwise.
- See the GAP help, for information on application software configuration variables.
- The terminal block screws should be torqued to 8–10 lb-in (0.9–1.1 N·m).
- Marine Type Approval installations require cabling to be shielded if it leaves the cabinet. CT wires may be shielded as a group and the shield may be conduit or similar.

Power Calculations

Individual and total watts, VARs, VA, and power factor inputs. A negative phase sequence voltage input and a THD voltage input are also provided.

All power calculations implement algorithms in accordance with IEEE 1459-2000.

The power inputs have adjustable software filters. All power inputs are updated every 3 cycles. With an input of 60 Hz, this equates to 50 ms.

The hardware does not require three phases for load calculations, the application can configure the module for single phase, and all functionality will be modified accordingly. The single phase input that must be provided is the A phase. The application can also configure the module for a “Y” or “delta” line configuration, and the calculations will compensate appropriately. If the physical connections are to a wye connected generator or load, the input to PowerSense should also be wye connected (line-to-neutral). If the physical connections are to a Delta connected generator or load (no neutral present), the input to PowerSense should also be Delta connected (line-to-line). The “Y” or “delta” configuration applies to the entire set of PT and CTs, it is not possible to configure the PTs for “Y”, and the CTs for “delta”, or vice versa.

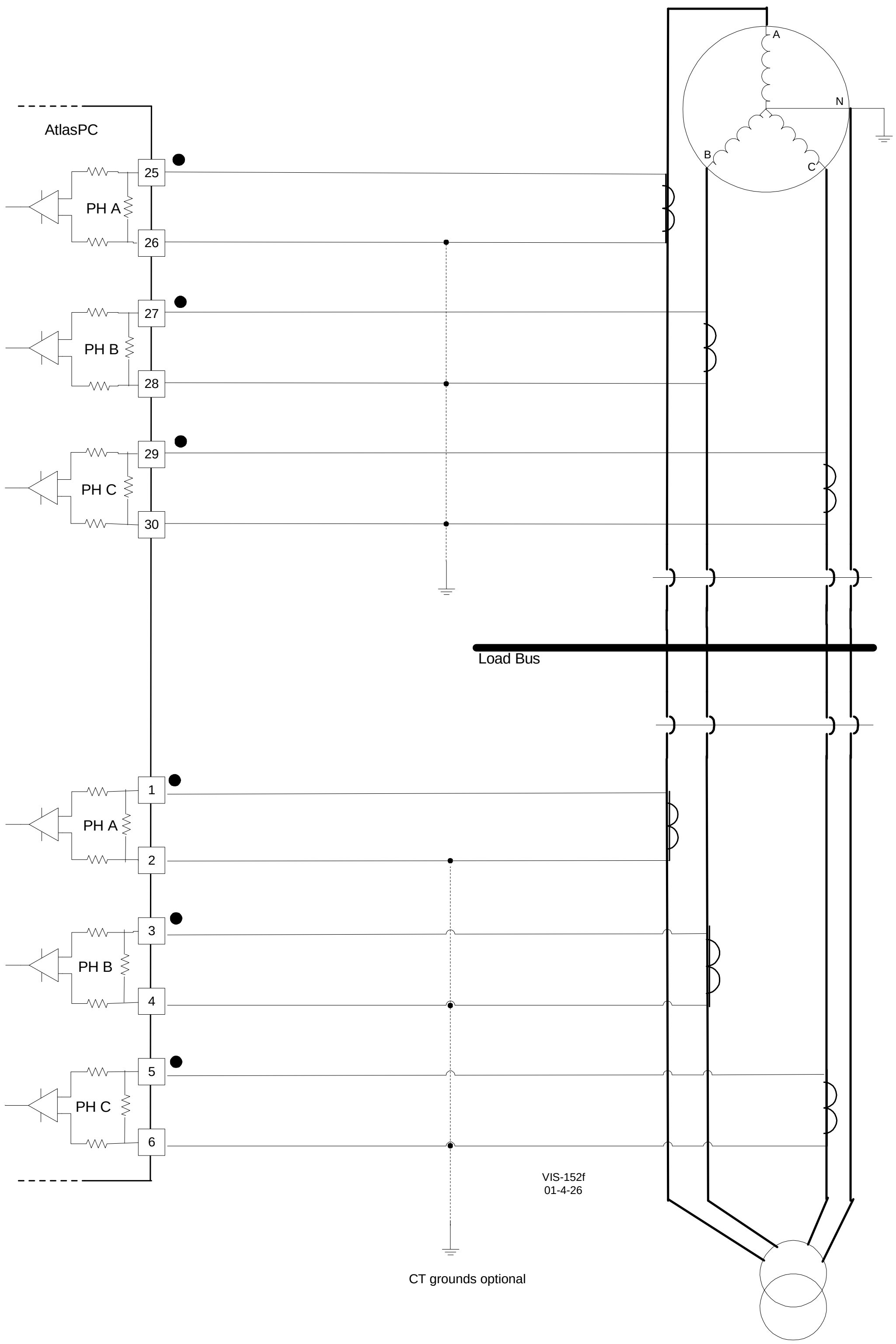


Figure 6-9. Wiring Example–CT Interface to the PowerSense Board

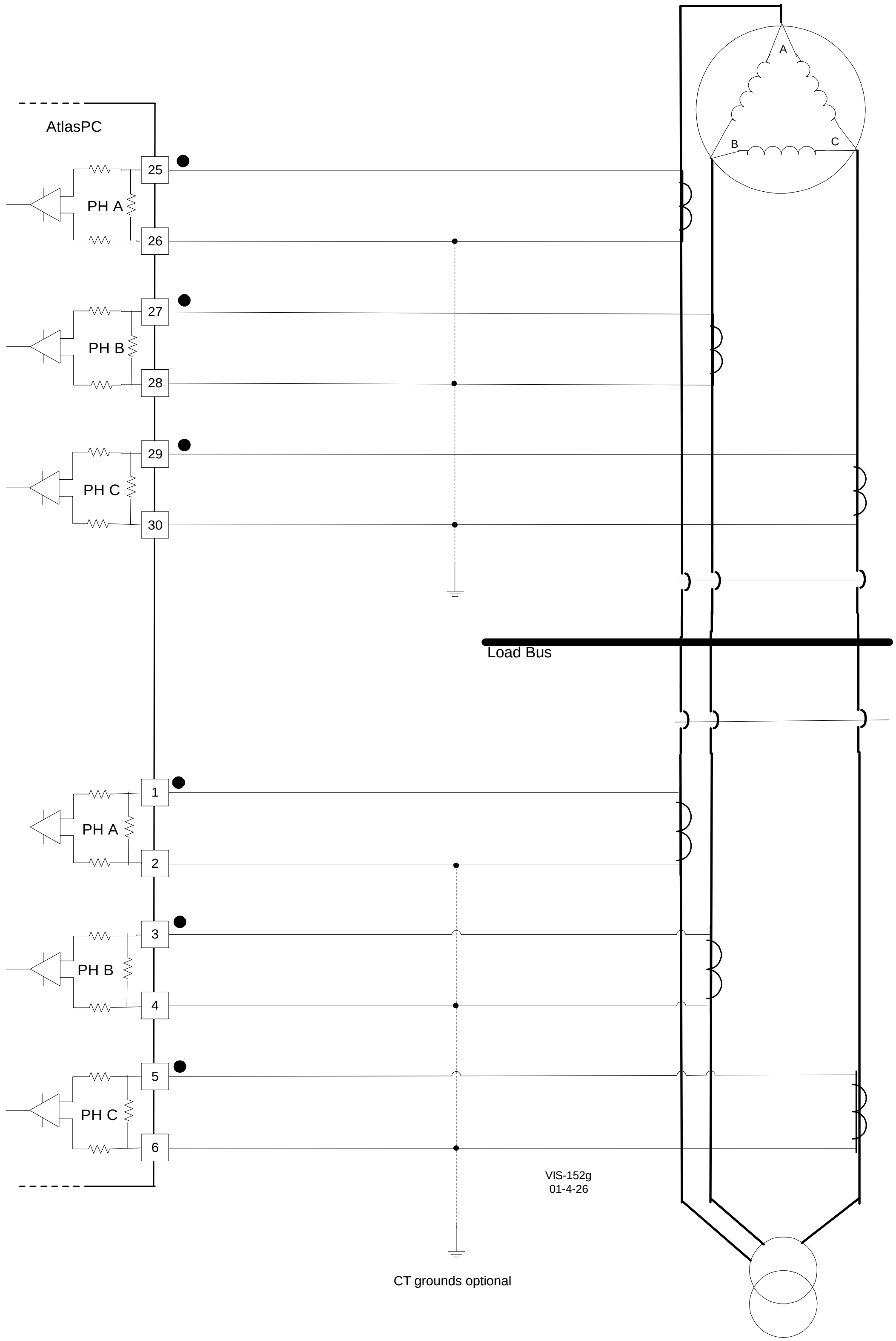


Figure 6-10. Wiring Example–CT Interface to the PowerSense Board

Speed Bias Output

The Speed Bias output is configurable for 4–20 mA with a full scale range of 0–24 mA, or as a ±3 V, 0–5 V, or PWM voltage output. When used as a PWM output, the PWM frequency is 500 Hz. Configuring the output requires wiring and application software configuration. This output is isolated from the rest of the control system, to prevent ground loops when connecting the PowerSense board to other controls.

Configuration Notes

- Refer to Figures 6-11 and 6-12 for Speed Bias Output wiring. Wires must be shielded.
- The Speed Bias output must be configured for the correct type, 4–20 mA or the voltage type in the application software.
- See the specifications section for the maximum output load.
- The output does not contain fault detection. If it is necessary to detect failures, then the device that is driven by the analog output, for example an actuator driver, must contain reference failure detection.
- The output cannot be used as a voltage output and a current output at the same time.

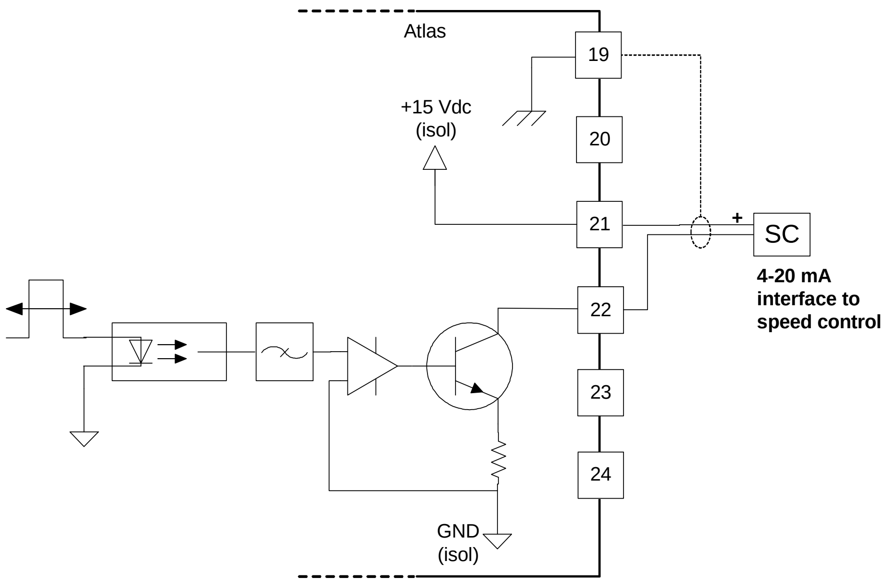


Figure 6-11. Wiring Example–Speed Bias Output Interface
(to the PowerSense Board configured for 4–20 mA)

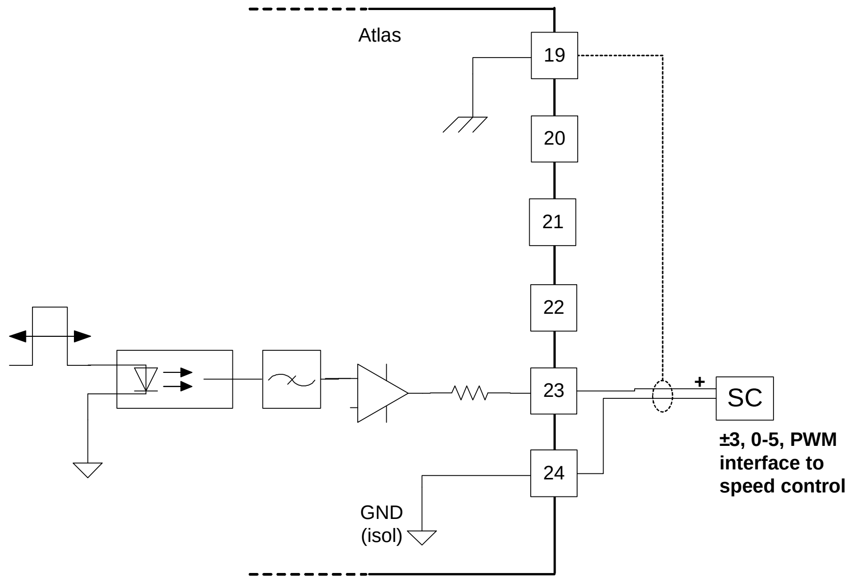


Figure 6-12. Wiring Example–Speed Bias Output Interface
(to the PowerSense Board configured for ±3 V, 0–5 V, or PWM)

Voltage Bias Output

The Voltage Bias output is configurable for 4 - 20 mA with a full scale range of 0 - 24 mA, or as a ±1, ±3V, or ±9V voltage output. Configuring the output requires wiring and application software configuration. This output is isolated from the rest of the control system to prevent ground loops when connecting the PowerSense board to other controls. The voltage outputs are configured in the software, therefore the ±9V output has about 3 times better accuracy and resolution than the ±3V output, which has about 3 times better accuracy and resolution than the ±1V output.

Configuration Notes

- Refer to Figures 6-13 and 6-14 for Voltage Bias Output wiring. Wires must be shielded.
- The Voltage Bias output must be configured for the correct type, 4–20 mA or the voltage type, in the application software.
- See the specifications section for the maximum output load.
- The output does not contain fault detection. If it is necessary to detect failures, then the device that is driven by the analog output, for example an actuator driver, must contain reference failure detection.
- The output cannot be used as a voltage output and a current output, at the same time.

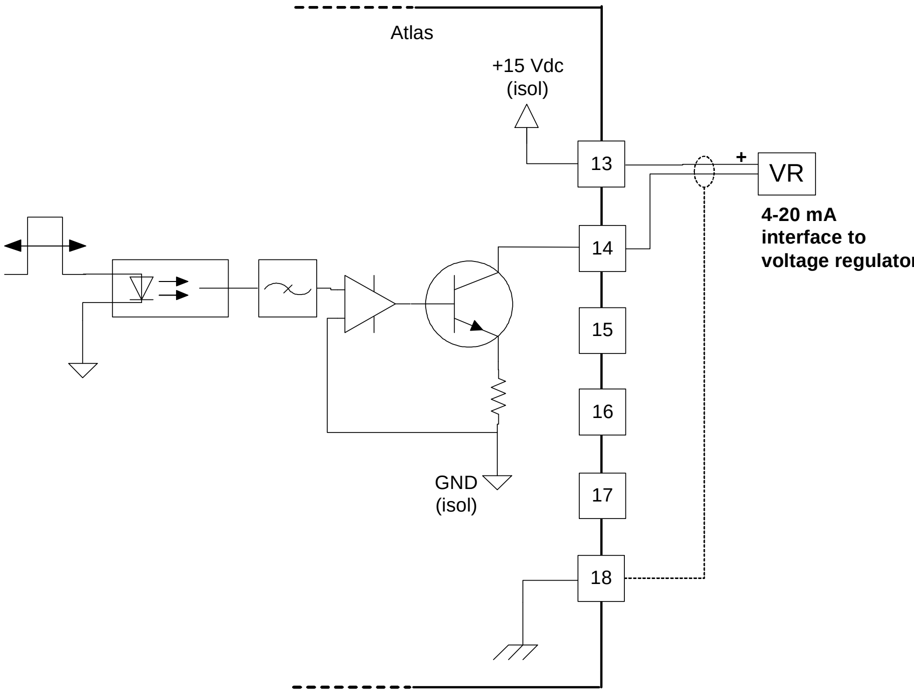


Figure 6-13. Wiring Example–Voltage Bias Output Interface
(to the PowerSense Board configured for 4–20 mA)

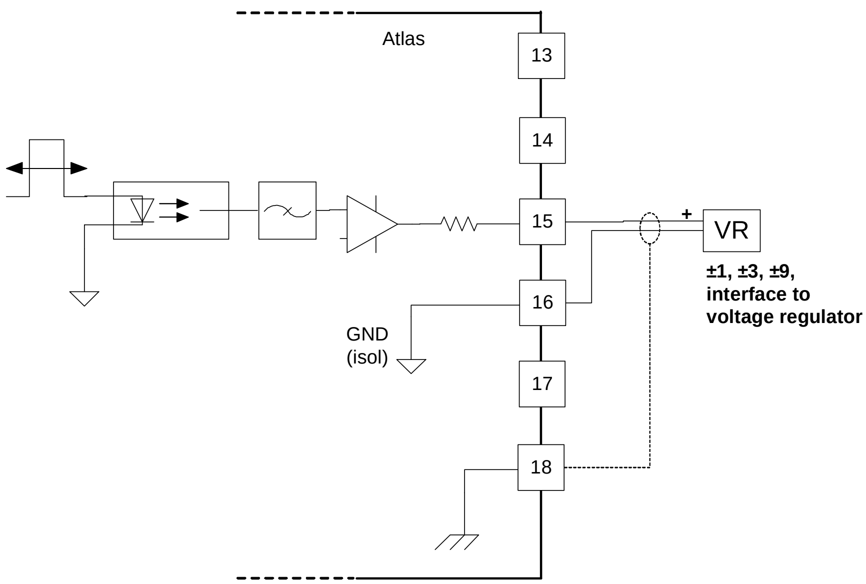


Figure 6-14. Wiring Example–Voltage Bias Output Interface
(to the PowerSense Board configured for ±1 V, ±3 V, or ±9 V)

Fault Detection (Board Hardware)

Each PowerSense board has a red fault LED that is turned on when the system is reset. During initialization of a board, which occurs after every CPU reset, the CPU turns the Fault LED on. The CPU then tests the board using diagnostic routines built into the software. If the diagnostic test is not passed, the LED remains on or blinks. Table 6-1 below explains what a blinking LED indicates. The LED will blink the appropriate number of times, rest for one second, then blink again in repetition. If the test is successful, the LED goes off. If the fault LED on a board is illuminated after the diagnostics and initialization have been completed, the PowerSense board may be faulty or may have the address DIP switches configured incorrectly. The DIP switch setting must match the module address set in the GAP application program. It cannot be the same address used by any other card on the PC/104 bus. These are factory set at the time the system is built.

Table 6-3. PowerSense Failure Codes

Number of LED Flashes	Failure
Off	No failure, system OK
Solid	Module in initialization mode
1	Hardware watchdog, CPU clock failure, reset fail
2	Unexpected Exception Error
3	RAM test failure
5	EEPROM failure
7	Kernel Watchdog Timeout
10	System Error
11	Board Identification Error
12	TPU RAM failure
13	Dual Port RAM test failure
14	QSM or ADC Initialization failure
15	Self-test status failure
20	Invalid A/D converter selected
21	QSPI timeout
24	ADC auto calibration time-out

Fault Detection (I/O)—In addition to detecting board hardware faults, the application program may detect I/O faults, by comparing values against each other at specific operating points. For example, if phases A and C are reading correctly, and phase B is significantly different, the application could annunciate a problem with phase B.

Microcontroller Faults—The system monitors a software watchdog, a hardware watchdog, and a software watchdog on the PC/104 bus communications. All outputs are shutdown in the event of a microcontroller fault or watchdog detection.

Troubleshooting Guide

PT Inputs

If a PT input is not functioning properly, verify the following:

- Measure the voltage and frequency on the terminal block, to ensure that they are correct.
- Check the wiring. Look for a loose connection at the terminal blocks and for disconnected or misconnected cables.
- Check the PT range configuration in the application software, to ensure that it corresponds to the rated voltage at the input.
- Check the system frequency configuration in the application software, to ensure that 50Hz or 60 Hz is selected, as appropriate.
- Check the “3 phase” configuration in the application software. In single phase mode, phases B and C will be set to 0.
- Check the A phase signal. B and C phase PTs will not read correctly without the A phase PT. If the A phase frequency is unstable, B and C readings will be unstable.
- Verify the settings to the PT/CT block in the application software.
- Verify the settings for wye or delta (L-N or L-L) match the actual wiring

- Verify proper grounding. Incorrect grounding practices may cause inaccurate voltage readings.

After verifying all of the above, the Atlas-II should be returned for service.

CT Inputs

If a CT input is not functioning properly, verify the following:

- Measure the current and frequency on the terminal block, to ensure that they are correct.
- Check the wiring. If the input is reading 0, look for a shorted connection at the terminal blocks and for misconnected cables.
- Check the system frequency configuration in the application software, to ensure that 50Hz or 60 Hz is selected, as appropriate.
- Check the “3 phase” configuration in the application software, in single phase mode phases B and C will be set to 0.
- Check the A phase PT signal, CT phases A, B, and C will not read correctly without the A phase PT. If the A phase PT frequency is unstable the CT readings will be unstable.
- Verify the settings to the PT/CT block, in the application software.
- Verify the settings for wye or delta (L-N or L-L) match the actual wiring
- If the CT common is not grounded, try grounding it to eliminate offsets in the readings. Be sure to ground it in the same location as the other system grounds following good, accepted grounding practices.

After verifying all of the above, the Atlas-II should be returned for service.

WARNING

HIGH VOLTAGE—Before disconnecting the secondary terminals of the current transformer or the connections of the current transformer at the control, ensure that the transformer is short-circuited.

Speed and Voltage Bias Outputs

If a speed or voltage output is not functioning properly, verify the following:

- Check to make sure that the output is wired to the correct terminals, 4–20 mA connections are different from voltage output connections.
- Check that the cable is shielded and the shield is properly grounded per the shields and grounding section in Chapter 2.
- Check the load resistance, ensure that it is less than the specification limit for the output current.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Disconnect the field wiring and connect a resistor across the output. If the output is correct across the resistor, there is a problem with the field wiring.
- Check the software configuration to ensure that the output is configured properly.

After verifying all of the above, the Atlas-II should be returned for service.

Chapter 7.
12-Channel Relay Module

General Information

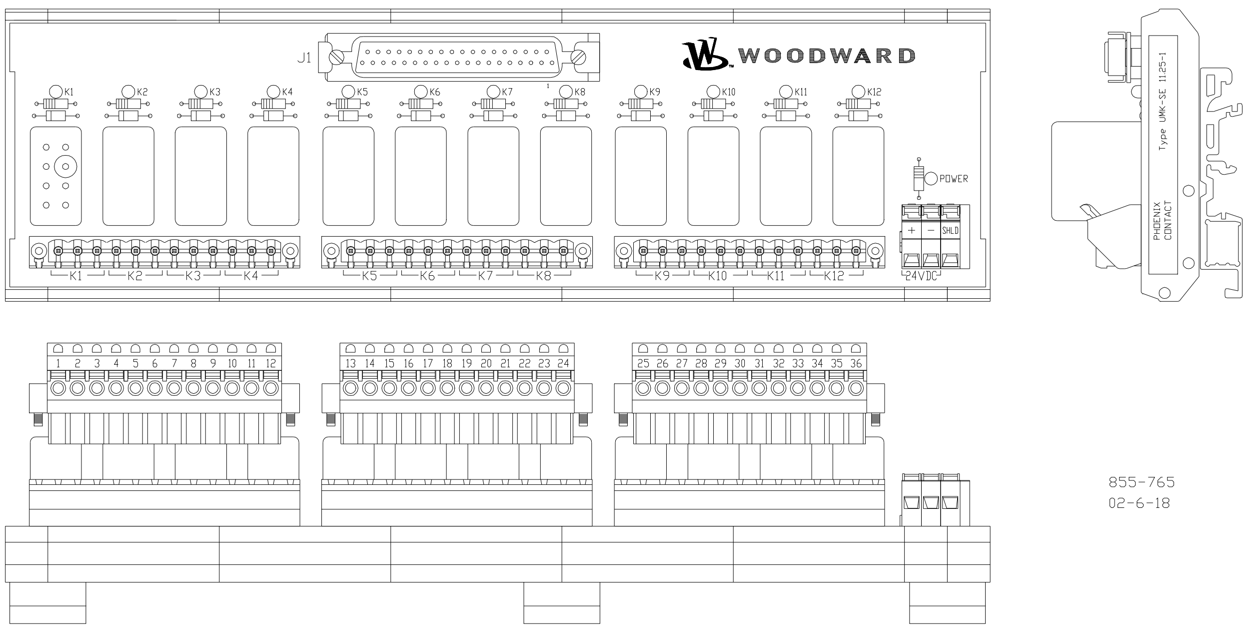


Figure 7-1. 12-Channel Relay Module

The Atlas system has 12 relay drivers on the power supply board. For customers that do not wish to wire their own discrete relays, Woodward can provide an integrated 12-channel relay module with cable harness that is certified for use in ordinary, hazardous, and marine locations.

The module is DIN rail mounted. Approximate dimensions are 254 mm long, 76 mm wide, and 64 mm tall (10 inches long, 3 inches wide, and 2.5 inches tall).

- Relay Module, Item Number 5441-699
- Cable, Item Number 5417-747

This equipment has been evaluated as EEx nC IIC T3 equipment under DEMKO Certificate No. 03 ATEX 0328750 U. Each device is suitable for use in Zone 2 explosive atmospheres. Device must be installed in a minimum IP54 enclosure as defined in IEC60529 and EN60529. This certification applies only to products bearing the DEMKO identification and the marking:

Ex II 3G.

Relay Information

Each relay has one set of normally open contacts and one set of normally closed contacts. The relay contact ratings are:

- 5 A at 28 Vdc resistive
- A at 125 Vdc resistive
- 3 A at 120 Vac resistive
- A at 120 Vac inductive
- 0.241 hp—120 Vac motor
- 0.112 hp—28 Vdc motor
- 0.5 A at 120 Vac tungsten

Shielding

There is a terminal on the module labeled “SHLD”. A wire should be connected between this terminal and a good local system ground. Alternatively, a ground wire can be crimped to the bare shield wire at the Atlas end of the cable and then tied to the chassis ground stud of the Atlas. If this shield wire is not used at the Atlas end of the cable, it should be trimmed back to the insulation jacket of the cable.

Board Status Lights

The module is equipped with twelve yellow LEDs to indicate when each relay has been energized, and one green LED to indicate that there is external power to the module. For proper operation, the green LED must be lit any time the Atlas system is being used.

Wiring

The relay module requires an external 18 to 32 Vdc power supply and a wiring harness. One end of this cable has been stripped back several inches, and individual wires are labeled with the terminal numbers of the appropriate terminals used on the Atlas power supply board. Refer to the following plant wiring diagram and the power supply chapter of this manual for more details.

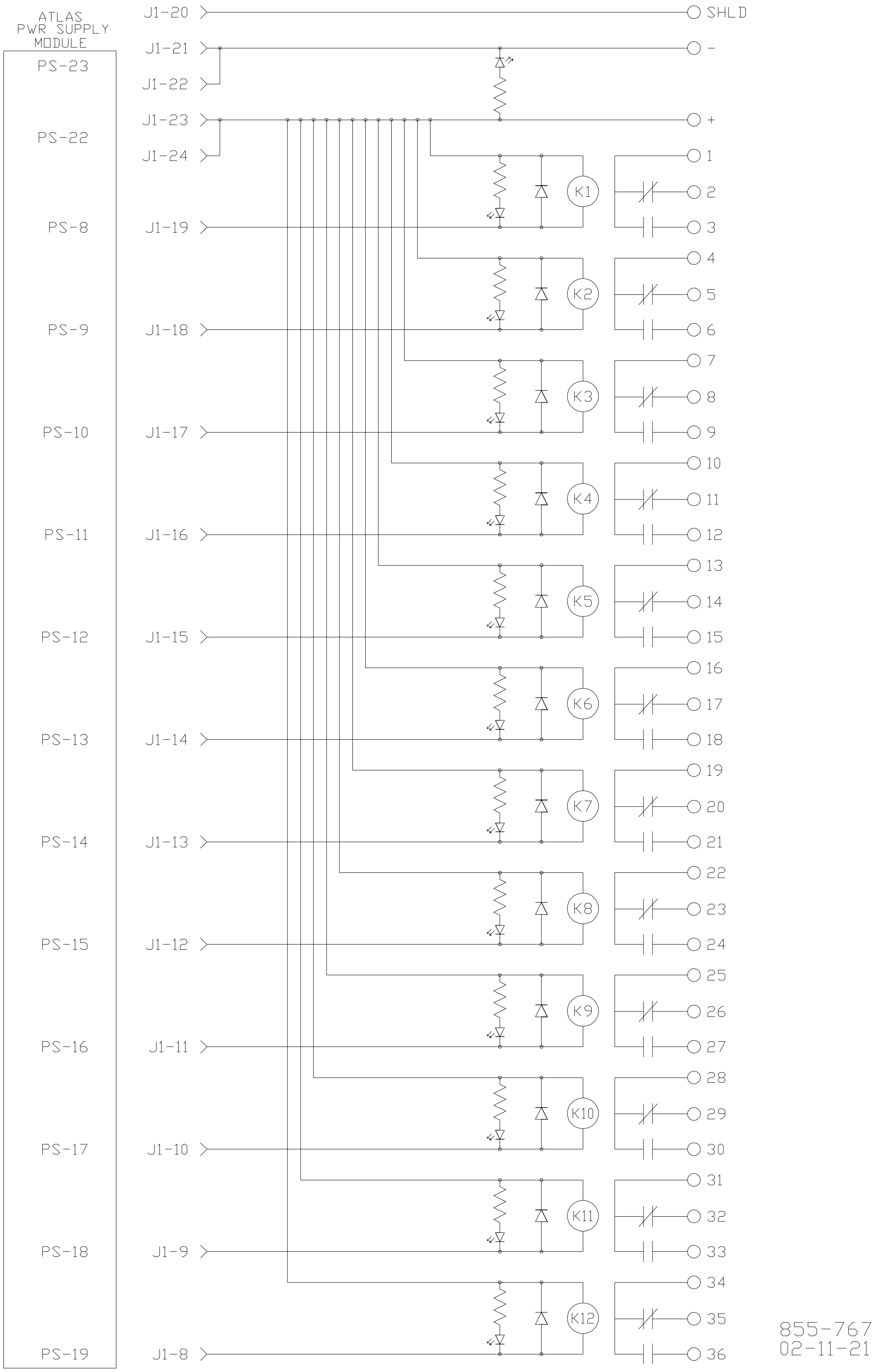


Figure 7-2. 12-Channel Relay Module Wiring Diagram

Chapter 8. Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty 5-01-1205 North American Terms and Conditions of Sale (Industrial Business Segment).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty 5-01-1205 North American Terms and Conditions of Sale (Industrial Business Segment) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in "like-new" condition and carry with it the full standard Woodward product warranty 5-01-1205 North American Terms and Conditions of Sale (Industrial Business Segment). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- Return authorization number
- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part number(s) and serial number(s)
- Description of the problem
- Instructions describing the desired type of repair

Packing a Control

Use the following materials when returning a complete control:

- Protective caps on any connectors
- Antistatic protective bags on all electronic modules
- Packing materials that will not damage the surface of the unit
- At least 100 mm (4 inches) of tightly packed, industry-approved packing material
- A packing carton with double walls
- A strong tape around the outside of the carton for increased strength

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- The part number(s) (XXXX-XXXX) that is on the enclosure nameplate
- The unit serial number, which is also on the nameplate

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name ____________________

Site Location ____________________

Phone Number ____________________

Fax Number

Prime Mover Information

Manufacturer ____________________

Turbine Model Number ____________________

Type of Fuel (gas, steam, etc.) ____________________

Power Output Rating ____________________

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number

Symptoms

Description ____________________

____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Appendix A. Acronyms and Glossary of Terms

Acronyms

ADC	Analog-to-Digital Converter
AWG	American Wire Gauge (metric equivalent is mm^2)
CE	The CE marking is a European proof of conformity and is also described as "passport" that allows manufacturers and exporters to circulate products freely within the EU. The letters "CE" (French for "Conformité Européenne") indicate that the manufacturer has satisfied all assessment procedures specified by law for its product.
CPU	Central Processing Unit. Executes the GAP application program.
CT	Current Transformer. Used to measure the generator or bus current.
dc	Direct Current
EEPROM	Electrically Erasable and Programmable Read Only Memory
EMC	Electromagnetic Conformity
EMI	Electromagnetic Interference
GAP	Graphical Application Program
I/O	Input/Output
LED	Light Emitting Diode
MFT	Minor Frame Timer. Used by the CPU for scheduling execution of the software.
MPU	Magnetic Pick-Up
MTBF	Mean Time Between Failures
PC	Personal Computer
PCB	Printed Circuit Board
PT	Potential Transformer. Used to measure the generator or bus voltage.
PWM	Pulse Width Modulated
RAM	Random Access Memory
RG	Rate Group. Defines how often software is executed.
RTD	Resistance Temperature Device
RXD	Receive Data Line
SRAM	Static Random Access Memory
SSTP	Shielded-Shielded Twisted Pair (or Double Shielded Ethernet Cables)
THD	Total Harmonic Distortion
TXD	Transmit Data Line
V/I	Voltage-to-Current converter

Glossary of Terms

Analog Input -	A 4–20 mA or 0–5 V input on the SmartCore CPU A5200 board, and a thermocouple, RTD or 4–20 mA input on the Analog Combo board.
Analog Output -	A 4–20 mA output, usually the full range is 0–24 mA.
Atlas-II Analog Combo Board -	An Atlas-II board with an analog format that connects to the Atlas-II SmartCore CPU A5200 board or PowerNet board, through the PC/104 interface. It contains 15 analog inputs, 2 speed sensor inputs, and 2 Analog outputs.
Atlas-II Chassis -	A combination of pieces required to hold the boards together, and may optionally include a keyboard and display.
Atlas-II Pentium CPU Board -	An Atlas-II board with a Pentium processor, for applications with a single Ethernet connection.
Atlas-II Platform -	The combination of boards, a power supply, and a chassis, that can be combined to compose a variety of controls for a variety of applications. The boards must have either a PC/104 connection, or a proprietary power bus connection, and meet certain packaging constraints.
Atlas-II Power Supply Board -	An Atlas-II board with primary power supply and 12 discrete outputs.
Atlas-II SmartCore CPU A5200 board -	An Atlas-II board with 6 analog inputs, 4 analog outputs, 2 actuator outs, 2 speed sensor inputs, 24 discrete inputs, 4 Ethernet, 2 can, and 2 serial communication ports. This board includes both the PC/104 and the power bus connections, allowing it to function as a backplane.
Backplane -	A board that ties other boards together electrically. Atlas-II needs either the SmartCore CPU A5200 board, or the PowerNet board, to connect the power bus voltages to the PC/104 bus.
Discrete Input -	An input used for switches or other contacts that register only two states, open or closed.
Discrete Output	Output drivers used for driving relays that register only two states, high or low.
Serial Port -	A connection for RS-232, RS-422, or RS-485.
Speed Sensor Input	An MPU or proximity probe input on the SmartCore CPU A5200 board, and a MPU only input on the Analog Combo board.

Appendix B. Wiring Diagrams

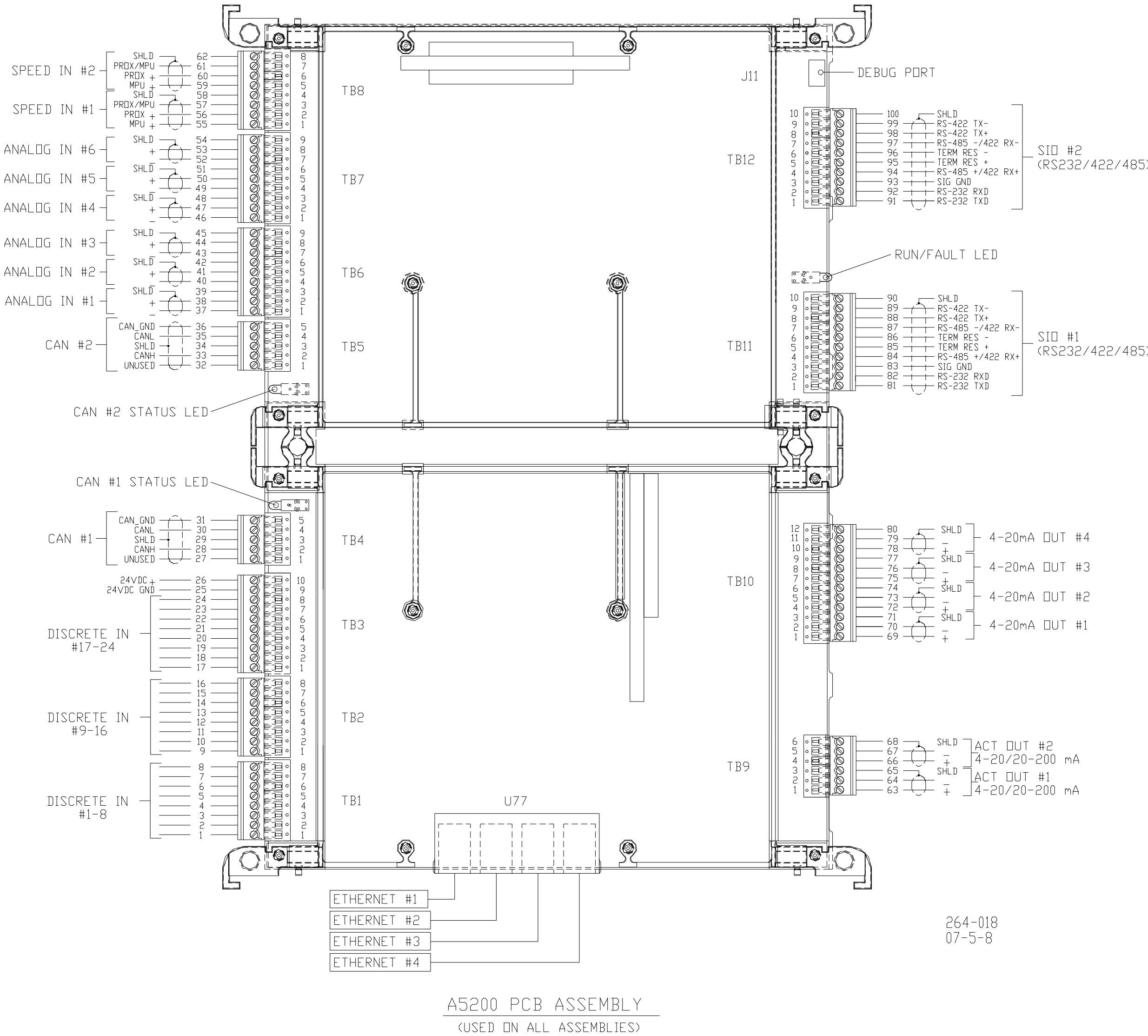


Figure B-1. SmartCore CPU A5200 board Connections

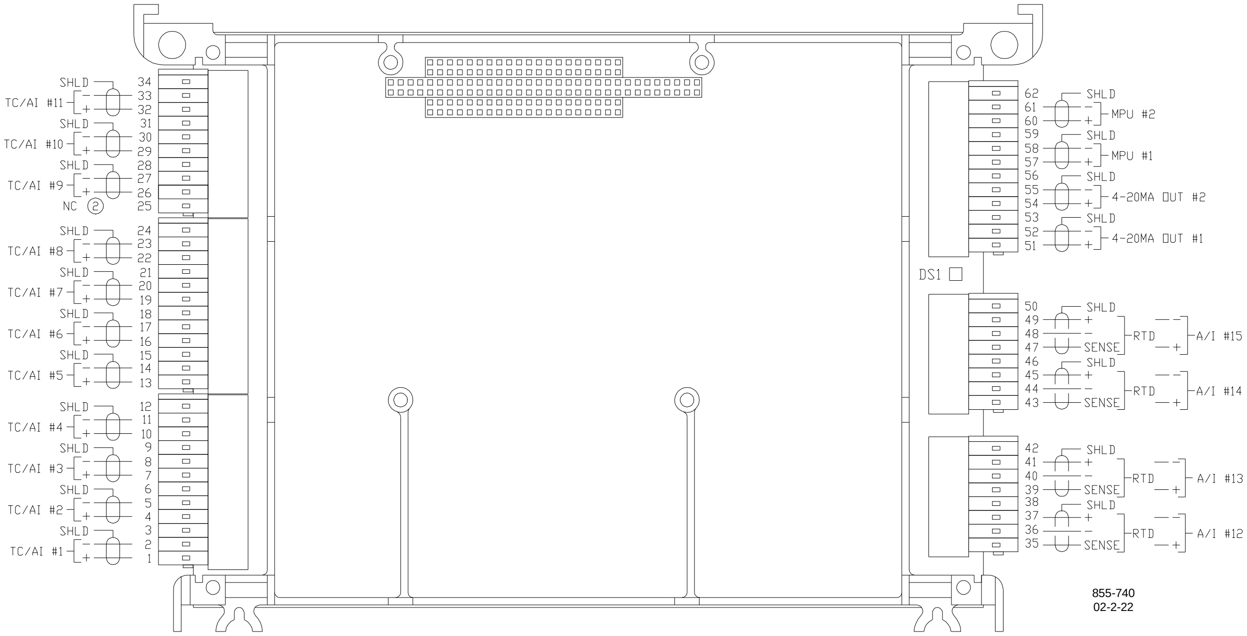


Figure B-2. Analog Combo Board Connections

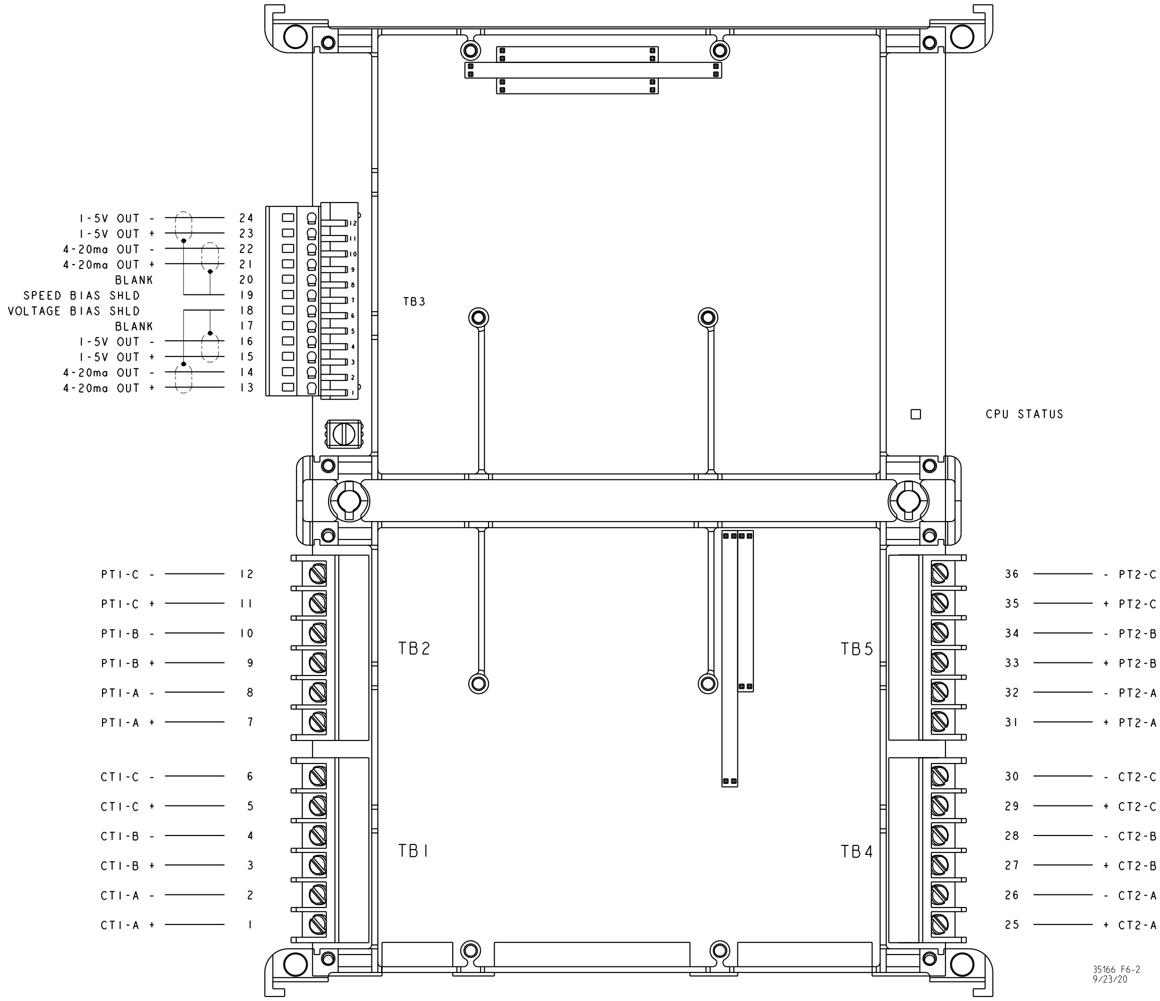


Figure B-3. PowerSense Board Connections

Released

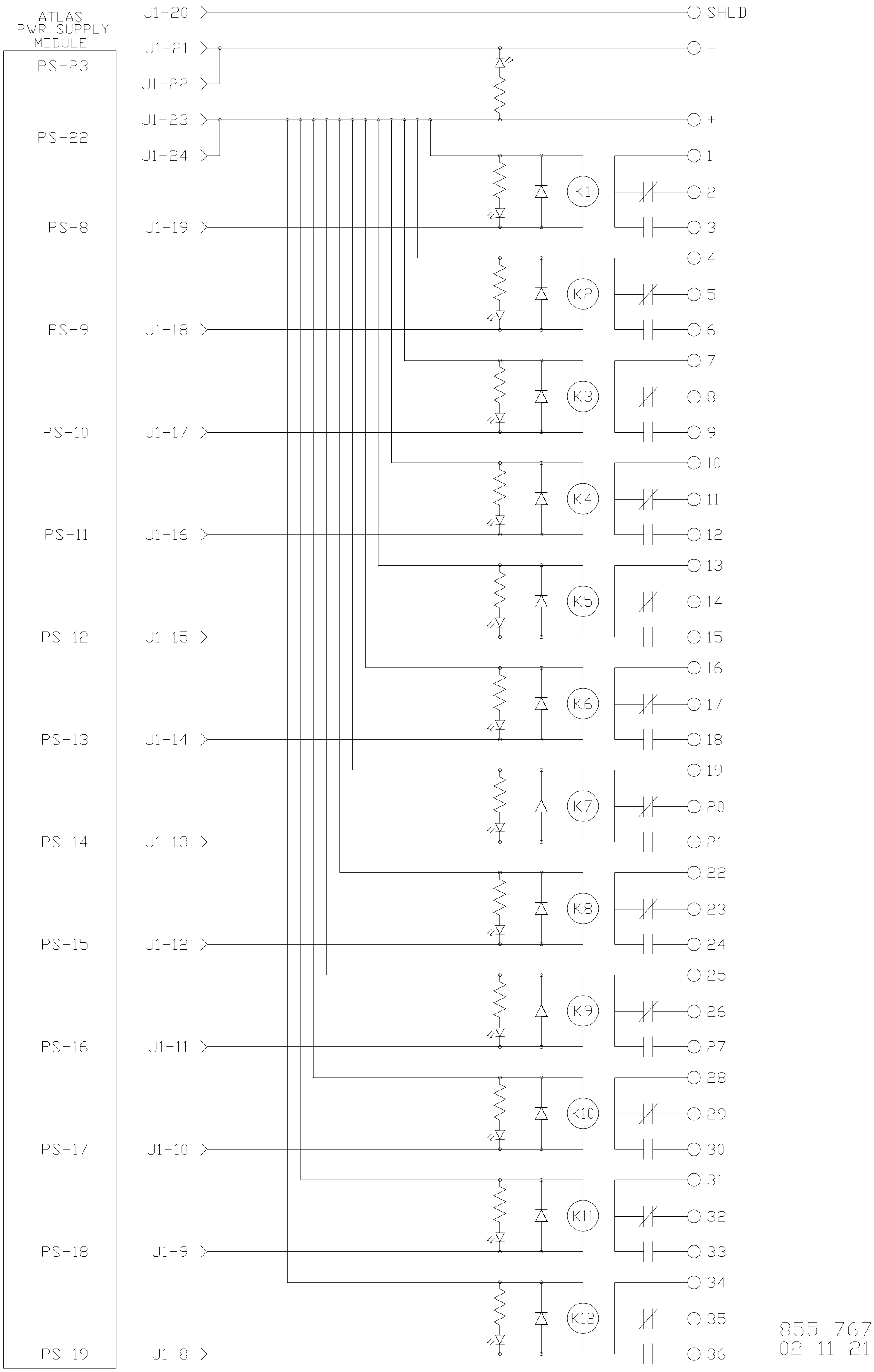


Figure B-4. 12-Channel Relay Module Connections

Appendix C.
Flash Codes

Table C-1. SmartCore CPU A5200 Failure Codes

Failure	Flash Code
RAM Test Failure	1, 4
Real Time Clock Test Failure	2, 2
Floating Point Unit Test Failure	2, 3
Flash Test Failure	2, 4
HD1 Flash Test Failure	2, 5
I2C Bus Test Failure	2, 6
Module Installed in wrong slot	2, 7
Main Chassis CPU switch must be set to 0	3,5
Remote RTN Rate Group 5 Slip	3, 7
Remote RTN Rate Group 10 Slip	3, 8
Remote RTN Rate Group 20 Slip	3, 9
Remote RTN Rate Group 40 Slip	3, 10
Remote RTN Rate Group 80 Slip	3, 11
Remote RTN Rate Group 160 Slip	3, 12

Table C-2 Analog Combo Failure Codes

Number of LED Flashes	Failure
1	Microprocessor failure
2	Bus, address, any unexpected exception error
5	Failure during EE test or erasing
7	Kernel software Watchdog count error
12	Failure during CPU Internal RAM test
13	Dual port RAM error

Table C-3. PowerSense Failure Codes

Number of LED Flashes	Failure
Off	No failure, system OK
Solid	Module in initialization mode
1	Hardware watchdog, CPU clock failure, reset fail
2	Unexpected Exception Error
3	RAM test failure
5	EEPROM failure
7	Kernel Watchdog Timeout
10	System Error
11	Board Identification Error
12	TPU RAM failure
13	Dual Port RAM test failure
14	QSM or ADC Initialization failure
15	Self-test status failure
20	Invalid A/D converter selected
21	QSPI timeout
24	ADC auto calibration time-out

Appendix D. Board Addresses

Board address numbers are necessary in GAP to identify the location of each board. Below are the possible combinations.

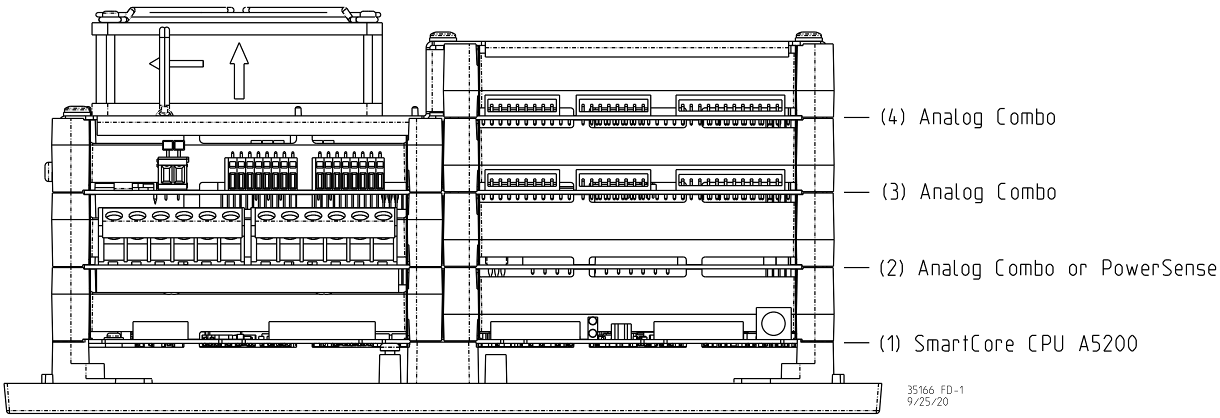


Figure D-1. Board Address Numbers

IMPORTANT

*** NOTES—**

All board addresses are factory configured.

Revision History

New Manual

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00359-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	ATLAS-II
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC) Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
Markings in addition to CE marking:	II 3 G, Ex nA IIC T3 X Gc
Applicable Standards:	EN 61000-6-4, (2017): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2, (2016): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN61010-1, (2010) : Safety Requirements for Electrical Equipment for measurement, control and laboratory use – Part 1 : General Requirements. EN60079-0, (2012) : Explosive Atmospheres - Part 0: Equipment- General Requirements EN60079-15, (2010) : Explosive Atmospheres - Part 15: Equipment protection by type of protection "n"

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Mike Row
Full Name

Per Authorized Signature
Position

Woodward, Fort Collins, CO, USA
Place

29-October-2018
Date

5-09-1183 Rev 30

Page 1 of 1

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **35166**.

B35166 : -

WOODWARD

PO Box 1519, Fort Collins CO 80522-1519, USA
1041 Woodward Way, Fort Collins CO 80524, USA
Phone +1 (970) 482-5811

Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.