



Hardware Manual



AtlasPC™ Digital Control

Volume 1

Manual 85586 consists of 2 volumes (85586V1 & 85586V2).

Manual 85586V1 (Revision P)

IMPORTANT



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

DEFINITIONS

- **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

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.



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.



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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.

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.

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*.

Revisions—Text changes are indicated by a black line alongside the text.

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IMPORTANT

Volume I contains all AtlasPC™ hardware information except the detailed Distributed I/O information, which is in Volume II.

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Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).
2. 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.
3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.
4. 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.

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*.

Chapter 1.

General Information

Introduction

This manual describes the Woodward AtlasPC™ 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 AtlasPC platform and available versions
- A physical description of the control hardware
- A description of all AtlasPC modules
- A listing of accessories that may be used with the platform
- Information on AtlasPC 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.

AtlasPC Control Description

The AtlasPC 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 AtlasPC control is programmed to the specific needs of the prime mover and its driven load.

At the heart of the AtlasPC 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 AtlasPC 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. If required, distributed I/O can be connected using optional communication modules that support Profibus, DeviceNet, and Ethernet protocols.

*—Modbus is a trademark of Schneider Automation Inc.

The hardware platform is based on the industry-standard PC/104 bus structure. In the AtlasPC 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 AtlasPC 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). AtlasPC field wiring is accomplished via terminal blocks that plug into the control modules.

Control Versions

The AtlasPC 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.

I/O Modules	Processor & Communication Modules
SmartCore	Profibus
PowerSense	DeviceNet
Analog I/O	Dual Ethernet
Power Supply	Pentium CPU

Table 1-1. AtlasPC Modules

Figure 1-1 shows diagrammatically the physical arrangement of the modules in the AtlasPC 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 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” configuration.

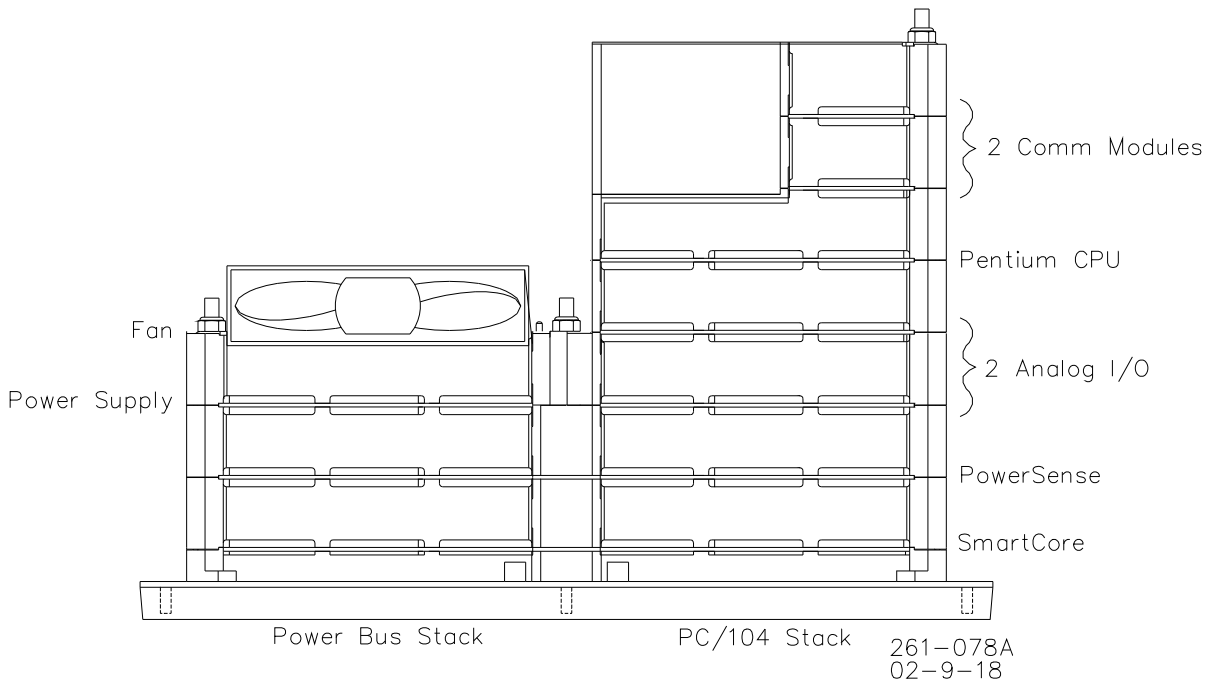


Figure 1-1. AtlasPC Module Layout

Control Accessories

The AtlasPC 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:

- **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 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 AtlasPC control through Ethernet or serial connections to provide operator access and control of the application machinery.

Regulatory Compliance

The AtlasPC™ control is suitable for use in Class I, Division 2, Groups A, B, C, D, per UL for Canada and US or non-hazardous locations only.

The AtlasPC control is suitable for use in European Zone 2, Group IIC environments when installed in an IP-54 minimum rated enclosure per DEMKO certification.

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

Field wiring must be suitable for at least 75 °C for operating ambient temperatures expected to exceed 50 °C.

A fixed wiring installation is required.

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

Connect ground screw to earth ground (see Figure 1-2).

These listings are limited to those units bearing the UL or DEMKO agency identifications.



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 or Zone 2 applications.



AVERTISSEMENT

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, Division 2 ou Zone 2.

IMPORTANT

Some degraded performance can occur on RTD and thermocouple inputs in the presence of radiated energy from transmitters such as cell phones. This degraded performance is in the form of a slight change in the accuracy of the measured temperature. It is recommended that operation of such devices be kept more than 3 m from the AtlasPC control. This will prevent any degradation. Installation of the AtlasPC control in a metal enclosure will also prevent any degradation.

Regulatory Compliance Specifications

European Compliance for CE Mark

EMC Directive	Declared to 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.
Low Voltage Directive	Declared to 73/23/EEC COUNCIL DIRECTIVE of 10 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.
ATEX—Potentially Explosive Atmospheres Directive	Declared to 94/9/EEC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.

Other European Compliance

DEMKO	Certified to EN50021, Zone 2: EEx nL IIC 20 ATEX 0220460U
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North American Compliance

UL	UL Listed for Class I, Division 2, Groups A, B, C, & D, T4A at 70 °C ambient. For use in Canada and the United States.
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These listings are limited to those units bearing the UL or DEMKO agency identification.

Marine Compliance

American Bureau of Shipping	ABS Rules 2003 SVR 4-2-1/7.3, 7.5.1, 7.9.3/17, 4-9-4/23, 4-9-7/Table 9
Det Norske Veritas	Standard for Certification No. 2.4, 2001: Temperature Class B, Humidity Class B, Vibration Class C, and EMC Class A
Lloyd's Register of Shipping	LR Type Approval Test Specification No. 1, 2002 for Environmental Categories ENV1, ENV2, and ENV3

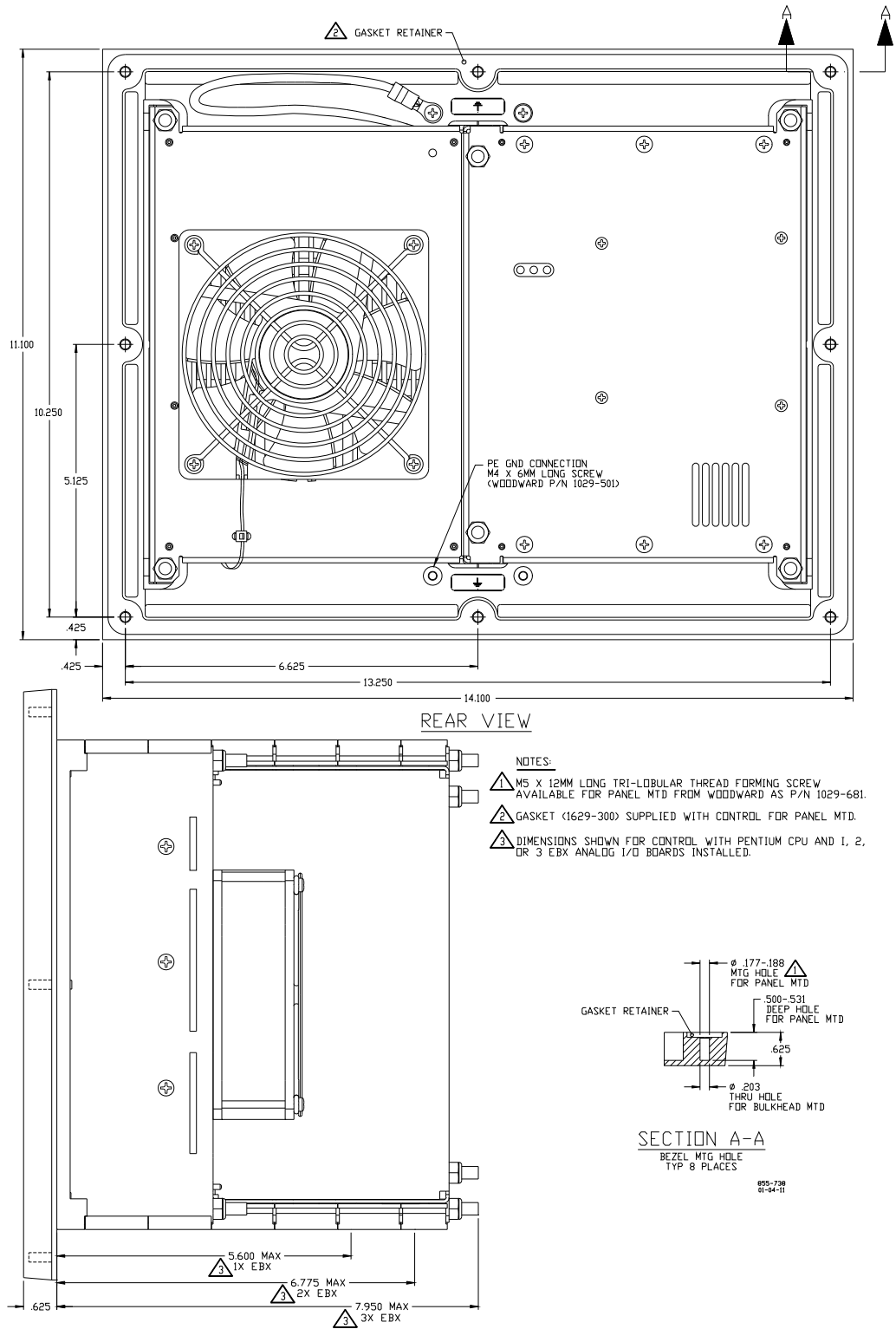


Figure 1-2. Physical Dimensions
(dimensions shown are in inches)

Chapter 2. Installation

Introduction

This chapter provides the general information for mounting location selection, installation, and wiring of the AtlasPC™ 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 AtlasPC control, consider the following:

- Protect the unit from direct exposure to water or to a condensation-prone environment.
- The operating range of the AtlasPC control is –20 to +70 °C (–4 to +158 °F).
- Provide adequate ventilation for cooling. Shield the unit from radiant heat sources.
- Do not install near high-voltage or high-current devices.
- 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 vi of this manual for WARNINGS and NOTICES. Be careful when unpacking the control. Check for signs of damage such as bent or dented panels, scratches, loose or broken parts. If any damage is found, immediately notify the shipper.

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

Mounting

Figure 1-2 shows the AtlasPC control layout and mounting pattern. The AtlasPC 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. An IP-54 minimum rated enclosure is required for European Zone 2 applications (per EN50021).

The standard AtlasPC package must be mounted to allow sufficient room for wiring access. Eight front panel mounting holes permit secure mounting. Depending on its configuration, the AtlasPC weighs between 3.4 and 4.5 kg (7.5 and 10 pounds), and has an operating range of -20 to $+70$ °C ambient air temperature. A minimum of 25 mm (1 inch) of clear space around the outer surfaces of the AtlasPC 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 AtlasPC Control Platform operates in a specified ambient temperature of -20 to $+70$ °C (-4 to $+158$ °F) with forced convection cooling. When Profibus, DeviceNet, CanOpen, or dual Ethernet is used, the operating temperature is limited to -20 to $+60$ °C (-4 to $+140$ °F).

NOTICE

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

Storage Temperature

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

Shock

The AtlasPC 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 AtlasPC Control Platform was tested to Lloyd's Test Specification No. 1, 2002, Vibration Test 1 (5–13.2 Hz, ± 1 mm; 13.2–100 Hz, ± 0.7 g).

Audible Noise Emission

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

Enclosure Protection

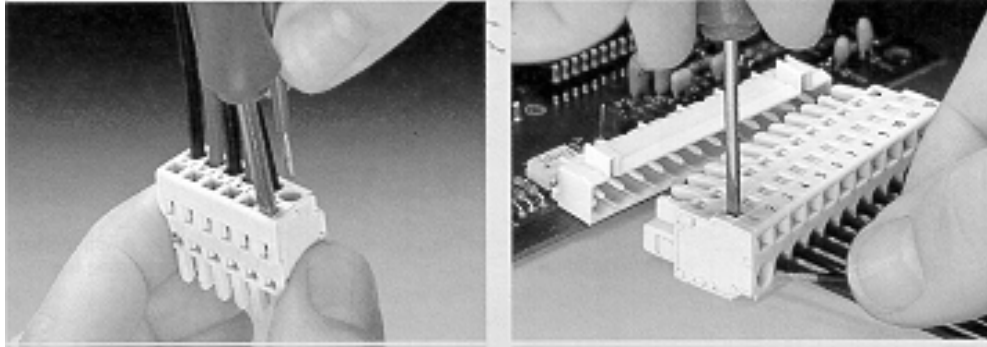
In order to meet Zone 2 European Group IIC, the AtlasPC Control must be mounted in an enclosure that meets or exceeds IP 54.

Electrical Connections

Most inputs and outputs to the AtlasPC control are made through "CageClamp" terminal blocks. For noise suppression, it is recommend that all low-current wires be separated from all high-current wire.

The pluggable terminal blocks on the I/O modules 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 2-1). The AtlasPC pluggable 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. Wires for the pluggable I/O terminals should be stripped 8 mm (0.3 inch).

Most of the AtlasPC control's terminal blocks are designed to be removed by hand. After AtlasPC 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.

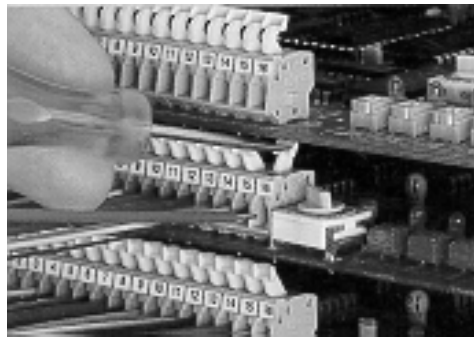


Method #1
Free Hand (holds spring open)

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

Figure 2-1. Spring Clamp

The AtlasPC 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).



Wiring Fixed Terminal

IMPORTANT

Do not tin (solder) the wires that terminate at the AtlasPC 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.

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.

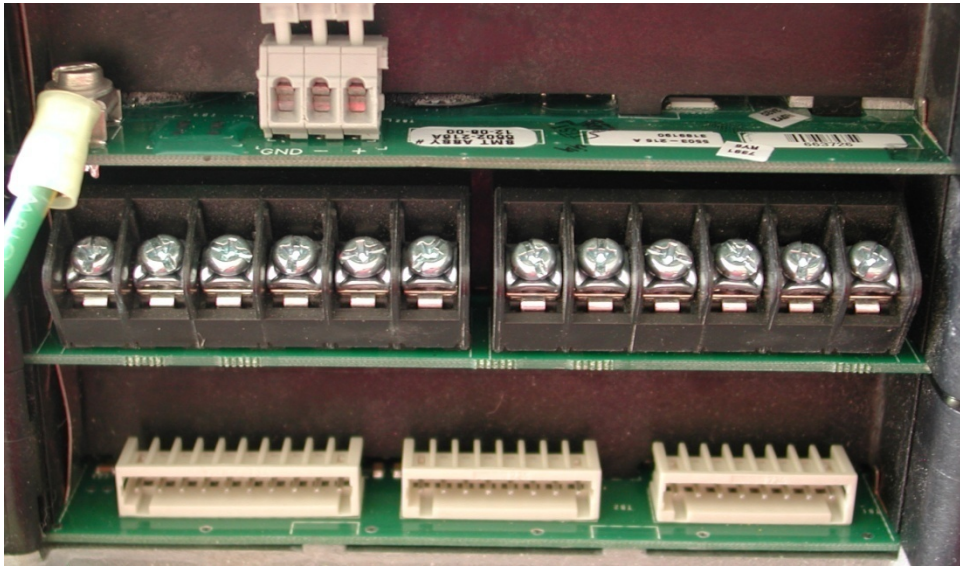


Figure 2-2. Fixed Terminals

Grounding

Protective Earth (PE) must be connected to the termination point on the backside of the unit next to the label with the symbol \oplus 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).

Recommended Grounding Practices

Providing the proper ground for the AtlasPC control is important. Improper connection of the control chassis to the 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 AtlasPC 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 AtlasPC 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 AtlasPC control. Typically this point is the designated ground for the generator set and related instrument transformers.

Shields and Grounding

An individual shield termination is provided at the terminal block for each of the signals requiring shielding. These include all sensor wiring and ac signal inputs. Relay outputs, contact inputs, and power supply wiring do not normally require shielding, but can be shielded if desired. All shielded cable must be twisted conductor pairs. Do not attempt to tin (solder) the braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Wire exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches). The other end of the shields must be left open and insulated from any other conductor.

The AtlasPC control is designed for shield termination to earth ground at the control. 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 other shield terminations except at the AtlasPC control should be ac coupled to earth through a capacitor. A 1000 pF, 500 V capacitor is sufficient. The intent is to provide a low impedance path to earth for the shield at frequencies of 150 kHz and up. Multiple direct connections of a shield to earth risk high levels of current to flow within the shield. See Woodward application note 50532, *Interference Control in Electronic Governing Systems*, for more information.

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.
2. Using a sharp, pointed tool, carefully spread the strands of the shield.
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.

For noise suppression reasons, it is recommend that all low-current wires be separated from all high-current wires. Input power ground terminal 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 can be grounded at both ends (AtlasPC control and load) if the cable length is sufficiently short (within a cabinet) to prevent ground loop current in the shield.

Cabinet Installations: If the AtlasPC control is installed in a cabinet, shielded I/O can be terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as at the control.

Input Power

The AtlasPC 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 AtlasPC 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 AtlasPC 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, or non-hazardous locations only.

Wiring must be in accordance with Class I, Division 2 wiring methods and in accordance with the authority having jurisdiction.

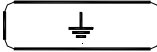
Do not connect more than one main power supply to any one fuse or circuit breaker.

Power supply output 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.

Significant inrush currents are possible when current is applied to the AtlasPC 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.

Input Power Wiring

Protective earth ground (PE) must be connected to the chassis at the termination

point on the back side labeled with . 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 PT wires, whichever is larger.

Note that the control's power supplies are not equipped with input power switches. For this reason, some means of disconnecting input power to each main power supply must be provided for installation and servicing.

It is expected that the installation of this equipment will include over current protection between the power source and the AtlasPC 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 AtlasPC 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 AtlasPC 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.

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

Table 2-1. Power Supply Requirements

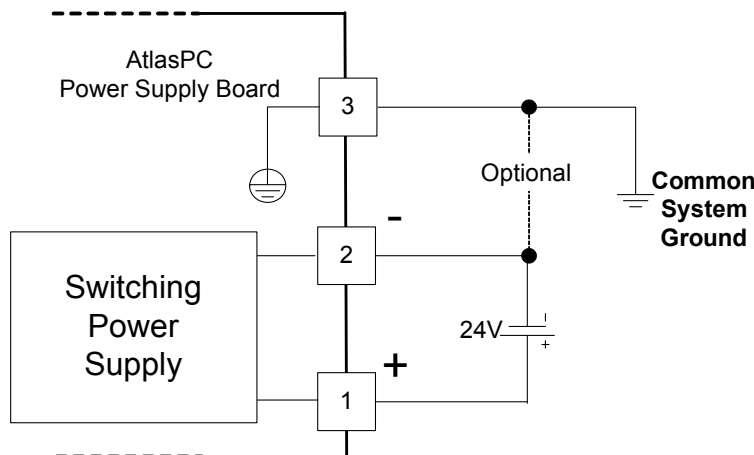
IMPORTANT

* 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.

Input Power Wiring Diagram

The power supply and ground connections are located on the power supply board.



Maintenance

The only part of the AtlasPC 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 and secure with the 4 screws.
- 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.

Chapter 3. Power Supply Boards

General Description

The AtlasPC 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 AtlasPC Control platform.

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

WARNING

The AtlasPC 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.

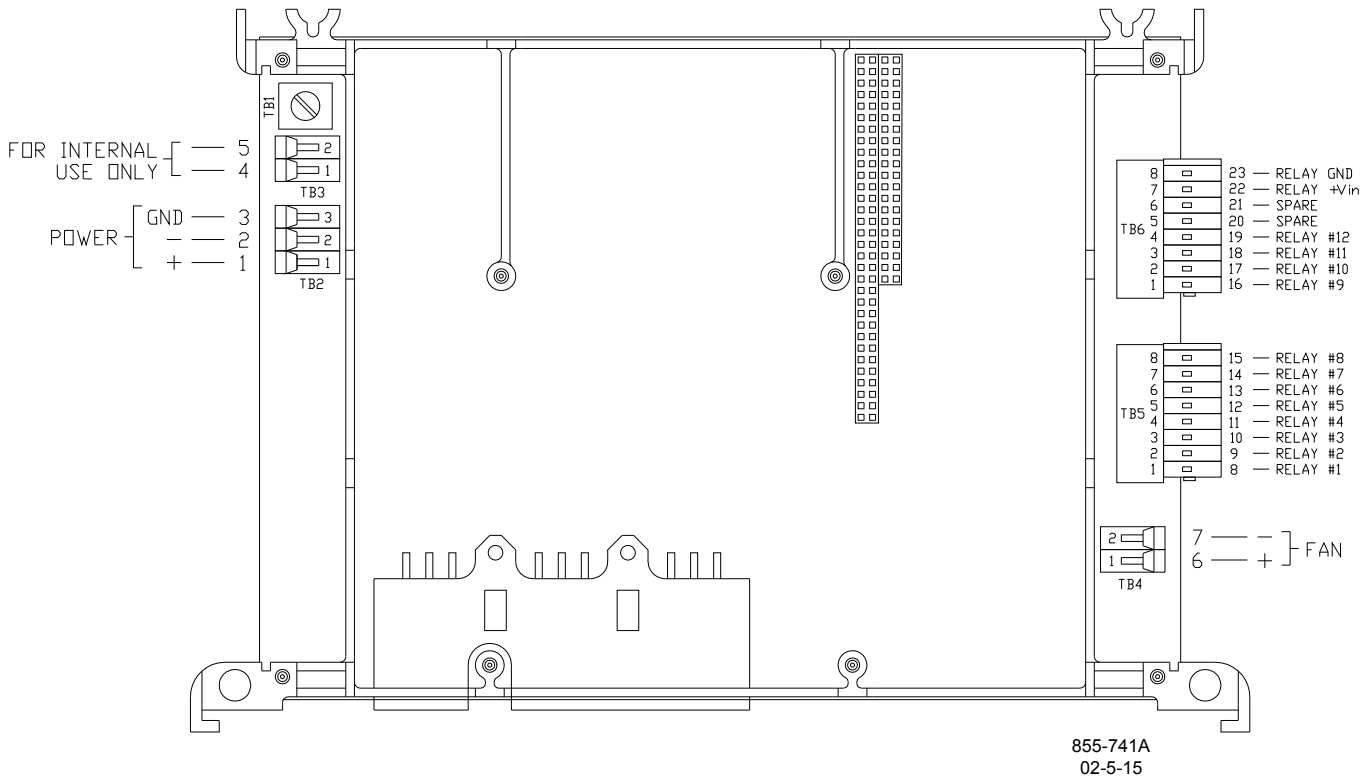


Figure 3-1a. Power Supply Board Connections (5503-216)

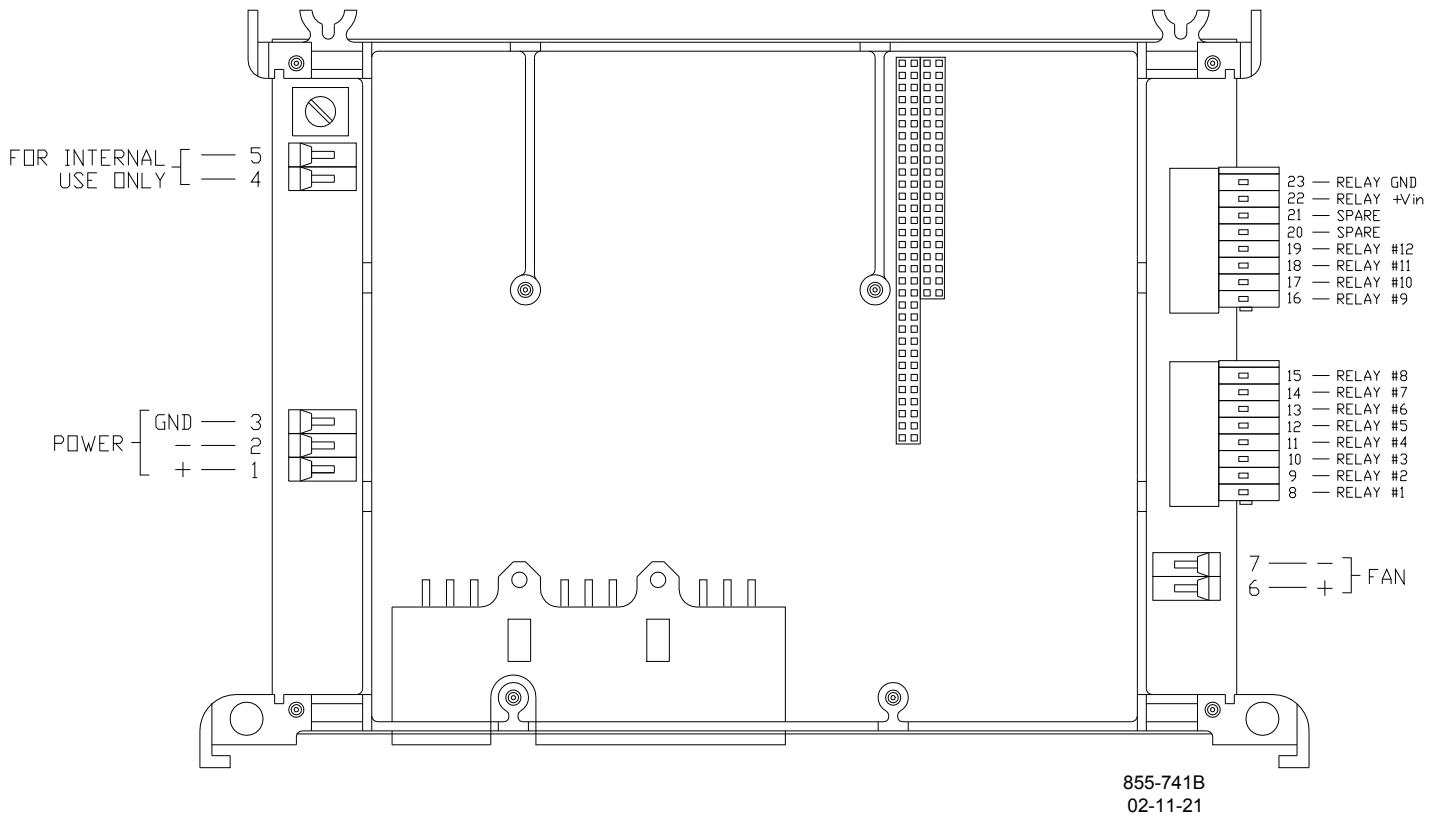


Figure 3-1b. AtlasPC Power Supply Board (601-1008)

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 AtlasPC control platform shall be wired such that no other device receives power from the wiring between the AtlasPC 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 AtlasPC 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 AtlasPC control only?

Discrete Output Checks

The AtlasPC 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 AtlasPC 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?

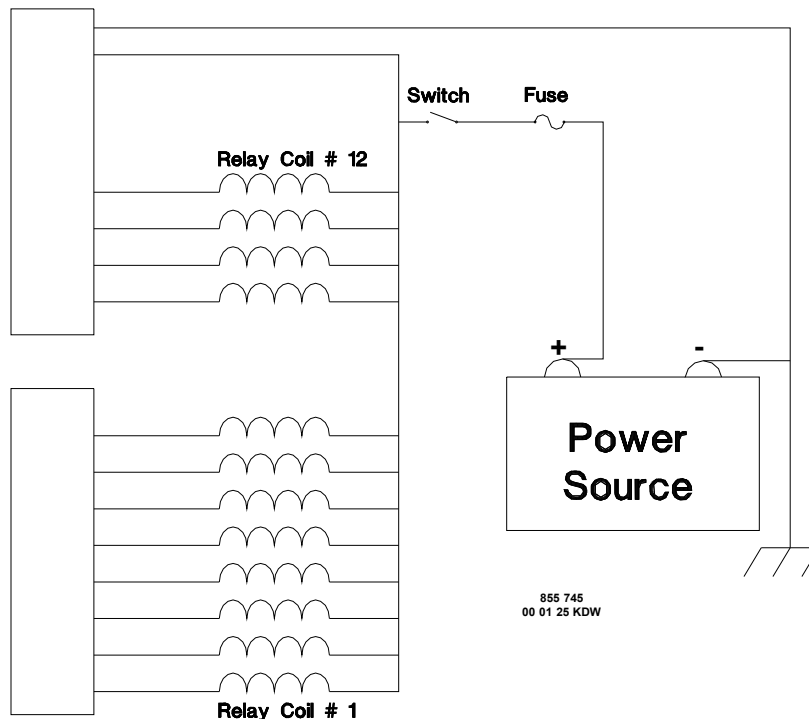


Figure 3-2. Discrete Output Wiring Example
(Discrete Output Interface Wiring to the Power Supply Board)

Configuration Notes

- Refer to Figure 3-2 for discrete output wiring.
- 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 9 contains a relay module that can be used with these discrete outputs.

Chapter 4. Pentium CPU Board

General Description

Every AtlasPC control contains one CPU board: either the Pentium CPU board or the SmartCore board. The CPU board runs the application program automatically upon boot-up. The Pentium CPU board runs a real-time operating system. Operating system functions are not re-documented in this manual. Please refer to the appropriate software manual if necessary.

A solid state hard-drive contains the operating system, Real Time kernel, Control Application, and appropriate utilities. The CPU board supports a standard PC/104 interface to read and write to the I/O boards.

When power is applied to the AtlasPC control system, the Pentium CPU board will perform a Power On Self-Test (POST), load the operating system, and then run the application program. The application will initialize each AtlasPC hardware module and begin gathering I/O data. Upon successful initialization, a red LED on each hardware module will be turned off.

NOTICE

Do not connect any non-isolated serial port device into the COM1 or COM2 CPU serial ports! Isolation is required! A system ground fault may be created, causing system shutdown and/or permanent damage to the Control System.

IMPORTANT

A 9-pin D-sub filter pin connector must be installed at the serial port prior to connection with the CPU.

IMPORTANT

When provided, the NT operating system on the hard drive is an embedded version of Windows NT that is designed for use with a real-time system only. No other applications are permitted.

Hardware Specifications

The Pentium CPU conforms to the Ampro/Motorola EBX v1.1 mechanical format and contains both PC/104 and PC/104+ bus connectors for interfacing with other Woodward and PC/104 compatible modules.

Electrical

- Power requirements are 5.0 Vdc, 2.5 A (max), 2.25 A (typical)
- 266 MHz Pentium processor, low power version, Tcase rating of 85 °C
- Processor uses a fan-heat sink
- Industrial rated solid state hard drive (CompactFlash)
- 64 MB Synchronous DRAM
- 8/16 bit PC/104 Interface (ISA bus)
- 32 bit PC/104+ Interface (PCI bus)
- (2) RS-232 Serial ports, 115K baud max, non-isolated (shield connected at chassis)
- (1) RJ45 10/100 Base-TX Ethernet (shield ac coupled at chassis)

Mechanical

- Stack-through PC/104 connector.
- Mechanical conformance to Ampro/Motorola EBX 1.1 specification (available at www.ampro.com). This specification defines board dimensions of 5.75 x 8.00 inches (146.0 x 203.2 mm), mounting hole locations, component locations, and component clearances.

CPU Interface Connections

The Pentium CPU supports 10/100 Ethernet and Serial communications. Each interface is cabled to the AtlasPC chassis through the use of "gland plates". These gland plates are also intended to support I/O connections to other I/O modules like Profibus. The connectors, pinouts, and interface requirements for the CPU communication ports are detailed in this section.

CPU Remote Reset Capability

Remote reset is supported using AtlasPC Remote Control Software over Ethernet or modem connections. The user may perform either an application reset or a system reset.

An application reset is purely software and consists of terminating and re-starting the application using Application Manager. A system reset may also be executed by using NetMeeting Remote Control to login to AtlasPC and perform a operating system shutdown and re-boot. NetMeeting can only be used on systems with Windows NT.

IMPORTANT

Appropriate security permissions are required to perform these functions.

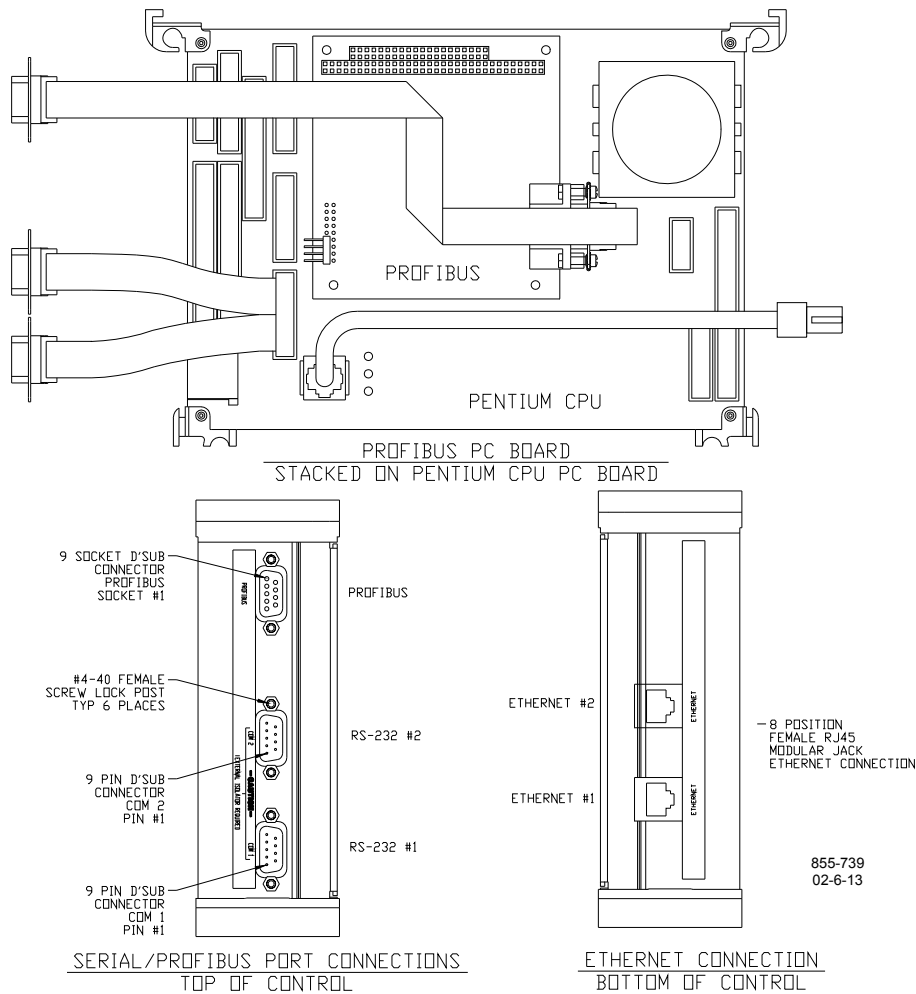


Figure 4-1. Pentium CPU Board Connections

10/100 Base-TX Ethernet

An auto-switching 10/100 Base-TX RJ45 Ethernet connector is available for system use. This connection will be used for control configuration, data gathering, remote monitoring, maintenance, and networking of multiple controls. Additionally, this port will be relied upon for interfacing TCP/IP Distributed I/O devices into the control system.

To ensure signal integrity and robust operation of Ethernet devices, double shielded Ethernet cables (SSTP) are required for customer installations. Their primary function is to provide EMI shielding and proper shield termination of the Ethernet cable.

IMPORTANT	To fully realize 100 Base-TX connectivity, downstream devices must be 100 Base-TX capable. As such, when using an Ethernet hub for multiple connections, either a fixed 100 Base-TX or an auto-switching 10/100 Base-TX hub would be necessary.
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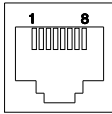
Connector	Signal Mnemonic
RJ45F 	Shielded RJ45 female receptacle
1	TX+
2	TX-
3	RX+
4	--
5	--
6	RX-
7	--
8	--
Shield	AC Coupled to Chassis GND

Table 4-1. Ethernet Port Pinout

(*—For further information on Ethernet connectivity, see Volume II of this manual.)

NOTICE

Use shielded Ethernet cable only! Use of non-shielded cable may result in permanent system damage.

RS-232 Serial Ports COM1, COM2

Two high speed, 115 kBaud RS-232 serial ports are available for system use. These ports support serial communication using various protocols and devices. Systems that include DeviceNet or CanOpen will have only one RS-232 serial port available.

For example, these ports can be configured for Modbus®* master or slave, ServLink Data and Control, Datalog Capture, Tunable Maintenance, or even modem access.

[*Modbus® is a trademark of Modicon, Inc.]

These communication ports are non-isolated and are susceptible to both EMI noise and ground loops related to PC connections and typical industrial environments. Shielded cables, a 9-pin D-sub filter connector, and Serial Port Isolator/Converter(s) are required when using these ports. The following standard options are available:

- RS-232–RS-232 Isolator
- RS-232–RS-485 Isolator/Converter
- RS-232–RS-422 Isolator/Converter
- 9-pin D-sub Filter Pin Connector Kit (Woodward part number 8928-7034)

IMPORTANT

A serial port Isolator/Converter must be properly installed, grounded, and powered prior to connection with the CPU. Once properly installed, it may be connected to the CPU or field device at any time.

IMPORTANT

A 9-pin D-sub filter pin connector must be installed at the serial port prior to connection with the CPU.

IMPORTANT

On AtlasPC controls using the NT operating system, it is possible under certain circumstances for the control to experience a failure to boot when an HMI (Human Machine Interface) is connected and actively accessing the COM1 port on the Pentium CPU.

This failure to boot is a rare anomaly embedded within the NT operating system and will not occur when using the VxWorks®* operating system.

If the AtlasPC control fails to boot with an HMI attached to the CPU COM 1 port, the accepted solution is to remove the COM1 cable before booting, and reconnect it following a successful boot.

The preferred alternative is for the GAP application program to use the COM ports on the SmartCore board if at all possible.

*—VxWorks is a trademark of Wind River Systems, Inc.

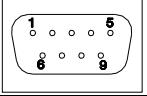
Connector	Signal Mnemonic
DB9M 	Shielded DB9 male connector
1	DCD
2	RX
3	TX
4	DTR
5	Signal Common
6	DSR
7	RTS
8	CTS
9	RI
Shield	Chassis GND

Table 4-2. Pentium COM Port Pinout

Chapter 5. SmartCore Board without Actuators

General Description

This chapter covers the SmartCore board without actuators, part number 5503-201.

Each SmartCore board contains circuitry for two speed sensor inputs, four analog inputs, four analog outputs, 3 serial ports, and 16 discrete inputs. Each speed sensor input may be from a magnetic pick-up or from a proximity probe, each analog input may be 4–20 mA or 0–5 V, and two of the serial ports, may be RS-232, RS-422, or RS-485. The other serial port is a dedicated RS-232 port.

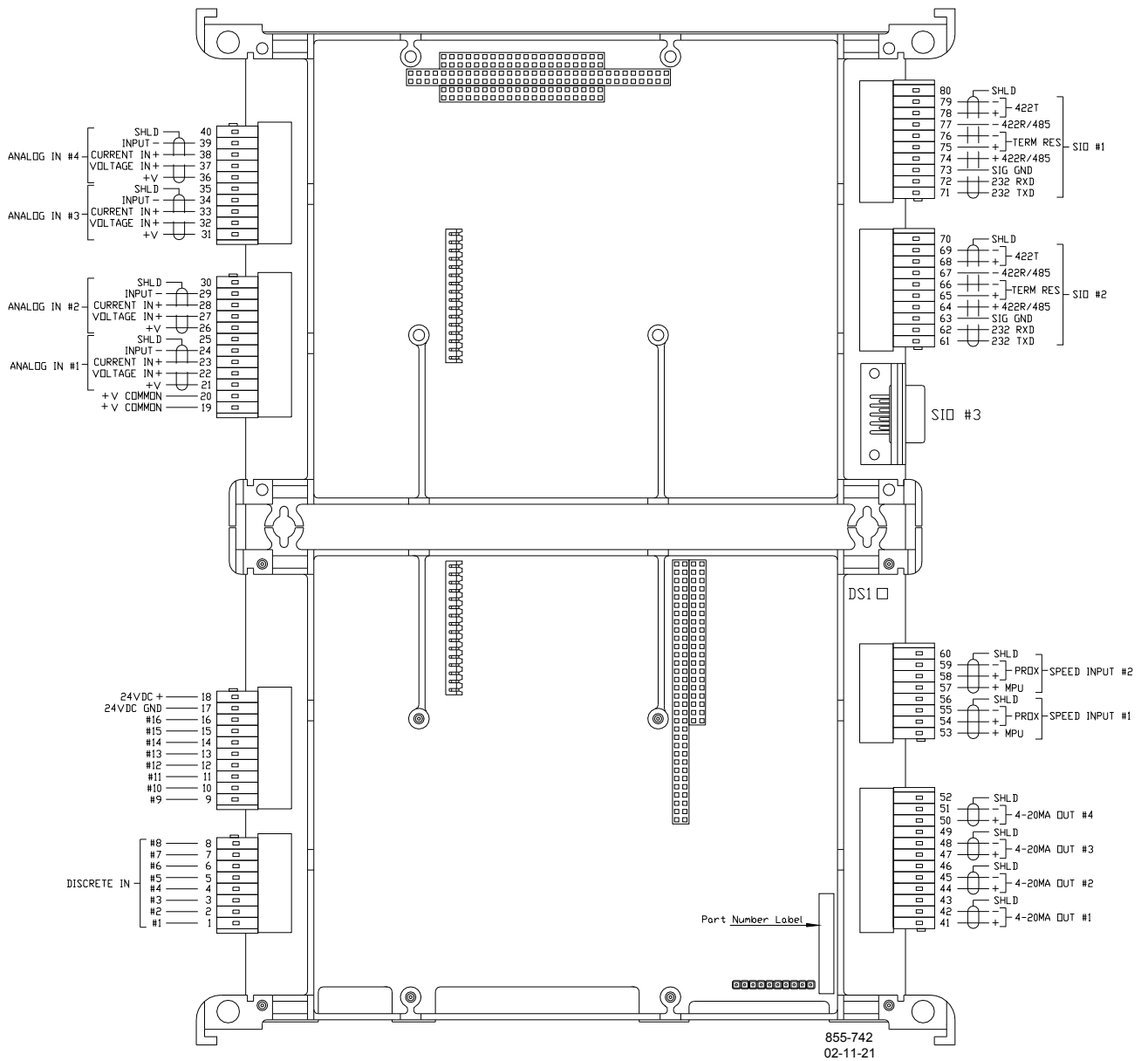


Figure 5-1. SmartCore Board Connections

Features

- 5 ms update rate
- On-board processor for automatic calibration of the I/O channels
- Analog inputs have 14 bit resolution
- Analog outputs have 12 bit resolution

Physical

The AtlasPC 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 screws. The SmartCore board is the size of two analog boards.

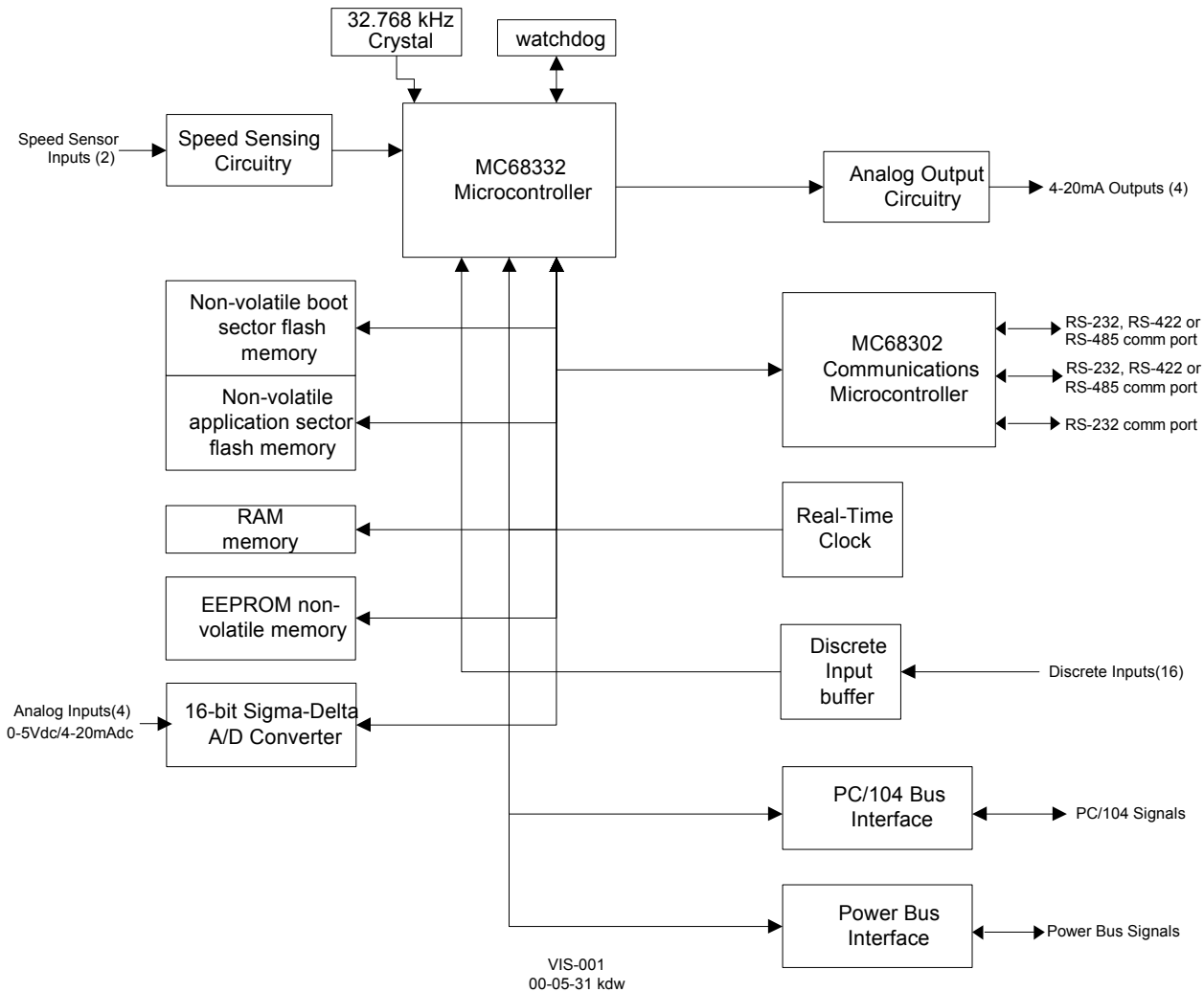


Figure 5-2. SmartCore Board Block Diagram

Specifications

Digital Speed Sensor Inputs

Number of channels	2 selectable as MPU or proximity probe, by terminal block wiring
Input frequency	100—24 950 Hz
Resolution	dependent on frequency, 13 bit minimum at maximum speed
Accuracy	less than $\pm 0.08\%$ full scale from -40 to $+85$ °C internal temperature

MPU Inputs

Minimum input amplitude	See Figure 5-3.
Maximum input amplitude	70 V peak-to-peak
Input impedance	>2 k Ω
Isolation voltage	500 Vac minimum, each channel is isolated from all other channels and from the AtlasPC platform

Proximity Probe Inputs

Voltage threshold /duty cycle at 1 kHz	at 16 Vin, duty cycle = 10–80% at 24 Vin, duty cycle = 10–80% at 28 Vin, duty cycle = 10–80%
Voltage threshold /duty cycle at 3 kHz	at 16 Vin, duty cycle = 15–65% at 24 Vin, duty cycle = 10–60% at 28 Vin, duty cycle = 10–55%
Input voltage range	16–28 Vdc
Available power	none
Isolation	500 Vac minimum, each channel is isolated from all other channels and from the AtlasPC platform
Input frequency	0.5–3 kHz

- A derivative output is provided to the application software. 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.
- No proximity probe power provided.
- If the proximity probe inputs are used, the corresponding MPU inputs must be jumpered.

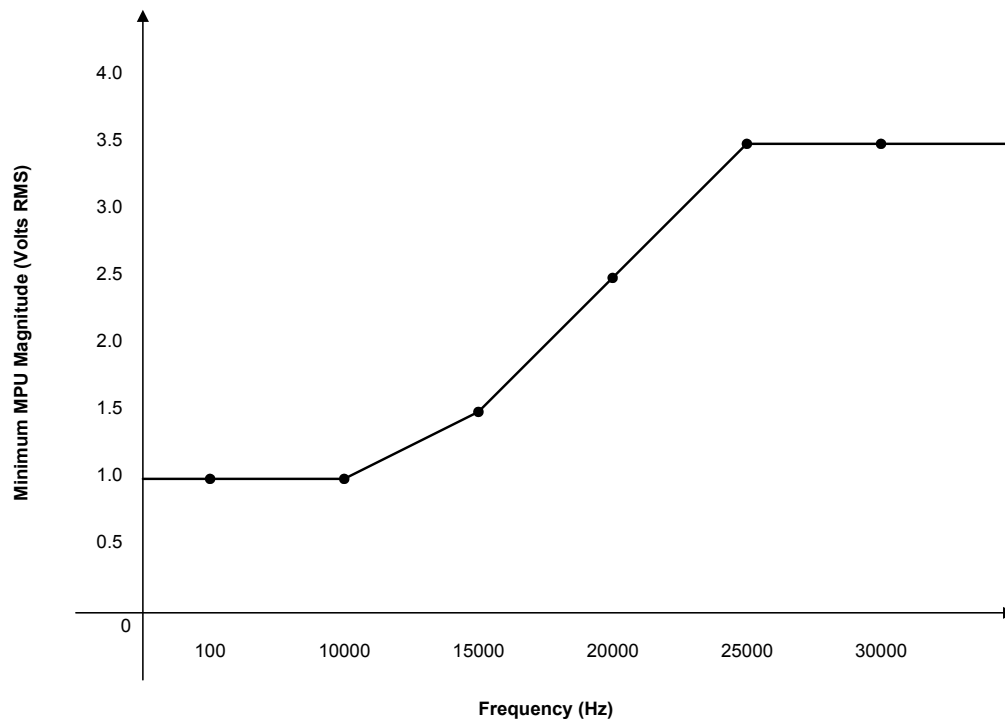


Figure 5-3. Minimum MPU Voltage Graph

Analog Inputs

Number of channels	4
Input type	4–20 mA or 0–5 V
Max. input current	25 mA \pm 5% if configured for 4–20 mA
Max. input voltage	5.0 V \pm 5% if configured for 0–5 V
Common mode rejection	80 dB minimum
Input common mode range	\pm 11 V minimum
Safe input common mode volt	\pm 40 V minimum
Input impedance	200 Ω (\pm 1%)
Anti-aliasing filter	2 poles at 10 ms
Resolution	14 bits
Accuracy @ 25 °C	less than \pm 0.1% of full scale, 0.025 mA
Temp Drift	171 ppm/ $^{\circ}$ C, maximum (1.1% of full scale, 0.275 mA) 30 ppm/ $^{\circ}$ C, typical (0.20% of full scale, 0.05 mA)
I/O Latency	1 channel at 1 ms, 1 channel at 3 ms, 1 channel at 5 ms, and 1 channel at 7 ms

- Loop power for the Analog inputs is NOT available.
- 4–20 mA or 0–5 V is selected in the GAP block software, for each input, and selected by terminal block wiring. Both the GAP field, and the wiring must be changed.

IMPORTANT

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

Analog Outputs

Number of channels	4
Output type	4–20 mA outputs, non-isolated
Common Mode Voltage	15 Vdc \pm 10%
Current output	4–20 mA
Max current output	25 mA \pm 5%
Min. load resistance	0 Ω
Max load resistance	300 Ω at 22 mA
Resolution	12 bits
Accuracy @ 25 °C	less than \pm 0.1% of full scale, 0.025 mA
Temperature Drift	140 PPM/°C, 0.23 mA maximum 70 ppm/°C, typical (0.45% of full scale, 0.11375 mA)

Discrete Inputs

Number of channels	16
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
Max input voltage	28 Vdc
Isolation voltage	500 Vac, all channels are isolated from the AtlasPC platform

- 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 AtlasPC platform and other I/O types.

Serial I/O

Number of channels	3
Channel configuration	1 - RS-232, 9 pin sub D 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

AtlasPC SmartCore Board Operation

This board includes no potentiometers and requires no field calibration. A SmartCore board may be replaced with another board of the same part number without any adjustment.

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 board, and the filter time constant is selectable at 8 milliseconds or 16 milliseconds. 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, irrespective of the speed range. An application may use any combination of accepted MPU and proximity probes, and any combination of speed ranges.

The SmartCore 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.

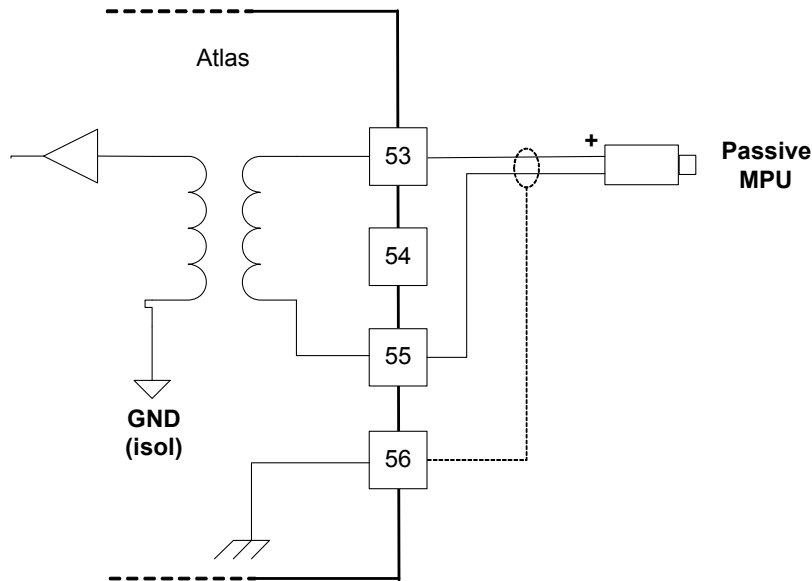


Figure 5-4. Wiring Example—MPU Interface to the SmartCore Board

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 board.

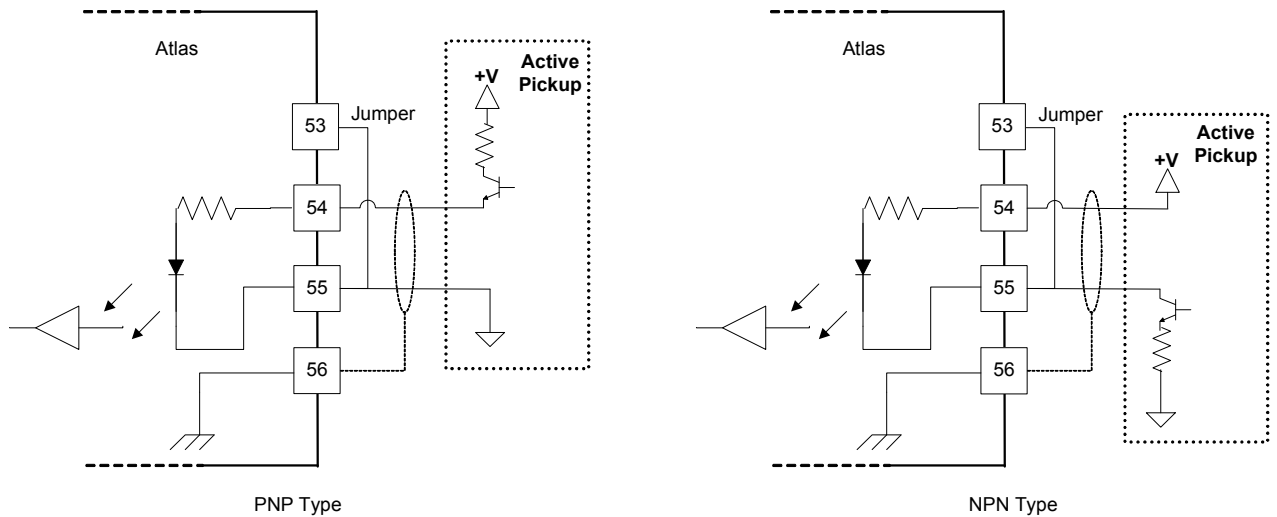


Figure 5-5. Wiring Example—Proximity Probe to the SmartCore Board

Configuration Notes

- Refer to Figures 5-4 and 5-5 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 $\times 1.2$)
 R = gear ratio

Analog Inputs

The analog inputs may be current or voltage type. If a current input is used, a jumper is installed on the terminal block, and the software must be selected for current. This allows the SmartCore card to use the applicable hardware calibration values. If a voltage input is needed, the jumper must be removed, and the software must be selected for voltage. See Figure 5-6 for jumper locations.

All analog inputs may be used with two-wire ungrounded (loop powered) transducers or isolated (self-powered) transducers. All analog inputs have 10 Vdc of common mode rejection. If interfacing to a non-isolated device which may have the potential of reaching over 10 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 board uses a 200 Ω resistor across the input.

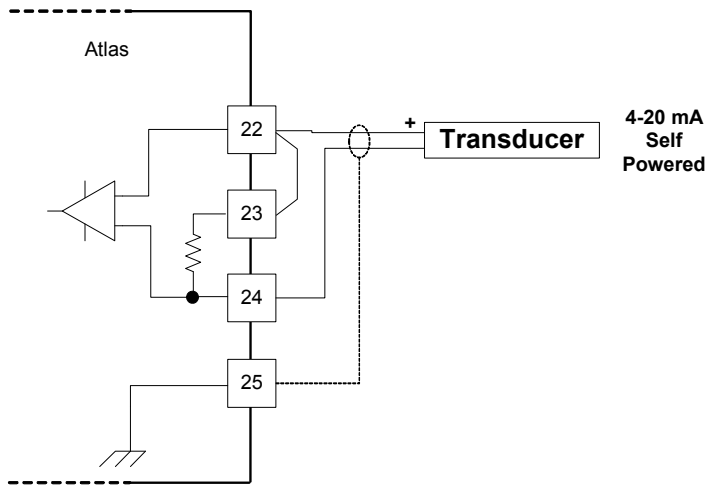


Figure 5-6a. Wiring Example—4–20 mA Input Interface to the SmartCore Board

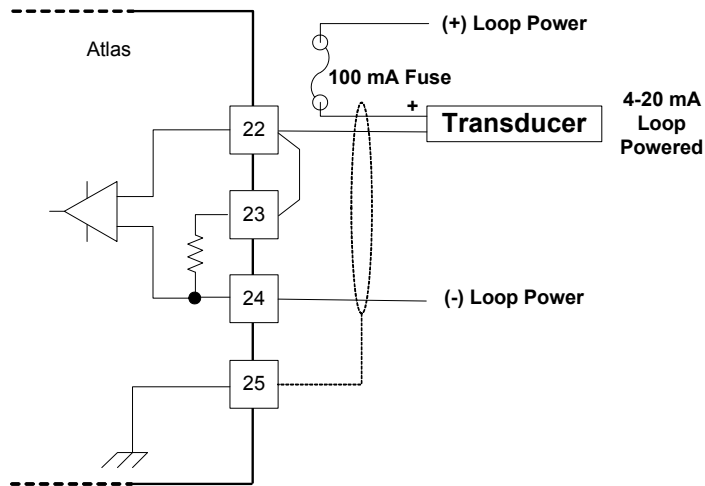


Figure 5-6b. Wiring Example—4–20 mA Input Interface using External Loop Power

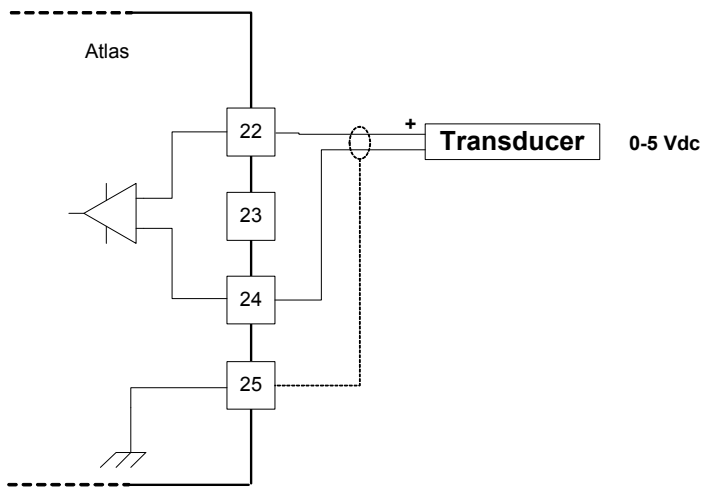


Figure 5-7. Wiring Example—0–5 V Input Interface to the SmartCore Board

Configuration Notes

- Refer to Figures 5-6 and 5-7 for analog input wiring.
- All 4–20 mA inputs have an input impedance of 200 Ω .
- When a 4–20 mA input is used, a terminal block jumper must be installed, per Figure 5-6.
- The application software must be configured for a 4–20 mA type input, or a 0–5 V type input.
- Loop power is NOT provided by the Atlas control, it must be sourced externally.

Analog Outputs

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

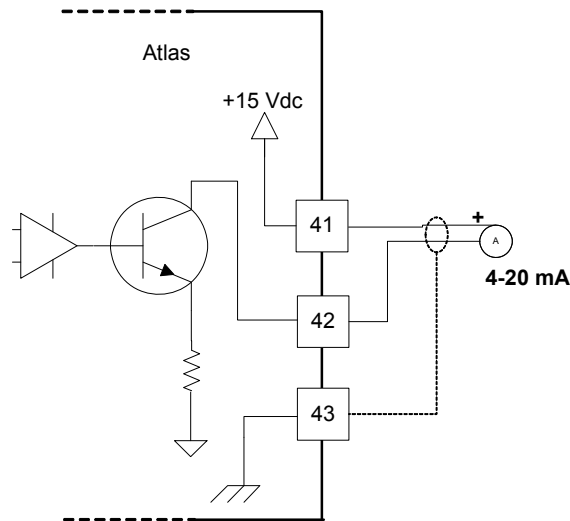


Figure 5-8. Wiring Example–Analog Output Interface to the SmartCore Board

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 AtlasPC control common.

Discrete Inputs

The SmartCore board accepts 16 discrete inputs. Contact wetting voltage may be supplied by the SmartCore card. Optionally, an external 18–28 Vdc power source can be used to source the circuit wetting voltage.

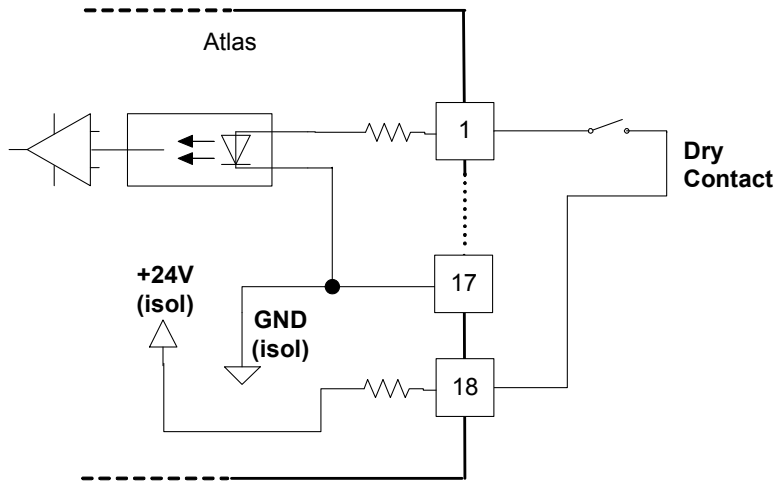


Figure 5-9. Wiring Example—Discrete Input Interface to the SmartCore Board

Configuration Notes

- Refer to Figure 5-9 for discrete input wiring.
- The discrete input commons are tied together, so each SmartCore 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 $100 \div V$, where V is the supply's rated voltage, or 5 A, whichever is less).
- The 24 V isolated contact power is protected by a 0.2 A poly switch. 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.

Serial I/O

The SmartCore board accepts three serial I/O connections. The first two ports are configurable for RS-232, RS-422, or RS-485. The last port is configurable for RS-232 only. RS-232 is specified to 50 feet (15 m), and RS-485 and RS-422 are specified to 4000 feet (1219 m).

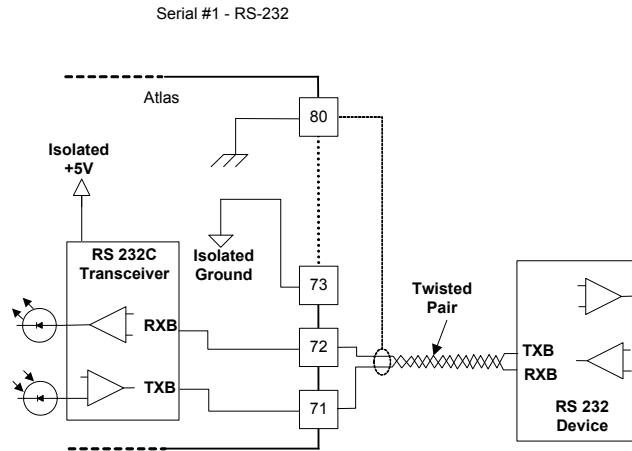


Figure 5-10. Serial #1–RS-232 Pinouts

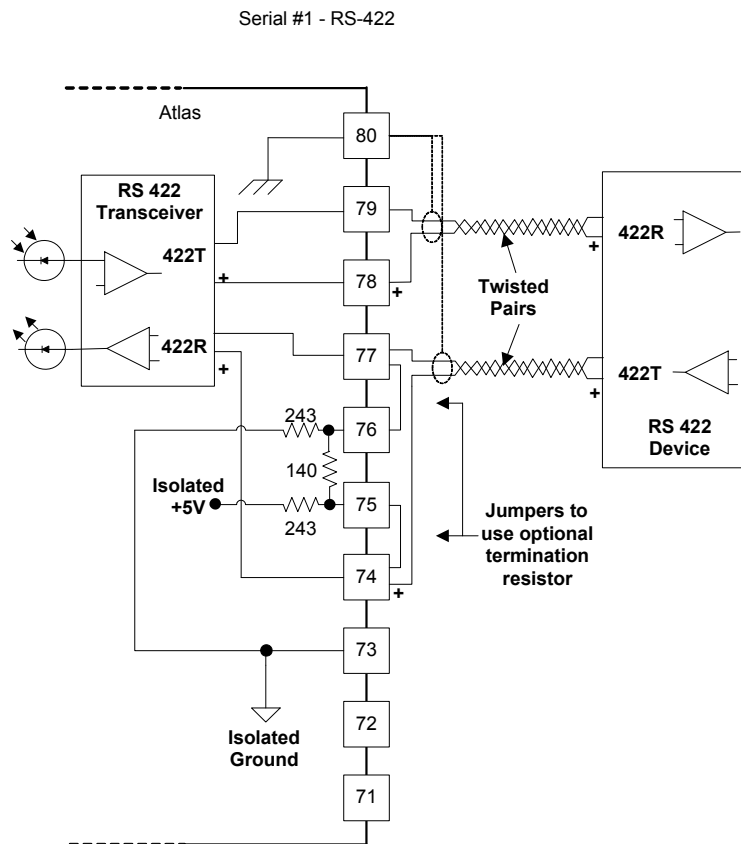


Figure 5-11. Serial #1–RS-422 Pinouts

Serial #1 - RS-485

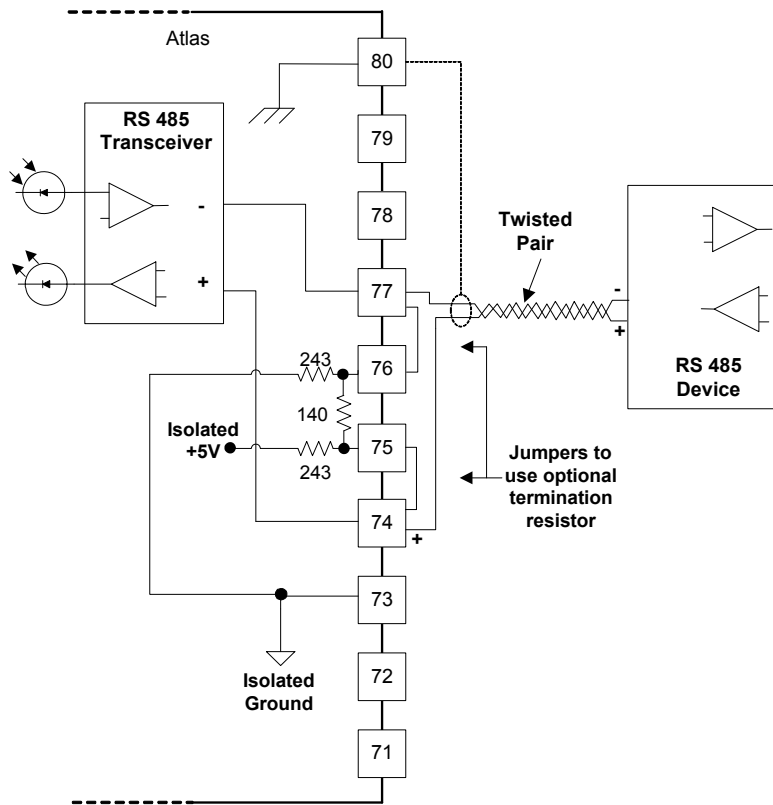


Figure 5-12. Serial #1–RS-485 Pinouts

Serial #2 - RS-232

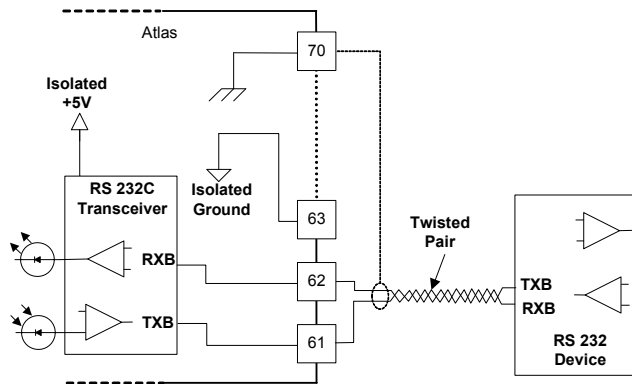


Figure 5-13. Serial #2–RS-232 Pinouts

Serial #2 - RS-422

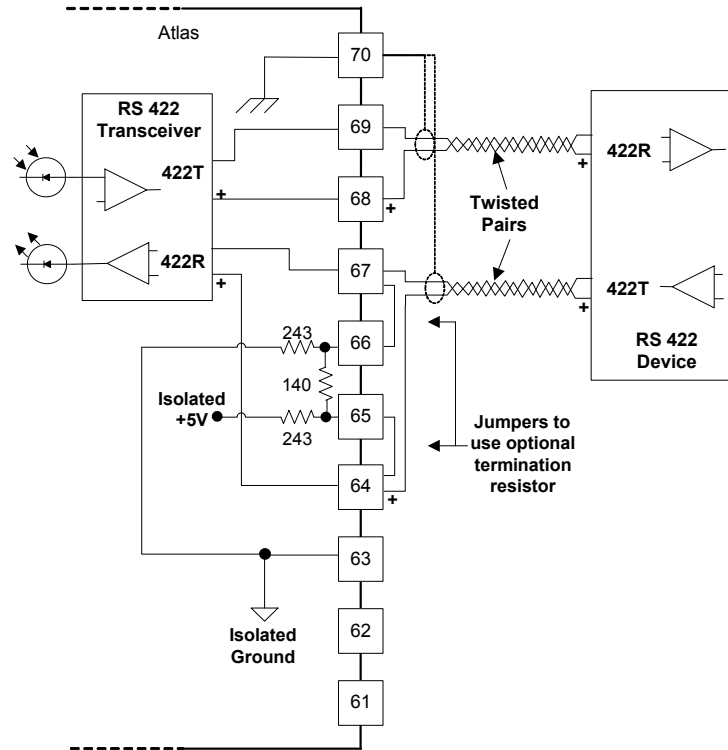


Figure 5-14. Serial #2-RS-422 Pinouts

Serial #2 - RS-485

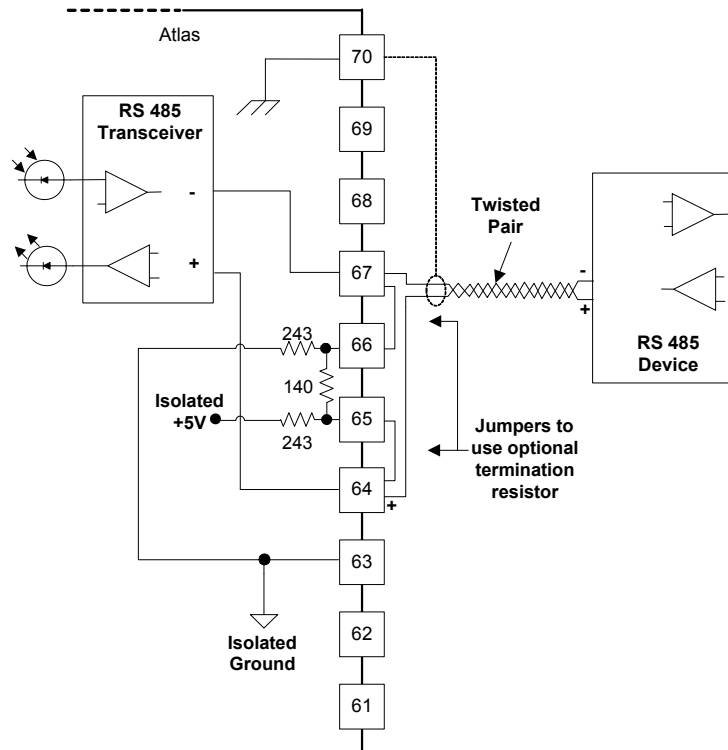


Figure 5-15. Serial #2-RS-485 Pinouts

Serial #3 - RS-232

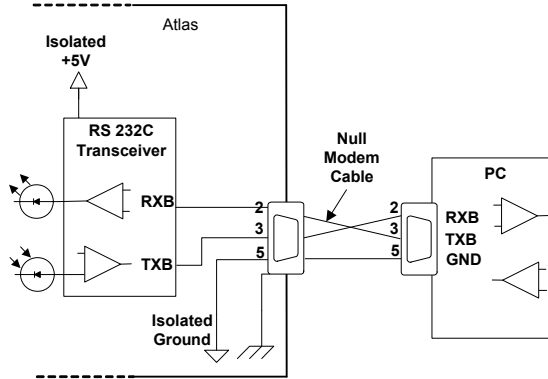


Figure 5-16. Serial #3–RS-232 Pinouts

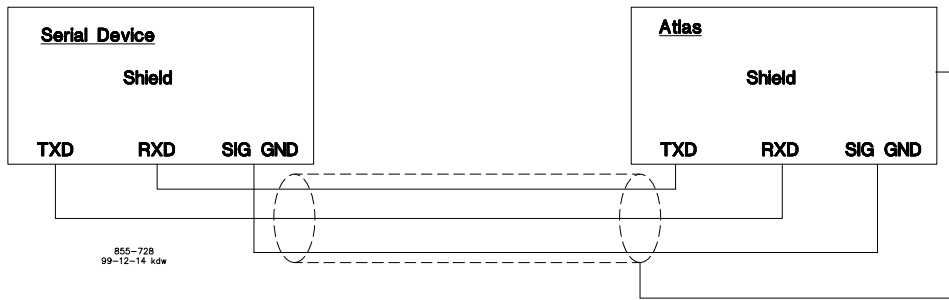


Figure 5-17. Wiring Example–RS-232 Interface to the SmartCore Board

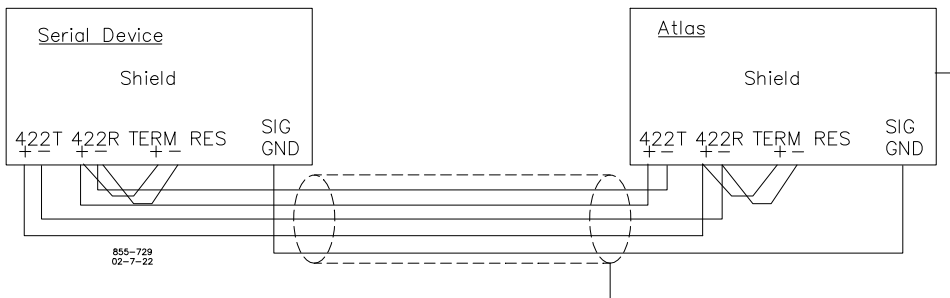


Figure 5-18. Wiring Example–RS-422 Interface to the SmartCore Board

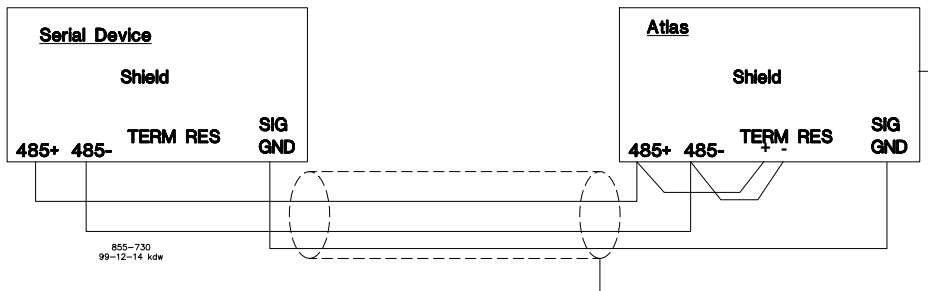


Figure 5-19. Wiring Example–RS-485 Interface to the SmartCore Board

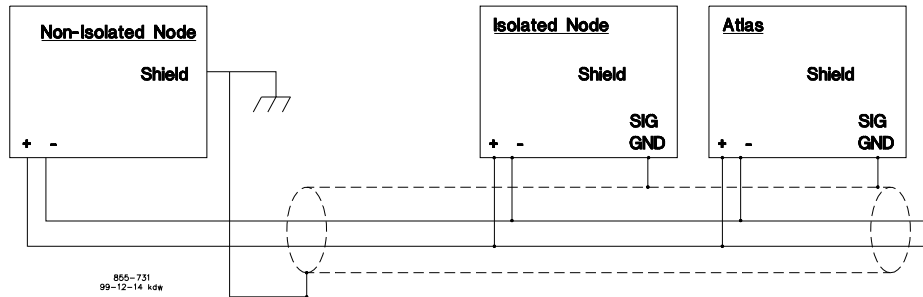


Figure 5-20. Wiring Example—Alternate Multipoint Wiring
(without a separate signal ground wire for the SmartCore board)

Configuration Notes

- Refer to Figure 5-17 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.
- Refer to Figure 5-18 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. The last unit in the network chain, and only the last unit, should have its receiver terminated with a resistor. The AtlasPC has resistors built in (TERM RES) for this purpose. This applies to both ends of the network.
- Refer to Figure 5-19 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 last unit in the chain, and only the last unit, should be terminated with a resistor. The AtlasPC has resistors built in (TERM RES) for this purpose. This applies to both ends of the network.
- The serial ports must be properly configured in the application software for the appropriate communication parameters.
- Termination resistors are available on the SmartCore board and should be wired across the network at the ends of the line.
- The serial ports are individually isolated from each other, and from the rest of the AtlasPC 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.

Fault Detection (Board Hardware)

Each SmartCore 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 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.

Number of LED Flashes	Failure
1	Microprocessor failure
2	Bus, address, any unexpected exception error
3	Failure during RAM test
4	Local watchdog timeout
5	Failure during EE test
6	Failure during FLASH programming or erasing
7	Kernel software watchdog count error
10	Failure during 68302 test
11	Failure during RTC test
12	TPU RAM Failure
20...	Operating system specific errors use 20 & above

Table 5-1. SmartCore Failure Codes

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 three 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 that shown in Figure 5-3.
- Verify that the signal waveform is clean and void of double zero crossings.
- Verify that no ground connection exists and that the resulting 60 Hz signal 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 AtlasPC 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 ground connection exists and that the resulting 60 Hz signal 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 AtlasPC 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.
- 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 AtlasPC 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 AtlasPC 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.
- 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 AtlasPC 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 AtlasPC should be returned for service.

Chapter 6. SmartCore Board with Actuators

General Description

This chapter covers the SmartCore board with actuators, part number 5503-302.

Each SmartCore board contains circuitry for two speed sensor inputs, six analog inputs, six analog outputs, 2 proportional actuator drivers, 3 serial ports, and 24 discrete inputs. Each speed sensor input may be from a magnetic pick-up or from a proximity probe, each Analog input may be 4–20 mA or 0–5 V, and two of the serial ports, may be RS-232, RS-422, or RS-485. The other serial port is a dedicated RS-232 port.

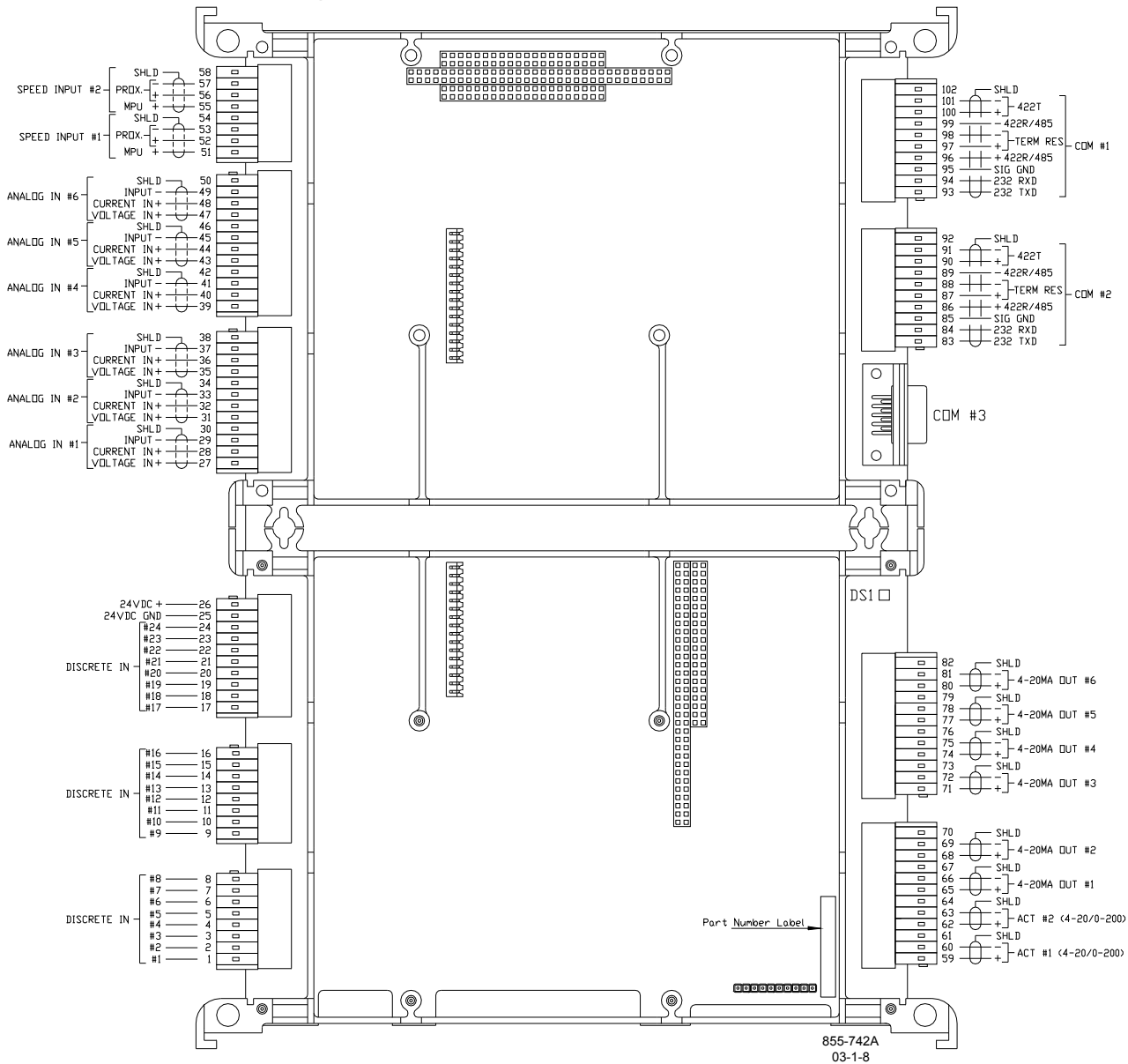


Figure 6-1. SmartCore Board with Actuators, Connectors

Features

- 5 ms update rate
- On-board processor for automatic calibration of the I/O channels
- Analog inputs have 14 bit resolution
- Analog outputs have 12 bit resolution

Physical

The AtlasPC 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 screws. The SmartCore board is the size of two analog boards.

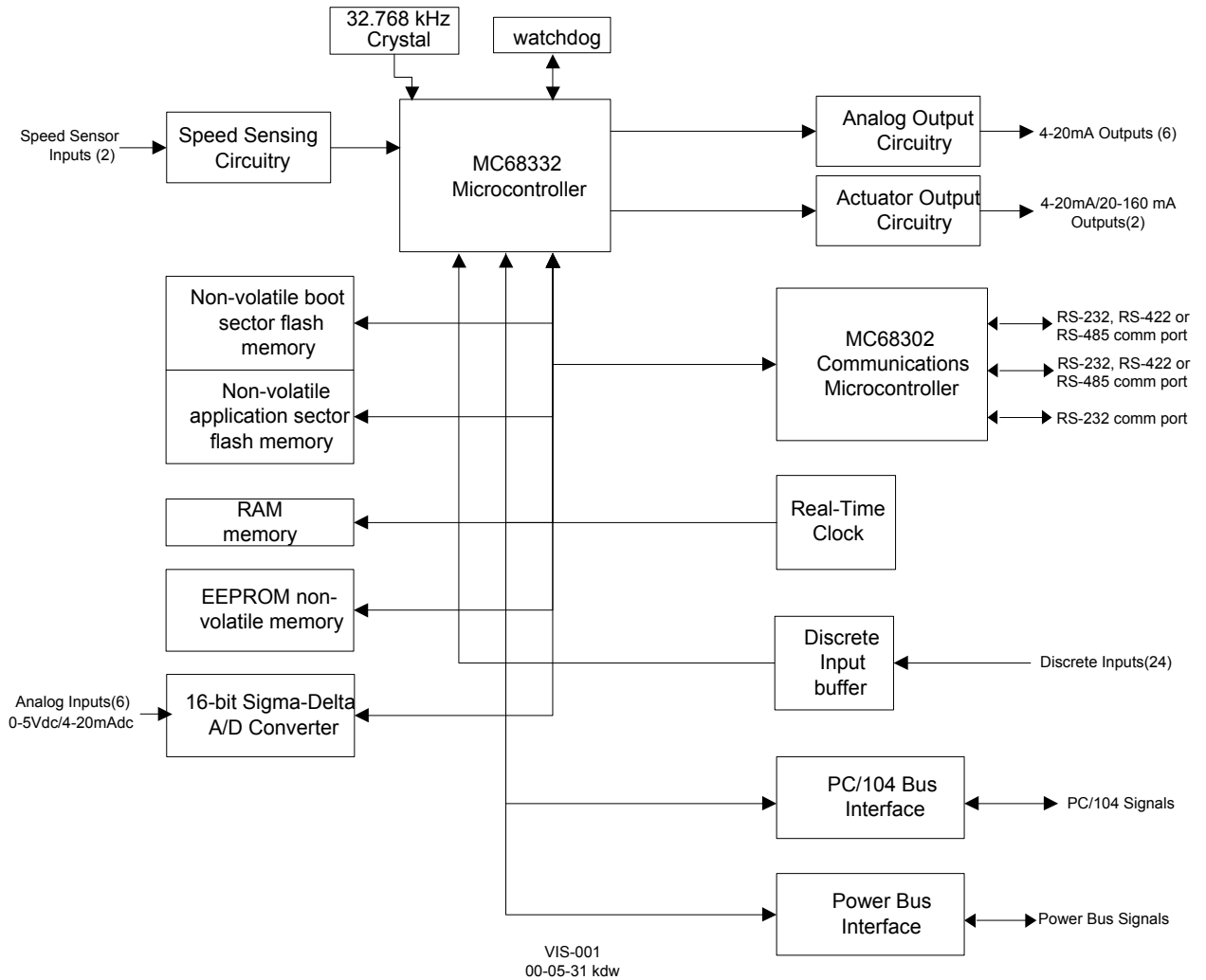


Figure 6-2. AtlasPC SmartCore Board Block Diagram

Specifications

Digital Speed Sensor Inputs

Number of channels	2 selectable as MPU or proximity probe, by terminal block wiring
Input frequency	100—24 950 Hz
Resolution	dependent on frequency, 13 bit minimum at maximum speed
Accuracy	less than $\pm 0.08\%$ full scale from -40 to $+85$ °C internal temperature

MPU Inputs

Minimum input amplitude	See Figure 5-3
Input amplitude	70 V peak-to-peak
Input impedance	>1.5 k Ω
Isolation voltage	500 Vac minimum, each channel is isolated from all other channels and from the AtlasPC platform

Proximity Probe Inputs

Voltage threshold /duty cycle at 1 kHz	at 16 Vin, duty cycle = 10–80% at 24 Vin, duty cycle = 10–80% at 28 Vin, duty cycle = 10–80%
Voltage threshold /duty cycle at 3 kHz	at 16 Vin, duty cycle = 15–65% at 24 Vin, duty cycle = 10–60% at 28 Vin, duty cycle = 10–55%
Input voltage range	16–28 Vdc
Available power	none
Isolation	500 Vac minimum, each channel is isolated from all other channels and from the AtlasPC platform
Input frequency	0.5–3 kHz

- A derivative output is provided to the application software. 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.
- No proximity probe power provided.
- If the proximity probe inputs are used, the corresponding MPU inputs must be jumpered.

Analog Inputs

Number of channels	6
Input type	4–20 mA or 0–5 V
Max. input current	25 mA \pm 5% if configured for 4–20 mA
Max. input voltage	5.0 V \pm 5% if configured for 0–5 V
Common mode rejection	80 dB minimum
Input common mode range	\pm 11 V minimum
Safe input common mode volt	\pm 40 V minimum
Input impedance	200 Ω (\pm 1%)
Anti-aliasing filter	2 poles at 10 ms
Resolution	14 bits
Accuracy @ 25 °C	less than \pm 0.1% of full scale, 0.025 mA
Temp Drift	171 ppm/ $^{\circ}$ C, maximum (1.1% of full scale, 0.275 mA) 30 ppm/ $^{\circ}$ C, typical (0.20% of full scale, 0.05 mA)
I/O Latency	2 channels at 1 ms, 2 channels at 3 ms, and 2 channels at 5 ms

- Loop power for the analog inputs is NOT available.
- 4–20 mA or 0–5 V is selected in the GAP block software, for each input, and selected by terminal block wiring. Both the GAP field, and the wiring must be changed.

IMPORTANT

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

Analog Outputs

Number of channels	6
Output type	4–20 mA outputs, non-isolated
Common Mode Voltage	15 Vdc \pm 10%
Max current output	25 mA \pm 5%
Min. load resistance	0 Ω
Max load resistance	300 Ω at 22 mA
Resolution	12 bits
Accuracy @ 25 °C	less than \pm 0.1% of full scale, 0.025 mA
Temperature Drift	140 PPM/ $^{\circ}$ C, 0.23 mA maximum 70 ppm/ $^{\circ}$ C, typical (0.45% of full scale, 0.11375 mA)

Actuator Outputs

Number of channels	2	
Actuator Type	Proportional, non-isolated	
Output Type	4-20 or 20-160 mA, software selectable	
Isolation	none	
Max current output	25mA \pm 5%	(4-20 mA output scale)
	200 mA \pm 5%	(20-160 mA output scale)
Min. load resistance	0 Ω	
Max load resistance	300 Ω at 22 mA	(4-20 mA output scale)
	45 Ω at 200 mA	(20-160 mA output scale)
Resolution	12 bits	
Accuracy @ 25 °C	less than \pm 0.1% of full scale, 0.026 mA	(4-20 mA output scale)
	0.2 mA	(20-160 mA output scale)
Readback Accuracy @ 25 °C	0.5%	
Temperature Drift	140 PPM/ $^{\circ}$ C maximum, 0.24 mA maximum	(4-20 mA output scale)
	1.82 mA maximum	(20-160 mA output scale)
	70 ppm/ $^{\circ}$ C typical	0.45% of full scale,
	0.12 mA	(4-20 mA output scale)
	0.91 mA	(20-160 mA output scale)
Readbacks	Actuator source and return currents	
Dither Current	25 Hz, fixed duty cycle, software variable amplitude	

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
Max input voltage	28 Vdc
Isolation voltage	500 Vac, all channels are isolated from the AtlasPC platform

- 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 AtlasPC platform and other I/O types.

Serial I/O

Number of channels	3
Channel configuration	1 - RS-232, 9 pin sub D 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

SmartCore 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 board, and the filter time constant is selectable at 8 milliseconds or 16 milliseconds. 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 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.

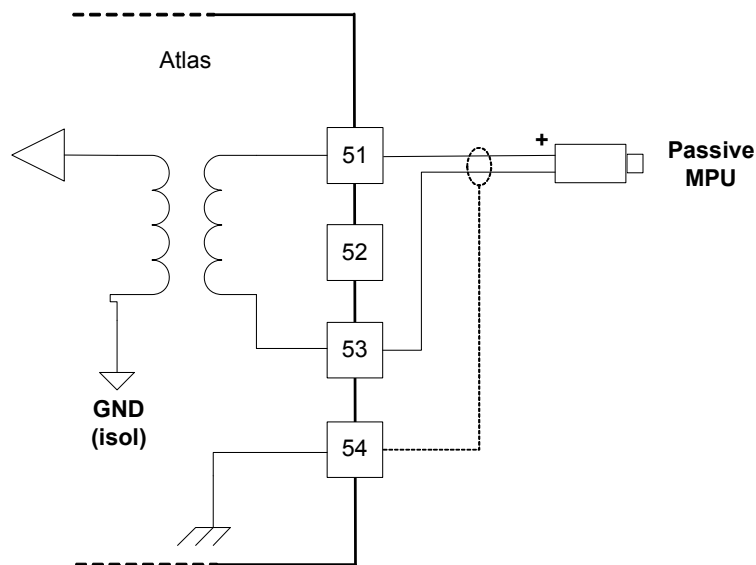


Figure 6-3. Wiring Example—MPU Interface to the SmartCore Board

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 board.

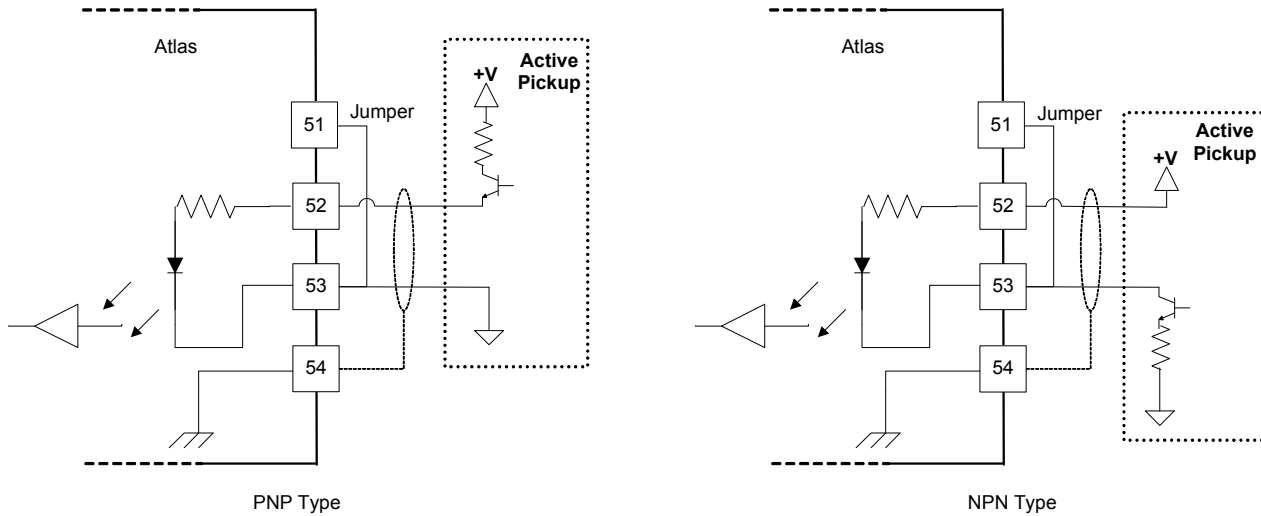


Figure 6-4. Wiring Example—Proximity Probe to the SmartCore Board

Configuration Notes

- Refer to Figures 6-3 and 6-4 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 $\times 1.2$)
 R = gear ratio

Analog Inputs

The analog inputs may be current or voltage type. If a current input is used, a jumper is installed on the terminal block, and the software must be selected for current. This allows the SmartCore card to use the applicable hardware calibration values. If a voltage input is needed, the jumper must be removed, and the software must be selected for voltage. See Figure 6-5 for jumper locations.

All Analog inputs may be used with two-wire ungrounded (loop powered) transducers or isolated (self-powered) transducers. All Analog inputs have 10 Vdc of common mode rejection. If interfacing to a non-isolated device, which may have the potential of reaching over 10 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 board uses a 200 Ω resistor across the input.

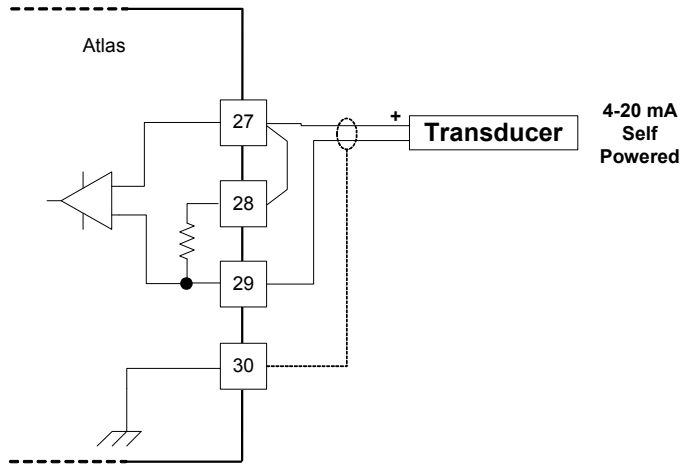


Figure 6-5a. Wiring Example—4–20 mA Input Interface to the SmartCore Board

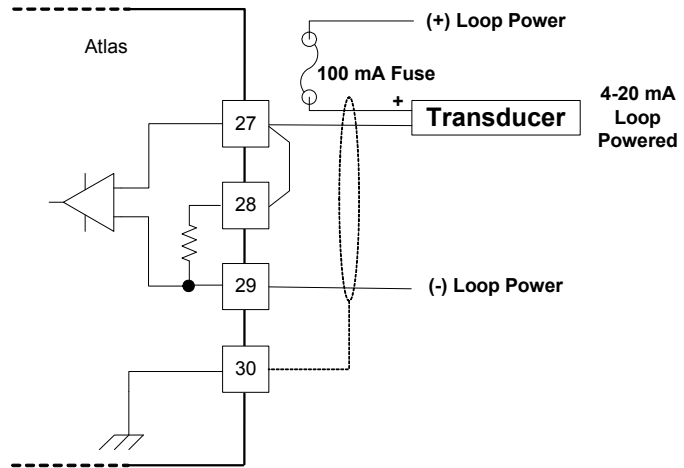


Figure 6-5b. Wiring Example—4–20 mA Input Interface using External Loop Power

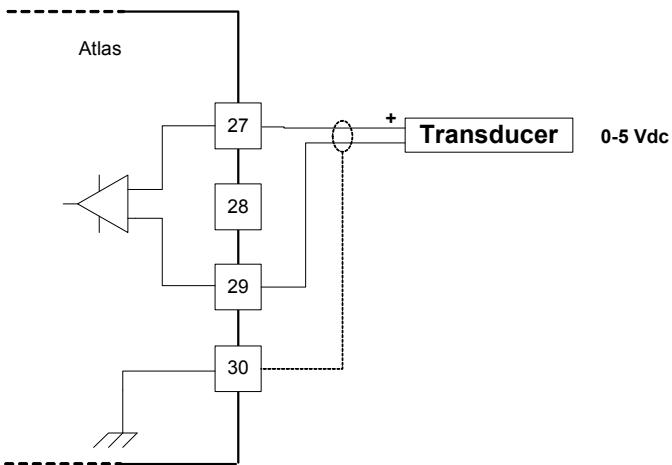


Figure 6-6. Wiring Example—0–5 V Input Interface to the SmartCore Board

Configuration Notes

- Refer to Figures 6-5 and 6-6 for analog input wiring.
- All 4–20 mA inputs have an input impedance of 200 Ω .
- When a 4–20 mA input is used, a terminal block jumper must be installed, per Figure 6-5.
- The application software must be configured for a 4–20 mA type input, or a 0–5 V type input.
- 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 0–24 mA. The SmartCore board has four analog outputs.

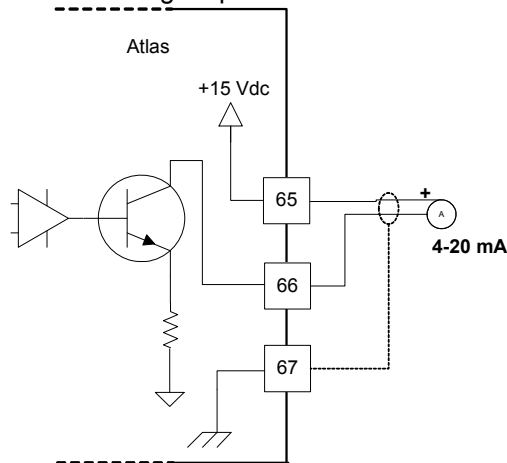


Figure 6-7. Wiring Example—Analog Output Interface to the SmartCore Board

Configuration Notes

- Refer to Figure 6-7 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 AtlasPC control common.

NOTICE

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

Actuator Outputs

The proportional actuator driver outputs are 4–20 mA or 20–160 mA with a full scale range of 0–24 mA or 0–200 mA. The SmartCore board has two proportional actuator driver outputs, each output with source and return current readbacks.

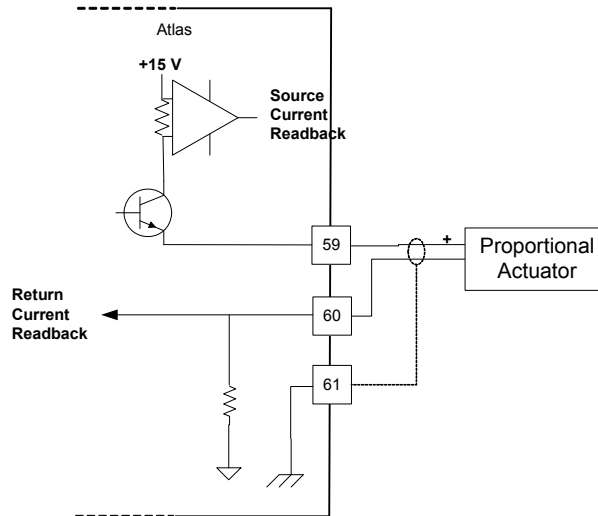


Figure 6-8. Wiring Example—Actuator Output Interface to the SmartCore Board

Configuration Notes

- Refer to Figure 6-8 for actuator output wiring.
- 4–20 mA or 20–160 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.
- The readbacks can be used in the application software for fault detection.

NOTICE

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

Discrete Inputs

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

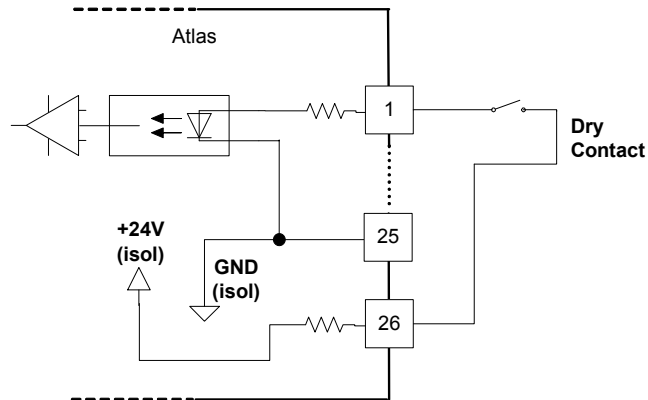


Figure 6-9. Wiring Example—Discrete Input Interface to the SmartCore Board

Configuration Notes

- Refer to Figure 6-9 for discrete input wiring.
- The discrete input commons are tied together, so each SmartCore 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 $100 \div V$, where V is the supply's rated voltage, or 5 A, whichever is less).
- The 24 V isolated contact power is protected by a 0.2 A poly switch. 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.

Serial I/O

The SmartCore board accepts three serial I/O connections. The first two ports are configurable for RS-232, RS-422, or RS-485. The last port is configurable for RS-232 only. RS-232 is specified to 50 feet (15 m), and RS-485 and RS-422 are specified to 4000 feet (1219 m).

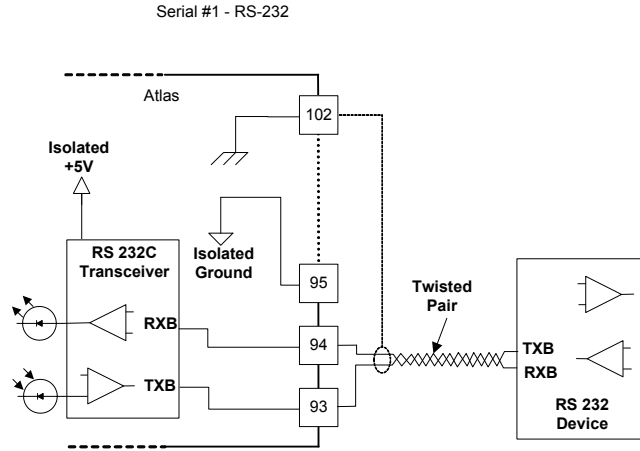


Figure 6-10. Serial #1–RS-232 Pinouts

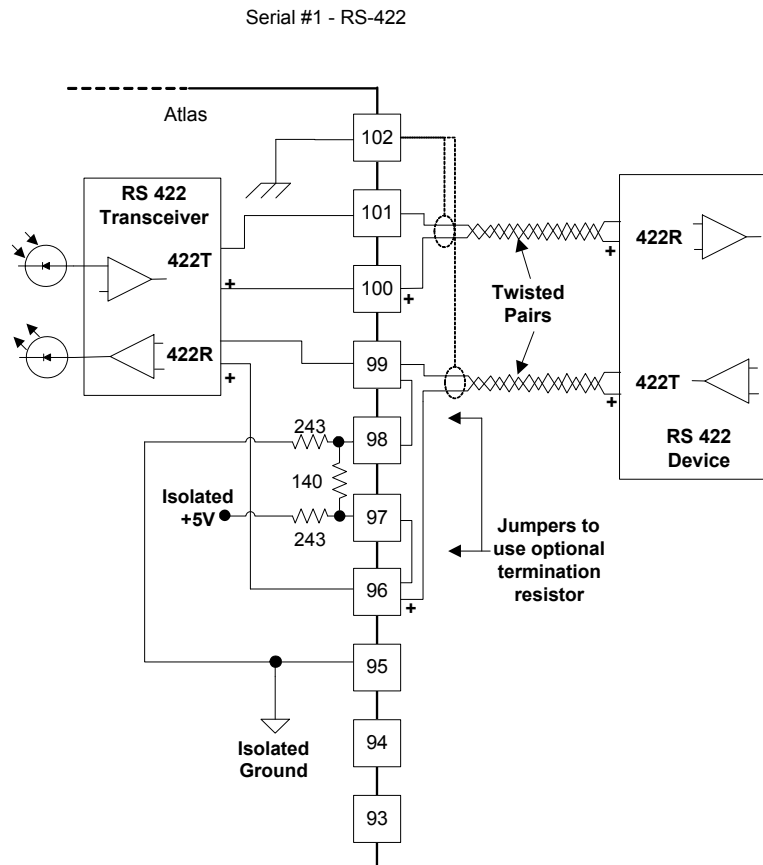


Figure 6-11. Serial #1–RS-422 Pinouts

Serial #1 - RS-485

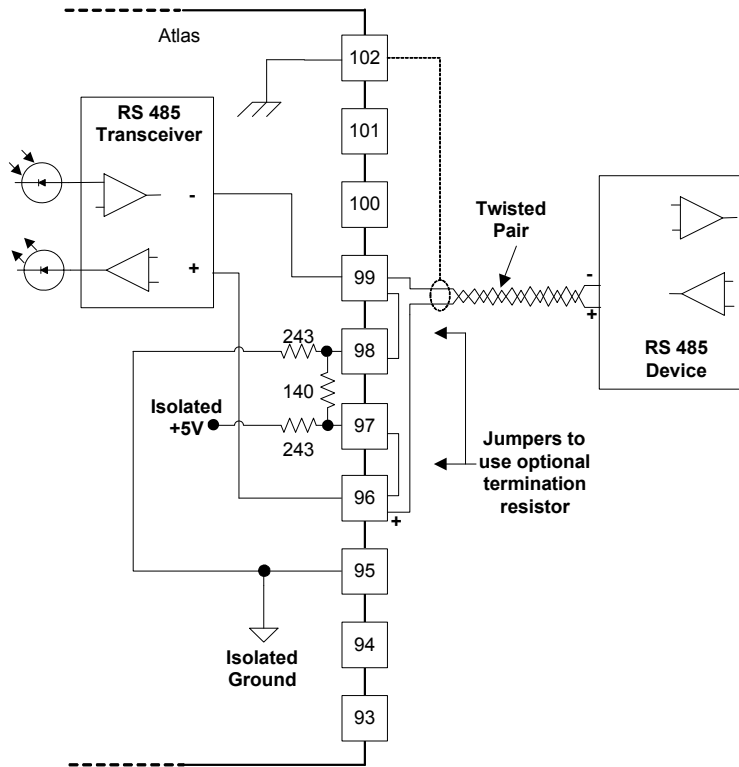


Figure 6-12. Serial #1-RS-485 Pinouts

Serial #2 - RS-232

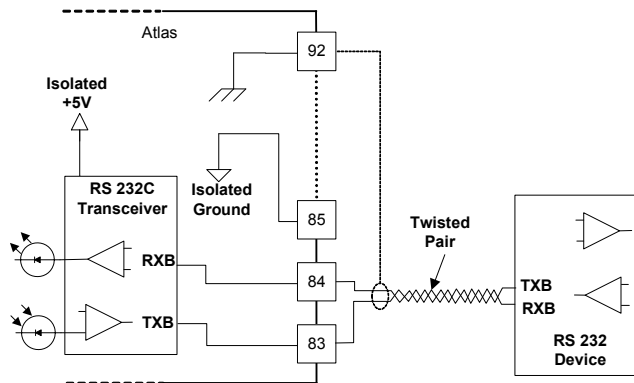


Figure 6-13. Serial #2-RS-232 Pinouts

Serial #2 - RS-422

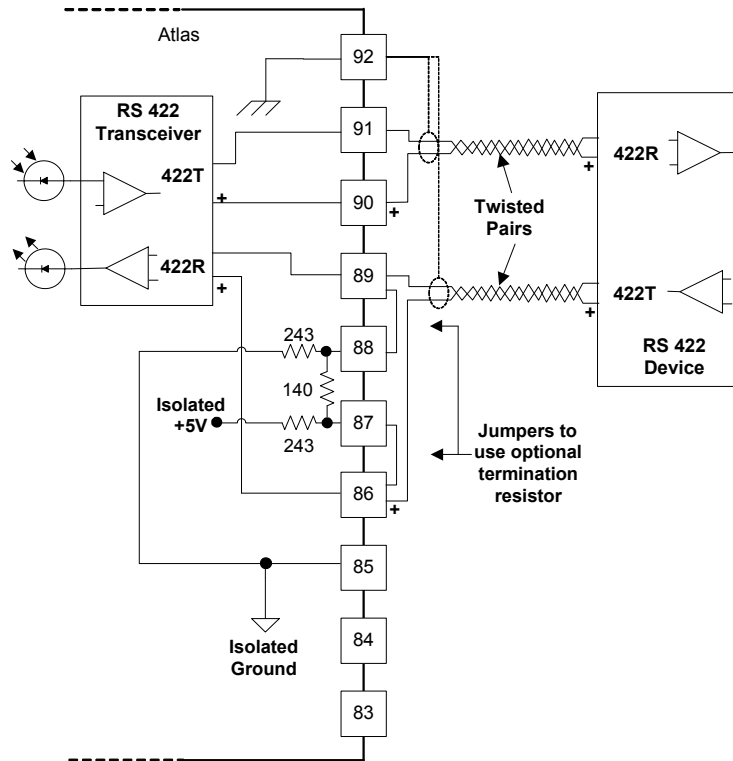


Figure 6-14. Serial #2-RS-422 Pinouts

Serial #2 - RS-485

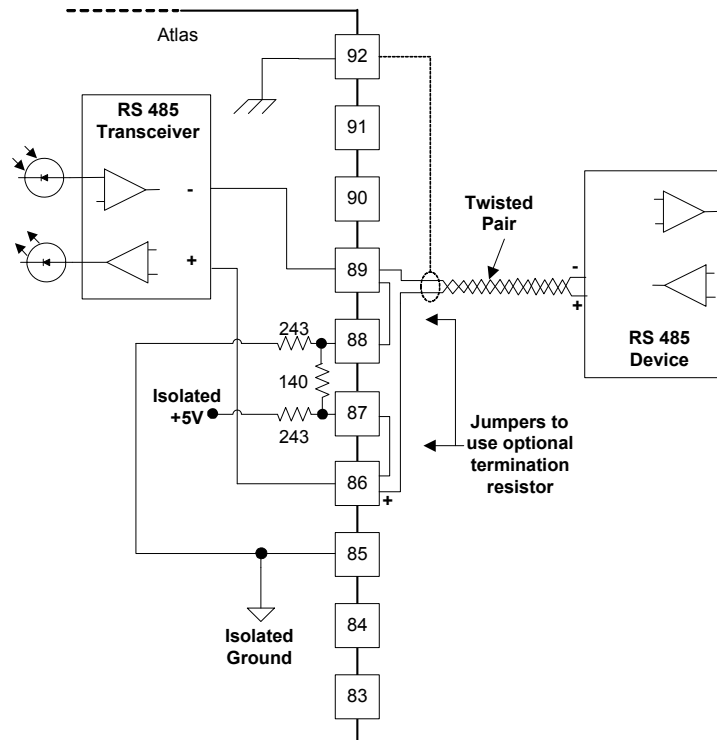


Figure 6-15. Serial #2-RS-485 Pinouts

Serial #3 - RS-232

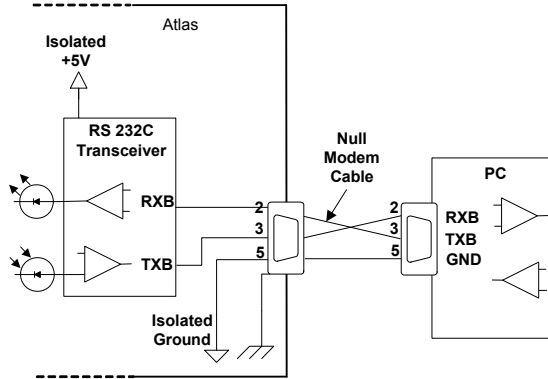


Figure 6-16. Serial #3–RS-232 Pinouts

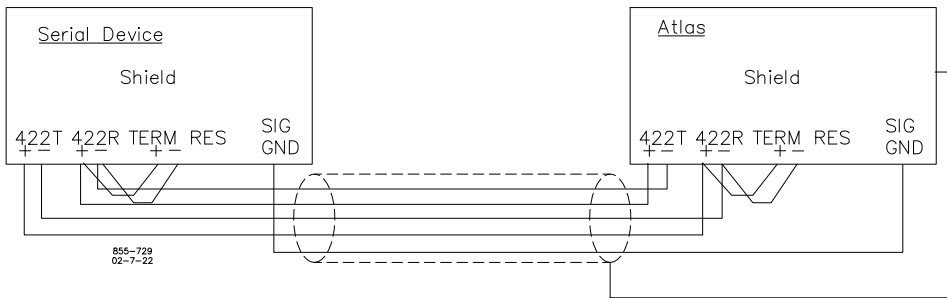


Figure 6-17. Wiring Example–RS-232 Interface to the SmartCore Board

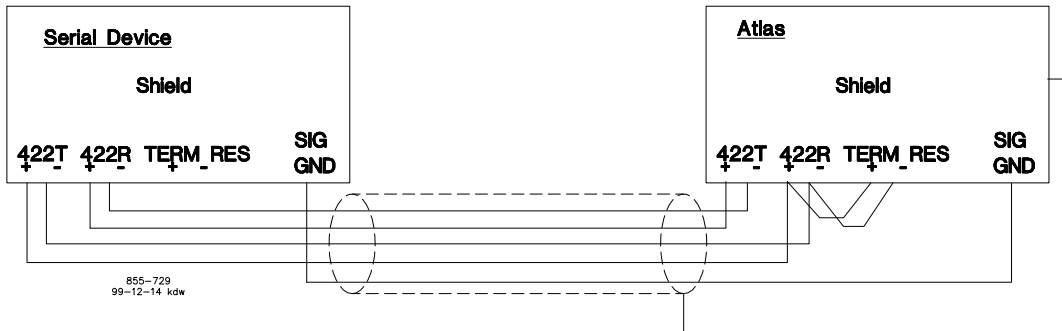


Figure 6-18. Wiring Example–RS-422 Interface to the SmartCore Board

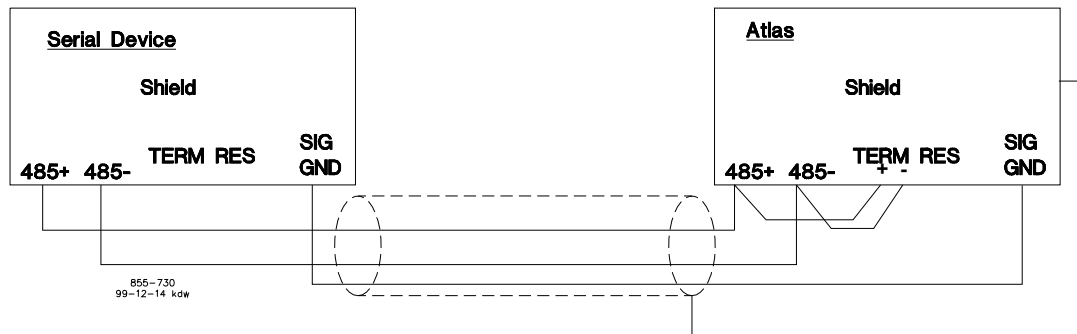
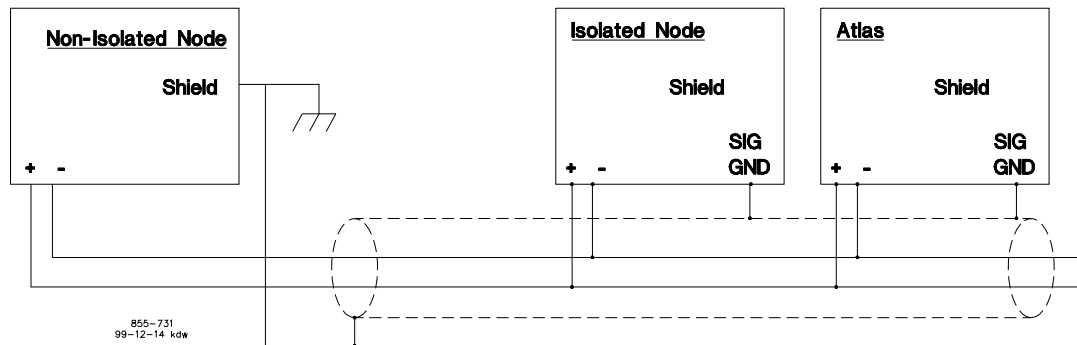


Figure 6-19. Wiring Example—RS-485 Interface to the SmartCore Board

Figure 6-20. Wiring Example—Alternate Multipoint Wiring
(without a separate signal ground wire for the SmartCore board)

Configuration Notes

- Refer to Figure 6-17 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.
- Refer to Figure 6-18 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. The last unit in the network chain, and only the last unit, should have its receiver terminated with a resistor. The AtlasPC has resistors built in (TERM RES) for this purpose. The unit at each end of the network should be terminated.
- Refer to Figure 6-19 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 last unit in the chain, and only the last unit, should be terminated with a resistor. The AtlasPC has resistors built in (TERM RES) for this purpose. The unit at each end of the network should be terminated.
- The serial ports must be properly configured in the application software for the appropriate communication parameters.
- Termination resistors are available on the SmartCore board and should be wired across the network at the ends of the line.

- The serial ports are individually isolated from each other, and from the rest of the AtlasPC 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.

Fault Detection (Board Hardware)

Each SmartCore 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 board may be faulty.

Number of LED Flashes	Failure
1	Microprocessor failure
2	Bus, address, any unexpected exception error
3	Failure during RAM test
4	Local watchdog timeout
5	Failure during EE test
6	Failure during FLASH programming or erasing
7	Kernel software watchdog count error
10	Failure during 68302 test
11	Failure during RTC test
12	TPU RAM Failure
20...	Operating system specific errors use 20 & above

Table 6-1. SmartCore Failure Codes

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 three 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 V_{rms}.
- Verify that the signal waveform is clean and void of double zero crossings.
- Verify that no ground connection exists and that the resulting 60 Hz signal 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 AtlasPC 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 ground connection exists and that the resulting 60 Hz signal 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 AtlasPC 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.
- 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 AtlasPC 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 AtlasPC 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 AtlasPC 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.
- 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 AtlasPC 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 AtlasPC should be returned for service.

Chapter 7. 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

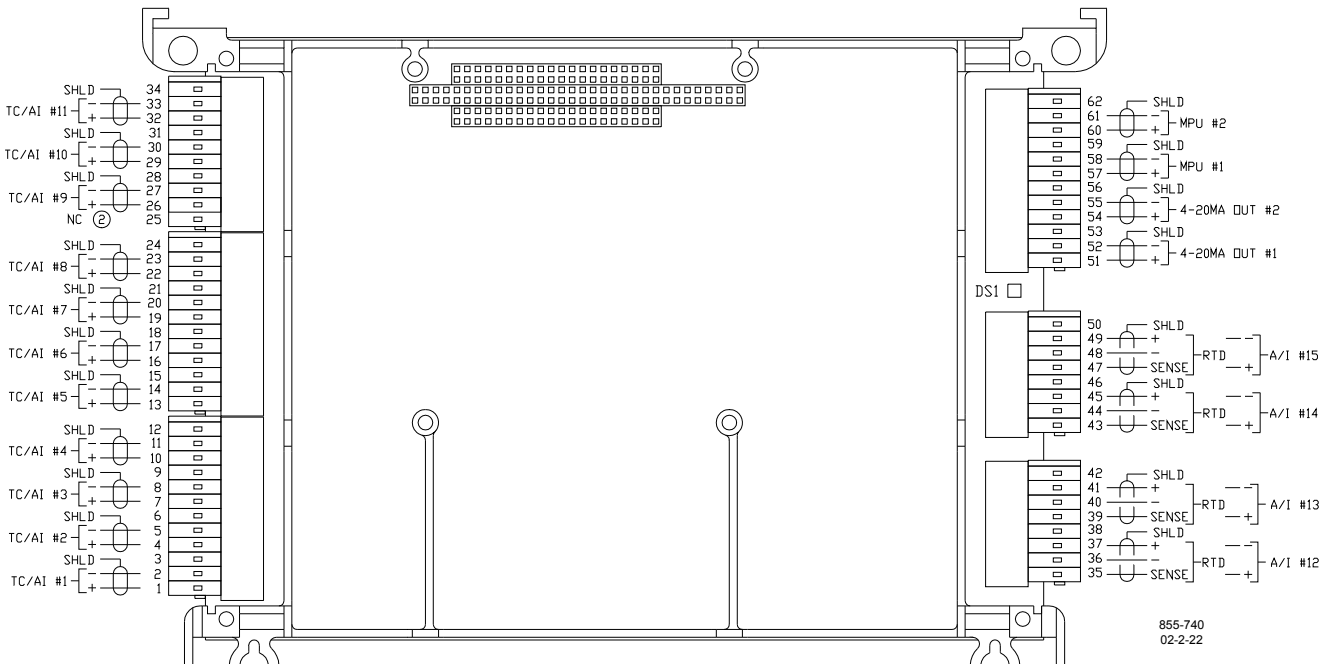


Figure 7-1. AtlasPC Analog Combo Board Connections

Physical

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

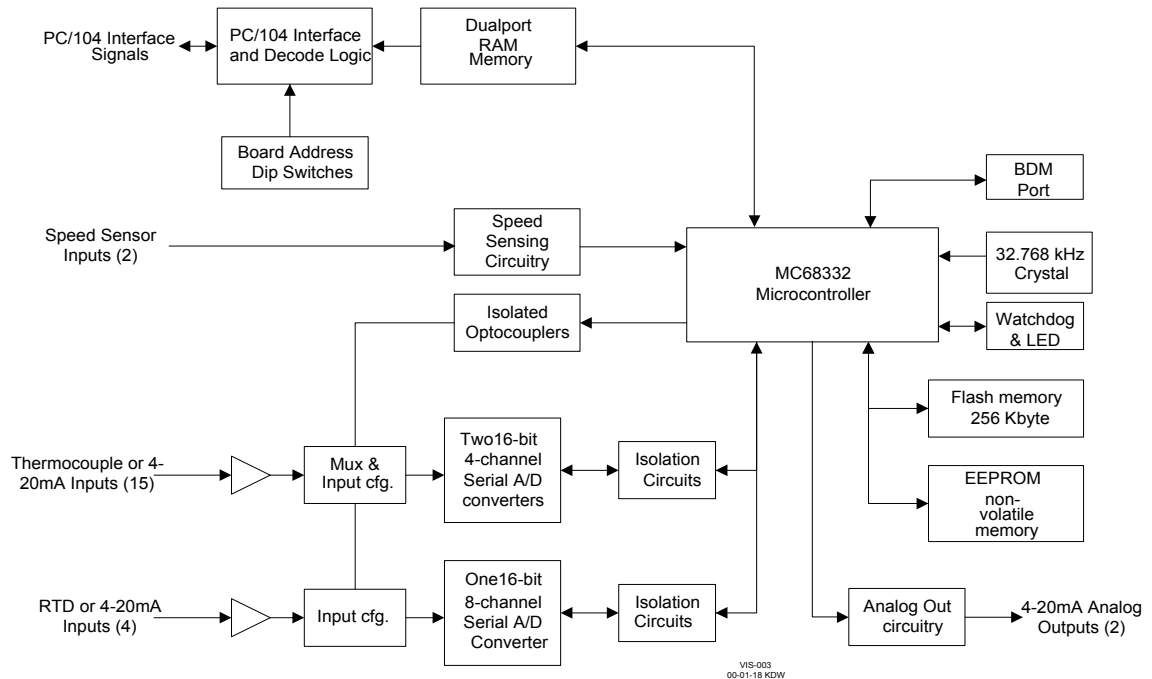


Figure 7-2. AtlasPC Analog Combo Board Block Diagram

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

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 AtlasPC 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.
 - 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 ($\pm 1\%$) for 4–20 mA inputs
Anti-aliasing filter	2 poles at 10 ms
Resolution	15 bits

Accuracy

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

Temperature 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

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 AtlasPC 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.

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 7-3.
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 AtlasPC platform
Resolution	dependent on frequency, 13 bit minimum at maximum speed
Accuracy	less than $\pm 0.08\%$ of full scale from -40 to $+85$ °C internal temperature

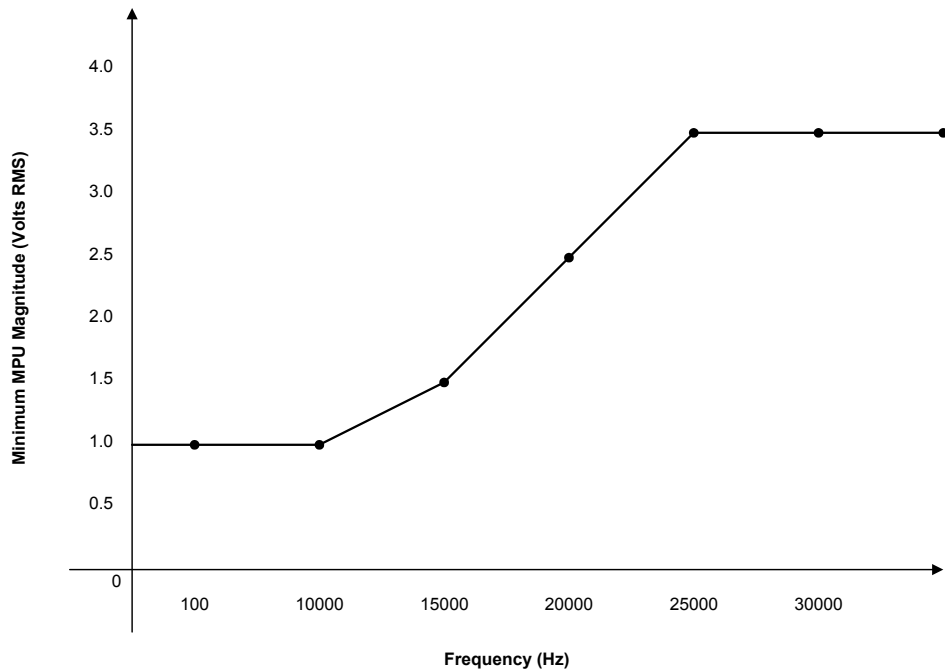


Figure 7-3. Minimum MPU Voltage

- 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/sec. At 5000 Hz, it can be as much as 12.5 Hz/sec. At 10 kHz, it can be as much as 25 Hz/sec. At 20 kHz, it can be as much as 80 Hz/sec. 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.

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.

AtlasPC 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.

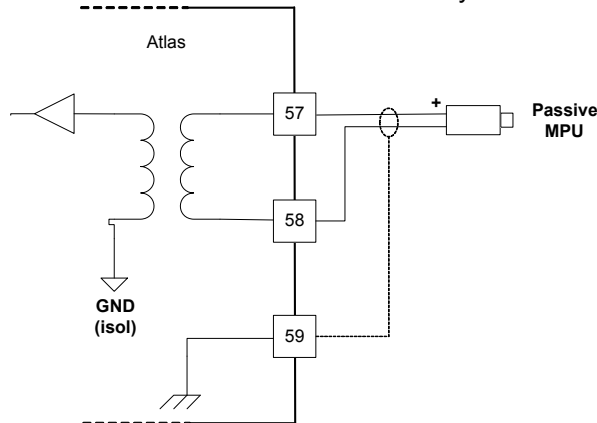


Figure 7-4. Wiring Example—MPU Interface to the Analog Combo Board

Configuration Notes

- Refer to Figure 7-4 for speed sensor wiring.

Speed Sensor Input Software Configuration Limitations

$(TxMxR)/60$ must be < 25000 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 AtlasPC 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.

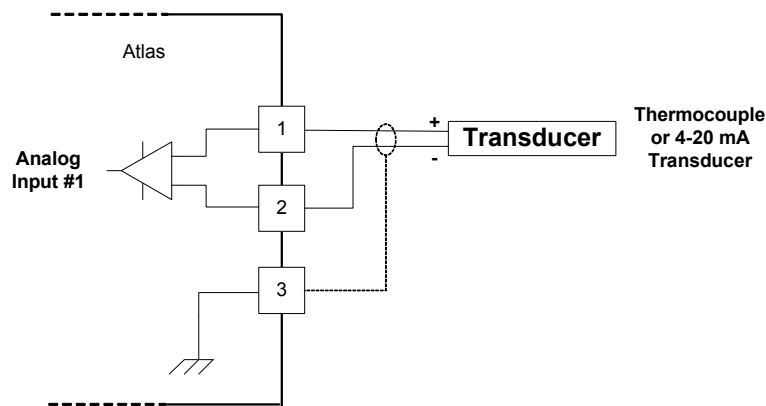


Figure 7-5a. Wiring Example—Analog Input Interface
(to the Analog Combo Board for 4–20 mA
and thermocouple inputs on inputs 1–11)

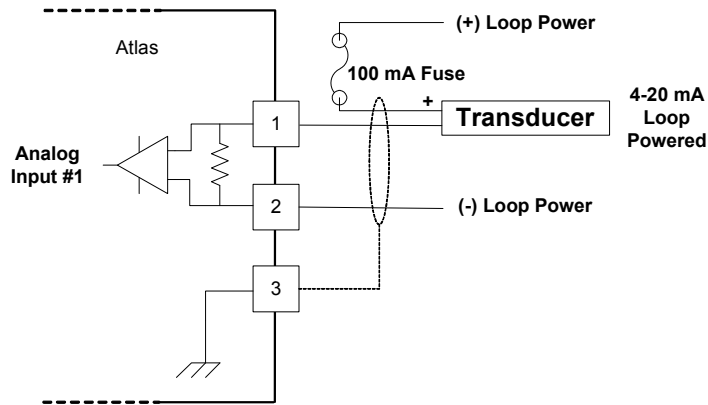


Figure 7-5b. Wiring Example—Analog Input Interface with External Loop Power

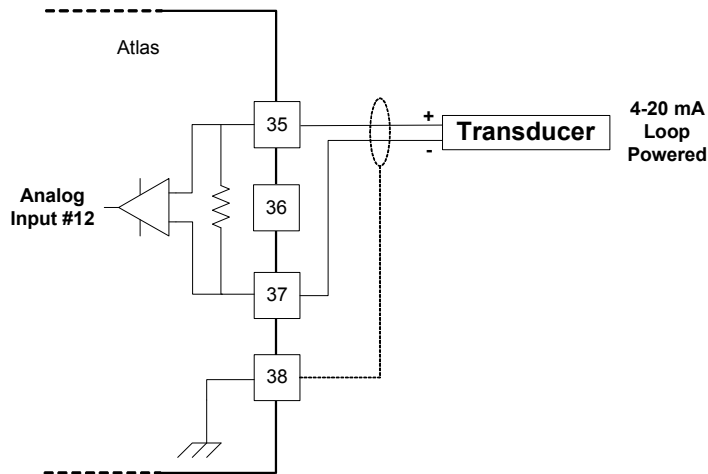


Figure 7-6. Wiring Example—4–20 mA Input Interface (to the Analog Combo Board for inputs 12–15)

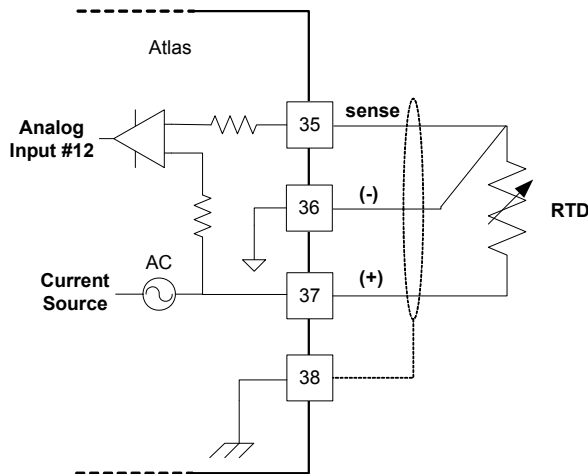


Figure 7-7. Wiring Example—RTD Input Interface (to the Analog Combo Board for inputs 12–15)

Configuration Notes

- Refer to Figures 6-5, 6-6, and 6-7 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 AtlasPC 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 ($^{\circ}\text{C}$ or $^{\circ}\text{F}$) 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.

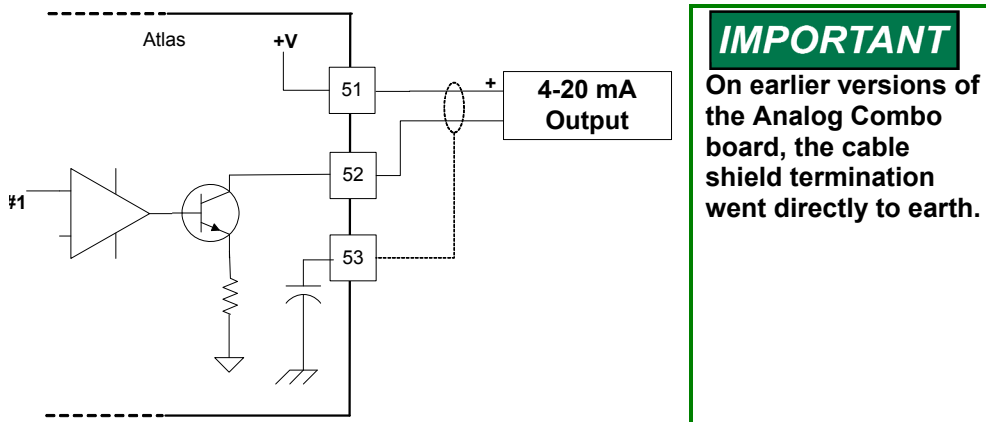


Figure 7-8. Wiring Example—Analog Output Interface (to the Analog Combo Board)

Configuration Notes

- Refer to Figure 7-8 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 AtlasPC 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 Board with actuators 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.

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 7-1 Analog Combo Failure

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 7-3.
- Verify that the signal waveform is clean and void of double zero crossings.
- Verify that no ground connection exists and that the resulting 60 Hz signal 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 AtlasPC 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. 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 AtlasPC 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 AtlasPC should be returned for service.

Chapter 8.

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, a voltage bias output, and a LON communications port.

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 updated after 3 cycles, which is 50 ms 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
- The LON port is isolated from the rest of the board

Physical

The AtlasPC PowerSense board connects to the CPU board through the PC/104 bus. It connects to the power supply, through the AtlasPC power bus. It requires a SmartCore 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 8-1).

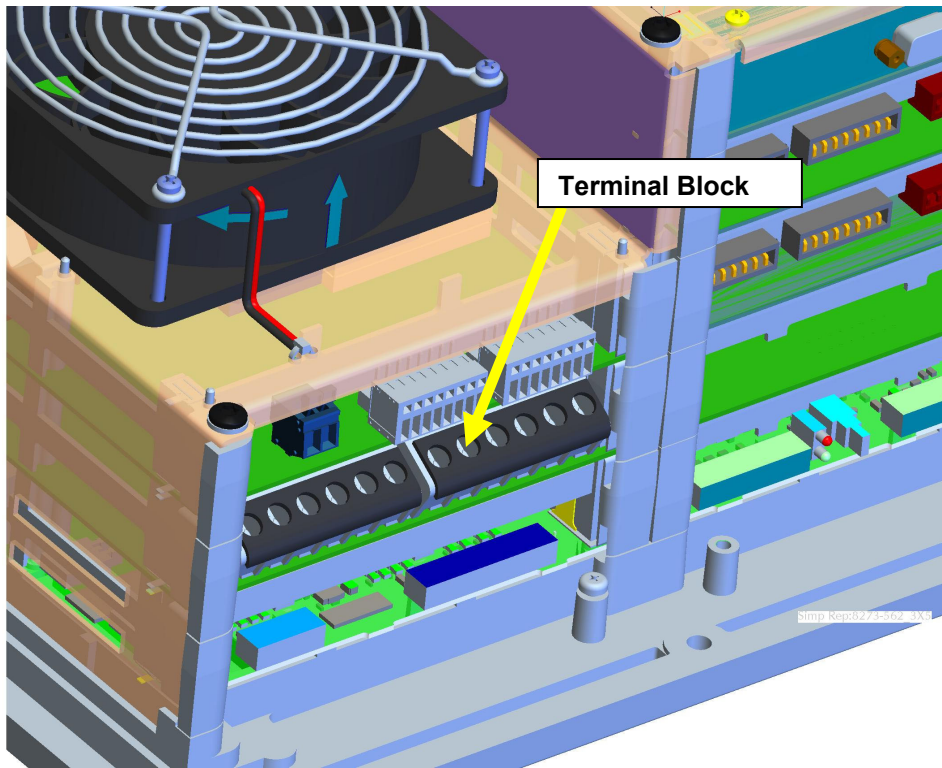


Figure 8-1. Terminal Block Covers

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 kV_{ac} of dielectric isolation.

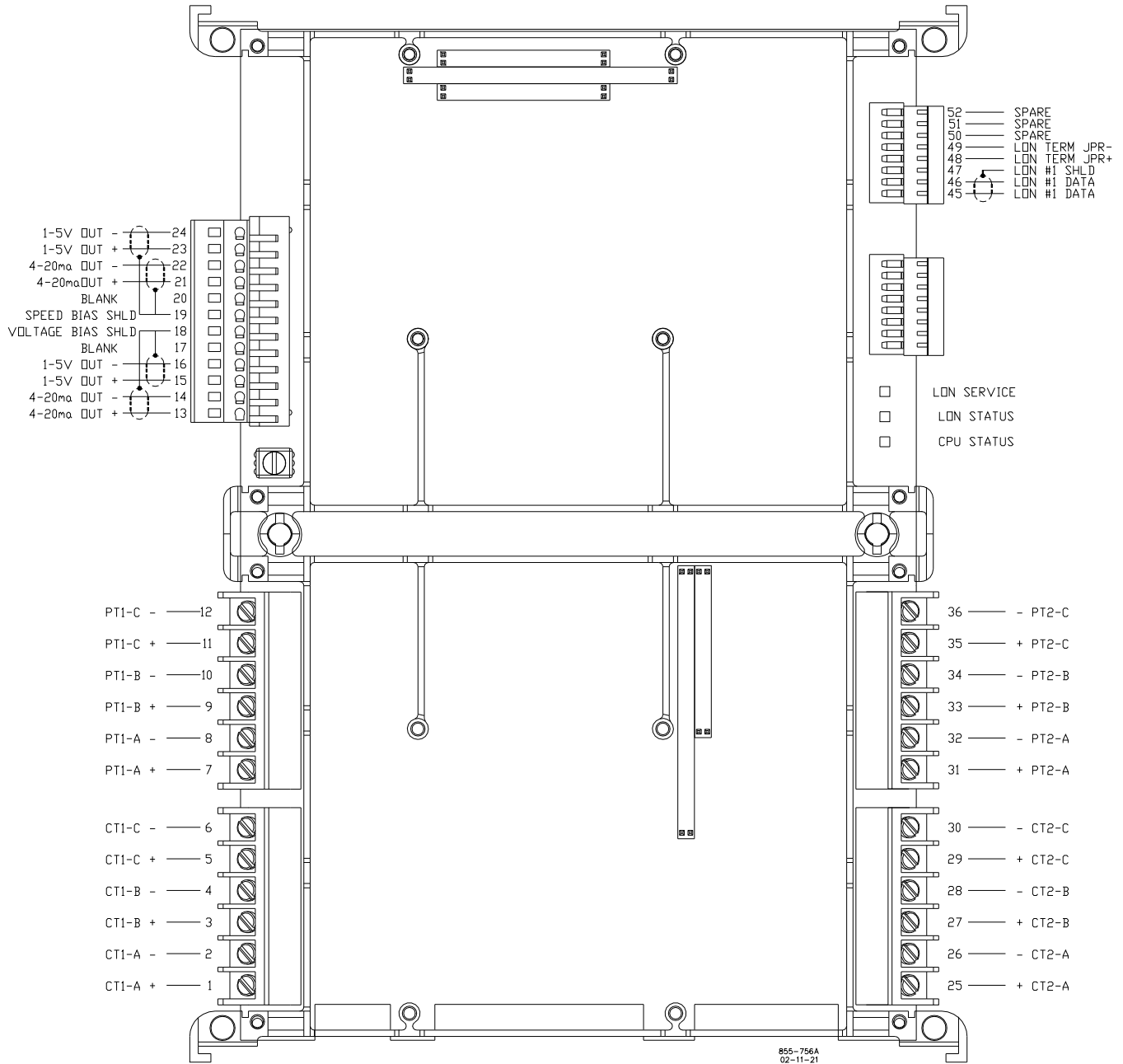


Figure 8-2. PowerSense Board Connections

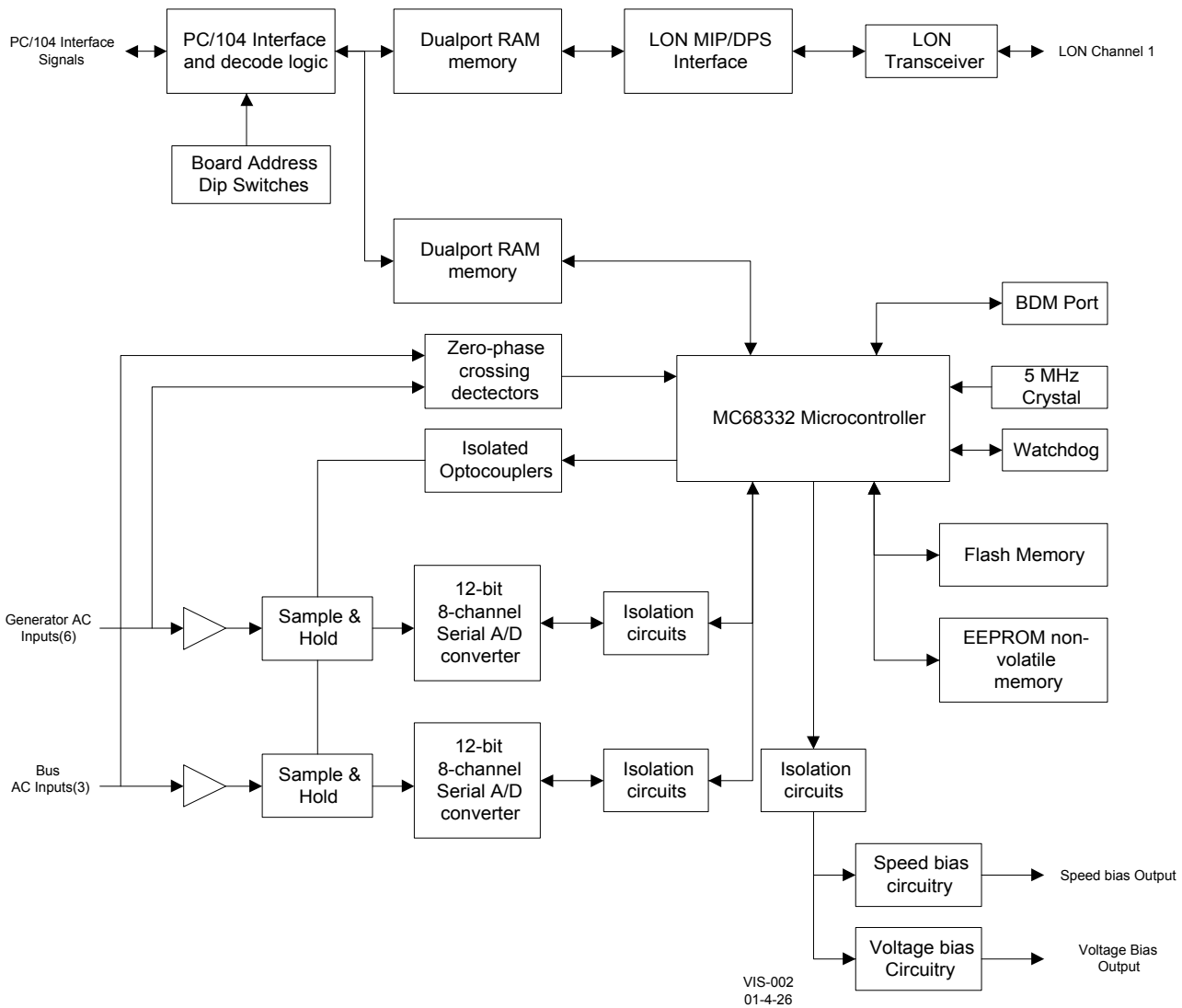


Figure 8-3. PowerSense Board Block Diagram

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

PT Temp Drift

(Vrange = 70/120/240 Vrms)	−40 to +85 °C	Any 40 °C change
Typical (1 σ):	< 0.4 % of Vrange 0.28V, 70V scale 0.48V, 120V scale 0.96V, 240V scale	< 0.3% of Vrange 0.21V, 70V scale 0.36V, 120V scale 0.72V, 240V scale
Max (3 σ):	< 1.2 % of Vrange 0.84V, 70V scale 1.44V, 120V scale 2.88V, 240V scale	< 0.8% of Vrange 0.56V, 70V scale 0.96V, 120V scale 1.92V, 240V scale

Input Impedance	400 k Ω 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
Accuracy	see PT/CT Accuracy Table

CT Temp Drift

(FullScale = 5 Arms)	−40 to +85 °C	Any 40 °C change
Typical (1 σ):	< 0.4% or 20.0 mA	< 0.3% or 15.0 mA
Max (3 σ):	< 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 \pm 5%
Voltage output options	0–5 V (5 V max \pm 5%), \pm 3 V (\pm 3V limit \pm 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 \pm 3 V output, 1k Ω for 0–5 V output, PWM output.
Resolution	11 bits, except for PWM output
Accuracy	less than \pm 0.1% of full scale @ 25 $^{\circ}$ C or \pm 0.006 V for \pm 3 V output \pm 0.005 V for 0–5 V output \pm 0.025 mA for 4–20 mA output

TempDrift (4–20 mA, FS = 25 mA)	<u>–40 to +85 $^{\circ}$C</u>	<u>Any 40 $^{\circ}$C change</u>
Typical (1 σ):	< 0.5% or 0.125 mA	< 0.3% or 0.075 mA
Max (3 σ):	< 1.2% or 0.30 mA	< 0.8% or 0.20 mA

Temp Drift (\pm 3V range)	<u>–40 to +85 $^{\circ}$C</u>	<u>Any 40 $^{\circ}$C change</u>
Typical (1 σ):	< 0.3% or 18.0 mV	< 0.2% or 12.0 mV
Max (3 σ):	< 0.7% or 42.0 mV	< 0.5% or 30.0 mV

TempDrift (0–5 V range and PWM)	<u>–40 to +85 $^{\circ}$C</u>	<u>Any 40 $^{\circ}$C change</u>
Typical (1 σ):	< 0.1% or 5.0 mV	< 0.1% or 5.0 mV
Max (3 σ):	< 0.2% or 10.0 mV	< 0.2% or 10.0 mV

- Options: 4–20 mA, 0–5 V, \pm 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 \pm 5%
Voltage output options	\pm 1, \pm 3, \pm 9 V selected by software switch and wiring
Max Voltage	\pm 9V \pm 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	7k Ω for \pm 9V output, 0 Ω for 4–20 mA output
Resolution	11 bits for \pm 9V, >9 bits for \pm 3V, >7 bits for \pm 1V
Accuracy	less than \pm 0.1% of full scale @ 25 $^{\circ}$ C or \pm 0.018V for \pm 1V, \pm 3V, \pm 9V output \pm 0.025 mA for 4–20 mA output

TempDrift (4–20 mA, FS = 25 mA)	–40 to +85 °C	Any 40 °C change
Typical (1 σ):	< 0.5% or 0.125 mA	< 0.3% or 0.075 mA
Max (3 σ):	< 1.2% or 0.30 mA	< 0.8% or 0.20 mA

Temp Drift ($\pm 9V$ range)	–40 to +85 °C	Any 40 °C change
Typical (1 σ):	< 0.3% or 54.0 mV	< 0.3% or 54.0 mV
Max (3 σ):	< 0.6% or 108.0 mV	< 0.5% or 90.0 mV

Temp Drift ($\pm 3V$ range)	–40 to +85 °C	Any 40 °C change
Typical (1 σ):	< 0.9% or 54.0 mV	< 0.9% or 54.0 mV
Max (3 σ):	< 1.8% or 108.0 mV	< 1.5% or 90.0 mV

TempDrift ($\pm 1V$ range)	–40 to +85 °C	Any 40 °C change
Typical (1 σ):	< 2.7% or 54.0 mV	< 2.7 % or 54.0 mV
Max (3 σ):	< 5.4% or 108.0 mV	< 4.5% or 90.0 mV

- options: 4–20 mA, $\pm 1V$, $\pm 3V$, $\pm 9V$; 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.

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 $\pm 0.9^\circ$
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
Harmonics 9, 11, 13	1% or 2.4 V, 240 Vac scale
	2% or 100 mA for current
	2% or 1.4 V, 70 Vac scale
Negative Phase Sequence Voltage or Current	2% or 2.4 V, 120 Vac scale
	2% or 4.8 V, 240 Vac scale
	0.5% or 25 mA for current
Typical Temperature Drift for voltage inputs	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 current inputs	<0.4% of Vrange for any 40 °C change
	<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 is 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 8-4 through 8-8 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 in-lbs (0.9038782 - 1.129848 N·m).

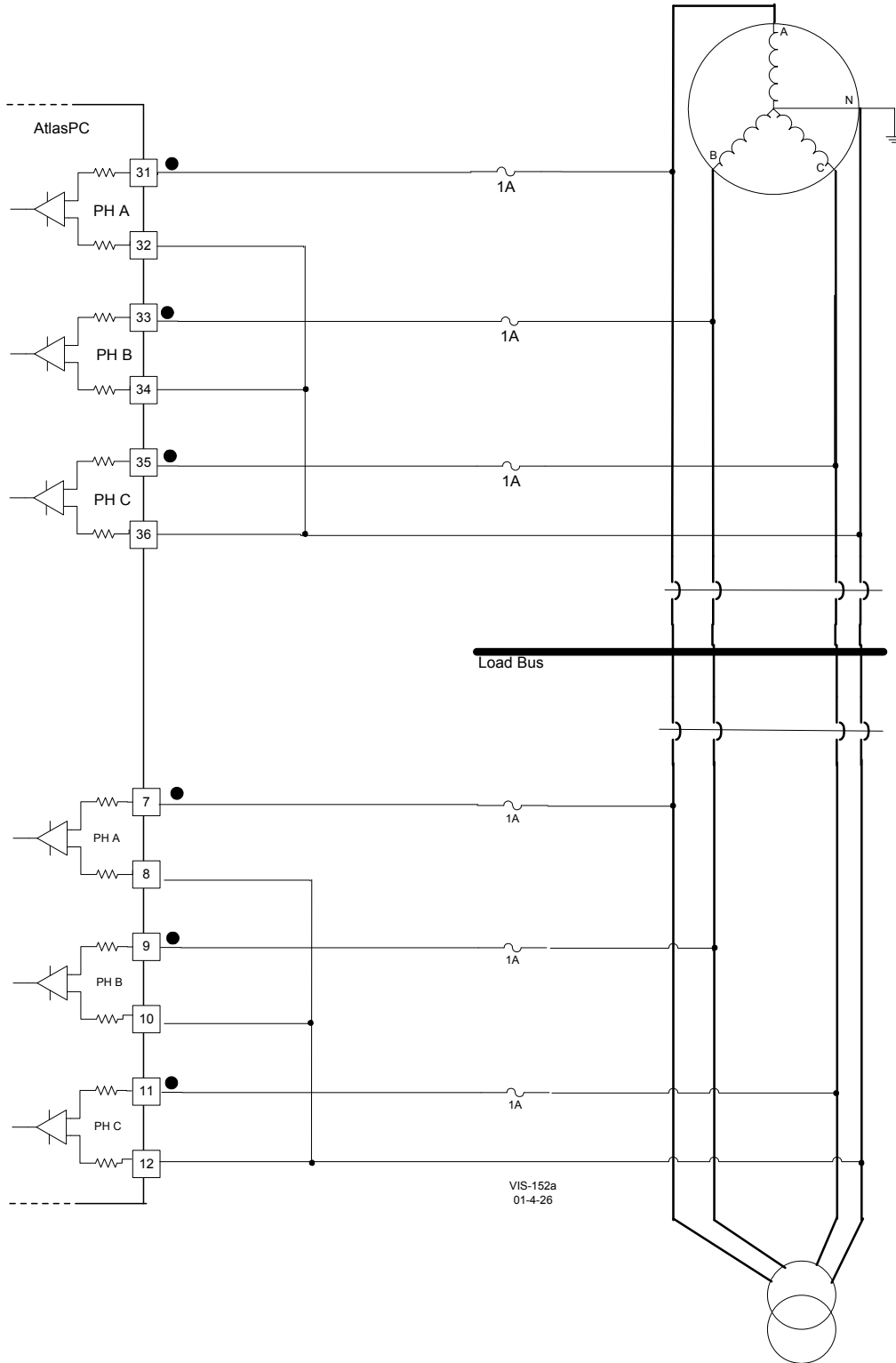


Figure 8-4. Wiring Example–Wye Connected System
(PT Interface wired L-N to the PowerSense Board)

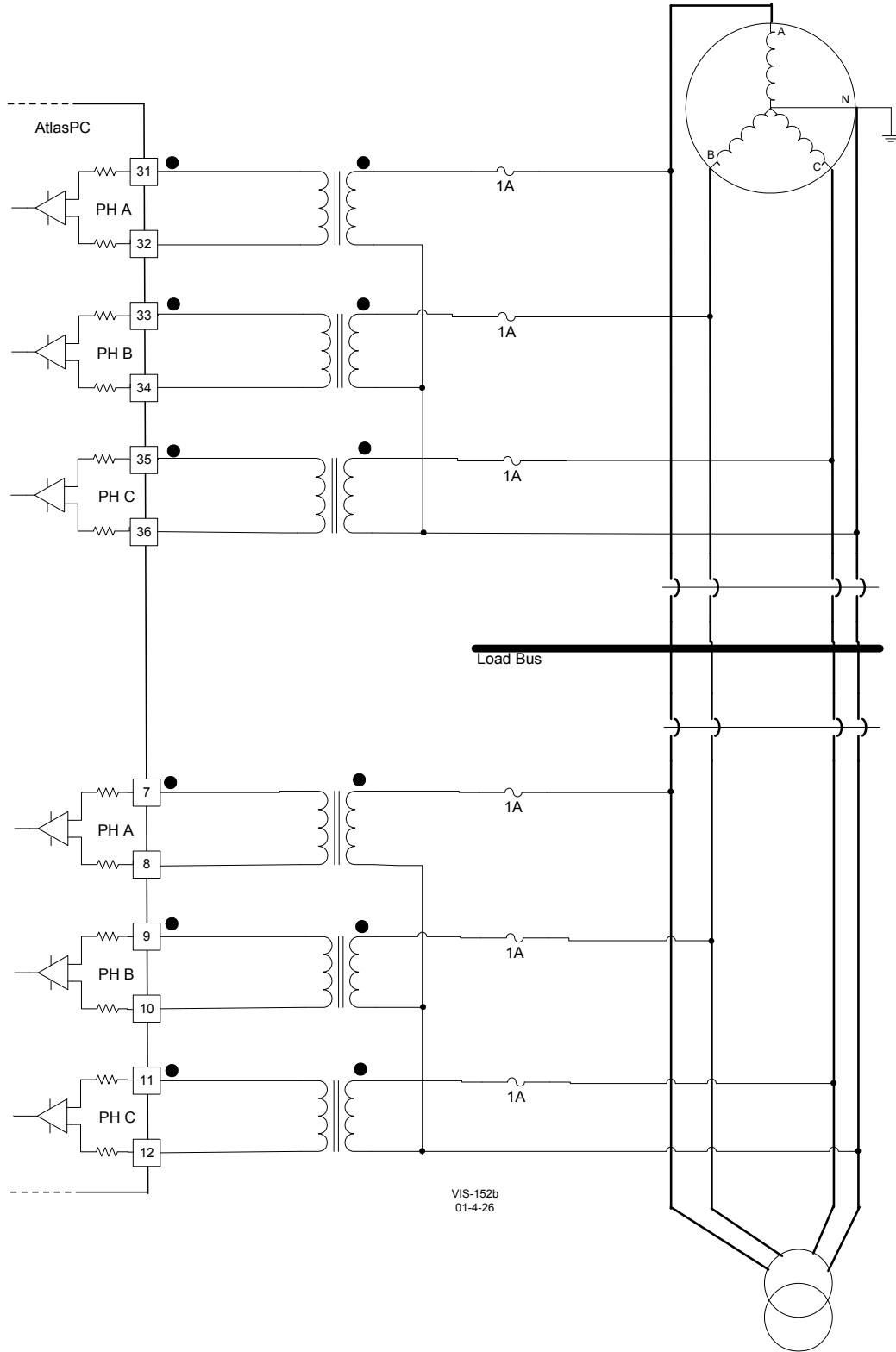


Figure 8-5. Wiring Example–Wye Connected System
(wired L-N to PowerSense with potential transformers used to step the voltage down to a level within the capability of the PowerSense inputs)

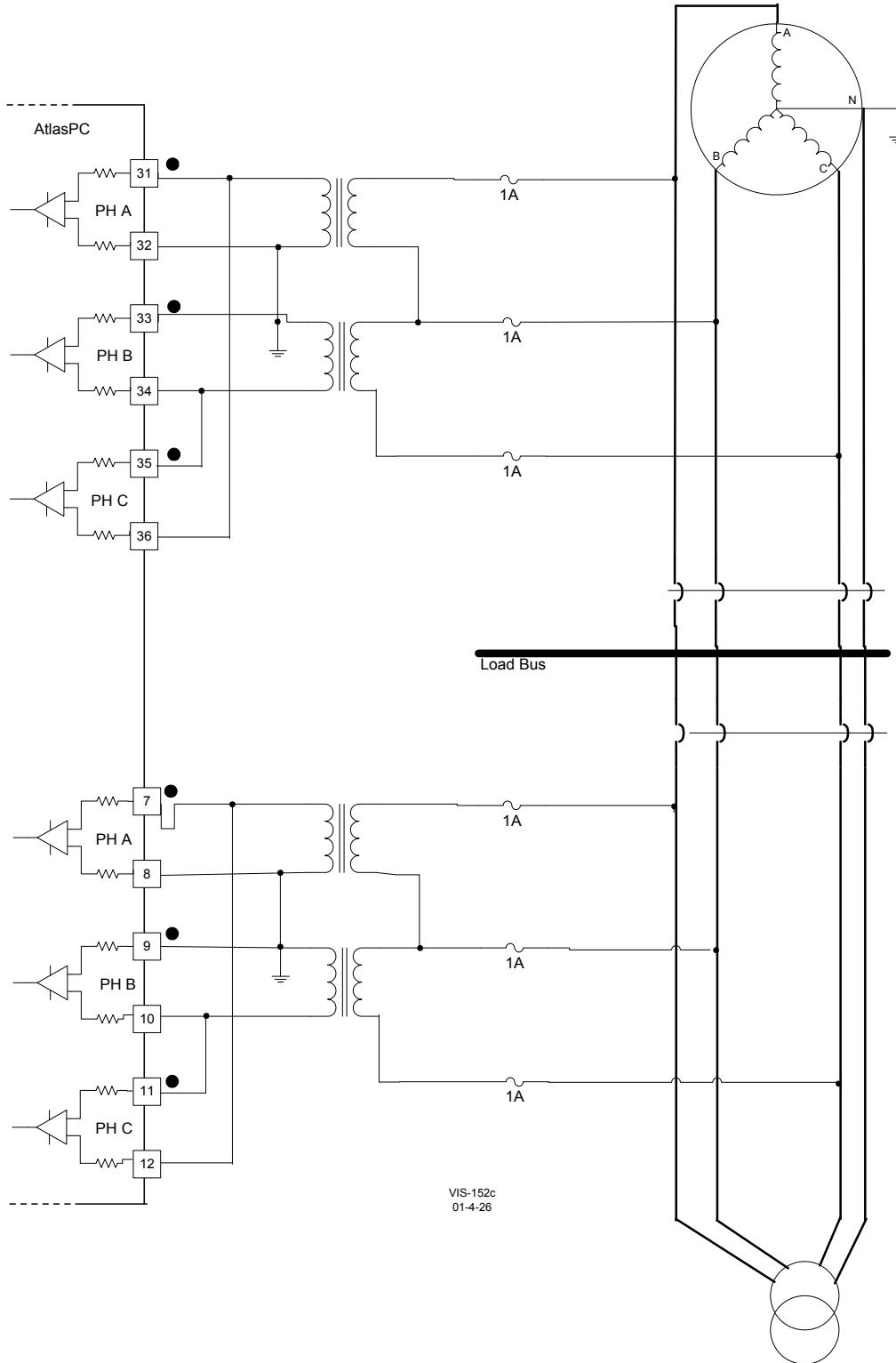


Figure 8-6. Example Wiring—Wye Connected System
 (wired L-L to PowerSense with potential transformers used to step the voltage down to a level within the capability of the PowerSense inputs; the ground on the b-phase input is optional.)

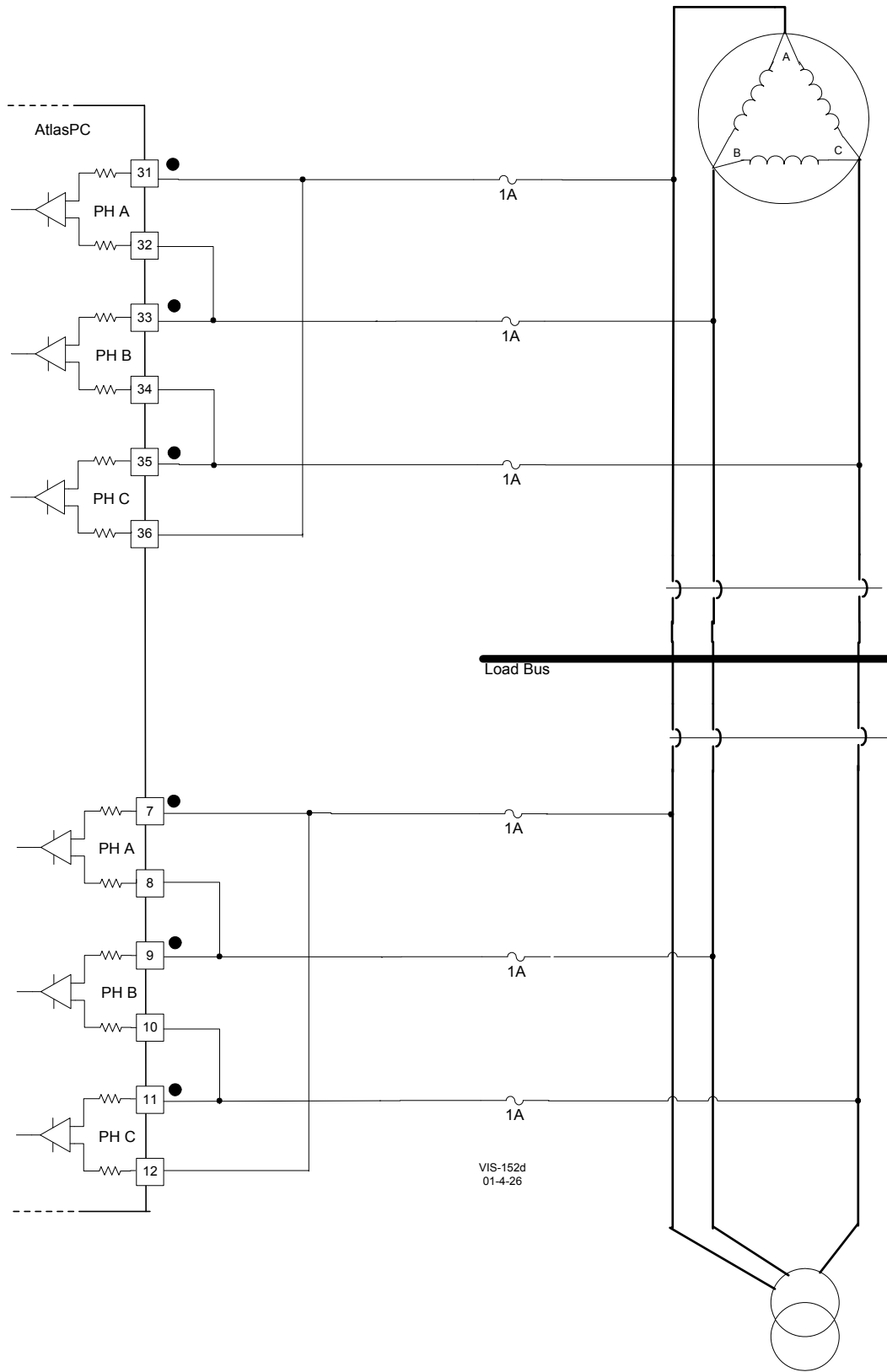


Figure 8-7. Wiring Example–Delta Connected System
(PT Interface wired L-L to the PowerSense Board)

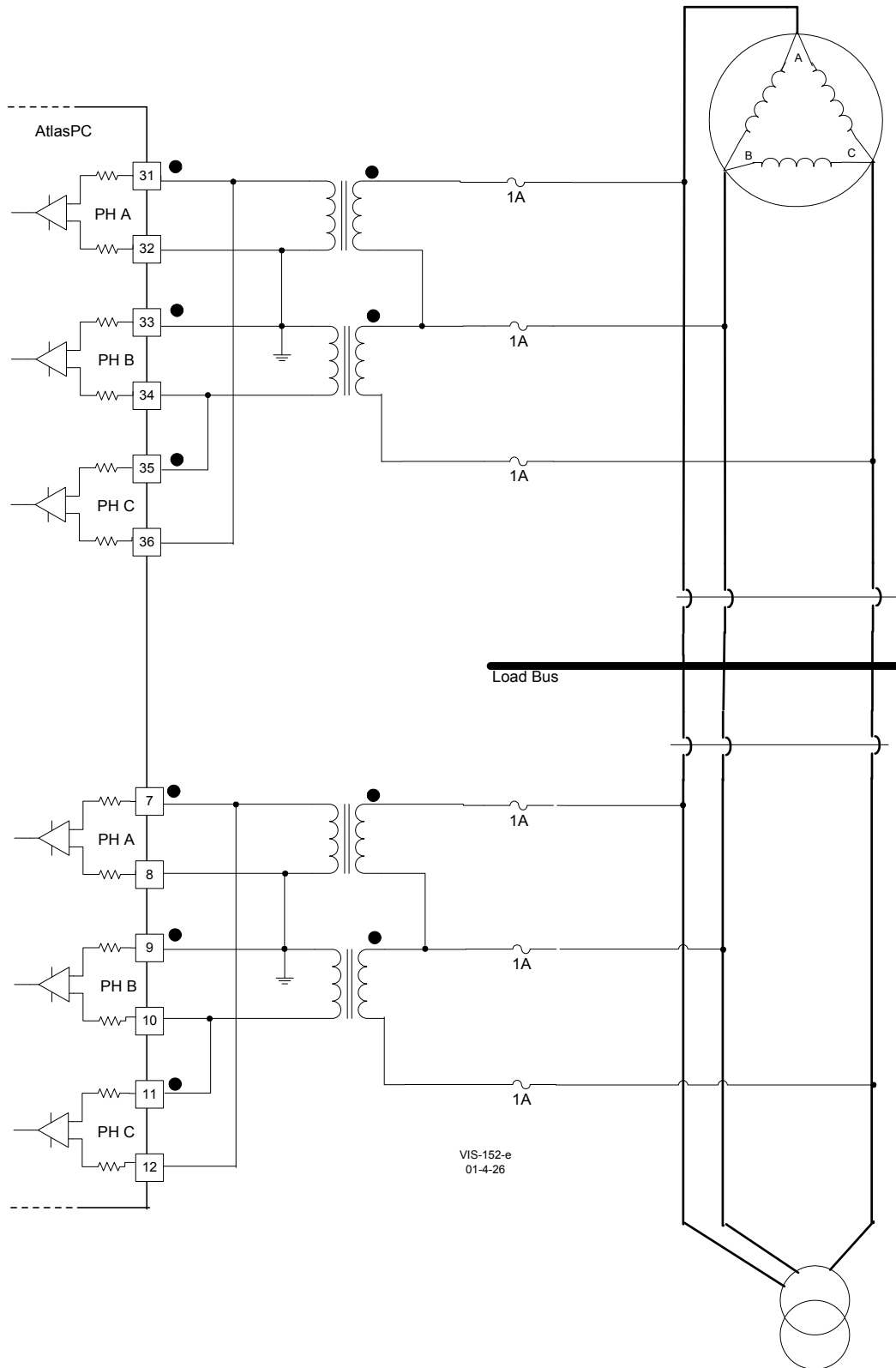


Figure 8-8. Wiring Example—Delta Connected System
 (wired L-L to PowerSense with potential transformers used to step the voltage down to a level within the capability of the PowerSense inputs; the ground on the B-phase input is optional.)

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).

Configuration Notes

- Refer to Figures 8-9 and 8-10 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).

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.

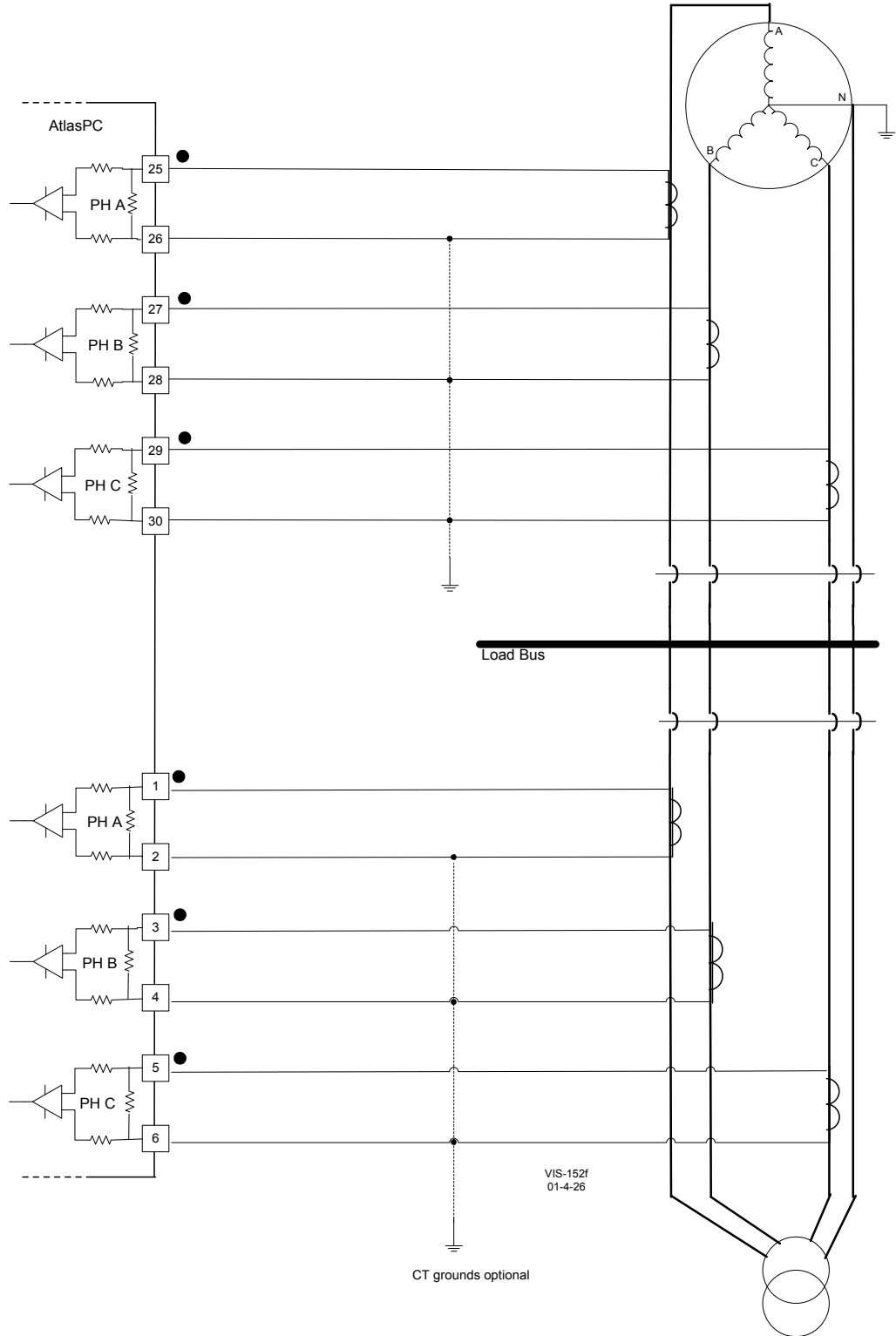


Figure 8-9. Wiring Example—CT Interface to the PowerSense Board

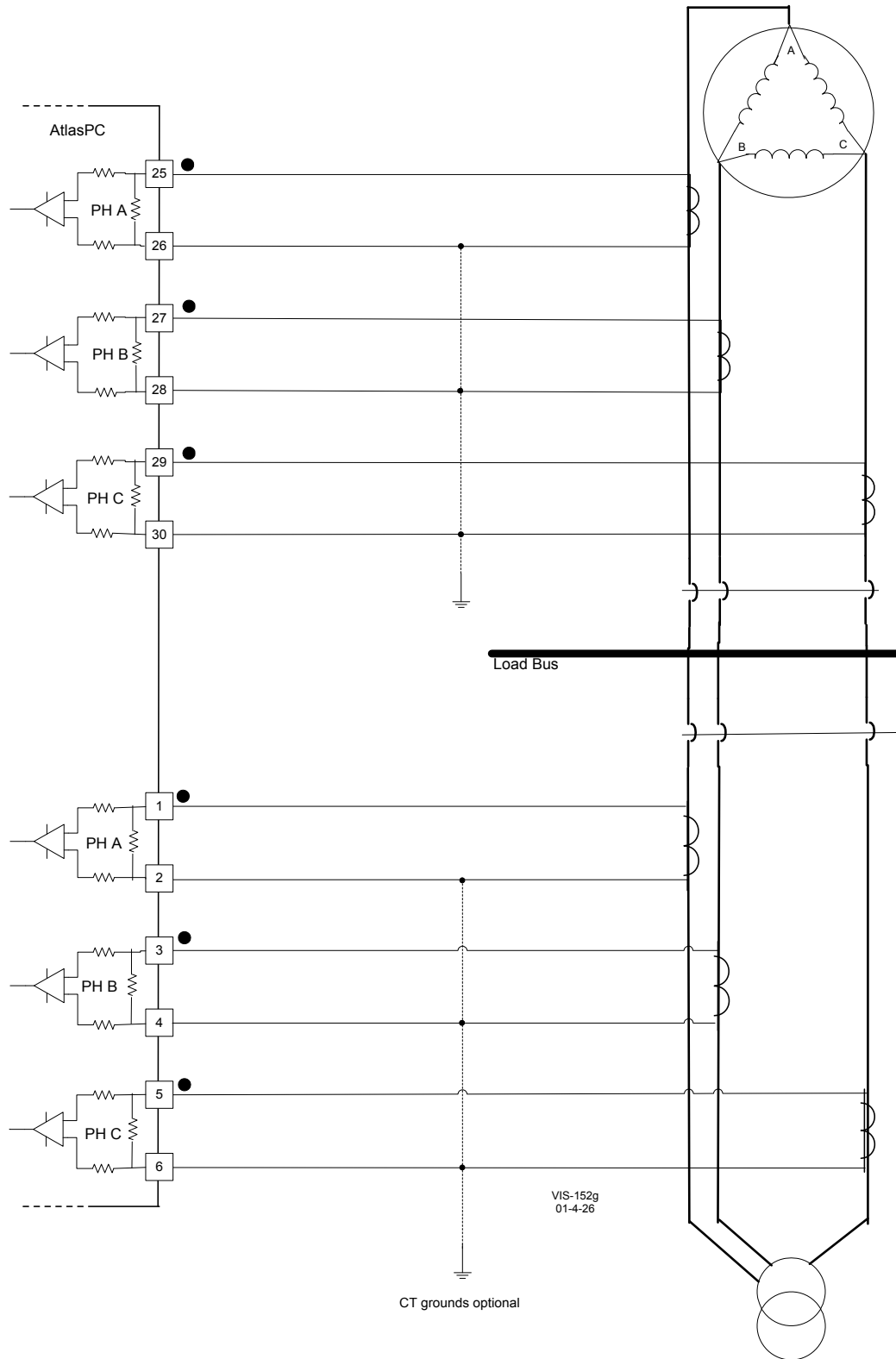


Figure 8-10. Wiring Example-CT Interface to the PowerSense Board

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 8-11 and 8-12 for Speed Bias Output wiring.
- 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.

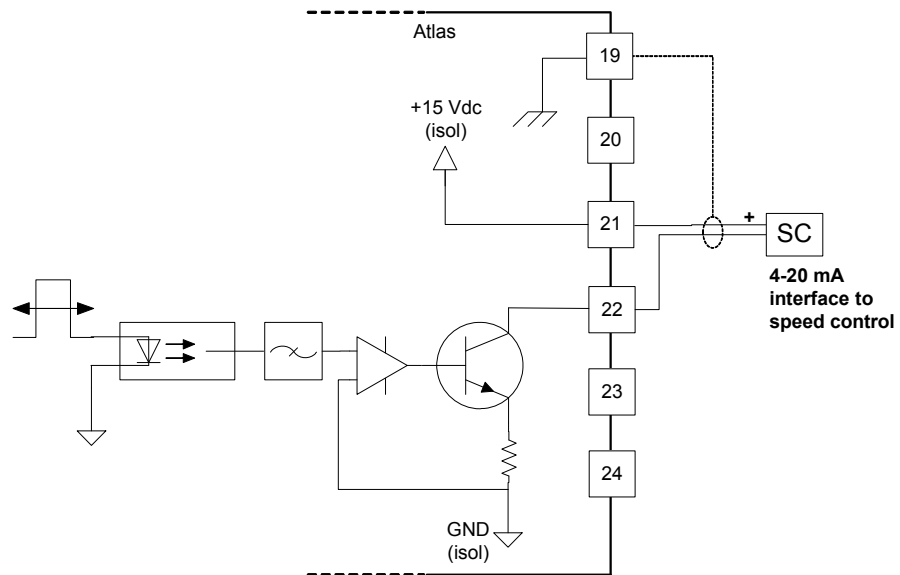


Figure 8-11. Wiring Example—Speed Bias Output Interface
(to the PowerSense Board configured for 4–20 mA)

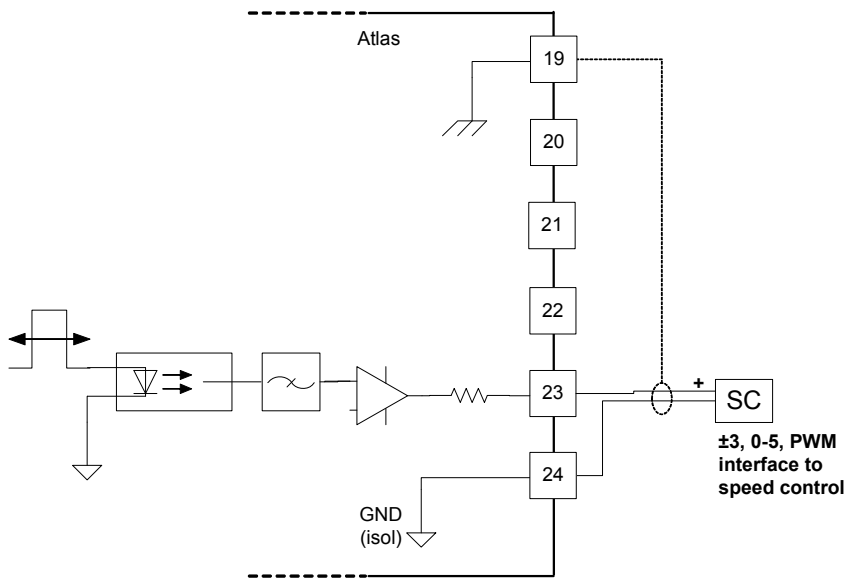


Figure 8-12. Wiring Example—Speed Bias Output Interface
(to the PowerSense Board configured for ± 3 V, 0–5 V, or PWM)

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 , ± 3 V, or ± 9 V 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 ± 9 V output has about 3 times better accuracy and resolution than the ± 3 V output, which has about 3 times better accuracy and resolution than the ± 1 V output.

Configuration Notes

- Refer to Figures 8-13 and 8-14 for Voltage Bias Output wiring.
- 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.

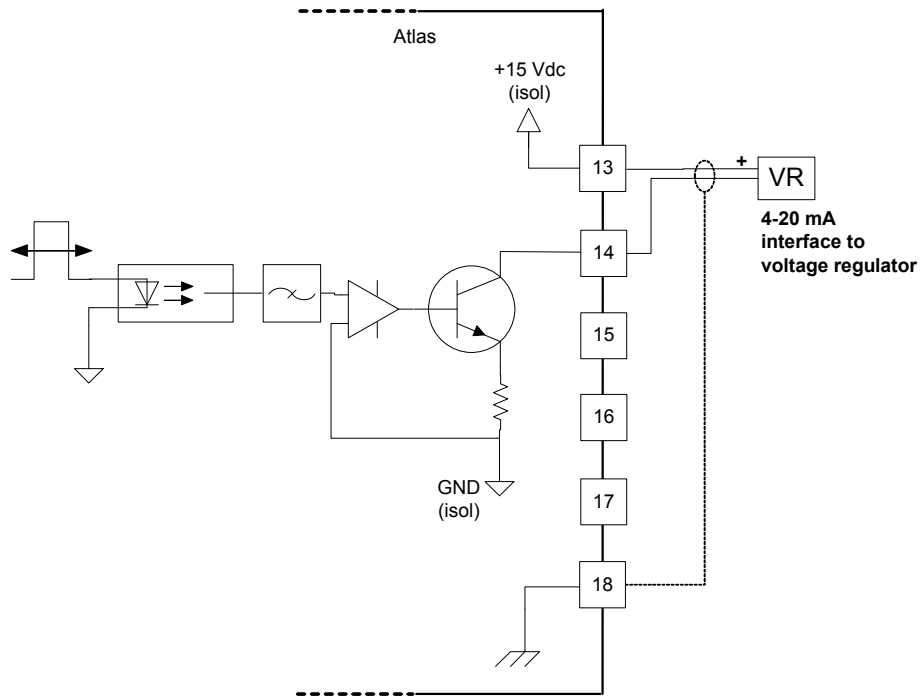


Figure 8-13. Wiring Example—Voltage Bias Output Interface (to the PowerSense Board configured for 4–20 mA)

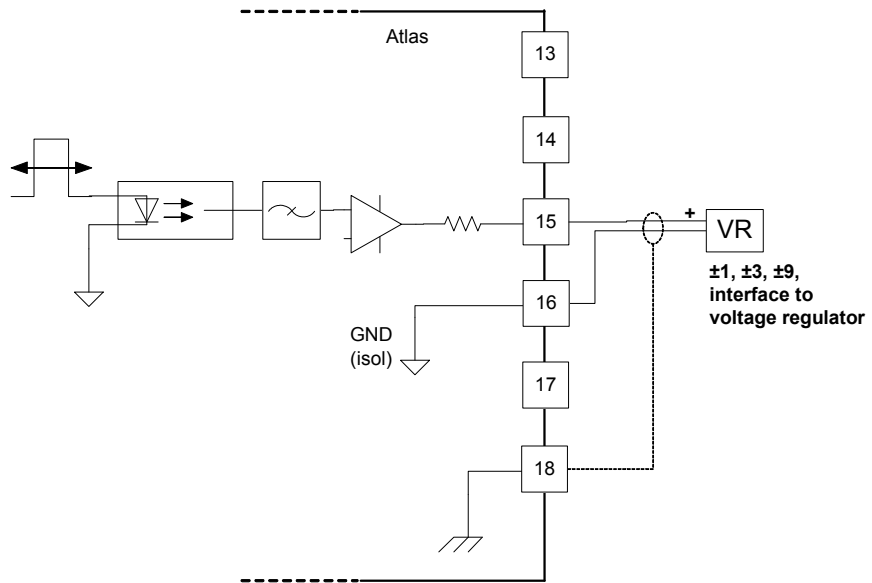


Figure 8-14. Wiring Example—Voltage Bias Output Interface (to the PowerSense Board configured for ± 1 V, ± 3 V, or ± 9 V)

LON Channel

The PowerSense board has one LON channel.

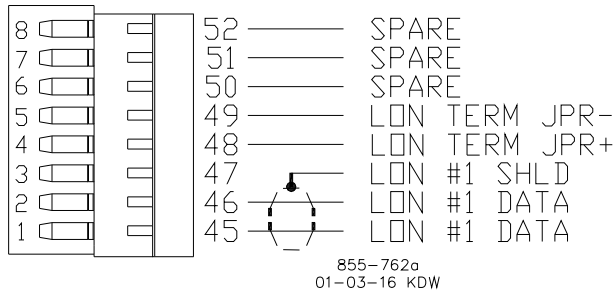


Figure 8-15. Wiring Example—LON Interface to the PowerSense Board

Configuration Notes

- Refer to Figure 8-15 for LON channel wiring.
- The LON network must be terminated with load terminating resistors.
- The LON channel is DSLC/MSLC and EGCP-3 compatible. It may only be used with specified Woodward equipment.

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 8-1 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.

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

Table 8-1. PowerSense Failure Codes

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 AtlasPC 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 AtlasPC should be returned for service.

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 AtlasPC should be returned for service.

LON Channel

If the LON channel is not functioning properly, verify the following:

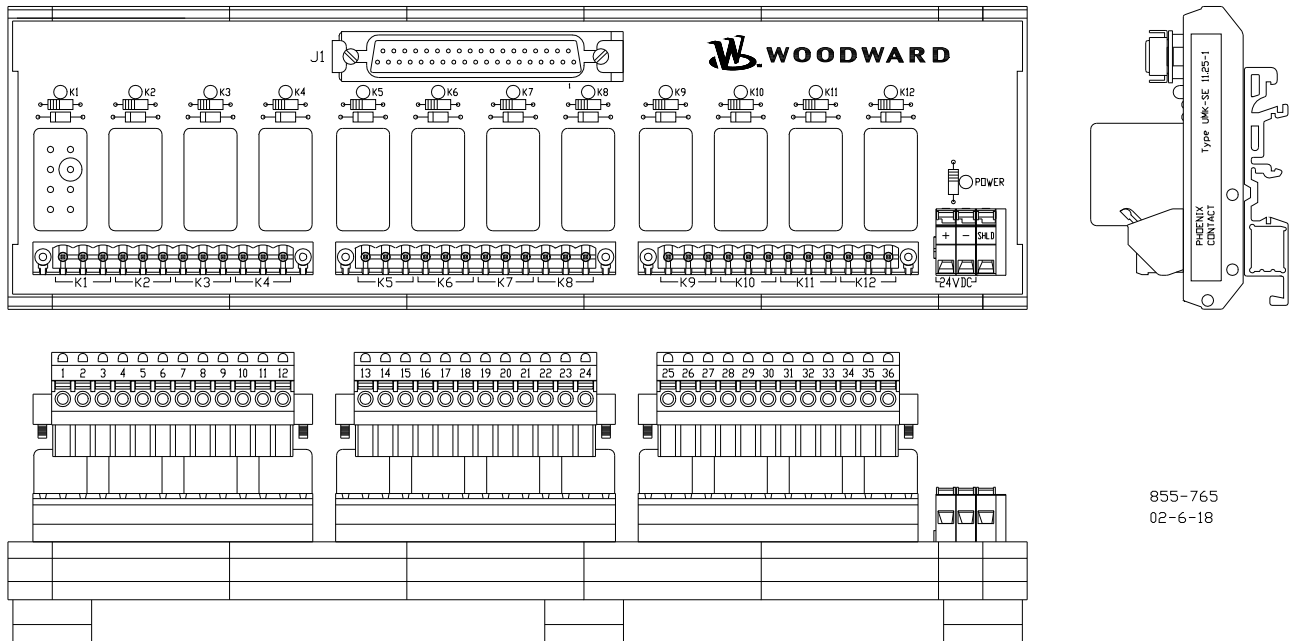
- Check the network wiring, it should be low capacitance cable.
- The cable length should not exceed the maximum allowed cable length.
- Check to make sure that termination networks are installed on the ends of the network.
- Check the software configuration.

After verifying all of the above, the AtlasPC should be returned for service.

Chapter 9.

12-Channel Relay Module

General Information



855-765
02-6-18

Figure 9-1. 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:



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
- 0.1 A at 125 Vdc resistive
- 3 A at 120 Vac resistive
- 2 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

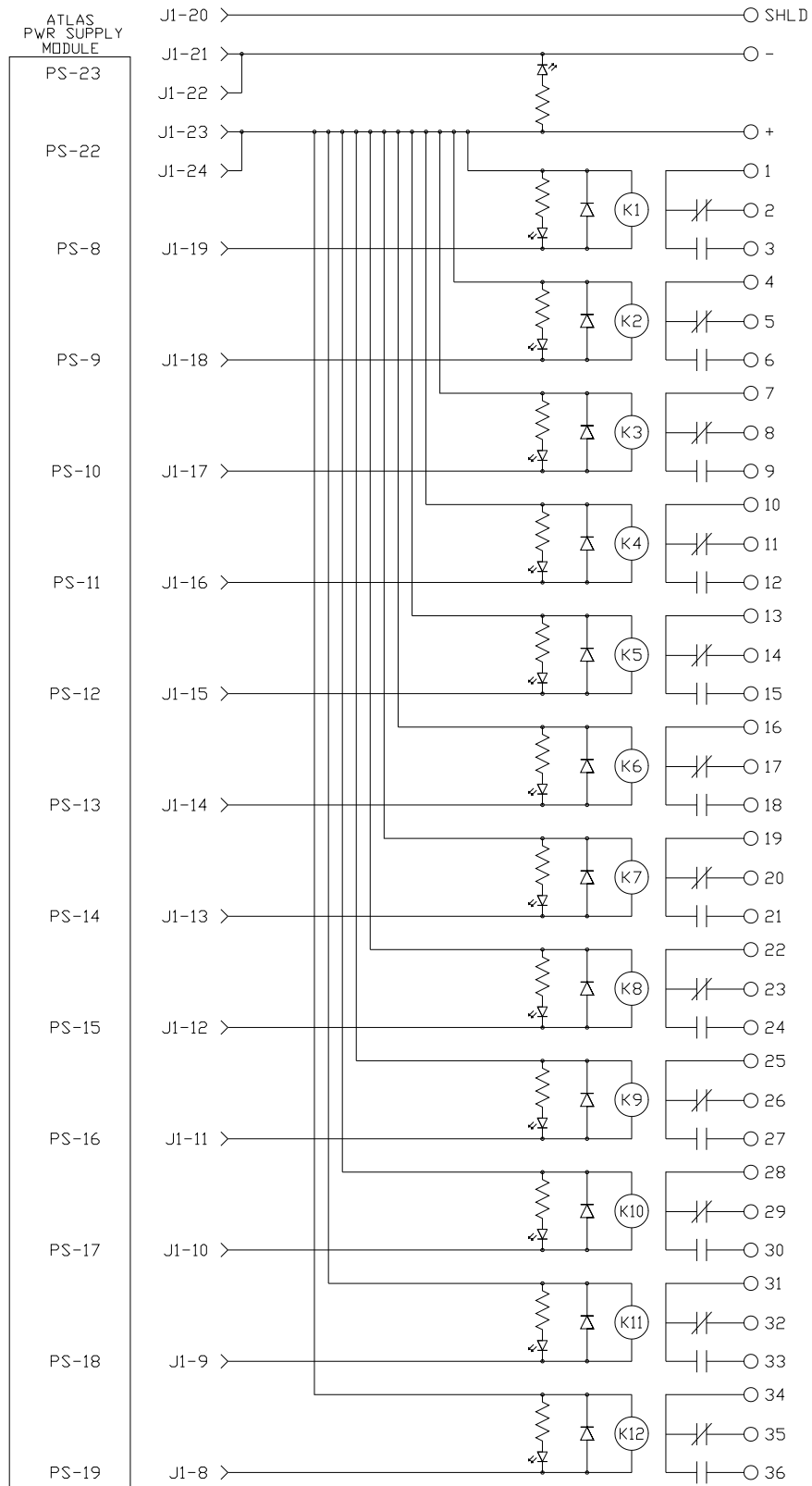
There is a terminal on the module labeled "SHLD". A wire should be connected between this terminal and a good local system ground. Alternatively, a ground wire can be crimped to the bare shield wire at the Atlas end of the cable and then tied to the chassis ground stud of the Atlas. If this shield wire 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.



855-767
02-11-21

Figure 9-2. 12-Channel Relay Module Wiring Diagram

Chapter 10.

DLE Serial Communications Board

General Information

The Atlas system can be provided with a DLE serial communications board. The DLE board has six ports—three RS-422 ports for communication with Honeywell pressure transducer modules, and three RS-485 ports for use with Woodward LM series and EQ series drivers. All ports are special purpose and are not designed for general communication functions.

Refer to manuals 85555 (Smart Pressure Transducer) and 26159 (EM/LQ Digital Driver) for more information about the transducer and driver modules used with the board.

For proper operation the end user will need a properly shielded cable, network terminations, and a program that has been written for their application.

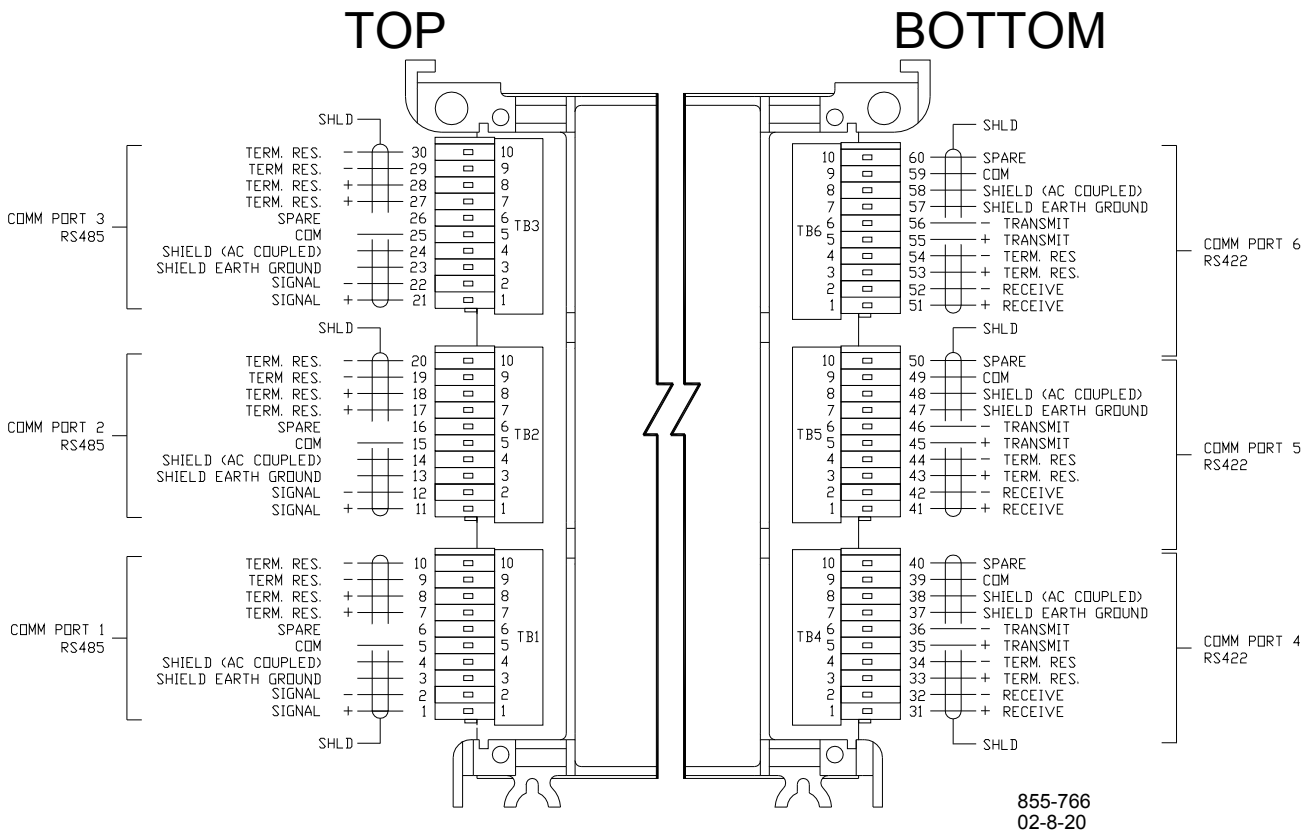


Figure 10-1. DLE Connections

Connectors

The connectors used with the DLE board come as part of a connector kit that ships with each Atlas control. If you are missing the connector kit, contact your sales representative.

RS-485 Cables

There are two options for cabling used with the RS-485 ports depending on the length of the cable run required:

- Standard shielded, twisted-pair for cables up to 30 m (100 ft)
- 0.3 mm² (22 AWG) low capacitance (36 pF/m or 11 pF/ft) cable for cables up to 120 m (400 ft)

The characteristic impedance of any cable selected should be near 120 Ω for best performance. Refer to your cable manufacturer for more information on characteristic impedance of cables.

The wiring must be one continuous cable between nodes, and must meet the requirements of EIA RS-485 for 500 kbps except that Woodward recommends that the maximum cable lengths be cut in half because typical prime mover installations have high levels of electrical interference.

RS-422 Cables

Use 20 AWG low capacitance cable such as Belden 89207A up to 150 m (500 ft). The characteristic impedance of any cable selected should be near 120 Ω .

IMPORTANT

Many customers are used to thinking of RS-422 and RS-485 as two-wire networks with shield, but the transceivers used on this board require a third “signal common” wire to ensure best performance in noisy environments. Please be sure to allow for this when ordering cable.

Termination

To achieve best performance with serial communication networks, it is necessary to terminate the network to prevent interference caused by signal reflections. For this reason, all ports on the DLE board are equipped with built-in network termination resistors.

Customers using the pressure transducer ports (RS-422) and the driver ports (RS-485) will be communicating with a single device, so the termination resistors will always need to be installed on each operating port.

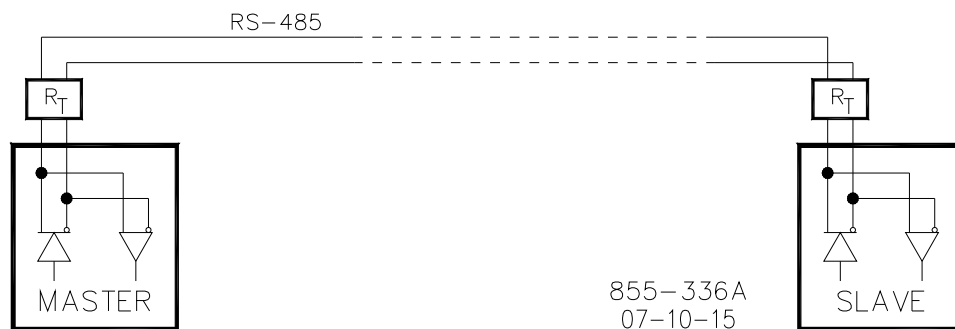


Figure 10-2. Terminator Locations

The termination resistors are connected by inserting jumper wires on the external plug in connectors. Jumper the following pins to connect the termination resistors as needed on the ports that you are using.

Comm Port #	Connect Pins
1	7 to 8 and 9 to 10
2	17 to 18 and 19 to 20
3	27 to 28 and 29 to 30
4	52 to 54 and 51 to 53
5	42 to 44 and 41 to 43
6	32 to 34 and 31 to 33

Shielding

Shielded cable is required between the AtlasPC and any other devices. Unshielded cables and improperly shielded cables will very likely lead to communication problems and unreliable control operation.

The shield must always be ac-coupled (connected through a capacitor) at one end and connected directly to earth on the opposite end for proper operation. The DLE board has been constructed so that the Shield/Drain connection can be either ac-coupled or directly connected to the Atlas chassis ground which must be tied to earth. Devices connected to the opposite end of the cable must provide for the opposite shield connection. For instance, if the ac-coupled connection is used on the DLE, the other end of the shield must be connected directly to earth.

Board Status Lights

The board is equipped with two LEDs labeled H and D to provide feedback from the board. The LED labeled H indicates operation of the Honeywell portion of the board, and LED labeled D indicates operation of the driver side of the board. During normal operation, the LEDs will light as soon as power is applied and will eventually turn off as the application starts running. This can take up to four minutes, depending upon the size of the application. If the board fails its own self test or failures are detected during normal operation, the LEDs will flash in particular coded patterns which will repeat periodically.

LED and Number of Flashes	Failure
H 1	RAM test fail (this test is done only at boot and application start)
H 2	exception error
H 3	dual port test fail (this test is done only at boot and application start)
H 4	watchdog timeout
H 7	kernel watchdog timeout
D 1	RAM test fail (this test is done only at boot and application start)
D 2	exception error
D 3	dual port test fail (this test is done only at boot and application start)
D 3	module watchdog timeout
D 7	kernel watchdog timeout

Table 10-1. DLE Failure Codes

IMPORTANT

Some users may not use both the RS-422 and RS-485 ports in their application. In this case, one LED will stay on all the time. This only signifies that one side of the board is not being used. It is not a failure unless a flash code appears.

Application Developer Information

IMPORTANT

Many end users will be purchasing pre-programmed Atlas units and will not need the information in this section. The information below is aimed at programmers using the GAP programming tool provided by Woodward.

Application developers must use version 3.04 or later of the GAP programming tool when using a DLE board.

DLE Address Configuration

The DLE serial communications board is always configured to use address 10 in Atlas systems. This is done because this board is a 16-bit board (versus 8-bit for everything else) and it consumes two address spaces in the stack. To simplify things, the board is factory-configured to be at address 10 to avoid address conflicts with other boards, and there are warnings enabled in the coder in the event that someone accidentally sets it incorrectly.

Driver Limitations

Each driver port (RS-485) can support only a single driver. The LM and EQ series drivers have been built so that they can complete a communications transaction in 5 milliseconds.

Chapter 11.

Service Options

Product Service 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 and 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 **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

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

Woodward Factory Servicing 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 (Woodward Product and Service Warranty 5-01-1205).

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 (Woodward Product and Service Warranty 5-01-1205) 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 (Woodward Product and Service Warranty 5-01-1205). 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 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 and reference www.woodward.com/support, and then **Customer Support**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems		Engine Systems		Turbine Systems	
Facility	Phone Number	Facility	Phone Number	Facility	Phone Number
Australia	+61 (2) 9758 2322	Australia	+61 (2) 9758 2322	Australia	+61 (2) 9758 2322
Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727	China	+86 (512) 6762 6727	China	+86 (512) 6762 6727
Germany:		Germany:			
Kempen	+49 (0) 21 52 14 51	Stuttgart	+49 (711) 78954-0		
Stuttgart	+49 (711) 78954-0	India	+91 (129) 4097100	India	+91 (129) 4097100
India	+91 (129) 4097100	Japan	+81 (43) 213-2191	Japan	+81 (43) 213-2191
Japan	+81 (43) 213-2191	Korea	+82 (51) 636-7080	Korea	+82 (51) 636-7080
Korea	+82 (51) 636-7080	The Netherlands	+31 (23) 5661111	The Netherlands	+31 (23) 5661111
Poland	+48 12 618 92 00	United States	+1 (970) 482-5811	United States	+1 (970) 482-5811
United States	+1 (970) 482-5811				

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (www.woodward.com/support) for the name of your nearest Woodward distributor or service facility.

For the most current product support and contact information, please refer to the latest version of publication **51337** at www.woodward.com/publications.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

General

Your Name _____
 Site Location _____
 Phone Number _____
 Fax Number _____

Prime Mover Information

Engine/Turbine Model Number _____
 Manufacturer _____
 Number of Cylinders (if applicable) _____
 Type of Fuel (gas, gaseous, steam, etc) _____
 Rating _____
 Application _____

Control/Governor Information

Please list all Woodward governors, actuators, and electronic controls in your system:

Woodward Part Number and Revision Letter

Control Description or Governor Type

Serial Number

Woodward Part Number and Revision Letter

Control Description or Governor Type

Serial Number

Woodward Part Number and Revision Letter

Control Description or Governor Type

Serial Number

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
LON	Local Operating Network
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

- AtlasPC™ Analog Combo board**—An AtlasPC board with an analog format that connects to the AtlasPC SmartCore board or PowerNet board, through the PC/104 interface. It contains 15 analog inputs, 2 speed sensor inputs, and 2 Analog outputs.
- AtlasPC Pentium CPU board**—An AtlasPC board with a Pentium processor, for applications that require more horsepower than the SmartCore board, or that require an Ethernet connection.
- AtlasPC Power Supply board**—An AtlasPC board with primary power supply and 12 discrete outputs.
- AtlasPC SmartCore board**—An AtlasPC board with 4 analog inputs, 4 analog outputs, 2 speed sensor inputs, 16 discrete inputs, and 3 serial communication ports. This board includes both the PC/104 and the power bus connections, allowing it to function as a backplane.
- AtlasPC Power Supply board**—An AtlasPC board with primary power supply and 12 discrete outputs.
- AtlasPC Chassis**—A combination of pieces required to hold the boards together, and may optionally include a keyboard and display.
- AtlasPC 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.
- Analog Input**—A 4–20 mA or 0–5 V input on the SmartCore 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.
- Backplane**—A board that ties other boards together electrically. AtlasPC needs either the SmartCore 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 registers 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 board, and a MPU only input on the Analog Combo board.

Appendix B. Wiring Diagrams

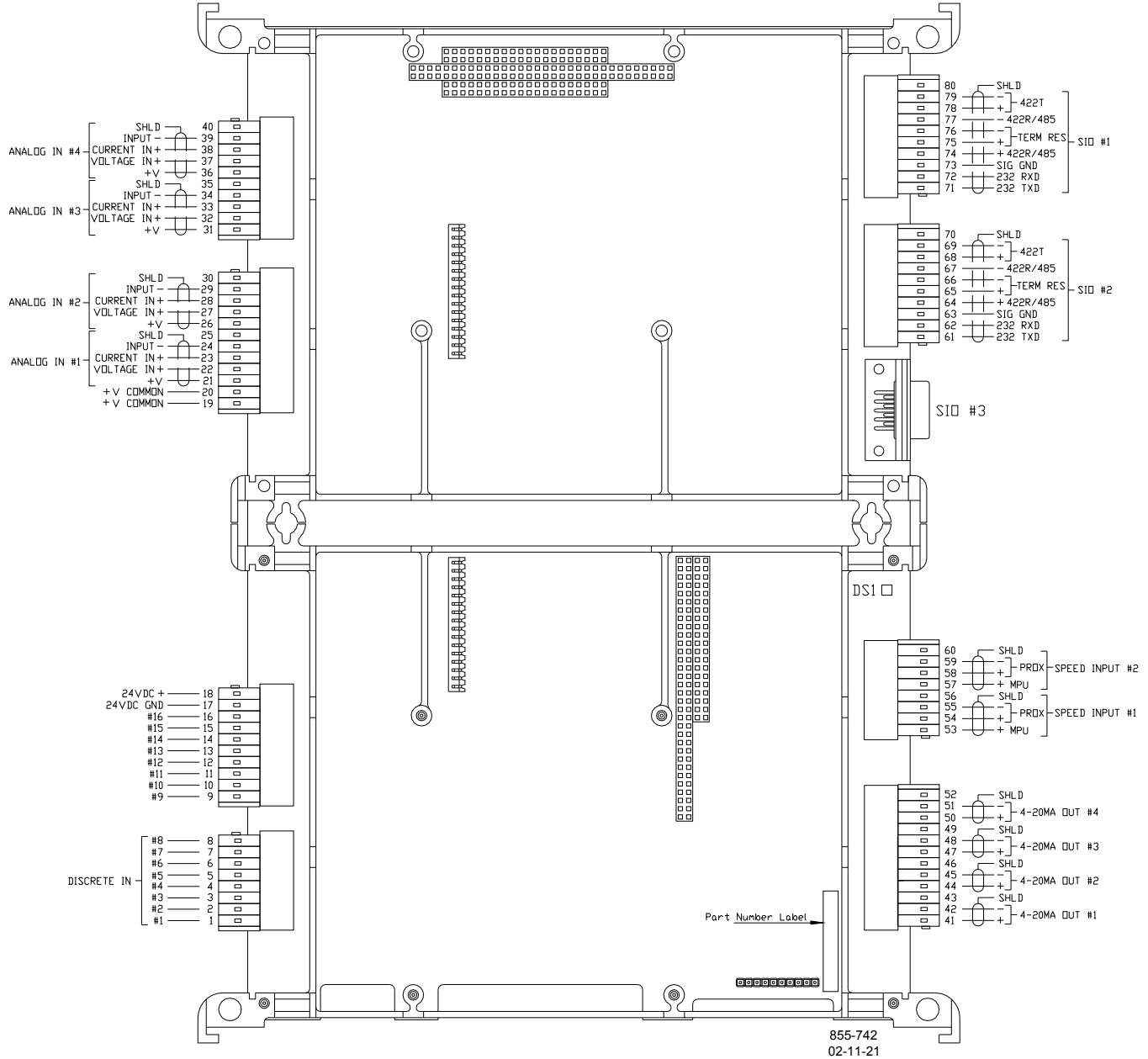


Figure B-1. SmartCore Board without Actuators Connections

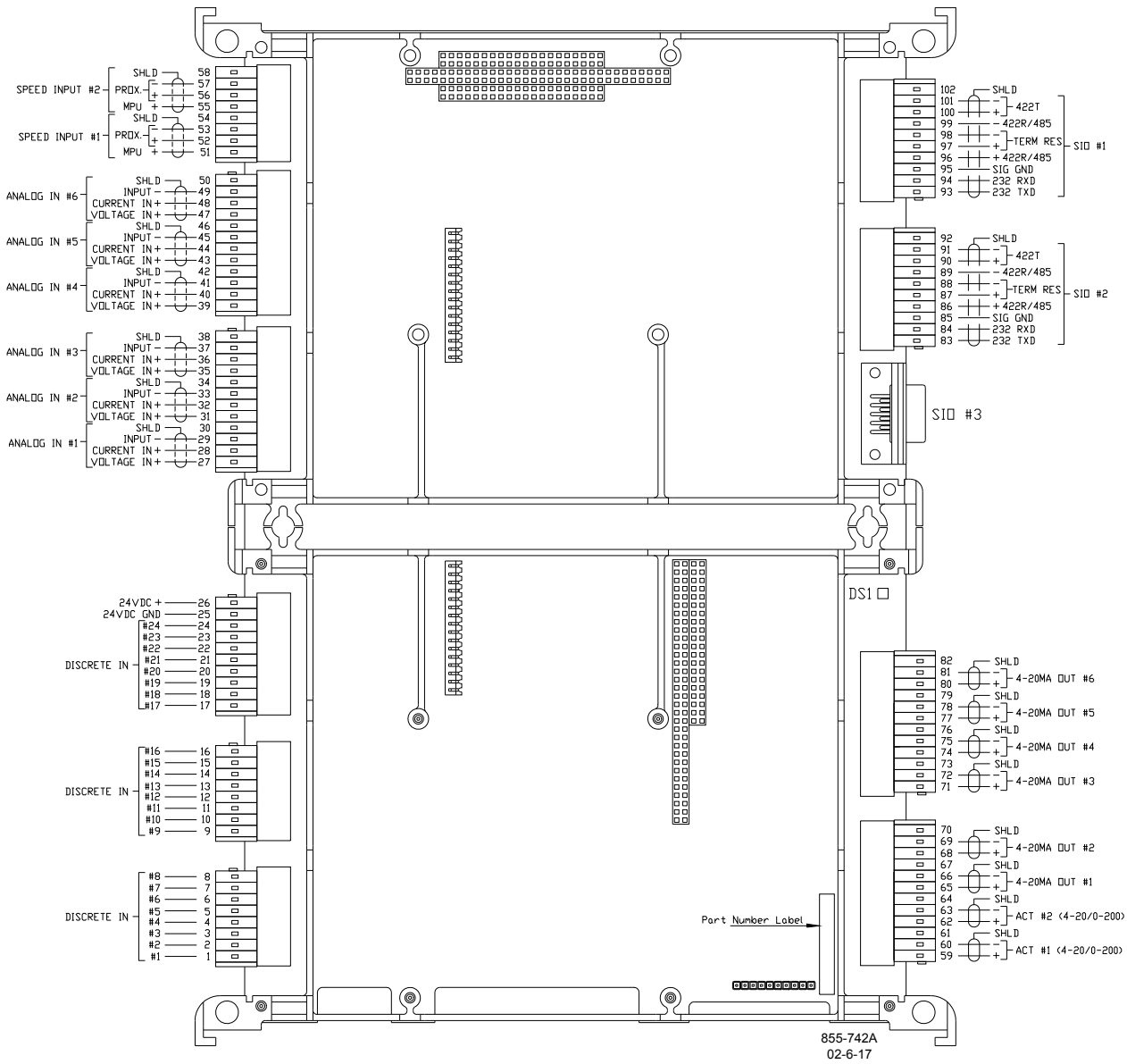


Figure B-2. SmartCore Board with Actuators Connections

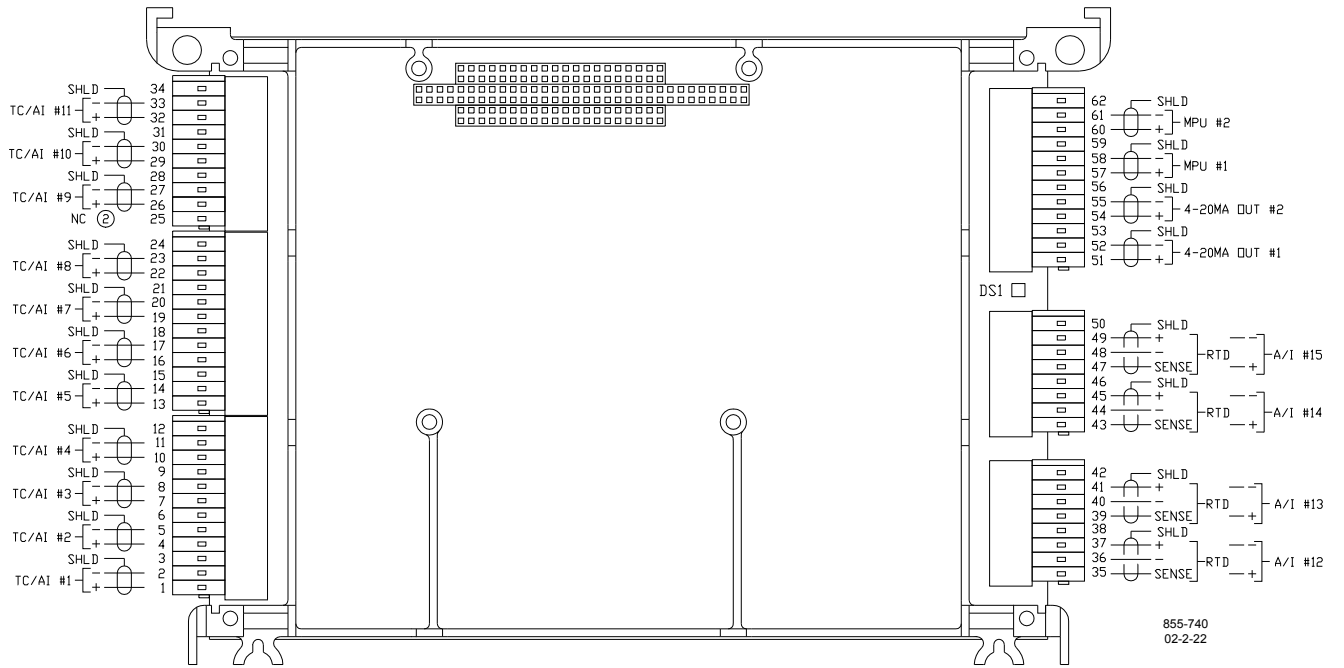


Figure B-3. Analog Combo Board Connections

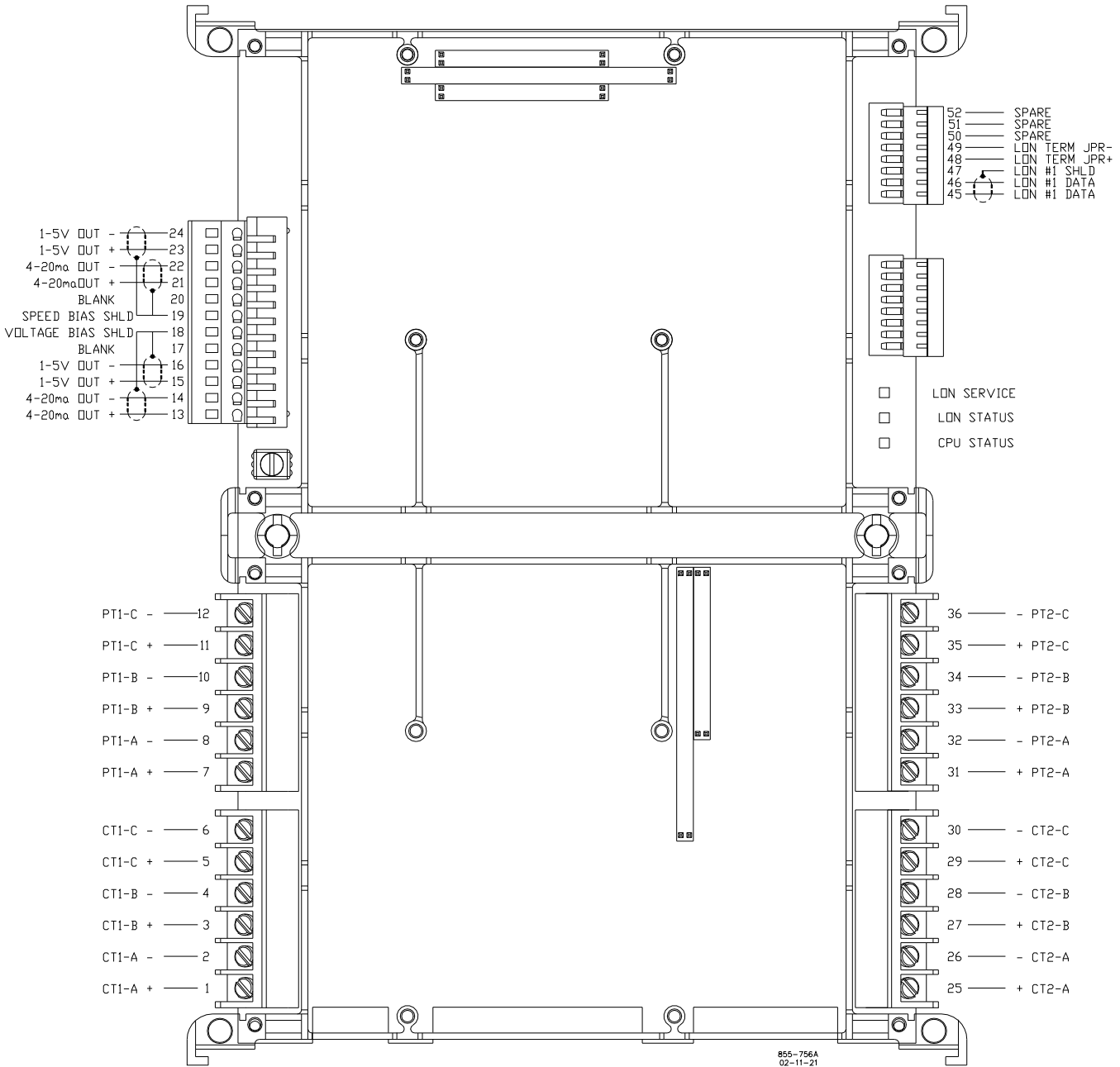
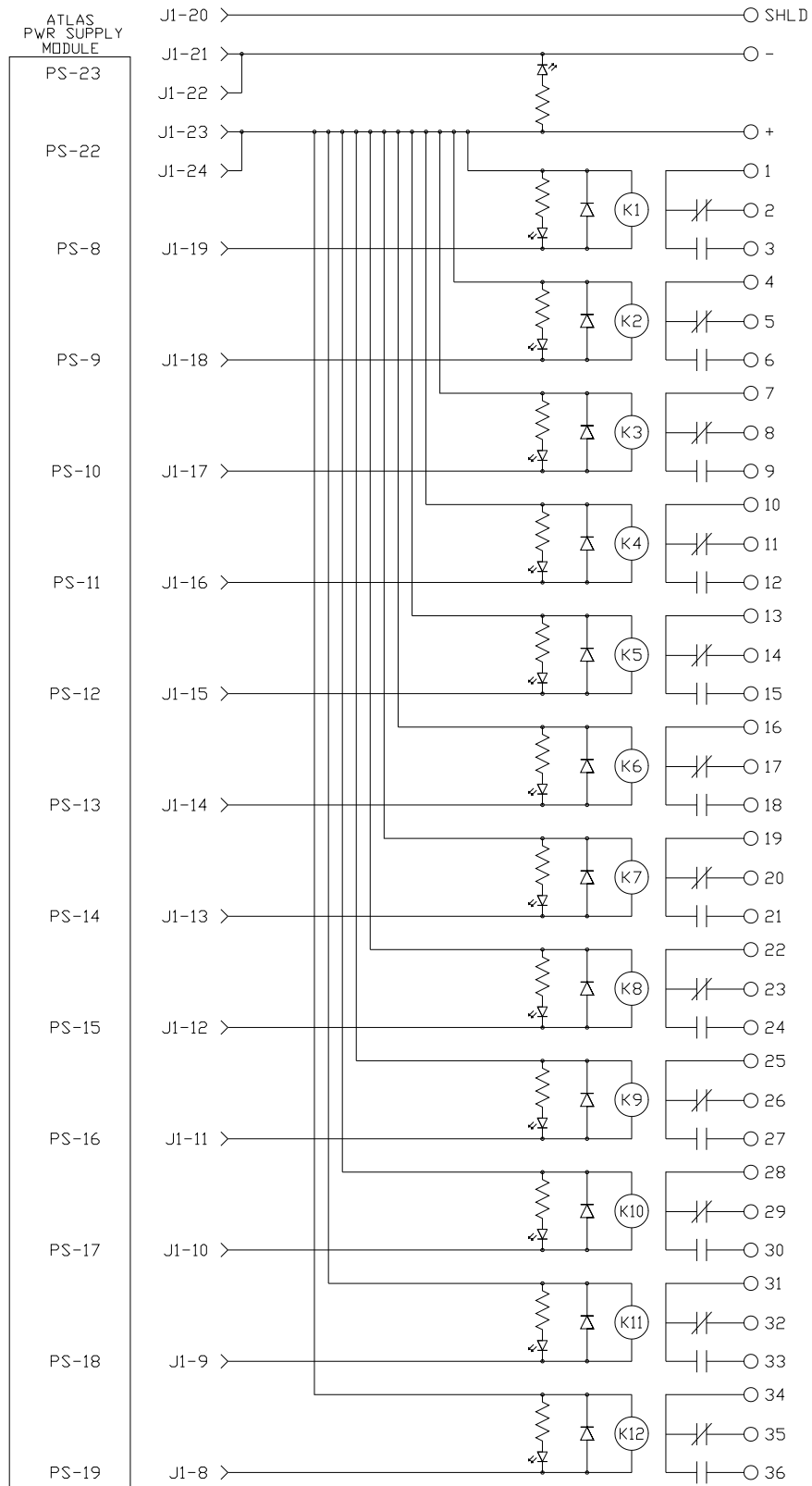


Figure B-4. PowerSense Board Connections



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Figure B-5. 12-Channel Relay Module Connections

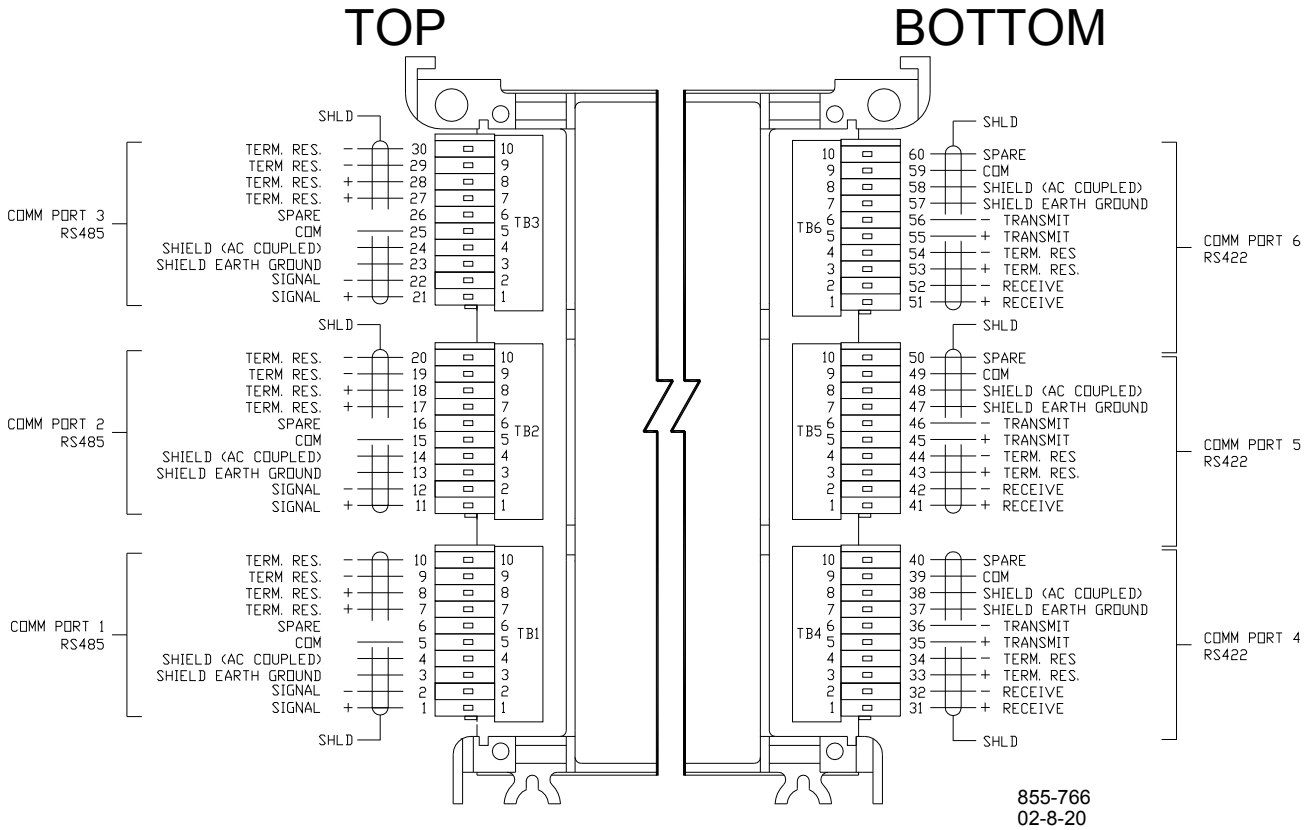


Figure B-6. DLE Connections

Appendix C. Flash Codes

Number of LED Flashes	Failure
1	Microprocessor failure
2	Bus, address, any unexpected exception error
3	Failure during RAM test
4	Local watchdog timeout
5	Failure during EE test
6	Failure during FLASH programming or erasing
7	Kernel software watchdog count error
10	Failure during 68302 test
11	Failure during RTC test
12	TPU RAM Failure
20...	Operating system specific errors use 20 & above

Table C-1. SmartCore without Actuators Failure Codes

Number of LED Flashes	Failure
1	Microprocessor failure
2	Bus, address, any unexpected exception error
3	Failure during RAM test
4	Local watchdog timeout
5	Failure during EE test
6	Failure during FLASH programming or erasing
7	Kernel software watchdog count error
10	Failure during 68302 test
11	Failure during RTC test
12	TPU RAM Failure
20...	Operating system specific errors use 20 & above

Table C-2. SmartCore with Actuators 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 Analog Combo 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

Table C-4. PowerSense Failure Codes

LED and Number of Flashes	Failure
H 1	RAM test fail (this test is done only at boot and application start)
H 2	exception error
H 3	dual port test fail (this test is done only at boot and application start)
H 4	watchdog timeout
H 7	kernel watchdog timeout
D 1	RAM test fail (this test is done only at boot and application start)
D 2	exception error
D 3	dual port test fail (this test is done only at boot and application start)
D 3	module watchdog timeout
D 7	kernel watchdog timeout

Table C-5. DLE Failure Codes

Appendix D. Board Addresses

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

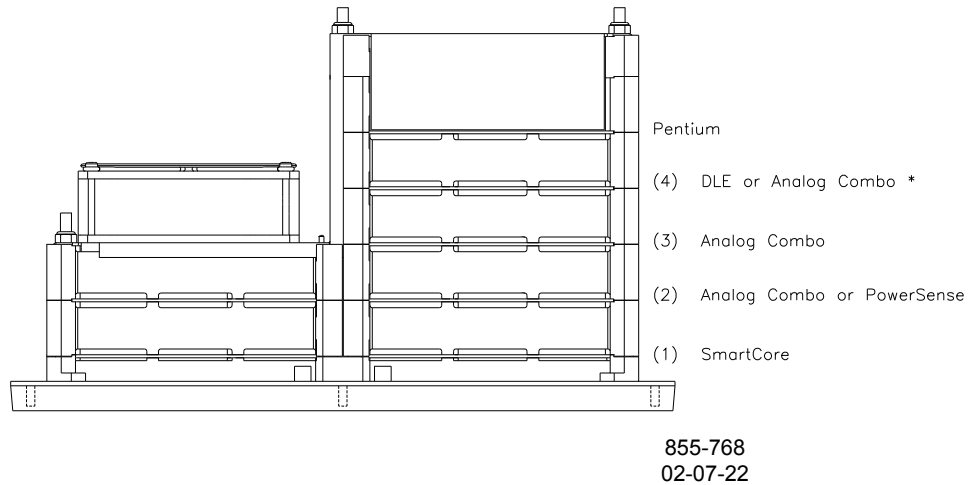


Figure D-1. Board Address Numbers

IMPORTANT

* When a DLE board is used, its address will always be 10. Boards above or below it are not affected since it is always located directly below the Pentium.

The Pentium has no board address number. The optional Fieldbus communication boards above the Pentium also have no board number.

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: WOODWARD GOVERNOR COMPANY (WGC)
Industrial Controls Group

Manufacturer's Address: 1000 E. Drake Rd.
Fort Collins, CO, USA, 80525

Model Name(s)/Number(s): Atlas PC Platform

Conformance to Directive(s): 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility as amended by 92/31/EEC and 93/68/EEC.
94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
73/23/EEC COUNCIL DIRECTIVE of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

Applicable Standards: EN61000-6-4, 2001: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments
EN61000-6-2, 2001: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments
EN50178, 1997: Electronic Equipment for Use in Power Installations
EN50021, 1999: Electrical apparatus for potentially explosive atmospheres - Type of protection 'n'

3rd Party Certification: DEMKO 02 ATEX 0220460U to EN50021

Notified Body for ATEX:

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature

Douglas W. Salter

Full Name

Engineering Manager

Position

WIC, Fort Collins, CO, USA

Place

Date

3/4/03

This Declaration of Conformity is in accordance with the
European Standard EN45014.
“General criteria for supplier’s
declaration of conformity”

The basis for the criteria has been found in international
documentation, particularly in
ISO/IEC Guide 22, 1982,
“Informations on manufacturer’s declaration of conformity
with standards or other technical specifications”.

Document No. 020815/1-03

Declaration of Conformity

We _____ **Phoenix Contact Inc.** _____
(Supplier’s Name)

**586 Fulling Mill Road
Middletown, PA 17057-2966**

(Address)

declare under our sole responsibility that the product

RELAY Module

(Name, type or model, batch or serial number, possibly sources and number of item)

WOODWARD 12CH RELAY P/N 5603266

to which this declaration relates is in conformity with the following standard(s)



or other normative document(s).

IEC 60664-1: 2002

EN 60999:1993

BS EN 50178:1998

Additional documentation (i.e. test reports) which were used as the basis for this Declaration of Conformity: WOODWARD Test Report #00104-04-EMC-EMC-03-10

EN50021: 1999

This product has been evaluated to EN50021:1999 under DEMKO Certificate No. 03 ATEX 0328750U. The device is marked EEx nC IIC and is suitable for use in Zone 2 explosive atmospheres.

Title and/or number and date of issue of the standard(s) or other normative document(s)

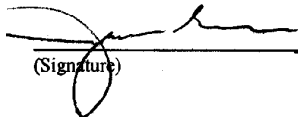
Following the provisions of Directive(s) (if applicable)

Low Voltage Directive (73/23/EEC)

EMC Directive (89/336/EEC)

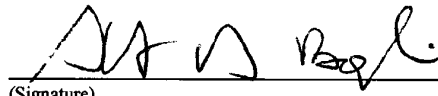
ATEX Directive (94/9/EC)

Middletown September 24, 2003
(Place and Date of issue)


(Signature)

James J. Gehenio
(Name or equivalent marking of authorized person)

Engineering Manager
(Title)


(Signature)

Kurt B. Boegli
(Name or equivalent marking of authorized person)

Chief Standards Engineer
(Title)

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **85586V1P**.



PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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