Distributed Power System SD3000/SF3000 Power Module Interface Rack and Modules

Instruction Manual S-3008-1

RELIANCE ELECTRIC

The information in the user's manual is subject to change without notice.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING

INSERTING OR REMOVING A MODULE OR ITS CONNECTING CABLES MAY RESULT IN UNEXPECTED MACHINE MOTION. TURN OFF POWER TO THE RACK BEFORE INSERTING OR REMOVING A MODULE OR ITS CONNECTING CABLES. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

WARNING

ONLY QUALIFIED RELIANCE PERSONNEL OR OTHER TRAINED PERSONNEL WHO UNDERSTAND THE POTENTIAL HAZARDS INVOLVED MAY MAKE MODIFICATIONS TO THE RACK CONFIGURATION, VARIABLE CONFIGURATION, AND APPLICATION TASKS. ANY MODIFICATIONS MAY RESULT IN UNCONTROLLED MACHINE OPERATION. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN DAMAGE TO EQUIPMENT AND BODILY INJURY.

WARNING

REGISTERS AND BITS IN THE UDC MODULE THAT ARE DESCRIBED AS "READ ONLY" OR "FOR SYSTEM USE ONLY" MUST NOT BE WRITTEN TO BY THE USER. WRITING TO THESE REGISTERS AND BITS MAY RESULT IN IMPROPER SYSTEM OPERATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

CAUTION: The modules in the power module interface rack contain static-sensitive components. Do not touch the module's circuit board or the connectors on the back of the module. When not in the rack, modules should be stored in anti-static bags. Failure to observe this precaution could result in damage to or destruction of the equipment.

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1.0 INTRODUCTION

The products described in this instruction manual are manufactured or distributed by Reliance Electric Industrial Company.

The AutoMax® Distributed Power System (DPS) is a programmable microprocessor-based control system that is capable of real-time control of A-C and D-C drives. The Universal Drive Controller (UDC) module in the AutoMax rack is used to control one or two drives. Both A-C and D-C drives can be controlled from one UDC module. Up to 10 UDC modules can be mounted in an AutoMax rack permitting control of up to 20 drives from a single rack. Drive types can be mixed throughout the process allowing each section to be customized with the most appropriate power technology.

The UDC module communicates over a fiber-optic link with a Power Module Interface (PMI) located at the Power Module up to 750 meters (2500 feet) away. Refer to figure 1.2. Each PMI can control one motor and drive. The control type (i.e., current for D-C, vector or brushless for A-C) is determined by the operating system contained in the PMI.

Note that if your system contains an SF3000 drive you should read the SF3000-specific information in Appendix G before continuing on with the rest of this manual.

As shown in figure 1.3, the PMI rack contains four modules: Power Supply (B/M O-60007), PMI Processor (B/M O-60021), Resolver and Drive I/O (B/M O-60031), and D-C Power Technology (B/M O-60023).

The PMI performs the following functions:

- **Executes the current minor loop algorithm**

  The primary function of the current minor loop (CML) is the regulation of armature current to match the armature current reference and the regulation of field current to match the field current reference output by a task running on the UDC module in the AutoMax rack.

  The programmer provides drive parameter data (entered during UDC module configuration), command data, gain values (derived from auto-tuning calculations), and a current reference. This information is automatically transferred to the PMI Processor at the end of every scan of the UDC module. The PMI Processor uses this information along with its internal algorithm to regulate current to the armature and field. The PMI Processor outputs SCR firing angles to the D-C Power Technology module in the PMI rack, which in turn provides the actual firing signals to the SCR gates.

- **Communicates with the UDC module in the AutoMax rack**

  The UDC module and the PMI Processor are both synchronized to the CCLK signal in the Multibus rack over a 10Mbit/sec fiber-optic link. The PMI Processor and the UDC module are synchronized so that a feedback message from the PMI Processor arrives at the UDC module just before it begins scanning the UDC tasks.

- **Processes the speed feedback signal**

  The PMI rack provides resolver-to-digital conversion for speed and position feedback. This data is sent to the UDC module for use in the UDC task. If desired, an analog tach may be used in place of, or in addition to, a resolver. Speed feedback sampling in the PMI rack is synchronized to within 1 μsec of the UDC scan.

- **Updates the drive I/O and rail I/O points**

  The PMI rack provides connections to digital and analog rails as well as digital drive I/O. The PMI Processor scans the rail I/O and the drive I/O while the control algorithms are running. This permits the I/O information to be integrated into the control algorithms as required.

> The thick black bar shown on the right-hand margin of this page will be used throughout this instruction manual to signify new or revised text or figures.

- **Accumulates diagnostic data for transmission to the UDC module**

  The operating system in the PMI rack performs diagnostic checks (e.g., to detect shorted SCRs) as well as tests for fault conditions (e.g., overspeed and tach loss) and displays the results on LEDs and stores them in memory locations in the UDC module.

This manual provides a hardware description of each piece of the Power Module Interface rack as well as installation guidelines. Note that this instruction manual does not describe specific applications of the standard hardware and software.

For more information, refer to the instruction manuals shown in figure 1.1.

Document	Document Part Number SD/SF3000 Binder S-3000
DPS Overview	S-3005
UDC Module	S-3007
Fiber-Optic Cabling	S-3009
Configuration & Programming	S-3006[1] S-3036[2]
Power Module Interface	S-3008
Power Module	S-3010
Diagnostics, Troubleshooting & Start-Up Guidelines	S-3011
Information Guide	S-3012

[1] SD3000 [2] SF3000

Figure 1.1 - DPS Documentation

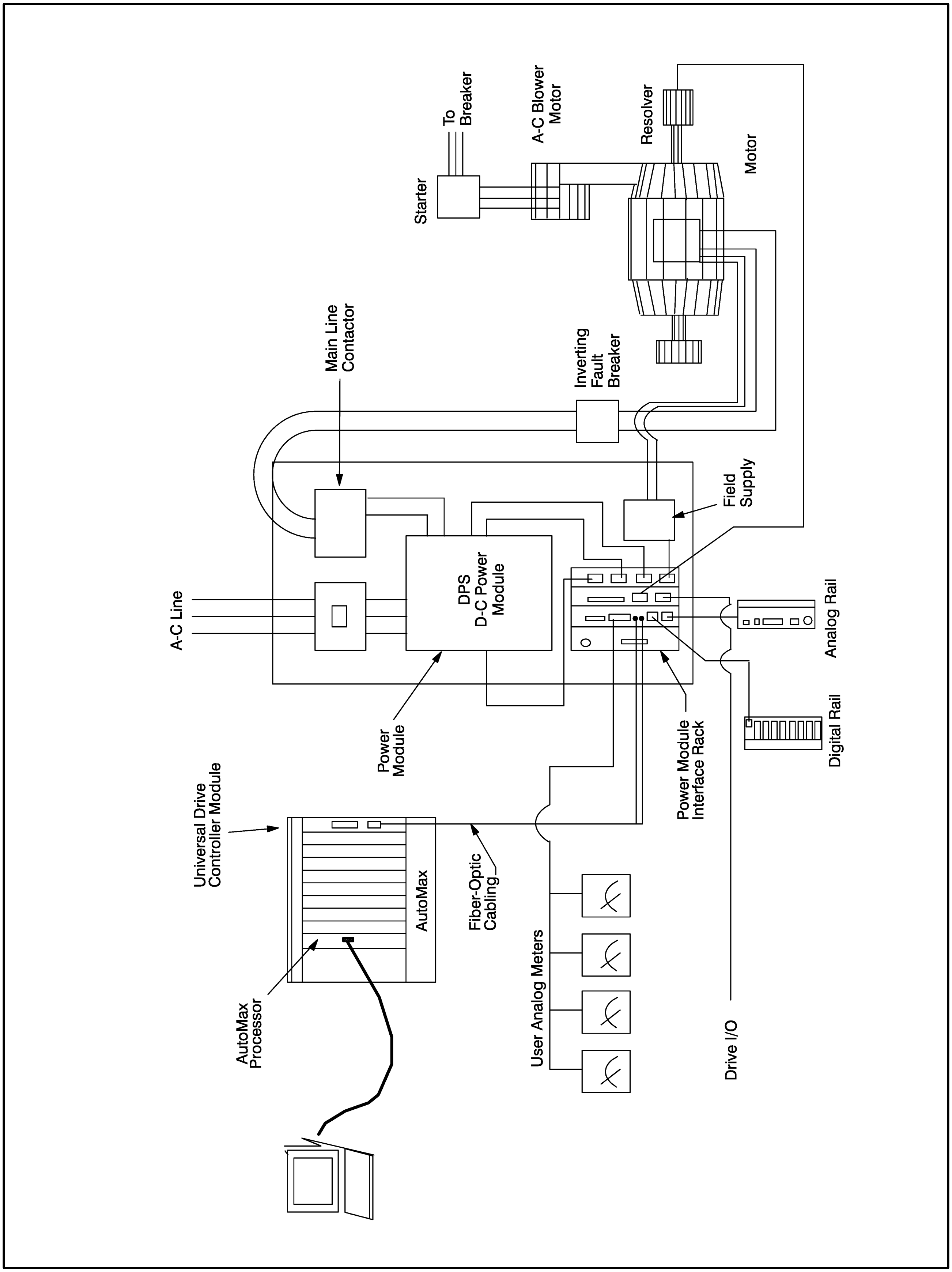


Figure 1.2 - Distributed Power D-C Drive

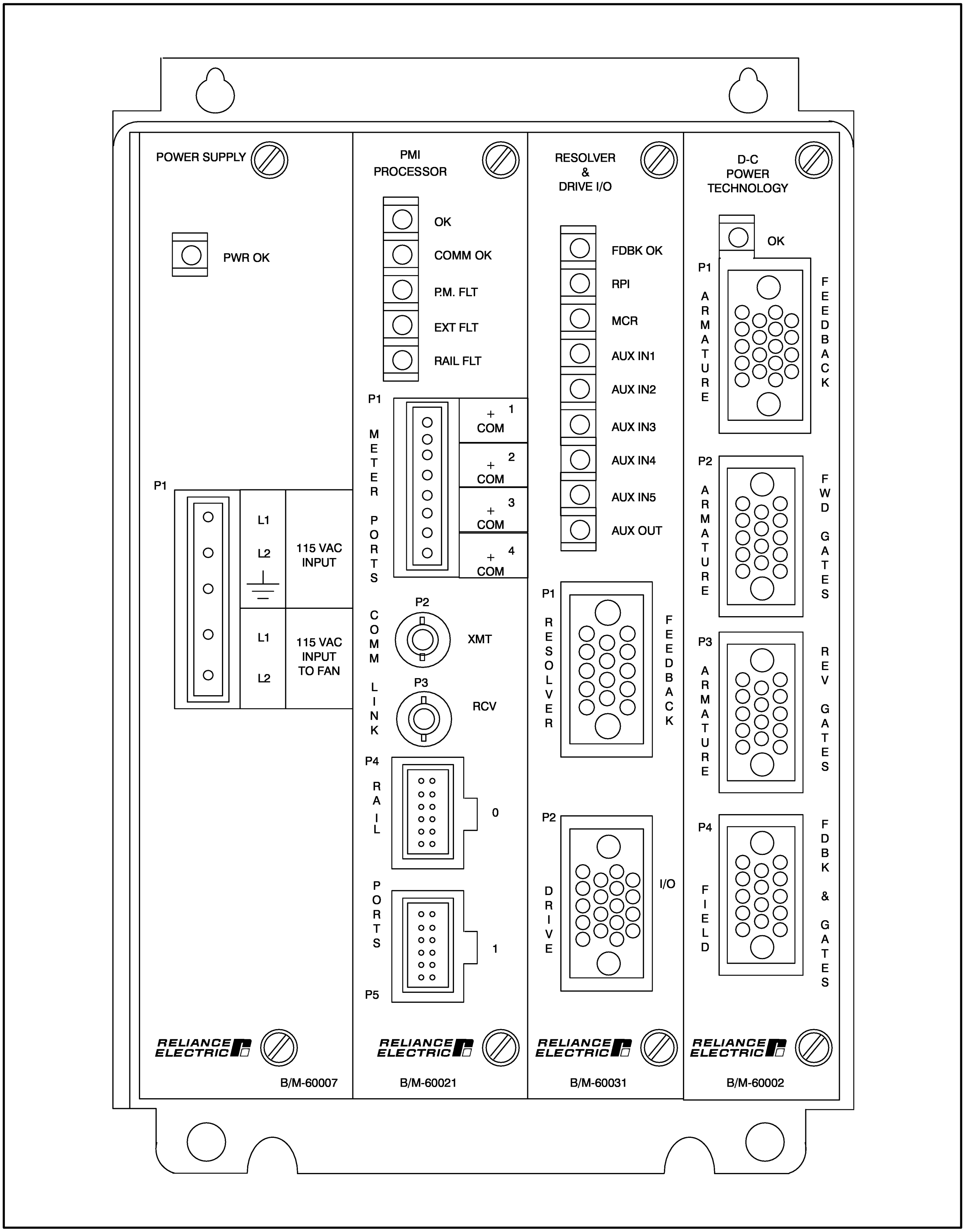


Figure 1.3 - Power Module Interface (PMI) Rack

2.0 RACK

The rack provides the mechanical means for mounting the Power Supply module, PMI Processor module, the Resolver and Drive I/O module, and the D-C Power Technology module. The following sections provide mechanical and electrical descriptions of the rack.

2.1 Rack Mechanical Description

The rack consists of a sheet metal card-cage type enclosure and a backplane. It provides one slot (the leftmost slot) for the power supply and three slots for modules. Mounting holes are provided on the flanges that extend above and below the rack. A grounding lug is provided on the bottom mounting flange. Rack dimensions are listed in Appendix A. The rack backplane contains a proprietary parallel bus with DIN-style connectors in each slot for connection to the modules. See figure 2.1.

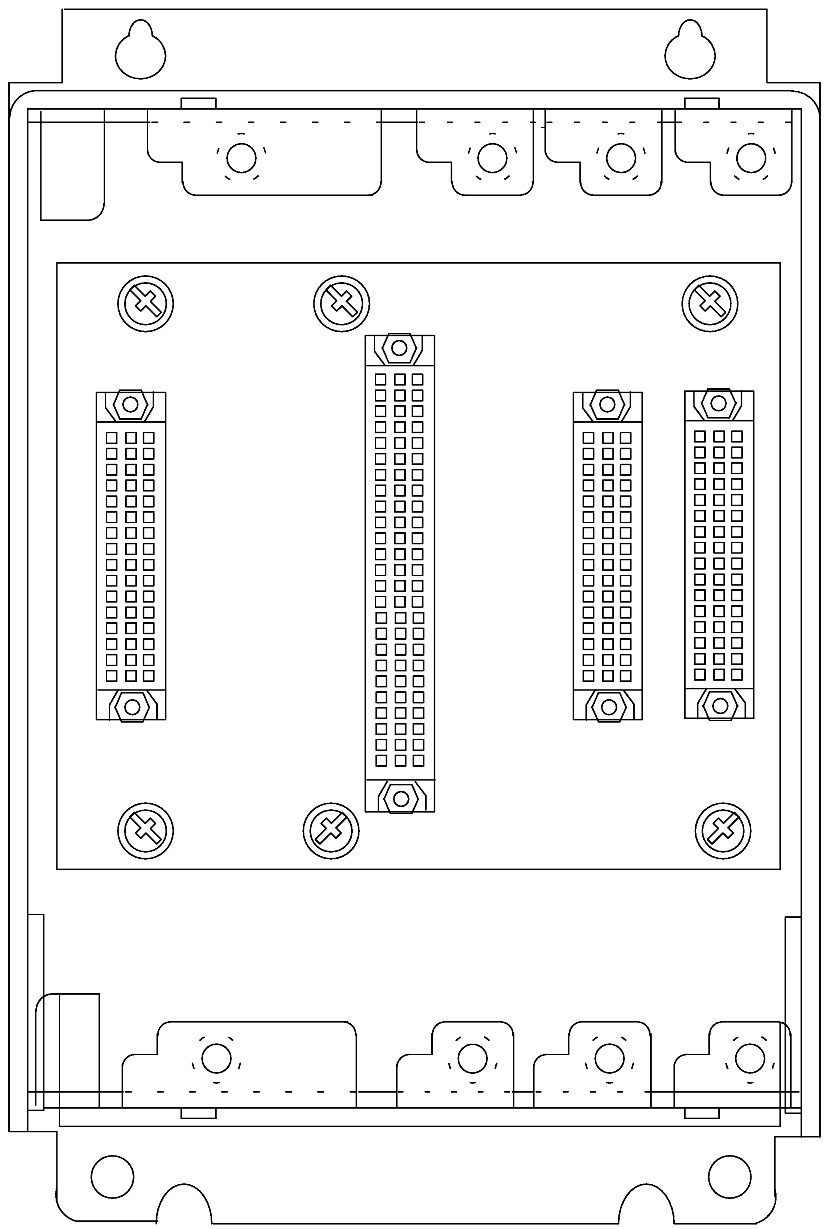


Figure 2.1 - The Rack

The rack is designed to be panel-mounted. It must be mounted within 3.5 meters (12 feet) of the Power Module to ensure the integrity of the power module interface signals. When the rack is used with drives 300 HP or less, it is part of the Power Module assembly and it shares the Power Module's fan. In all other cases, it requires its own fan.

2.2 Rack Electrical Description

The backplane of the rack supports a set of proprietary parallel bus lines based on Intel's 80960SA processor bus architecture. These serve as the electrical connection for all slots in the rack. Bus accesses are multiplexed address and data. Data is transferred in 16-bit words. Two system clocks, 4MHz and 10MHz, and interrupt lines are also provided to allow for close synchronization of real-time control.

Dedicated drive control signals on the rack backplane limit the slot placement of the modules in the rack. See figure 2.2.

Module	**Slot Location**			
	C1	**C2**	**C3**	**C4**
Power Supply (B/M O-60007)	*			
Processor (B/M O-60021)		*		
Resolver & Drive I/O (B/M O-60031)			*	
D-C Power Technology (B/M O-60023)				*

Figure 2.2 - Module Placement

3.0 POWER SUPPLY MODULE

Through its connection to the backplane of the PMI rack, the Power Supply module (B/M O-60007) provides the D-C voltages necessary for the operation of all of the modules contained in the rack including the gate driver circuitry.

The following sections provide mechanical and electrical descriptions of the Power Supply module. See figure 3.3 for a block diagram of the module.

3.1 Power Supply Module Mechanical Description

CAUTION: This equipment must be connected to a power source for which it was designed. Verify that the available power is 115 volts A-C (10kVa maximum input source). Failure to observe this precaution could result in damage to equipment.

The Power Supply Module is a printed circuit board assembly that plugs into the leftmost slot of the PMI rack. The module consists of a printed circuit board and a faceplate. The faceplate contains thumbscrews at the top and the bottom of the module to secure the module in the rack. The connector located on the back of the module connects to the rack backplane. Refer to figure 3.1 for the module faceplate. Module dimensions are listed in Appendix B.

The faceplate of the module contains an LED indicator labeled “PWR OK” and a five-point connector. The LED indicator is described in detail in section 3.1.1. The connector provides the means to connect the 115 VAC power for rack and fan operation. Terminal “L1” is the connection for the A-C hot input line. Terminal “L2” is the connection for the A-C neutral input line. The ground terminal must be connected to earth ground in addition to the ground wire connected to the PMI rack’s grounding lug.

DANGER

UNGROUNDED EQUIPMENT PRESENTS A SHOCK HAZARD. THE GROUND TERMINAL ON THE POWER SUPPLY MODULE AND THE GROUNDING LUG ON THE RACK ARE NOT CONNECTED TOGETHER. CONNECT BOTH POINTS TO AN EXTERNAL EARTH GROUND. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

The 115 VAC input is internally hardwired to the L1 and L2 terminals labeled “115VAC OUTPUT TO FAN”. These provide the connection to a separate fan assembly, if required.

The following sections refer to the status registers in the UDC module for both drive A and drive B. The drive A register number is shown first followed by the drive B register number (A/B).

3.1.1 LED Indicator

The “PWR OK” LED on the faceplate of the Power Supply module is driven by the PMI Processor module. When lit, this LED indicates that all backplane voltages are at acceptable operating levels. Note that if the PMI Processor module is not in the rack with the Power Supply module, the PWR OK LED will be off even if the voltage levels are correct. The status of the Power Supply is available in the UDC module’s dual port memory (register 202/1202, bit 12). Refer to the appropriate Configuration and Programming instruction manual for a complete description of this status bit.

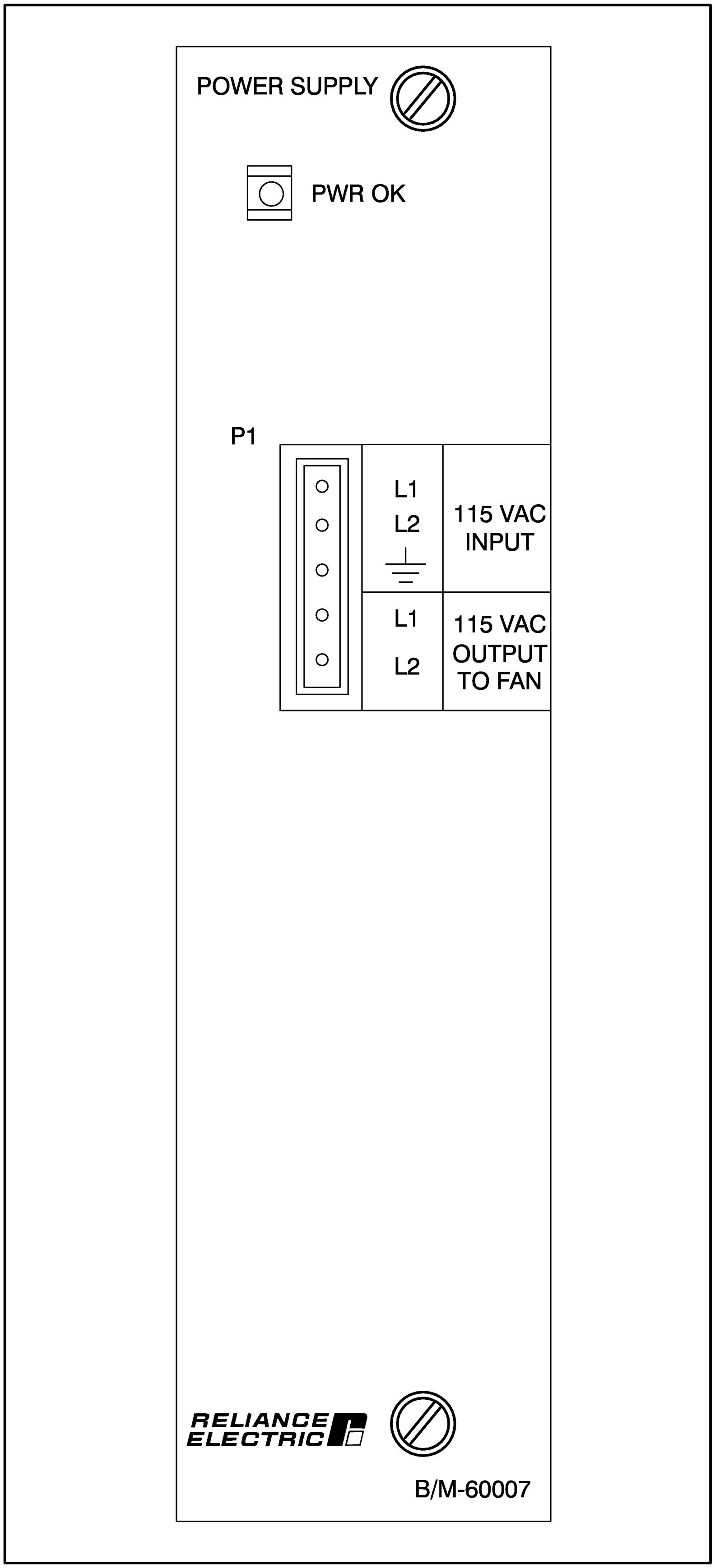


Figure 3.1 - Power Supply Module Faceplate

3.2 Power Supply Module Electrical Description

The Power Supply module contains 5V and +/− 18V power supplies. The +/−18V are post-regulated to the voltages required by each module.

When the Power Supply module powers up, it executes a “soft start,” gradually increasing the output voltage until it reaches the voltage necessary for logic operations. The 5V and +/−18V supplies are monitored by the PMI Processor via the backplane. When the backplane voltages are above specified levels (4.75V and +/−15.5V, respectively), the PMI Processor will turn on the “PWR OK” LED on the faceplate of the Power Supply module.

If the A-C line is lost for more than 25 milliseconds, the 5V line will begin to drop. When it falls below 4.75V, the PMI Processor generates a signal to shut down the rack and turns off the “PWR OK” LED on the Power Supply module. The PMI Processor module’s power supply monitor circuit is described in detail in section 4.2.2 of this manual.

Internal current-limiting circuitry prevents a short circuit on either output from damaging the supply. The input fuse is not user-serviceable. If the fuse blows, it indicates a problem with the Power Supply module and the module should be replaced. See figure 3.2 for a typical input power signal.

The Power Supply module contains a solid-state airflow switch to monitor the airflow through the rack. Bit 12 of UDC register 203/1203 will be set if airflow is not being sensed.

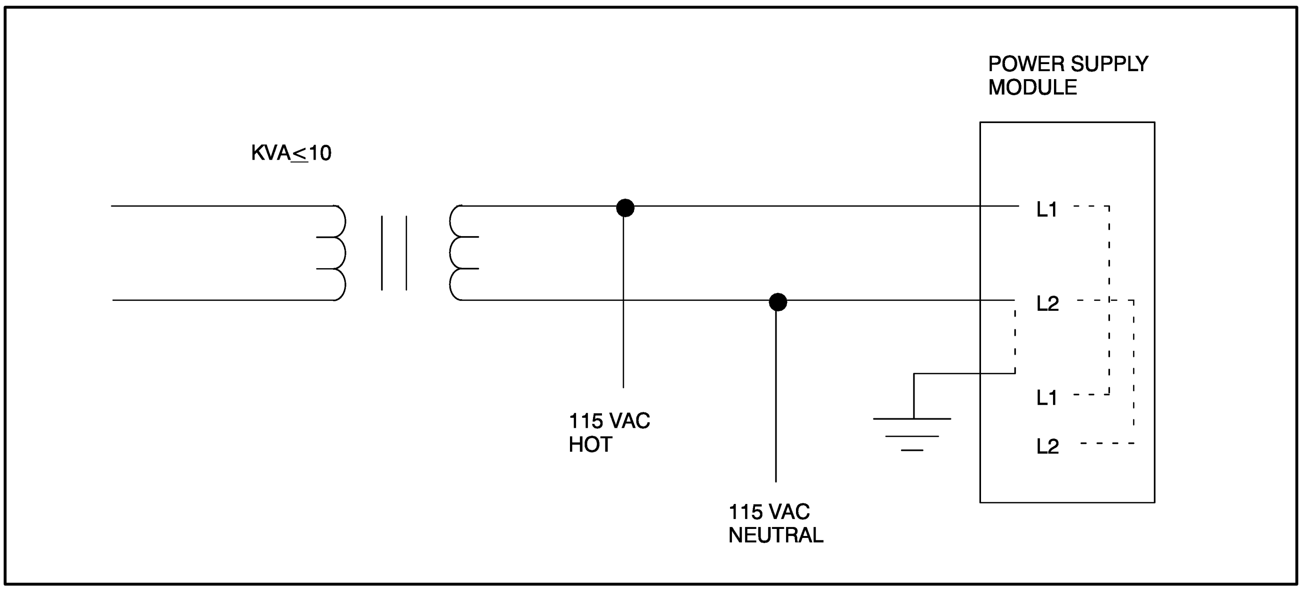


Figure 3.2 - Typical Input Power Connections

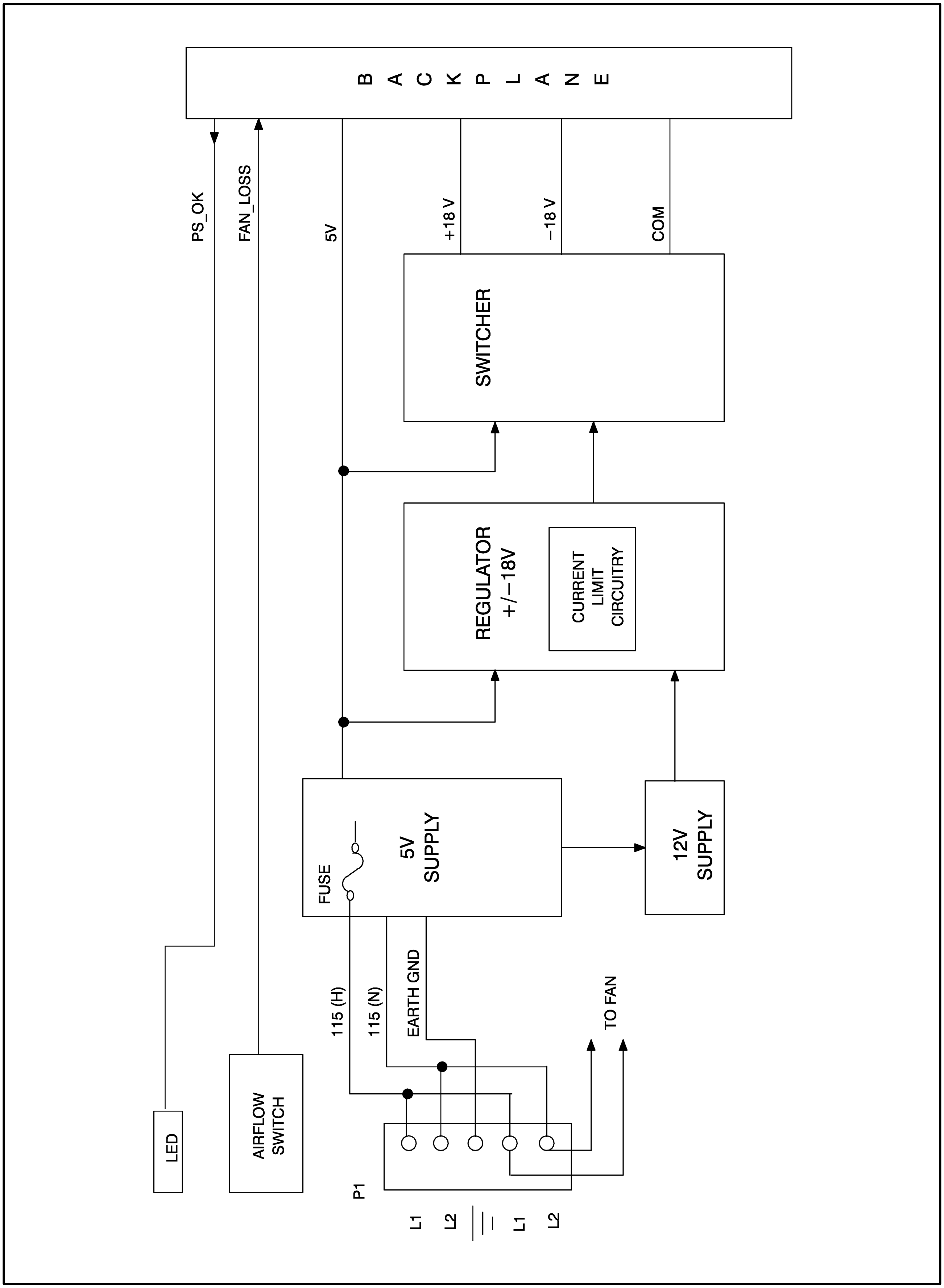


Figure 3.3 - Power Supply Module Block Diagram

4.0 POWER MODULE INTERFACE PROCESSOR MODULE

The Power Module Interface (PMI) Processor module (B/M O-60021) controls all communication within the PMI rack and executes the control algorithm. The module receives its operating system and the minor loop reference value over the fiber-optic link from the UDC module. The PMI Processor uses this information along with its internal algorithm to regulate current to the armature and field. The PMI Processor also transmits I/O values, speed feedback data, and the results of diagnostic tests over the fiber-optic link to the UDC module.

A fixed set of variables can be output to the four meter ports on the face of the PMI Processor module for metering purposes. The module also provides two AutoMate® rail ports for connection to digital and analog rails.

The following sections provide mechanical and electrical descriptions of the PMI Processor module. Figure 4.3 shows a block diagram of the module.

4.1 PMI Processor Module Mechanical Description

The PMI Processor module is a printed circuit board assembly that plugs into the first slot to the right of the Power Supply in the PMI rack. The module consists of a printed circuit board and a faceplate. Screws are located on the top and bottom of the module faceplate to secure the module to the rack. The connector on the back of the module attaches to the rack backplane. Module dimensions are listed in Appendix C. See figure 4.1 for the module faceplate.

The faceplate contains four programmable D/A ports labeled “METER PORTS” for connection to user-supplied metering or data-logging devices. Transmit and receive ports are provided on the faceplate for connection to the fiber-optic link with the UDC module in the AutoMax rack. The module is shipped with dust caps covering the fiber-optic ports. The dust caps should not be removed until the fiber-optic cables are installed, and should be replaced if the cables are disconnected, to prevent dust accumulation and the resulting loss of signal integrity.

WARNING

TURN OFF, LOCKOUT, AND TAG POWER TO BOTH THE RACK CONTAINING THE UDC MODULE AND TO ITS CORRESPONDING PMI HARDWARE BEFORE VIEWING THE FIBER-OPTIC CABLE OR TRANSMITTER UNDER MAGNIFICATION. VIEWING A POWERED FIBER-OPTIC TRANSMITTER OR CONNECTED CABLE UNDER MAGNIFICATION MAY RESULT IN DAMAGE TO THE EYE. FOR ADDITIONAL INFORMATION REFER TO ANSI PUBLICATION Z136.1-1981. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Two AutoMate rail ports on the faceplate support direct connection to any two of the following in any combination:

M/N 45C1A - AutoMate I/O Rail (containing 8 two-point digital I/O modules each)
M/N 61C345 - 4 Input 4-20 mA Analog Rail Module
M/N 61C346 - 4 Input 0-10 VDC Analog Rail Module
M/N 61C365 - 4 Output 4-20 mA Analog Rail Module
M/N 61C366 - 4 Output 0-10 VDC Analog Rail Module
M/N 61C350 - 2-In/2-Out 0-10 VDC Analog Rail Module
M/N 61C351 - 2-In/2-Out 4-20 mA Analog Rail Module
M/N 45C630 - 4-Decade Thumbwheel Switch Input Module
M/N 45C631 - LED Interface Module

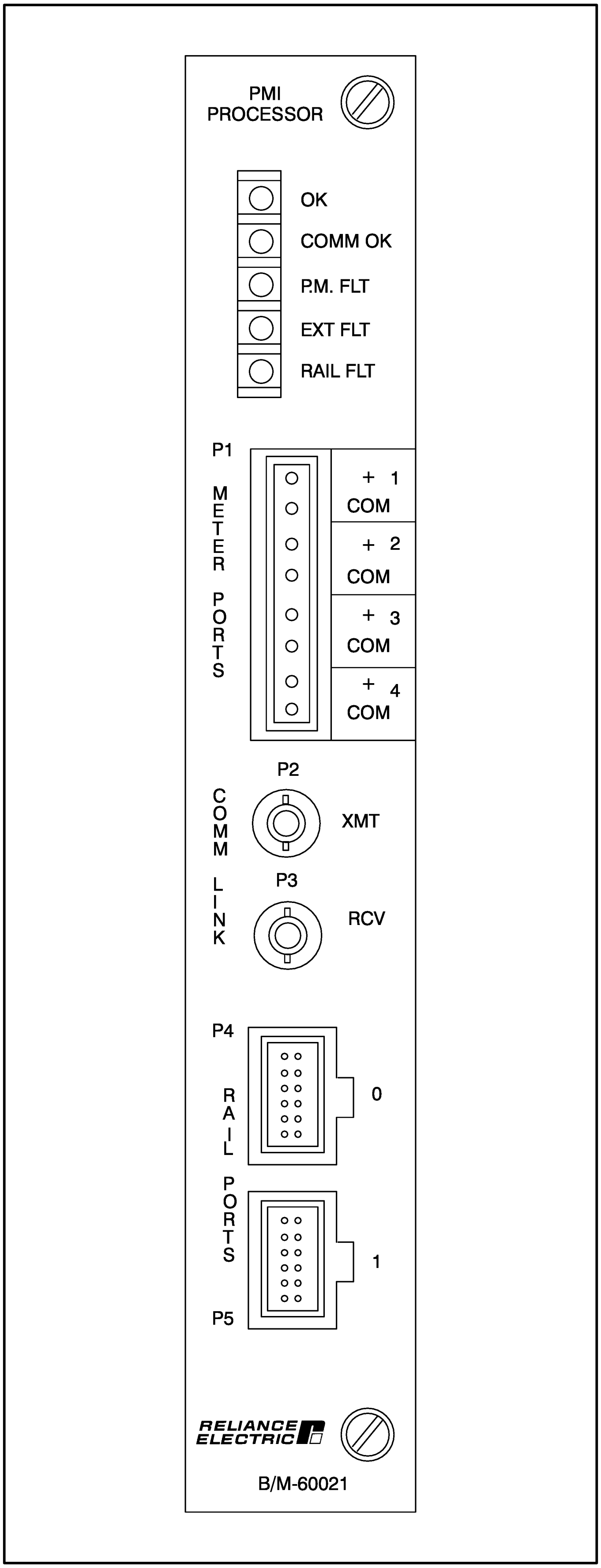


Figure 4.1 - PMI Processor Module Faceplate

Digital I/O modules can be mixed in an I/O Rail connected to the PMI Processor module. Analog rail modules must be used in rail mode only. Local Heads (M/N 61C22) are not supported.

The five LEDs on the module faceplate indicate the status of the PMI Processor and the connected drive. The LED functions are described in detail in section 4.1.1.

The following sections refer to the status registers in the UDC module for both drive A and drive B. The drive A register number is shown first followed by the drive B register number (A/B).

4.1.1 LED Indicators

The five LEDs on the faceplate indicate the status of the PMI Processor and the Power Module. They also indicate the status of the communication links between the PMI Processor and the UDC module, and between the PMI Processor and the digital and/or analog rails.

Refer to the appropriate Drive Configuration and Programming instruction manual for a complete description of the registers and status bits indicated in the following section.

The LEDs are defined as follows:

OK (green) - When power is applied to the module, this LED will turn on to indicate the PMI Processor module has passed its internal power-up diagnostics. After power up, this LED will turn off if the internal watchdog "times" out.

COMM OK (green) - When lit, this LED indicates messages are being received correctly over the fiber-optic link from the UDC module. If this LED is off, it indicates there is a fault in the link or that the UDC module is unable to communicate.

If the PMI Processor does not receive a message from the UDC module for two or more CCLK periods, or logs two consecutive communication errors of any type, the PMI Processor module will shut the drive down.

Detailed information about the communication link (e.g., number of messages sent and received, CRC error count) is displayed in the UDC/PMI Communication Status Registers (80-89/1080-1089) on the UDC module.

P.M. FLT (red) - When lit, this LED indicates that one of the hardware fault conditions listed below has been detected in the Power Module.

- A shorted SCR is detected. Check register 204/1204 to identify the SCR that has shorted.

  Corresponding UDC location: Register 202/1202, bit 0.

- The field current feedback value is less than the Field Loss Trip Point parameter value entered during configuration for 5 times the electrical time constant of the field. This assumes FML_RUN@ (100/1100, bit 4) has been turned on.

  Corresponding UDC location: Register 202/1202, bit 6.

- The field current feedback dips below the Field Loss Trip Point for 30 msec after the field has been turned on.

  Corresponding UDC location: Register 202/1202, bit 6.

- The field current feedback is greater than 1.5 times the hot field amps parameter value for 30 msec., or the field current feedback is greater than rated power module current for 30 msec. Both conditions cause errors during the field ID test or when the field is turned on. These errors can be caused by miswiring the 181 and 183 A-C line to the field Power Module.

  Corresponding UDC location: Register 202/1202, bit 6.

The P.M. FLT LED is also used to indicate any failure that may occur during power-up diagnostics. If a failure occurs, the P.M. FLT LED will flash. If the PMI Processor fails any of its power-up diagnostics, it must be replaced.

EXT FLT (red) - When lit, this indicates that one of the external fault conditions listed below has occurred.

- A-C line synchronization fault. The A-C line voltage is missing for more than 2 seconds.

  Corresponding UDC location: Register 202/1202, bit 3.

- Instantaneous overcurrent fault. The armature current feedback value is greater than the Max Current Limit parameter plus 75%.

  Corresponding UDC location: Register 202/1202, bit 4.

- Overspeed fault. The motor's velocity exceeds the Over Speed Trip (RPM) value entered during configuration.

  Corresponding UDC location: Register 202/1202, bit 10.

- The user's application program has instructed the LED to turn on.

  Corresponding UDC location: Register 101/1101, bit 2.

RAIL FLT (red) - When lit, this LED indicates communication between a rail and the PMI Processor has been disrupted, or that a rail has been configured but is not plugged in.

Registers 0-23 are available in the UDC module for rail variable configuration and diagnostic purposes. If a rail communication problem is detected and logged in registers 4, 10, 16, or 22, then bit 13 in the Drive Warnings register (203/1203) will be set.

Note that rail faults will not affect the operation of the drive. The user must ensure that the application task tests the rail fault registers and forces appropriate action in the event of a rail fault.

4.2 PMI Processor Module Electrical Description

The PMI Processor module contains a RISC (Reduced Instruction Set Computer) microprocessor operating at 16 MHz. High speed communication with the UDC module is controlled by an on-board serial communications controller. Data is transmitted over the fiber-optic link at 10M bit/sec utilizing the High-Level Data Link Control (HDLC) protocol. Data integrity is checked using a CRC (Cyclic Redundancy Check) error detection scheme.

The module contains an on-board watchdog timer that is enabled when power is applied to the module. After the module has performed its internal diagnostics, the watchdog timer will become idle until it is activated again by the module's operating system. Once re-activated, the on-board CPU must reset the watchdog timer within a specified time or the PMI Processor will shut down. The MCR output on the Resolver and Drive I/O module will then be turned off under hardware control within .5 seconds. Rack power must be cycled to reset the watchdog timer.

4.2.1 Power-Up Routine

When power is applied to the PMI rack, the LEDs will blink three times to test the LEDs, and the PMI Processor will perform a series of internal diagnostics. The P.M. FLT LED on the faceplate will flash if the module fails any of these diagnostics. If the diagnostics are passed, the OK LED on the faceplate will turn on.

The PMI Processor will request its operating system from the UDC module as soon as communications are established over the fiber-optic link. After the operating system has been downloaded from the UDC module (a process that takes approximately 1/2 second), the PMI Processor will send a feedback message. The UDC module will respond with a command message and configuration data. The configuration data contains the synchronization information for the PMI rack.

The module uses non-volatile EPROM to store the initial start up software and power-up diagnostics and to establish communication with the UDC module. After power-up, the module stores data in and operates out of volatile SRAM. If power is removed from the rack, all data and the module's operating system will be lost. When power is returned to the rack, the PMI Processor module will begin its normal power-up routine.

4.2.2 Power Supply Monitor Circuit

The PMI Processor monitors the +5V and the +/−18V supplies via the backplane. When these voltages are above specified levels (4.75V and +/−15V, respectively), the PMI Processor will turn on the PWR OK LED on the Power Supply module.

If the 5V line falls below 4.75V, an on-board monitor circuit generates a local power loss signal. This signal will remain on for a minimum of 40 mSec regardless of the state of the 5V line. When this occurs, the PMI Processor shuts down, and all other modules in the rack enter a safe power down state. The local power loss signal will turn off 40 mSec after the 5V line rises above 4.75V. The PMI Processor will then begin its normal power-up routine.

4.2.3 Meter Ports

The module faceplate contains four analog output ports on a single connector labeled METER PORTS. The ports provide 8-bit resolution (7 bit plus sign) of internal data to the analog output over a +/−10 volt range.

Each port can be connected to a separate analog device (e.g., a meter or other data-logging device). Each device can be located up to 4 meters (13 feet) from the PMI Processor. A removable terminal block connector is used to connect the analog devices to the PMI Processor. All connections are made using 2.08-0.326 mm^2 (14-22 AWG) wire.

The four meter ports are not isolated from each other or from system common. There is one common for each port, but these are tied together as shown in figure 4.2. Maximum output current is 20 milliamps.

The meter ports can be set up off-line during parameter entry for the UDC module or on-line using the "Setup UDC" selection from the Programming Executive software Monitor menu. The outputs can be scaled so that a small portion of the total signal can be expanded to provide full scale output on the meter or other data-logging device. The current value of each variable is written to the analog output every current minor loop scan. The ports default to "not used" and output zero volts. Meter port configuration is described in the Drive Configuration and Programming instruction manual.

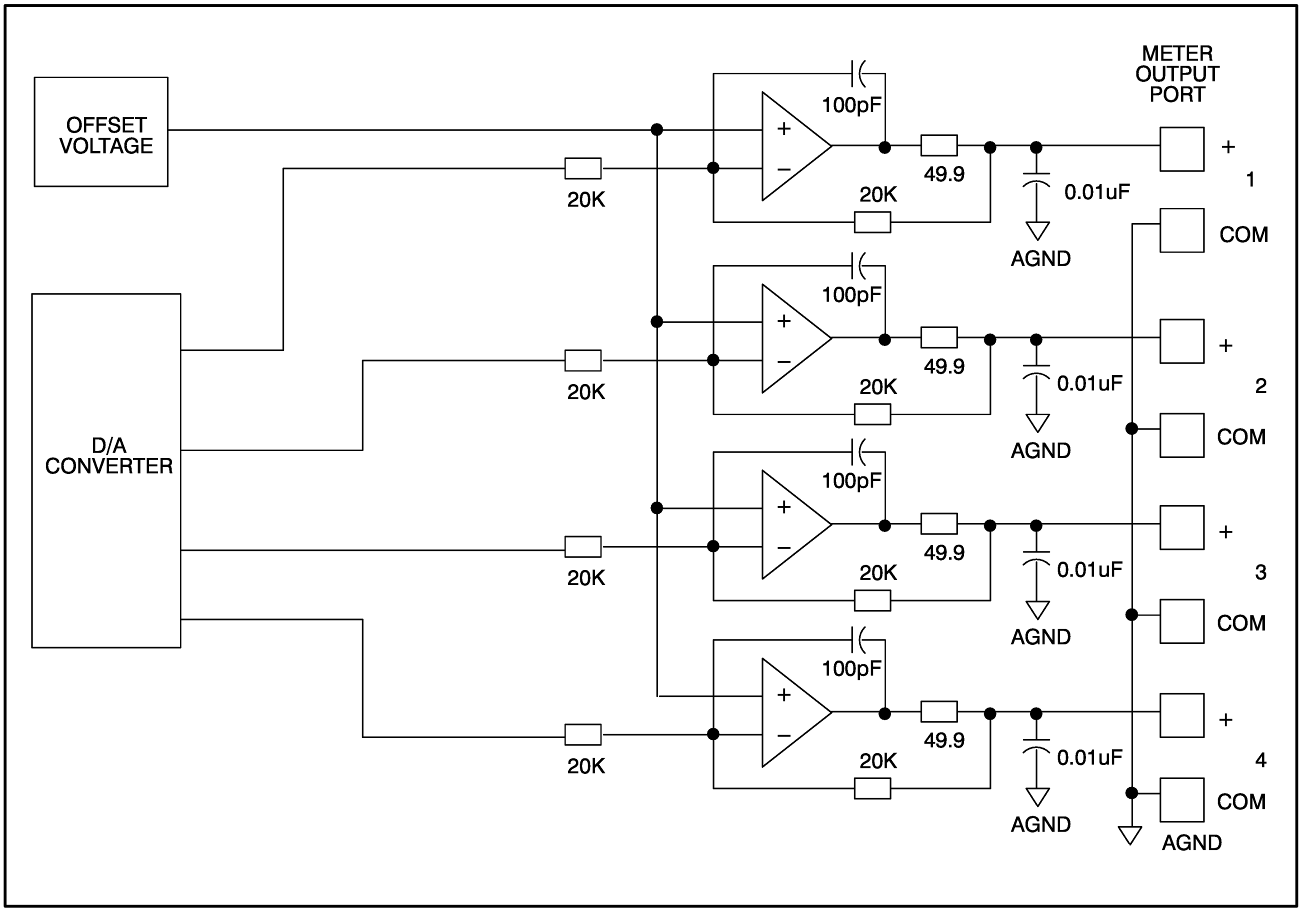


Figure 4.2 - Meter Port Output Circuit

4.2.4 Rail Ports

The two AutoMate rail ports on the faceplate support direct connection to digital and analog rails as described in section 4.1. The rails receive the 5V required for their operation through their connection to the PMI Processor. If the PMI rack is reset or power is removed, all outputs are turned off. Note that rail cables must not be plugged/unplugged under power.

Rails are updated asynchronously. While the CML is running, digital rails are updated every 5 msec (both ports). Analog rails are updated every 20 msec (both ports). Rail faults are reported in UDC registers 4, 10, 16, and 22 and will not trigger a drive shutdown.

Note that rail faults will not affect the operation of the drive. The user must ensure that the application task tests the rail fault registers and forces appropriate action in the event of a rail fault.

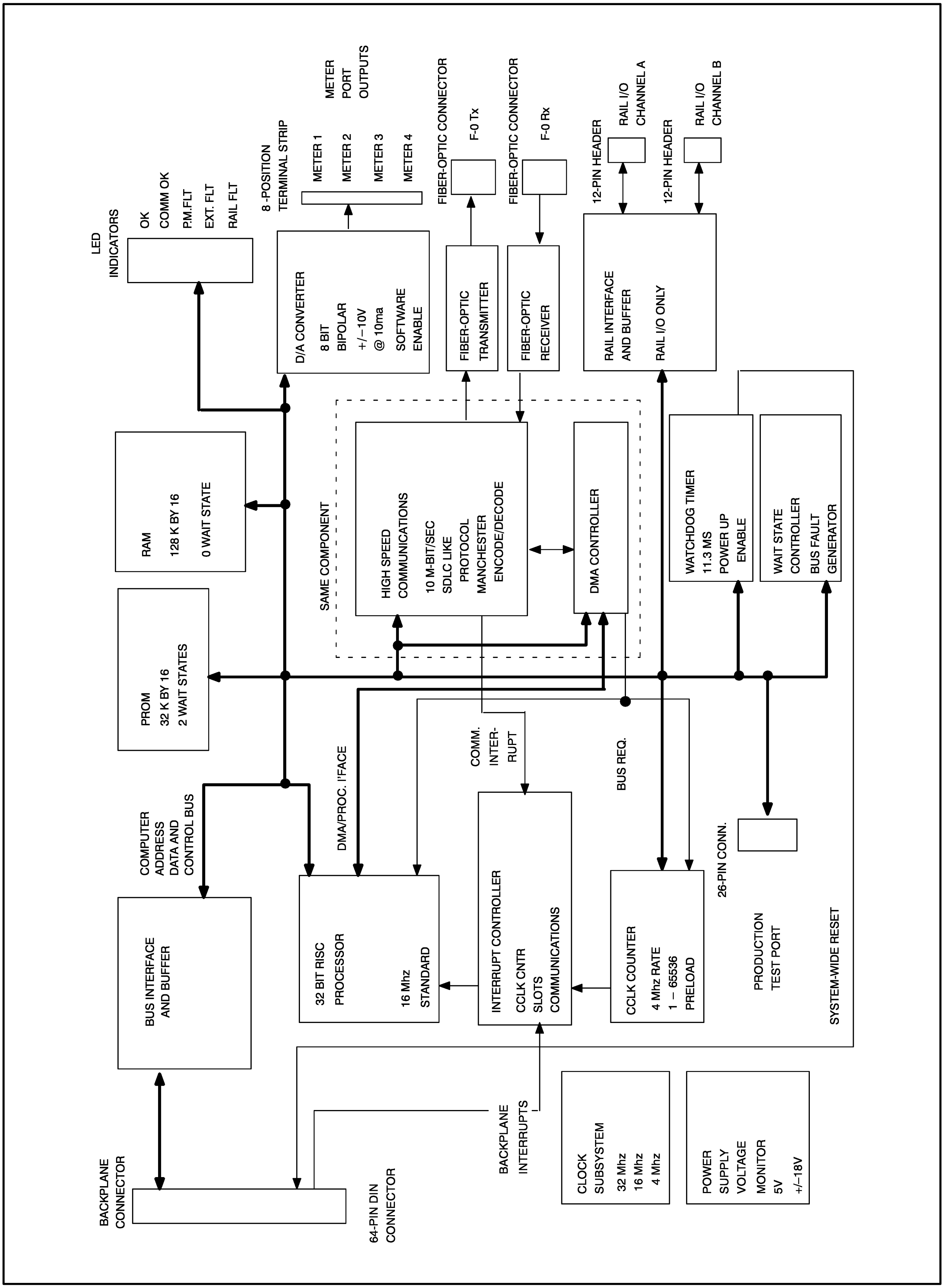


Figure 4.3 - PMI Processor Module Block Diagram

5.0 RESOLVER AND DRIVE I/O MODULE

The Resolver and Drive I/O module (B/M O-60031) converts the analog sine and cosine resolver feedback signals into digital format for use within the user's application program. An external strobe input is also provided to permit a user-generated signal to latch the resolver position data. The module self-tunes to compensate for varying lengths and types of resolver wiring.

The module provides an analog input connection which can be used for an analog tachometer or other user input device. The module also provides digital I/O connections which can be used for standard drive-related signals, such as an inverting fault input and M-contactor output, or for other user-designated functions.

The following sections provide mechanical and electrical descriptions of the Resolver and Drive I/O module. Figure 5.11 shows a block diagram of the module.

5.1 Resolver and Drive I/O Module Mechanical Description

The Resolver and Drive I/O module is a printed circuit board assembly that plugs into the slot to the right of the PMI Processor module in the PMI rack. The module consists of a printed circuit board and a faceplate. Screws are located on the top and bottom of the module faceplate to secure the module to the rack. The connector on the back of the module connects to the rack backplane. Module dimensions are listed in Appendix D. See figure 5.1 for the module faceplate.

The top connector, labeled "RESOLVER FEEDBACK," is used for connecting the resolver signal into the PMI rack. This connector will also accept a signal from an analog tachometer or other analog field device as long as the signal is in the correct range. In addition, there is a 24 V digital input that serves as a strobe for latching the resolver position externally.

A resolver and an analog tachometer may both be connected to the module (e.g., the analog input may be used for tension feedback at the same time that the resolver input is used for speed feedback). However, only one of these devices will be monitored for overspeed and tachometer loss faults. The speed feedback type is selected during UDC parameter configuration. (Refer to the Drive Configuration and Programming instruction manual for more information.)

The bottom connector, labeled "DRIVE I/O," is used for connecting drive-related or other digital I/O devices to the PMI rack. Six digital inputs and two digital outputs are provided on the faceplate. Five of the inputs and one of the outputs are user-programmable.

The connectors on this module and the other modules in the rack contain key pins to prevent cables from being connected to the wrong module. Refer to chapter 7 for the cable part numbers.

Nine LEDs on the module faceplate indicate the status of the resolver feedback and digital I/O. The LED functions are described in detail in section 5.1.1.

The following sections refer to the UDC dual port registers for both drive A and drive B. The drive A register number is shown first followed by the drive B register number (A/B).

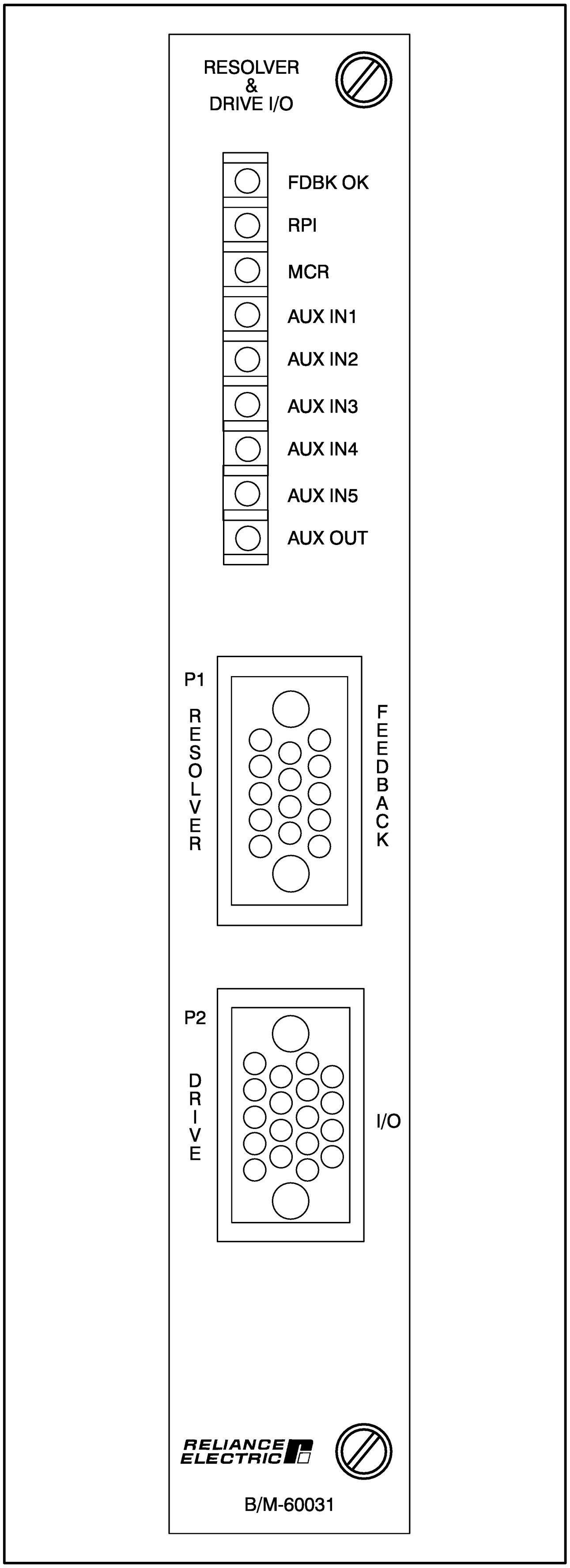


Figure 5.1 - Resolver and Drive I/O Module Faceplate

5.1.1 LED Indicators

The status of the resolver feedback signal and the drive I/O is indicated by nine LEDs on the module faceplate as well as in the UDC module's dual port memory. Refer to the D-C Drive Configuration and Programming instruction manual (S-3006) for a complete description of the status bits indicated below.

The LED indicators on the module faceplate are defined as follows:

FDBK OK (Green) - When lit, this LED indicates that the module is receiving feedback from the resolver and that no resolver feedback faults have been detected. If the LED is off, it indicates one of the following feedback faults has occurred.

- Tachometer loss fault. Armature voltage is greater than 40% of rated value and speed feedback is less than 5% of motor base speed.

  Corresponding bit location: Register 202/1202, bit 7

- Broken wire fault. Resolver sine and/or cosine signals are missing.

  Corresponding bit location: Register 202/1202, bit 8

The following eight LEDs indicate the status of the digital drive I/O connected to the module through the DRIVE I/O connector on the module faceplate. Refer to section 5.2.3 for a description of the drive I/O and the connector pinout.

RPI (Green) - When lit, this LED indicates that the run permissive input signal (RPI) is detected on pin A. The RPI signal typically originates from the drive's coast stop circuit.

Corresponding bit location: Register 201/1201, bit 0.

MCR (Amber) - When lit, this LED indicates the MCR output signal is being driven on (pin P). This output is used to control an M-Contactor. In D-C contactor systems, the output is under control of the PMI Processor's operating system. In A-C contactor systems, the output is under the control of the PMI Processor's operating system and the user's AutoMax task.

Corresponding bit location: Register 101/1101, bit 1.

AUX IN1 (Green) - When lit, this LED indicates the presence of a 115 volt signal on this input (pin C). This input should be used to indicate the status of the M-Contactor.

Corresponding bit location: Register 201/1201, bit 1.

AUX IN2 (Green) - When lit, this LED indicates the presence of a 115 volt signal on this input (pin E). It is often used to indicate the status of an inverting fault breaker.

Corresponding bit location: Register 201/1201, bit 2.

AUX IN3 (Green) - When lit, this LED indicates the presence of a 115 volt signal on this input (pin H). It is often used to indicate the status of the Power Module's airflow sensing switch.

Corresponding bit location: Register 201/1201, bit 3.

AUX IN4 (Green) - When lit, this LED indicates the presence of a 115 volt signal on this input (pin K). It is often used to indicate the status of the motor's thermal switch.

Corresponding bit location: Register 201/1201, bit 4.

AUX IN5 (Green) - When lit, this LED indicates the presence of a 115 volt signal on this input (pin M).

Corresponding bit location: Register 201/1201, bit 5.

AUX OUT (Amber) - When lit, this LED indicates the output signal has been turned on (pin S).

Corresponding bit location: Register 101/1101, bit 4.

5.2 Resolver and Drive I/O Module Electrical Description

The Resolver & Drive I/O module produces the +/−15V power required for its operation from the +/−18VDC supplied on the backplane from the PMI Power Supply. The module contains a fuse on the 5V input which is not user-serviceable. If the fuse blows, it indicates a problem with the module and the module should be replaced. Bit 9 of the Drive Fault register (202/1202) will be set when a blown fuse is detected.

The following sections provide electrical descriptions for the resolver input, analog input, and digital drive I/O circuitry.

5.2.1 Resolver Input

The Resolver Feedback connector is used for both resolver input and analog input signals. The Resolver Feedback connector pinout is shown below:

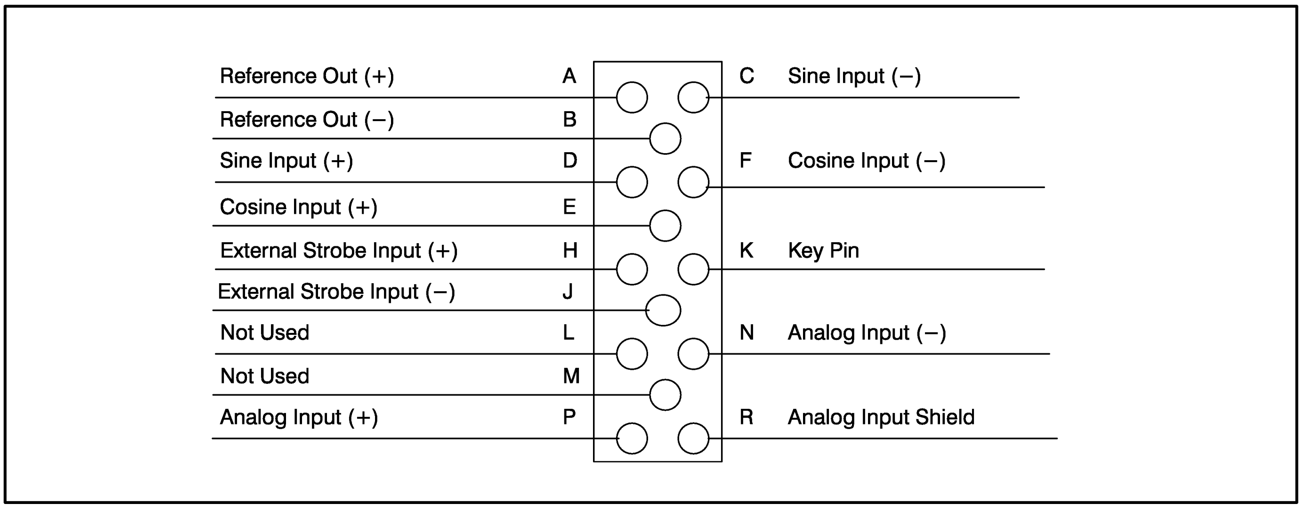


Figure 5.2 - Resolver Feedback Connector Pinout

The module contains a tracking ratiometric resolver-to-digital (R/D) converter that outputs a 12-bit digital number indicating the absolute electrical position of the resolver shaft. A two-bit revolution counter extends operation over four electrical resolutions. The counter is reset whenever power is turned on to the system or a system reset command is asserted by the PMI Processor over the rack backplane. The resolver data format is shown in figure 5.3.

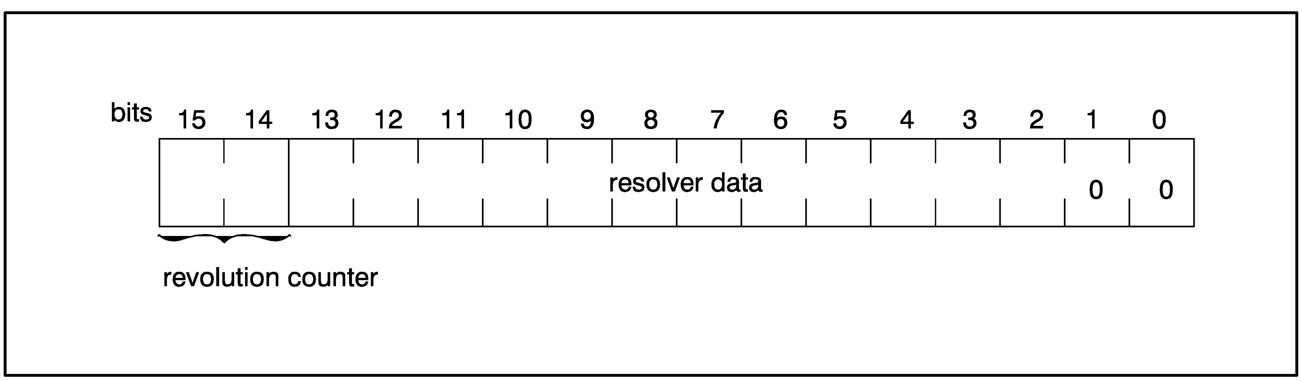


Figure 5.3 - Resolver Data Format

The module produces a nominal 26 volt rms 2381 Hertz sine wave reference output signal which is capable of driving a 500 ohm load. The stator signals (sine and cosine) are input through a matched isolation transformer pair. The transformers are matched for gain and phase shift. The ratio of the sine and cosine amplitudes is then converted to an angular position. Position data is sent to the UDC module by the PMI Processor before every scan of the UDC task. The UDC task calculates speed using this position data.

The module supports two methods of sampling the digital position of the resolver. In the first method, the position is sampled once per UDC task scan at the rate defined in the SCAN_LOOP control block in the UDC task. This block tells the UDC task how often to run based on the CCLK signal on the AutoMax rack backplane. The PMI Processor sends the position data to the UDC module immediately before it is needed by the UDC module for the next UDC task scan. Position data measured using this method is stored in the UDC module's dual port register 215/1215 in the format shown in figure 5.3.

The second method allows position sampling between scans or when an external event occurs by using an external strobe input (i.e., a user-generated signal). The module provides an isolated 24 VDC input with a relatively high degree of filtering (approximately 800 Hz). The external strobe input circuit is shown in figure 5.4.

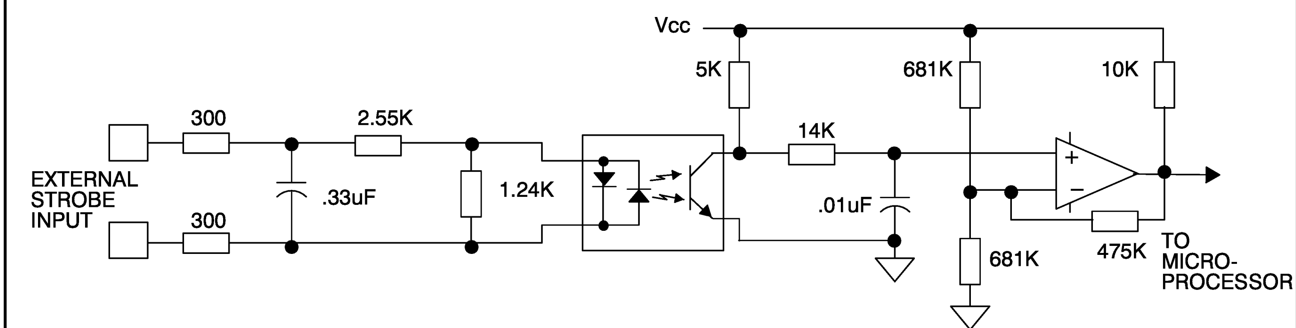


Figure 5.4 - External Strobe Input Circuit

Figure 5.5 shows the relationship between the time the external strobe is detected and the point at which the resolver position is sampled. Response time is subject to temperature, component tolerance, and input voltage level. Note that the input signal pulse width should be greater than 300 μsec and the frequency should be less than 1000 pulses per second.

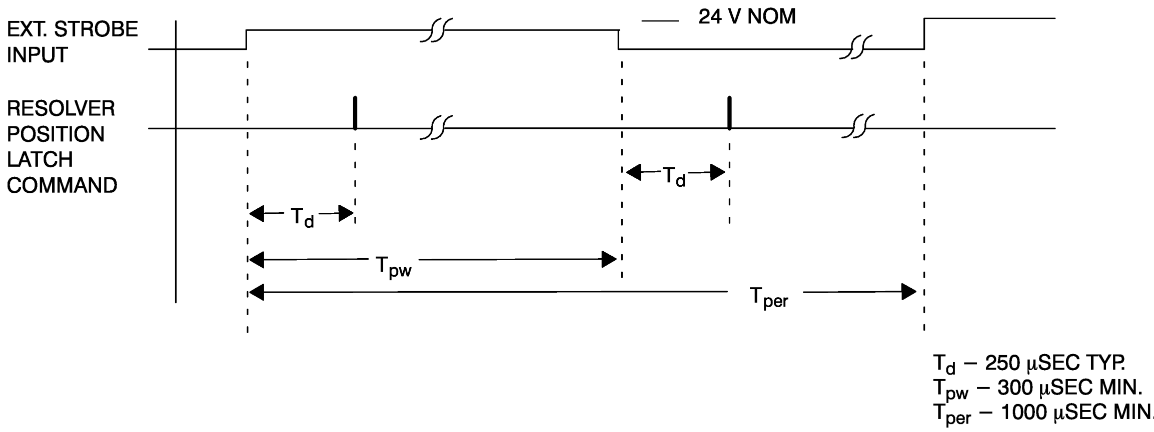


Figure 5.5 - External Strobe Detection Logic Timing Diagram

Strobe input detection is enabled by setting bits 8 and/or 9 in UDC register 101/1101. The resolver position can be sampled on the strobe input's rising edge, falling edge or both. Latched data is sent to the UDC module immediately before it is needed by the UDC module for the next UDC task scan. Note that the PMI operating system detects only one edge per UDC scan. If you choose to have the resolver position sampled on both edges of the strobe's input, the leading edge will be detected in one scan and the falling edge in the next scan. Position data measured using this method is placed in UDC register 216/1216 in the format shown in figure 5.3.

Bit 8 of UDC register 201/1201 is set to indicate that the strobe signal has been detected. This bit is set for only one scan to allow a strobe to be detected every scan. The UDC task must check this bit each scan to ensure the validity of the strobe data in register 216/1216. Bit 9 of register 201/1201 is set or cleared when the external strobe is detected and indicates whether the strobe level was rising (1) or falling (0). Both methods of sampling resolver position (i.e., time-driven and event-driven) may be used simultaneously.

5.2.1.1 Resolver Feedback Precautions

WARNING
WHEN THE RESOLVER AND DRIVE I/O MODULE IS USED WITH A RESOLVER OR AN ANALOG TACHOMETER IN A DRIVE CONTROL SYSTEM, THE USER MUST ENSURE THAT THE CORRECT FEEDBACK TYPE HAS BEEN SELECTED DURING CONFIGURATION OR PROVIDE AN INDEPENDENT METHOD OF DETECTING OVERSPEED. OTHERWISE, A FEEDBACK LOSS WILL NOT BE DETECTED, RESULTING IN MOTOR OVERSPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY AND IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT.

WARNING
THE USER IS RESPONSIBLE FOR ENSURING THAT THE DRIVEN MACHINERY, ALL DRIVE TRAIN MECHANISMS, AND THE MATERIAL IN THE MACHINE ARE CAPABLE OF SAFE OPERATION AT MAXIMUM SPEEDS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT.

When this module is used with a resolver or an analog tachometer in a drive control system, the user must ensure that a resolver or an analog tachometer has been selected as the feedback type during configuration to ensure speed feedback loss is detected. Only the feedback type selected during configuration is monitored for feedback loss.

The user must also determine the maximum safe operating speed for the motor, connected machinery, and material being processed. Then, the user must either verify that the system is incapable of reaching that speed, or ensure that the correct overspeed parameter value has been entered during configuration. Refer to Appendix D for the maximum safe operating speed for each resolver type.

Resolver Restrictions

The module cannot discriminate between X1, X2 and X5 resolvers, it only detects electrical rotations. One mechanical rotation is equivalent to one electrical rotation for a X1 resolver, two electrical rotations for a X2 resolver, and five electrical rotations for a X5 resolver. The practical limit of electrical speed that the module can detect is dependent both upon the resolver selected and upon the resolution selected during drive parameter configuration. See Appendix D.

5.2.1.2 Resolver Calibration

The resolver input can be used with X1, X2, and X5 resolvers with cable distances as shown in chapter 7 of this manual without having to externally tune the cable. Cable recommendations are shown in chapter 7.

The module contains circuitry to synchronize the reference waveform to within 10 degrees of the returning waveforms. This synchronization corrects for any phase shift which can occur between the reference and stator signal (i.e., stator signals lagging the reference) and can increase as the cable length increases. This is done automatically at power up after the PMI Processor receives the configuration data from the UDC module indicating that a resolver has been selected for speed feedback.

The module incorporates calibration procedures to adjust the gain to the proper level and balance the sine/cosine waveforms. These procedures should be initiated during initial system installation, if the resolver is replaced, or if the resolver cabling is changed (e.g., the cable is lengthened, shortened, or a different cable type is used). After the calibration procedures are performed, the gain and balance values are sent, along with other feedback data, to the UDC module to be stored for use at subsequent power ups. The values are stored in local tunables with the reserved names RES_BAL% and RES_GAN%.

Note that Distributed Power Systems are designed to be used with the Reliance resolvers described in Appendix D. The validity of the results of these calibration procedures is not guaranteed if resolvers other than those described in Appendix D are used.

Gain Calibration

The gain calibration is performed when the value stored in RES_GAN% equals zero (i.e., at initial system start up or by setting the value to zero). This procedure may be performed while the resolver is turning or stationary. Do not perform this procedure while the minor loop is running (i.e., bit 0 of register 200/1200 is set) or a drive fault will be generated (register 202/1202, bit 8). The procedure adjusts the gain to bring the stator voltages to a nominal 11.8 VAC. The range of the gain adjustment is 0-37 VAC at the rotor with a resolution of 0.15V. The nominal value is 26 VAC. When the gain calibration procedure is completed, bit 6 of UDC register 201/1201 will be set, and the gain value will be stored in RES_GAN%. Large gain values (close to 255) may indicate a problem with the resolver wiring or connections. Always check the value stored in RES_GAN% after the gain calibration procedure has been completed.

Note that the resolver must be connected to the motor in order for this procedure to be completed. If the system determines a maximum gain value (255) and detects a broken wire (indicated by bit 8, register 202/1202) while attempting to tune the gain, it will assume that a resolver is not connected. When the broken wire bit is cleared by the operating system (indicating that a resolver has been connected), the gain calibration procedure will automatically re-start. If bit 6 of register 201/1201 is not set, then the calibration procedure has not been completed.

Balance Calibration

The balance calibration procedure is initiated by setting bit 6 of UDC register 101/1101 (RES_CAL@) after turning the drive on and takes a few seconds to one minute to complete. This procedure must be performed while the resolver is rotating at one-half base speed (5 RPM minimum speed; speed does not have to be constant). The faster the resolver is turning, the faster the calibration procedure will be performed. Balance calibration compensates for different cable lengths or characteristics. One twisted-pair wire can yield more or less capacitance than another twisted-pair wire of the same length. Therefore, one channel could have more or less voltage on it than the other. If each stator has different capacitance on it, different response curves result. These curves should be equal for optimum performance.

The balance calibration procedure minimizes oscillations that occur due to imbalances between channels by adding capacitance to the sine or cosine channel. The module calculates the capacitance value which yields the smallest velocity variations with sine/cosine magnitudes within 1% of each other. Due to the characteristics of the cable or to noise problems, it is possible that the magnitudes will not be within 1% of each other. In this case, the module will calculate the capacitance value that minimizes velocity variations. When the balance calibration procedure is completed, bit 7 of UDC register 201/1201 will be set, and the balance value will be stored in RES_BAL%. If the sine/cosine magnitudes are not within 5% of each other, bit 5 of UDC register 203/1203 will also be set.

Checking Calibration Procedure Results

As described previously, bits 6 and 7 of UDC register 201/1201 will be set to indicate the gain and balance calibration procedures, respectively, have been completed. These bits do not indicate that the procedures were successful or that the resulting values are valid. After each test, check the value stored in the local tunables RES_GAN% and RES_BAL%. If the value is near or at its maximum value, it may indicate a problem.

After the balance test, check the ID Test Error bit (bit 5, UDC register 203/1203). This bit will be set if the balance calibration procedure was unsuccessful or yielded unexpected results. Failures may be caused by leaving the resolver unconnected during the procedure or by using cable runs beyond the recommended lengths (refer to chapter 7). Calibration procedure failures will not prevent the operation of the drive.

Refer to the appropriate Drive Configuration and Programming instruction manual for more information about these local tunables.

5.2.2 Analog Input

The Resolver Feedback connector is used for both resolver input and analog input signals. Refer to figure 5.2 for the connector pinout.

The analog input operates over the range of +/−10V differential (+/−30V common mode). Refer to figure 5.6. It is the user's responsibility to ensure that the input signal is scaled to conform to this range. The input is bandwidth-limited to 300 Hz. The resolution of the input is 12 bits (11 bits plus sign) or 4.88m V per bit. The input impedance 1.3 megohms and is resistively isolated.

If an analog tachometer is not used, the input may be used for other purposes as long as the signal is within the correct range.

The PMI Processor sends the analog input data to the UDC module immediately before it is needed by the UDC module for the next UDC task scan. The analog input data is stored in UDC register 214/1214. The value may range from −2047 (−10 volts) to +2047 (+10 volts).

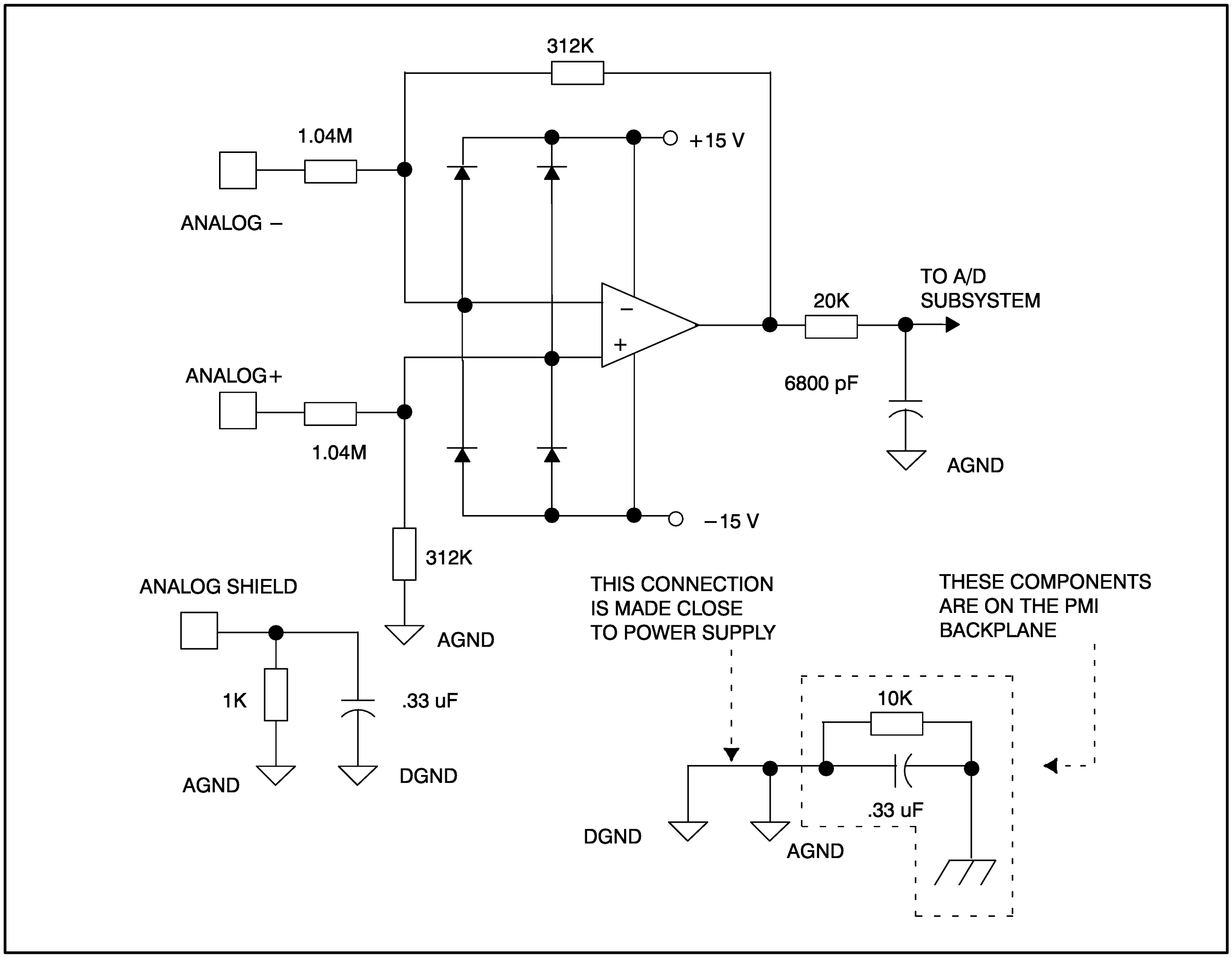


Figure 5.6 - Analog Input Circuit

5.2.3 Drive I/O

The digital drive I/O operate with 115 VAC (50/60Hz) nominal line voltage. All input and output channels have isolated commons with an isolated voltage rating limited to 150 VAC. All inputs and outputs have isolation voltage ratings of 1500 volts between the I/O and the PMI rack's power supplies. See figures 5.7 through 5.9 for the input and output circuit diagrams.

The status of the drive I/O is indicated in UDC register 201/1201 and by eight LEDs on the module faceplate. In the event of a power loss, or a system reset command is initiated by the PMI Processor, all outputs are turned off.

The Drive I/O connector pinout is shown in figure 5.10.

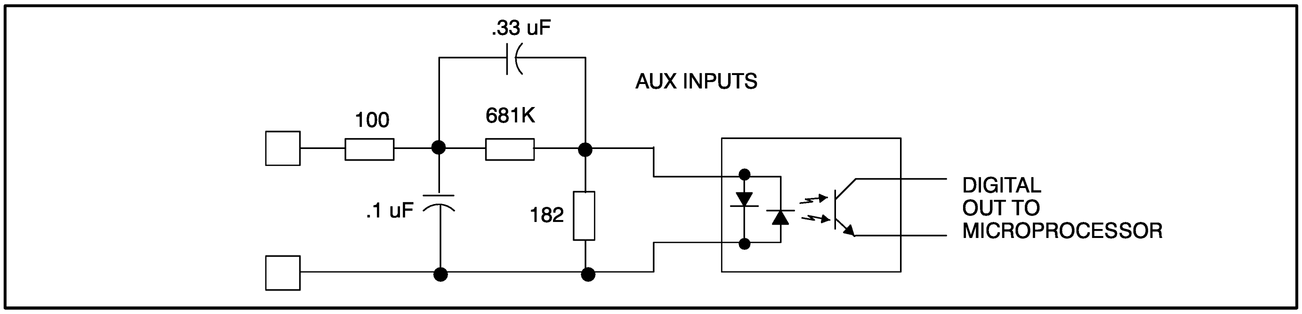


Figure 5.7 - Auxiliary Input Circuit

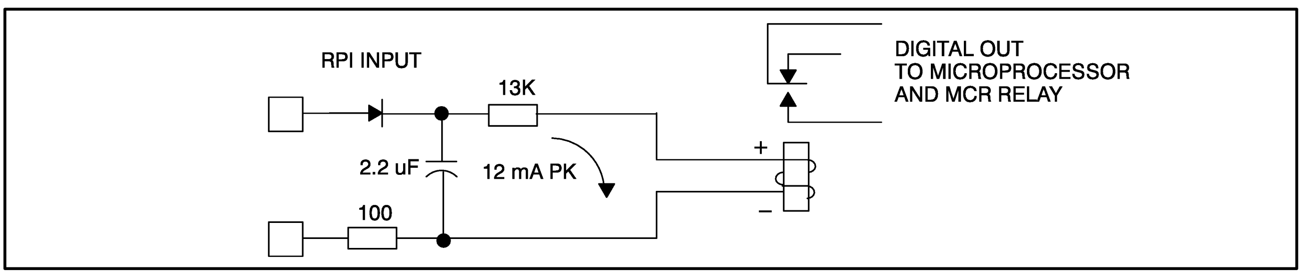


Figure 5.8 - Run Permissive Input (RPI) Circuit

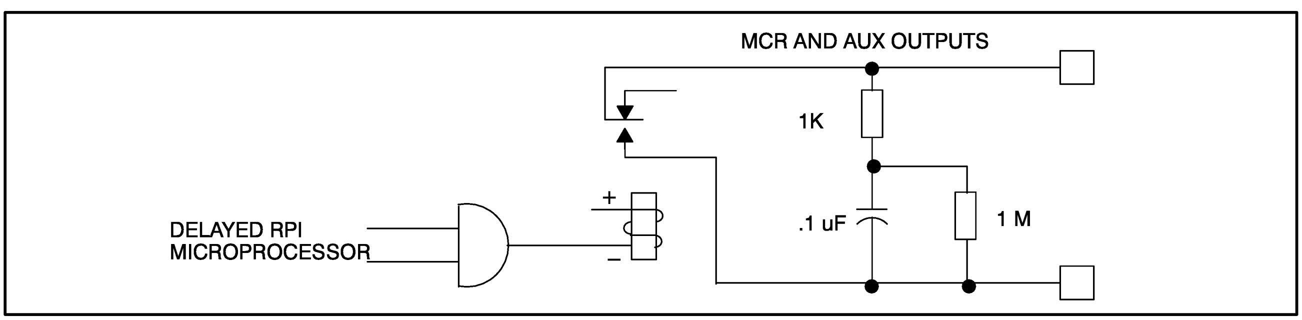


Figure 5.9 - MCR and Auxiliary Output Circuit

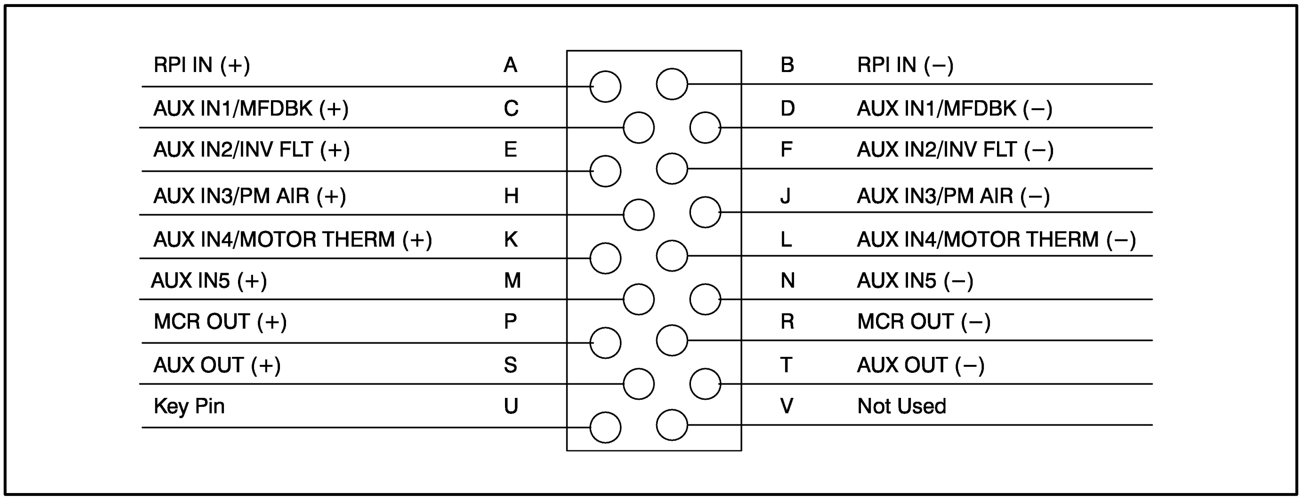


Figure 5.10 - Drive I/O Connector Pinout

The RPI input is used for the Run Permissive Input which is usually connected to the coast stop circuit. The M-Contactor, used either to switch D-C power to the motor or to switch A-C power to the Power Module, must be wired into the AUX IN1/MFBK input for monitoring purposes, and the MCR output must be used to control the M-Contactor. If both an A-C and D-C contactor are used, the A-C contactor status must have a set of contacts wired to the AUX IN1/MFBK input.

In systems using an M-Contactor to switch D-C power to the motor, when the Run Permissive Input (RPI) turns on and the interlock tests are complete, internal software turns on the MCR output as long as the CML_RUN input is on. When the RPI input turns off, the CML_RUN input turns off, or a fault is detected, the PMI Processor begins commanding zero current. When discontinuous conduction (i.e., current stops flowing and the PMI Processor turns off the MCR output when it first detects zero current) is detected, the MCR output is turned off by the PMI Processor.

In systems using a contactor to switch A-C power to the Power Module, the MCR output is controlled by the AutoMax application task. This task must turn on the MCR bit (101/1101, bit 1) to close the M-Contactor. When the RPI input or the CML_RUN input turns off, or a fault is detected, the PMI Processor begins commanding zero current and the AutoMax task must turn off the MCR output. The UDC task can turn off the MCR output even if the RPI input is on by turning off the MCR bit. Note that in systems using an A-C contactor, the PMI rack must not receive its power from the load side of the contactor.

In both types of systems, regardless of the state of the MCR bit, if the RPI input turns off, the MCR output will be turned off under hardware control within .5 seconds as a failsafe measure.

Note that while the auxiliary I/O inputs are defined by the user, the recommended purpose for each input/output is indicated in the pinout in figure 5.10. This provides a built-in standard for design consistency from application to application.

The AUX IN2/INV FLT IN input can be used to monitor the status of the inverting fault circuit breaker, if one is used. The AUX IN3/PM AIR LOSS input can be used to monitor the status of a power module airflow sensing switch. The AUX IN4/MOTOR THERM IN input can be used to monitor the status of a motor thermostat. These inputs can be used for any other auxiliary 115V switch function at the user’s discretion.

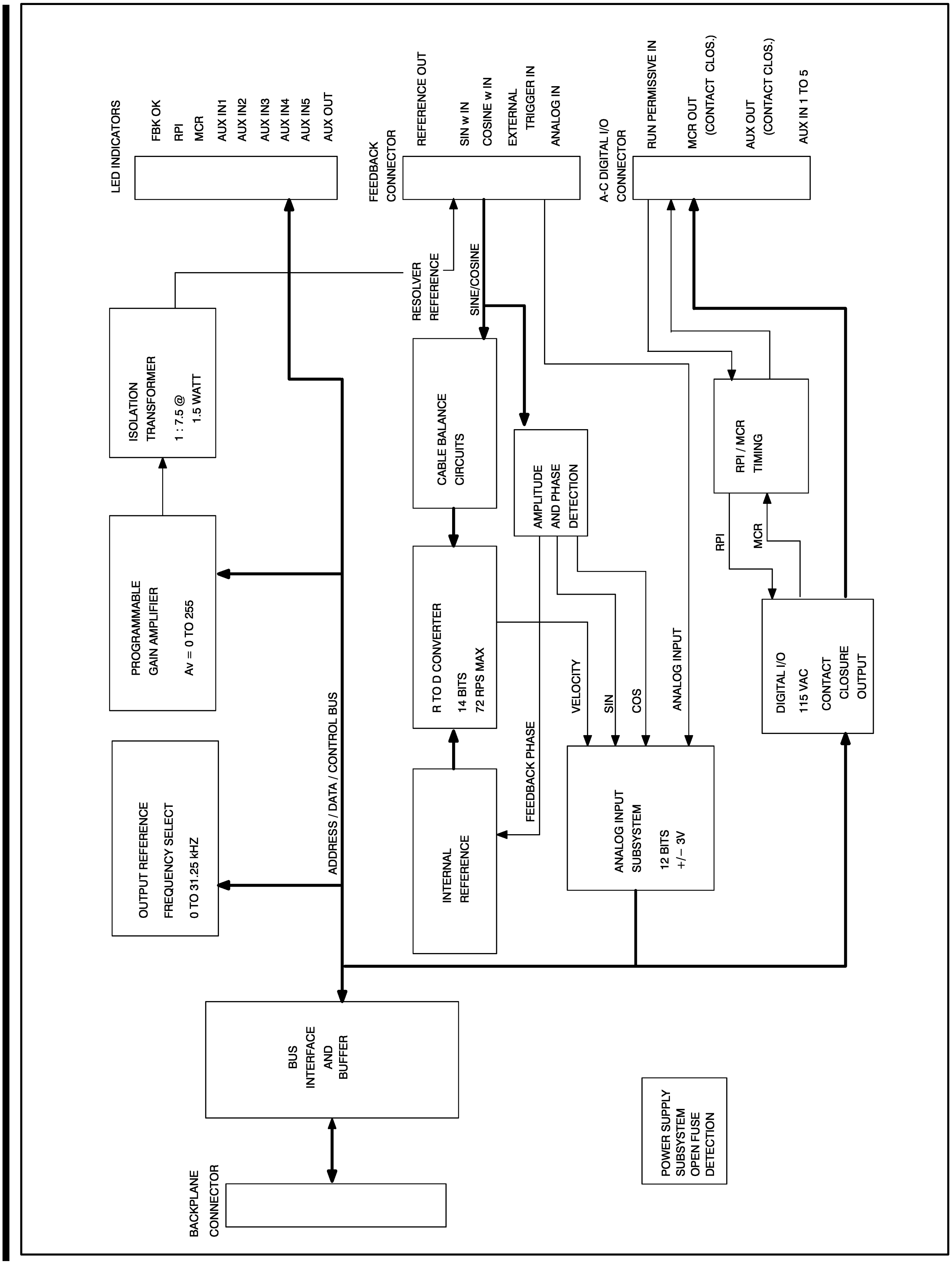


Figure 5.11 - Resolver and Drive I/O Module Block Diagram

6.0 D-C POWER TECHNOLOGY MODULE

The D-C Power Technology module (B/M O-60002) digitizes all armature and field Power Module signals for use in the armature and field current regulation algorithms. Based on the feedback inputs and the current reference value provided by the UDC module, the PMI Processor executes the armature and field current regulation algorithm and outputs firing angle information to the D-C Power Technology module. The module, in turn, provides the proper firing signals to the power devices in the armature Power Module and in the field Power Module, when field control is required.

The following sections provide mechanical and electrical descriptions of the D-C Power Technology module. A block diagram of the module is provided at the end of this chapter.

6.1 D-C Power Technology Module Mechanical Description

The D-C Power Technology module is a printed circuit board assembly that plugs into the rightmost slot of the PMI rack. The module consists of a printed circuit board and a faceplate. Screws are located on the top and bottom of the module faceplate to secure the module to the rack. The connector on the back of the module connects to the rack backplane. Module dimensions are listed in Appendix E. See figure 6.1 for the module faceplate.

One LED on the faceplate indicates the on/off status of the gate driver circuits.

The faceplate contains the following connectors for monitoring feedback signals and driving gate pulse transformers:

P1 - Armature Feedback (18 pin) is used for the drive armature analog feedback signals.

P2 - Armature Forward Gates (14 pin) provides the firing signal outputs for the forward section of the armature Power Module.

P3 - Armature Reverse Gates (14 pin) provides the firing signal outputs for the reverse section of the armature Power Module, if used.

P4 - Field Feedback and Gates (14 pin) is used for the field analog feedback signals and provides firing signal outputs for the field Power Module, if used.

6.1.1 LED Indicator

When lit, the OK LED on the faceplate indicates that power has been switched on to the gate driver circuits. Refer to section 6.2.2 for information about the gate driver circuits.

Note that the OK LED will not turn on until the operating system is loaded into the PMI. The drive parameters must be loaded into the UDC module to select which operating system to load into the PMI.

The OK LED will turn on when the following occurs:

- The CML_RUN@ bit (register 100/1100, bit 0) is set after the Shorted SCR Diagnostic is run.

The OK LED will turn off if any of the following occurs:

- The PMI rack is reset by the PMI Processor
- The on-board FPGAs fail to configure properly
- The on-board watchdog “times” out
- The +5 VDC logic supply falls below a pre-determined level

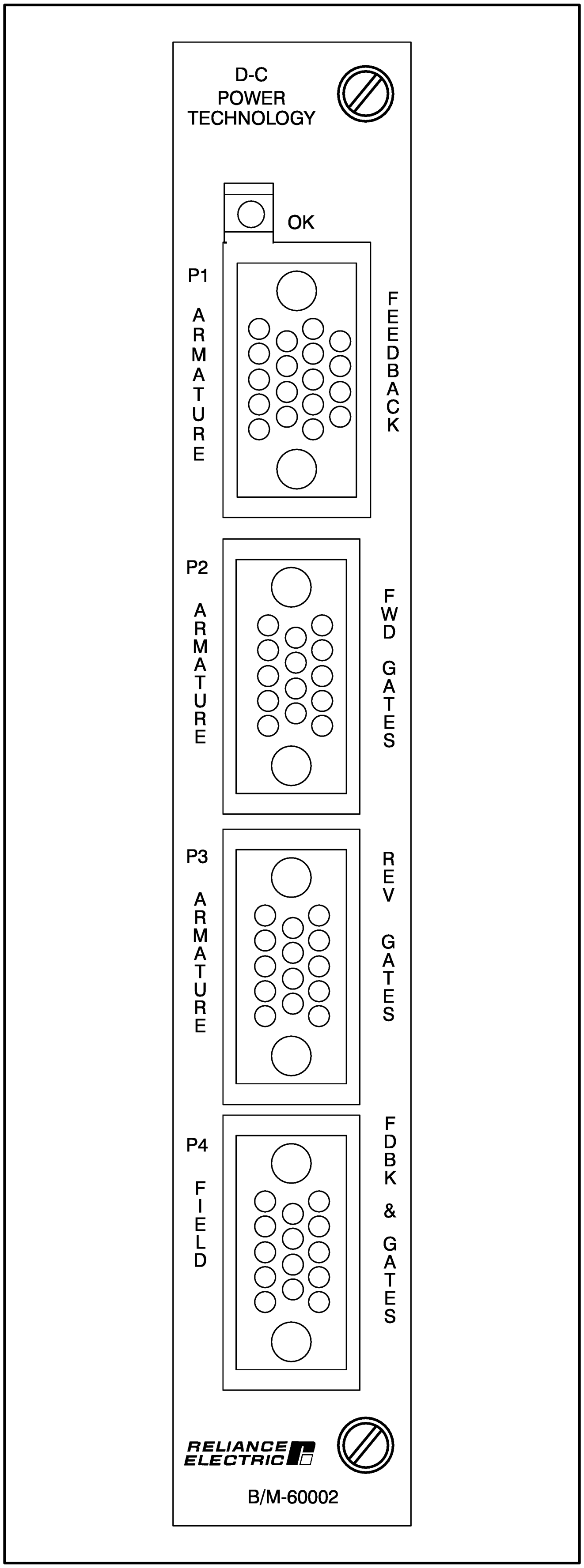


Figure 6.1 - D-C Power Technology Module Faceplate

6.2 D-C Power Technology Module Electrical Description

The D-C Power Technology module contains an on-board watchdog timer which is reset by the PMI Processor via the backplane. If it is not reset within a specified time, the watchdog will time out. If a timeout occurs, the power to the gate drivers is switched off, and the OK LED on the faceplate turns off. Bit 11 of UDC dual port register 202/1202 is set if the watchdog times out.

The module contains two field-programmable gate arrays (FPGA) which are configured at power-up or after a backplane reset signal has been asserted by the PMI Processor. An FPGA configuration failure will prevent the OK LED from being illuminated.

The module monitors the 5V logic supply via the backplane. This is independent of the power supply monitoring that is performed by the PMI Processor (refer to section 4.2.2). If the 5V line falls below a pre-determined level, the module is reset, and power to the gate drivers is switched off.

The following sections describe the input and output signals for each of the four connectors on the faceplate. Figure 6.2 provides an overview of the signal sources. Feedback data is updated on the module at each SCR firing. The PMI Processor reads the data at that time, and after a system-controlled time delay. It then performs the calculations required by the control algorithms.

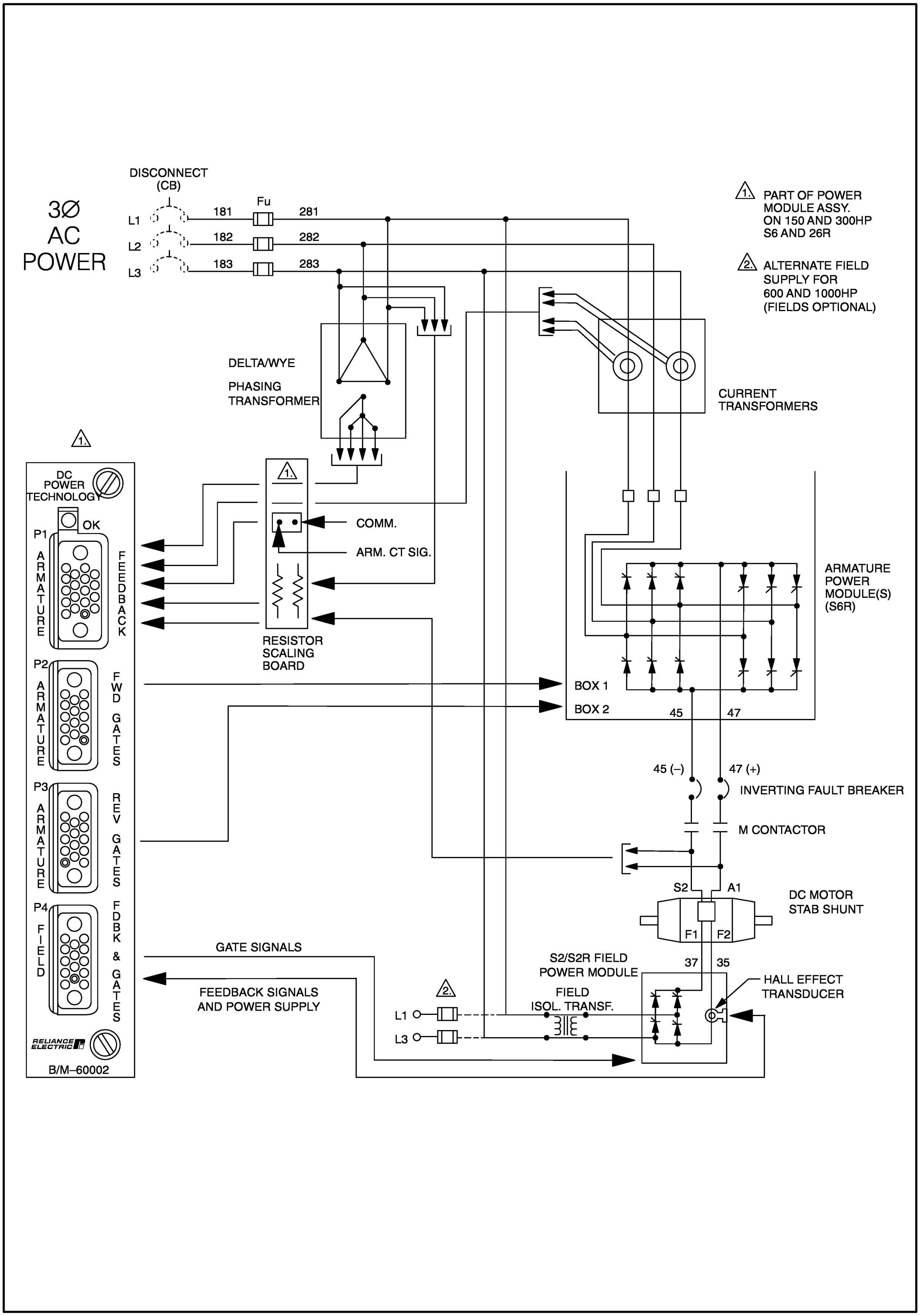


Figure 6.2 - Signal Sources

6.2.1 Armature Feedback (Connector P1)

Signals used for armature current, armature voltage, and A-C line voltage feedback are input through connector P1, labeled “ARMATURE FEEDBACK,” on the D-C Power Technology module.

Figure 6.3 shows the pinout for connector P1.

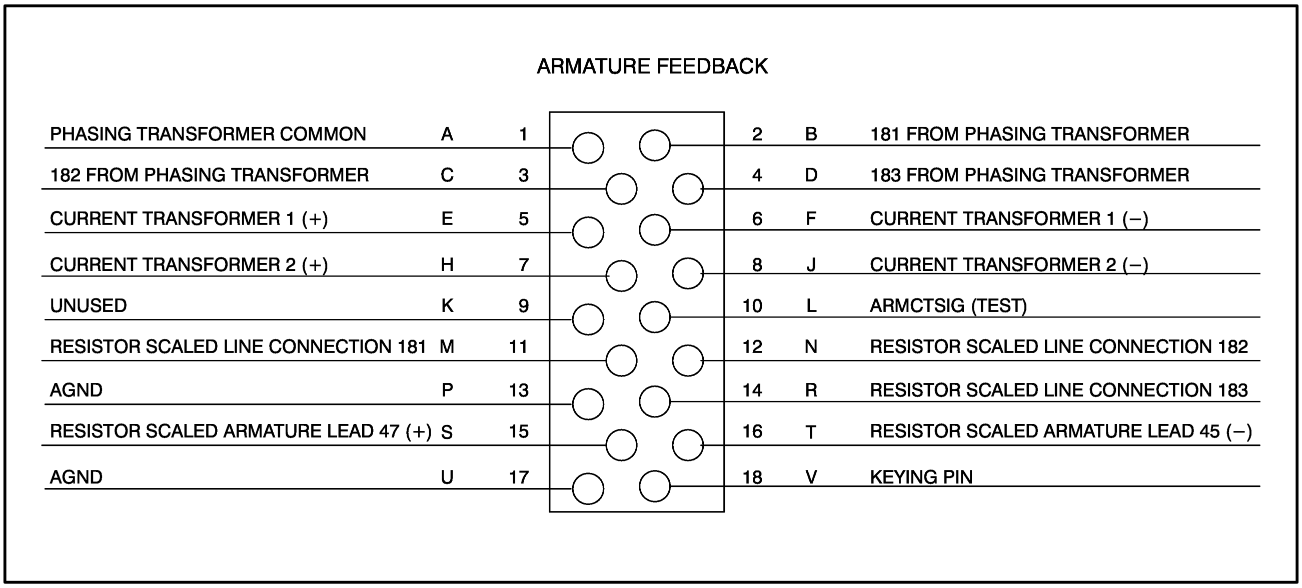


Figure 6.3 - Connector P1 Pinout (Armature Feedback)

6.2.1.1 Armature Current Feedback

Input signals:

Pin E: Current transformer 1 (+)

Pin F: Current transformer 1 (–)

Pin H: Current transformer 2 (+)

Pin J: Current transformer 2 (–)

Armature current feedback is used for the following purposes:

- Feedback for the current algorithm
- Overcurrent protection
- Application control tasks
- Motor CEMF determination

The armature current feedback signal originates from two current transformers (CTs) monitoring the A-C line current to the SCR bridge. The D-C Power Technology module full-wave rectifies and converts this signal into a D-C voltage signal proportional to the armature current using an internal fixed 10.2 ohm burden resistor. The resulting voltage signal is scaled by a programmable gain amplifier (PGA). The PGA output is integrated from SCR firing to SCR firing to provide a time-averaged current signal. This minimizes errors common to sampling techniques, such as sampling during a line spike or notch.

The measured armature current is displayed in amps in register 208/1208 of the UDC module’s dual port memory. It is displayed in counts in register 207/1207. Refer to Appendix E in the D-C Drive Configuration and Programming instruction manual (S-3006) for information regarding armature current feedback scaling.

The armature current feedback signal is monitored for a severe overcurrent condition. If the armature current feedback value exceeds the maximum current limit value plus 75%, the drive is shut down, and the fault is reported in UDC register 202/1202, bit 4.

Armature current feedback is also used for Counter EMF measurement. The Counter EMF register (210/1210) in the UDC module's dual port memory displays the measured Counter EMF voltage.

6.2.1.2 Voltage Feedback

Input signals:

Pin S: Resistor scaled armature lead 47

Pin T: Resistor scaled armature lead 45

Pin M: Resistor scaled line connection 181

Pin R: Resistor scaled line connection 183

Voltage feedback is used for the following purposes:

- Motor CEMF determination
- Application control tasks
- Bridge cross-over

An external resistor scaling board (part number 612885-5R) in the Power Module measures the voltage across the motor and reduces it to a current-limited signal acceptable to the module. This signal is integrated from SCR firing to SCR firing to provide a time-averaged voltage signal. The measured armature voltage is displayed in register 209/1209 of the UDC's dual port memory.

On regenerative drives, voltage across the SCRs is measured and scaled by the external resistive scaling assembly and input into an on-board SCR conduction comparator that is used for both fast bridge change and diagnostics (e.g., shorted SCR test). Using this data, the PMI Processor computes the SCR firing angles for both bridges and decides which bridge to fire. Power bridge changes from motoring to regeneration can be achieved with a 250 μsec minimum dead time.

6.2.1.3 A-C Line Voltage Feedback

Input signals:

Pin A: Phasing transformer common

Pin B: 181 from phasing transformer

Pin C: 182 from phasing transformer

Pin D: 183 from phasing transformer

A-C line voltage feedback is used for the following purposes:

- Monitor A-C line phase angle to synchronize the firing of the armature and field Power Module SCRs to that of the A-C line
- Linearize Power Module gain in the current algorithm
- Detect A-C line phase loss
- Detect low A-C line
- Input to inverting fault protection
- Detect phase rotation

A phasing transformer in the Power Module isolates and scales the three phase A-C line that feeds the Power Module. The secondary side of the transformer supplies a nominal 6.3V RMS to the D-C Power Technology module. The module full-wave rectifies and filters the three-phase input. The resulting D-C signal is multiplexed to the 12-bit (11 bit plus sign) A/D converter. The A-C Line Voltage Feedback register 206/1206 in the UDC module's dual port memory displays the corresponding A-C RMS line voltage.

If the A-C line voltage falls 15% below the A-C line voltage value entered during parameter configuration, the system will set bit 1 of UDC Drive Warning register 203/1203 indicating a loss of A-C line voltage. This will not affect the operation of the drive. The phase angle will be adjusted automatically to give the correct current amount, and the module will continue to fire the SCRs as long as A-C line zero crossings are detected. The user is responsible for defining in his application task what action is taken by the drive if this condition occurs.

If an A-C line zero crossing is not detected at the expected interval, the system will set bit 3 of UDC Drive Warning register 203/1203. If an A-C line zero crossing is not detected within 2 seconds, the drive is shut down and the fault is reported in bit 3 of UDC register 202/1202.

The PMI Processor identifies the phasing of the A-C line when A-C power is applied by observing the relationship of the 181 and 182 input signals. Bit 10 of UDC register 200/1200 is set if the line is phased ABC and it is cleared if the line is phased ACB. (Bit 11 of register 200/1200 is set to indicate the phase relationship has been tested and the data is valid.) The system adjusts to either phasing without user programming. Note, however, that if a blower motor is connected and the phases change, the blower motor will run in reverse. It is the user's responsibility to test the status of these bits in his application program.

6.2.2 Gate Drivers

The D-C Power Technology module provides the circuitry required to fire the gate driver circuits for an S6 or an S6R armature configuration and a single-phase, two- or four-quadrant field regulator. The armature Power Module's SCRs are fired every 1/6 of the line period (every 2.78 msec on the average) at 60 Hz. The field supply SCRs are fired every 1/2 of the line period (every 8.33 msec on the average) at 60 Hz.

Firing signal outputs are provided through the following faceplate connectors:

P2 - Armature Forward Gates

P3 - Armature Reverse Gates

P4 - Field Feedback and Gates

The connector pinouts are shown in the figures below. Note that in figure 6.6, Connector P4 is also used for the field analog feedback signals. Field feedback signals are described in section 6.2.3.

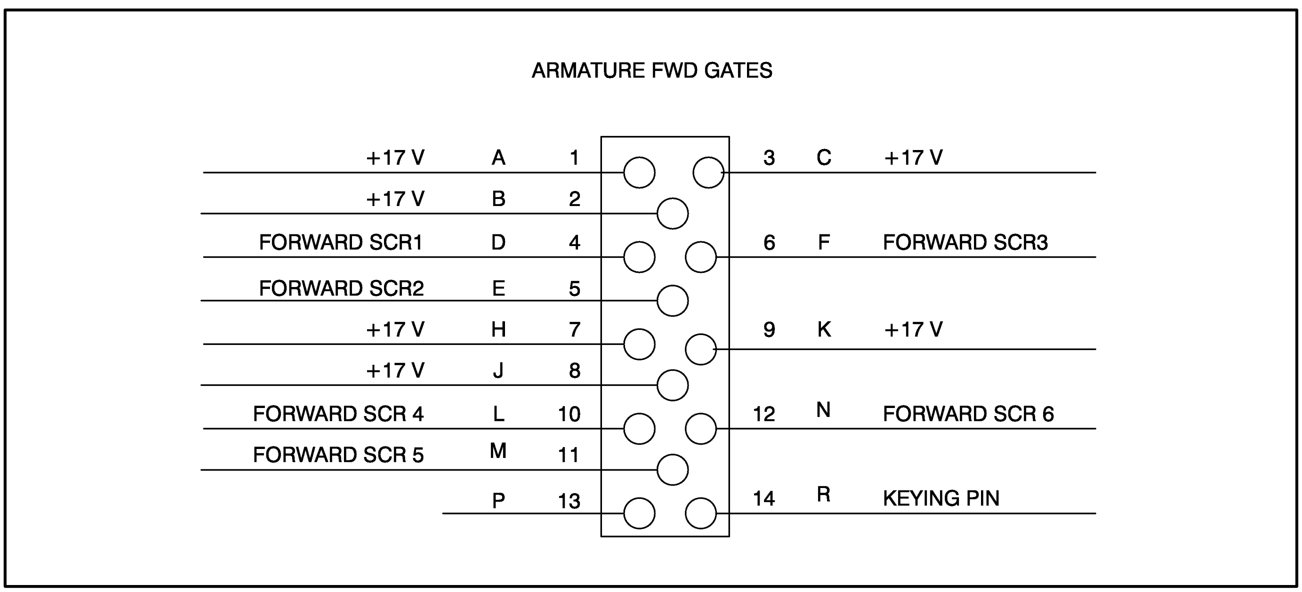


Figure 6.4 - Connector P2 Pinout (Armature Forward Gates)

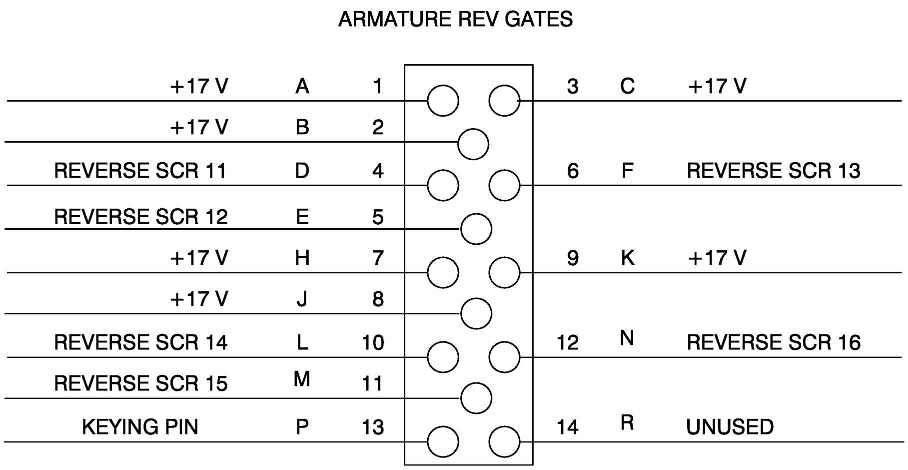


Figure 6.5 - Connector P3 Pinout (Armature Reverse Gates)

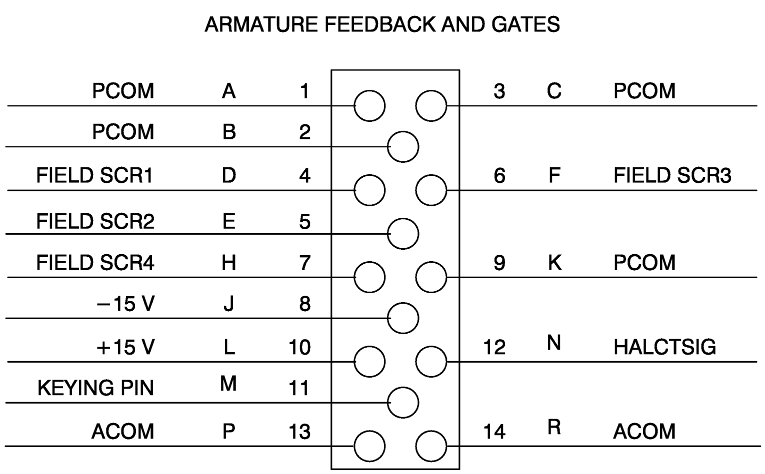


Figure 6.6 - Connector P4 Pinout (Field Feedback and Gates)

The module provides burst (repetitive) firing of the gates to guard against premature SCR turn-off due to electrical disturbances. The gate firing pulse train is shown in figure 6.7. Gate firing specifications are listed in Appendix E.

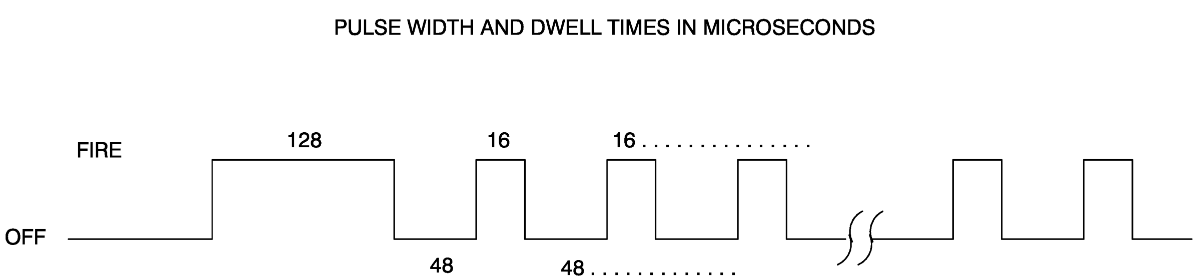


Figure 6.7 - Gate Firing Pulse Train

The signal use to fire the gate driver pulse transformers is supplied via the backplane from the Power Supply module. The module supplies gate power for up to 12 armature SCRs and 4 field SCRs. Figure 6.8 shows the gate drive circuitry.

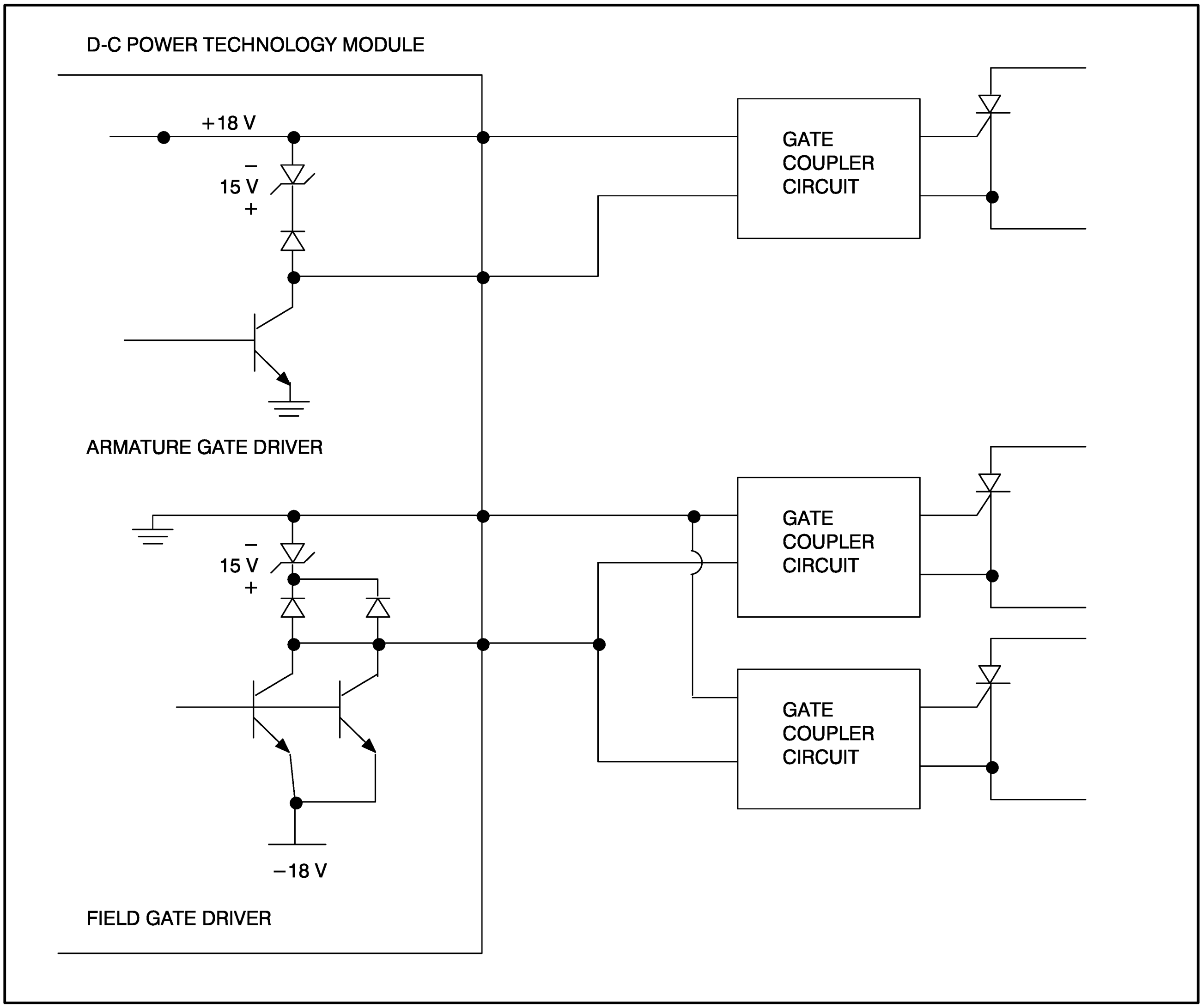


Figure 6.8 - Gate Driver Circuitry

6.2.3 Field Feedback (Connector P4)

Connector P4, labeled “FIELD FDBK & GATES,” is used for both field current feedback signals and firing signal outputs for the field Power Module, if used. This section describes the field current feedback signals. Refer to section 6.2.2 for a description of the firing signal outputs. The P4 connector pinout is shown in figure 6.7.

Field current feedback is used for the following purposes:

- Field current minor loop
- Field loss detection

An external Hall effect transducer senses the output current of the SCR bridge. The resulting D-C signal is filtered and multiplexed to the 12-bit A/D converter. Using this data, the PMI Processor will automatically adjust the phase angle to produce the correct current level. The measured field current is displayed in amps in register 212/1212 of the UDC module’s dual port memory. It is displayed in counts in register 211/1211.The power required to power the Hall-effect transducer is provided through the faceplate of the module.

The PMI Processor tests for field loss every time the field SCRs are fired. If the field current feedback is less than the field loss trip point value entered during configuration, the drive is shut down and the fault is reported in register 202/1202, bit 6 of the UDC module’s dual port memory.

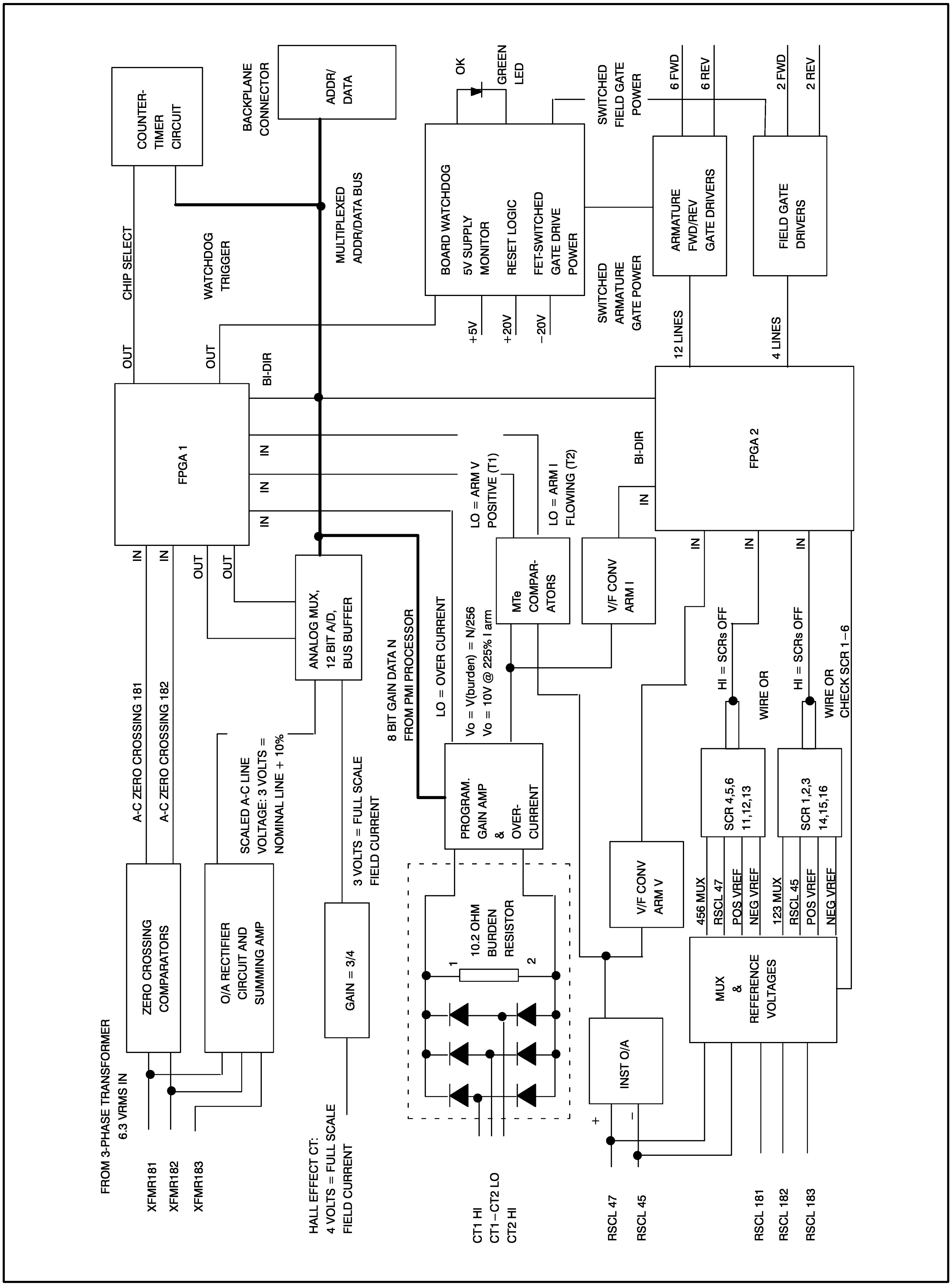


Figure 6.9 - D-C Power Technology Module Block Diagram

7.0 INSTALLATION GUIDELINES

DANGER

ONLY QUALIFIED PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THE CONTROLLED EQUIPMENT SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL AND OTHER MANUALS APPLICABLE TO YOUR INSTALLATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE PARTICULARLY IMPORTANT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

UNGROUNDED EQUIPMENT PRESENTS A SHOCK HAZARD. IF YOUR DRIVE CABINET IS MOUNTED SUCH THAT THE CABINET IS NOT GROUNDED, A GROUND WIRE MUST BE CONNECTED TO THE CABINET FOR PERSONNEL SAFETY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

CAUTION: This equipment must be connected to a power source for which it was designed. Verify that the available power is 115 volts A-c (10 kVa maximum input source). Failure to observe this precaution could result in damage to or destruction of the equipment.

CAUTION: The modules in the power module interface rack contain static-sensitive components. Do not touch the module's circuit board or the connectors on the back of the module. When not in the rack, modules should be stored in anti-static bags. Failure to observe this precaution could result in damage to or destruction of the equipment.

For drives 300 HP and less, the PMI rack is shipped from the factory as part of the Power Module assembly. In this case, the PMI rack assembly (805401-1R) contains the rack and the four modules. In this configuration, the rack shares the Power Module's fan.

For 600-1000 HP drives, the PMI rack is mounted on a panel separate from the Power Module and requires its own fan. In this case, the PMI rack assembly (805401-1S) contains the rack, the four modules, and a fan.

This section provides guidelines for installing and replacing the PMI rack and the modules and their related cable assemblies. This section provides general guidelines only. Always refer to the wiring diagrams supplied with your system for specific installation information.

7.1 Wiring

The user must ensure that the installation of wiring conforms to all applicable codes. To reduce the possibility of noise interfering with the control system, exercise care when installing wiring from the system to external devices. For detailed recommendations, refer to IEEE Standard 518.

7.2 Rack Installation

The rack is designed to be panel-mounted using M6 or 1/4”-20 screws. The holes in the top flange have a keyhole shape and the lower holes are U-shaped to facilitate mounting. Refer to figures 7.1 and 7.2 for the mounting dimensions.

Use the following guidelines when installing the PMI rack:

- Ensure there is enough space for the rack, wiring, terminal strips or other devices that must be mounted near the rack.
- Allow large enough clearance around the rack to provide accessibility for inspection, maintenance, and module replacement.
- Allow 50 mm (2”) of clearance above and below the rack for cooling purposes.
- Do not mount heat-generating equipment underneath the rack.
- Mount the rack within 3.5 meters (12 feet) of the Power Module (if it is not part of the Power Module assembly).
- Mount the rack in a vertical position only.
- Rack ambient temperature must not exceed 60° C (140° F).
- Rack ambient temperature must not be less than 0° C (32° F).
- Relative humidity must be between 5 and 95% (non-condensing).
- Ambient air must be clean and dry and free of flammable or combustible vapors, chemical fumes, oil vapor, steam, excessive moisture and dirt.

7.2.1 Grounding Considerations

DANGER

UNGROUNDED EQUIPMENT PRESENT A SHOCK HAZARD. THE GROUND TERMINAL ON THE POWER SUPPLY MODULE AND THE GROUNDING LUG ON THE RACK ARE NOT CONNECTED TOGETHER. CONNECT BOTH POINTS TO AN EXTERNAL EARTH GROUND. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

The ground terminal on the Power Supply module and the grounding lug on the rack are not connected together. Both points must be attached externally to earth ground and checked with an ohmmeter before power is applied. Use a star washer (toothed lock washer) to ensure effective grounding. Refer to figure 7.3 for the location of the Power Supply Module ground terminal and the rack grounding lug.

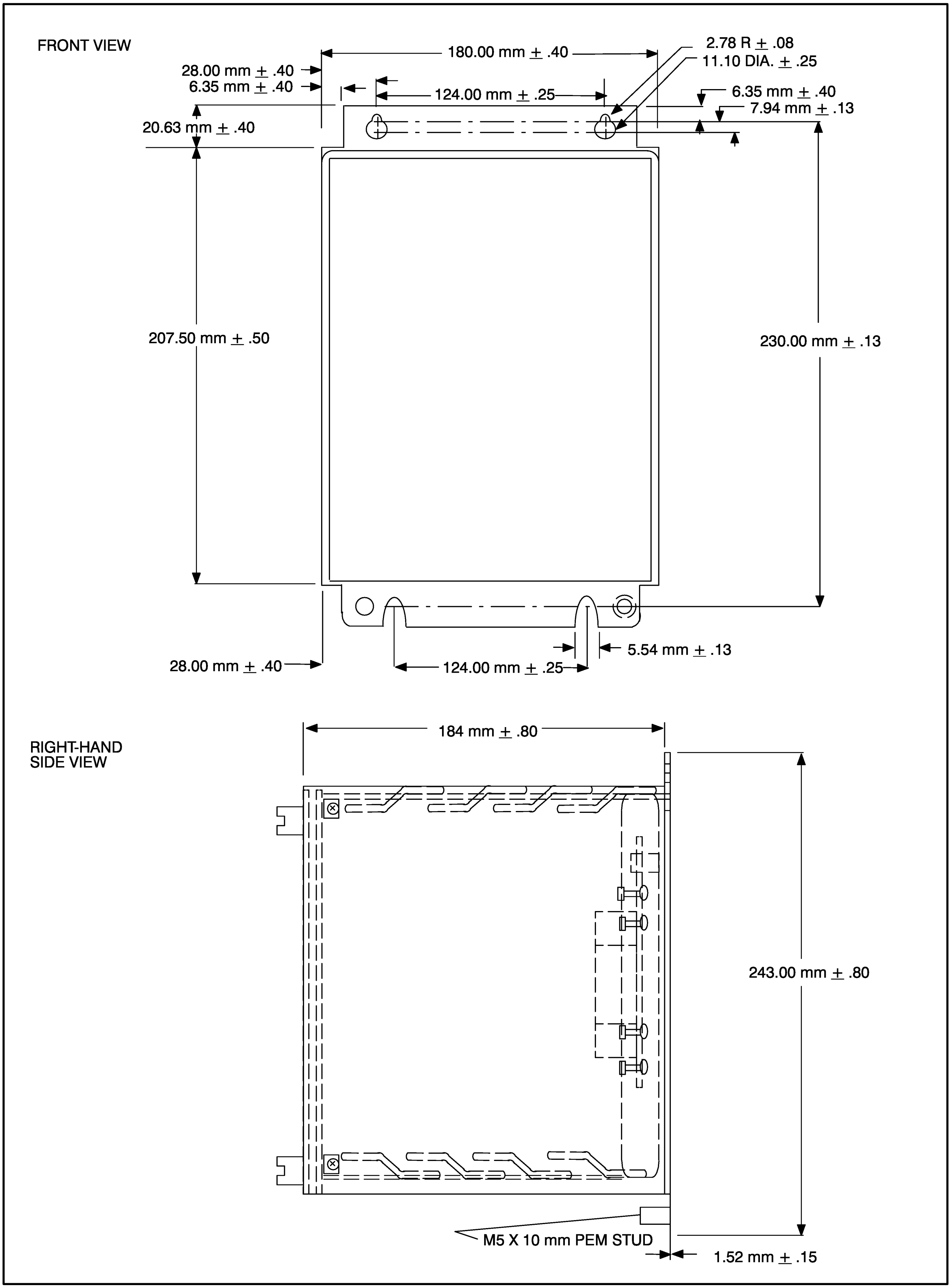


Figure 7.1 - PMI Rack Mounting Dimensions

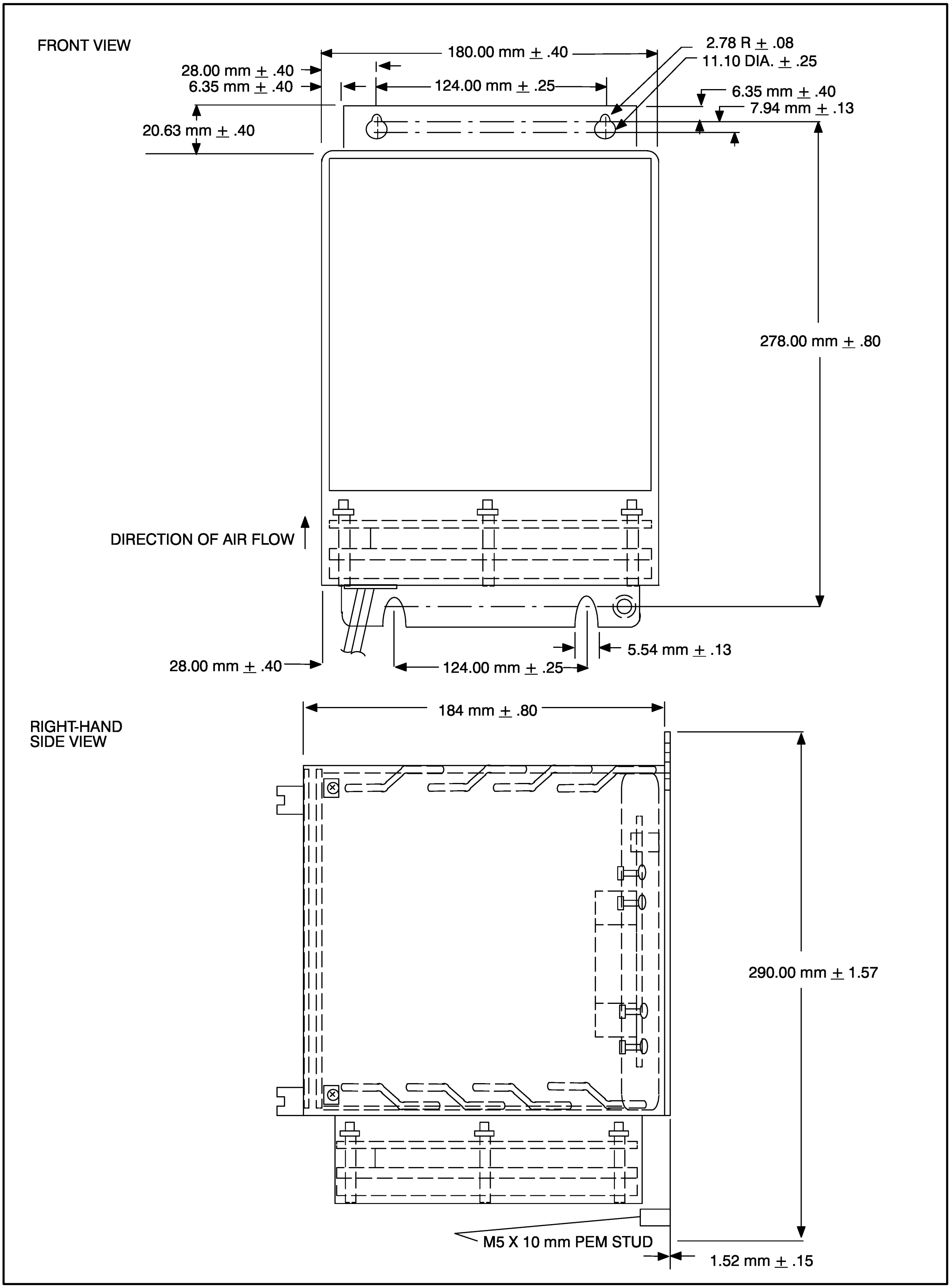


Figure 7.2 - PMI Rack Mounting Dimensions (with Fan)

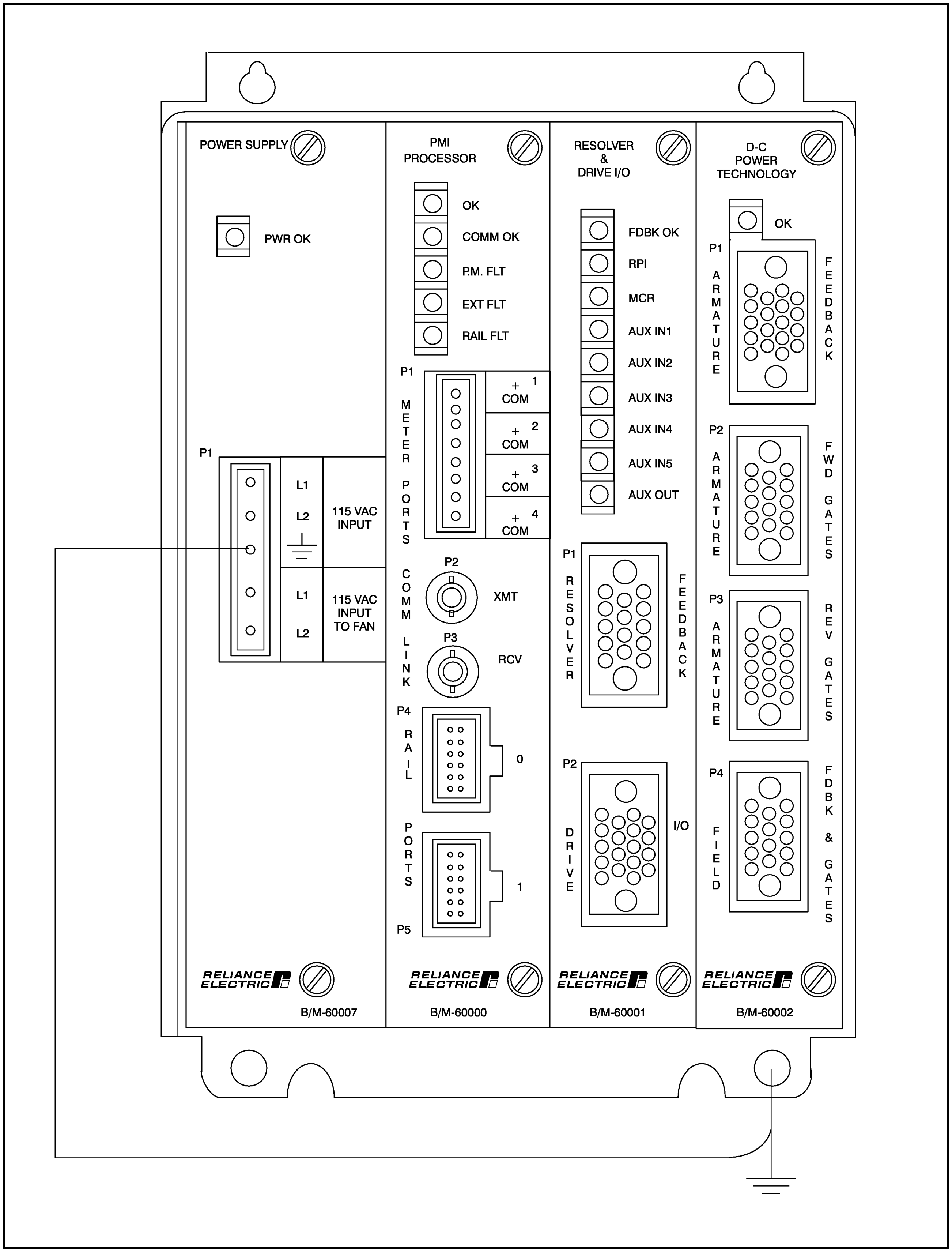


Figure 7.3 - Location of Power Supply Ground Terminal and Rack Grounding Lug

7.3 Module Installation/Replacement Guidelines

WARNING

INSERTING OR REMOVING A MODULE OR ITS CONNECTING CABLES MAY RESULT IN UNEXPECTED MACHINE MOTION. TURN OFF POWER TO THE RACK BEFORE INSERTING OR REMOVING A MODULE OR ITS CONNECTING CABLES. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

CAUTION: The modules in the Power Module Interface Rack contain static- sensitive components. Do not touch the module's circuit board or the connectors on the back of the module. When not in the rack, modules should be stored in anti-static bags. Failure to observe this precaution could result in damage to or destruction of the equipment.

The PMI Processor's operating system will not download to the PMI rack if any modules are in the wrong slots or are missing from the rack. Ensure the modules are placed in the rack according to figure 7.4.

Module	**Slot Location**			
	C1	C2	C3	C4
Power Supply	*			
Processor		*		
Resolver & Drive I/O			*	
D-C Power Technology				*

Figure 7.4 - Module Placement

Use the following guidelines when installing or removing a module:

- Ensure that power to the rack as well as power to the wiring leading to the rack is off.
- Use the metal guides provided in the rack to facilitate sliding the module into/out of the rack.
- Use care when inserting a module into the rack to avoid bending the connector pins.
- Ensure the module is well seated in the rack. Use the thumbscrews provided at the top and bottom of the module faceplate to secure the module to the rack.
- The individual modules are not enclosed; therefore, a module's circuit board is exposed when it is out of the PMI rack. Wear a ground strap and handle the module by the edges only. When not in use, the module should be stored in an anti-static bag.

7.4 Power Supply Module Connections

This section describes the input power and fan connections for the Power Supply module.

DANGER

THE POWER SUPPLY MODULE OPERATES USING A-C INPUT VOLTAGE CAPABLE OF PRODUCING SEVERE SHOCK. MAKE CERTAIN THAT THE EXTERNAL A-C SUPPLY CIRCUIT IS TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE OR ANY CONNECTING CABLES. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SERIOUS BODILY INJURY OR LOSS OF LIFE.

Drives 300 HP and less are shipped from the factory with the Power Supply module already wired to the control terminal board. In this configuration, the PMI rack shares the Power Module's fan.

On 600-1000 HP drives, the PMI rack's fan is connected to the terminals on the Power Supply module labeled "115 VAC OUTPUT TO FAN". The Power Supply module must be wired from the control power source using twisted pair wire. Refer to the following figure for connecting input power to the Power Supply module.

Wire Color	Wire Label	Power Supply Faceplate Connector
Red	A-C Line	L1
White	A-C Common	L2
Green	Ground	⏚

Figure 7.5 - Input Power Connections

7.5 PMI Processor Module Connections

This section describes the connections to the meter ports, the fiber-optic ports, and the rail ports on the PMI Processor module.

7.5.1 Meter Ports

A removable terminal block connector is used to connect analog devices to the PMI Processor module. Disconnect the terminal block connector from the module and use 2.08-0.326 mm^2 (14-22 AWG) twisted wire to connect the devices to the terminal block. Common leads may be tied together or run separately. The maximum wire length is 4 meters (13 feet). Figure 7.6 illustrates the terminal connections.

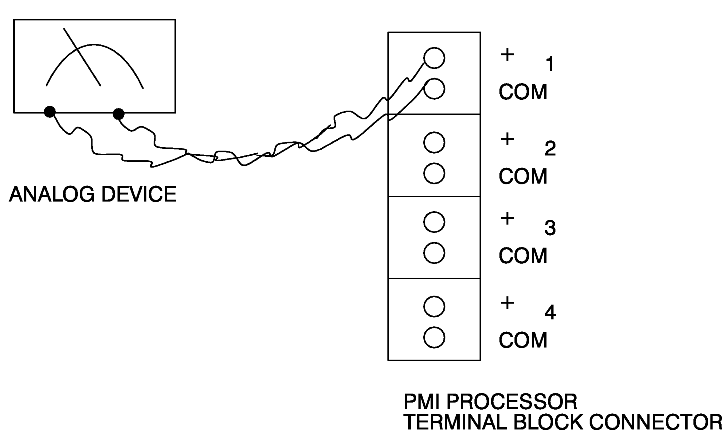


Figure 7.6 - Meter Port Connections

7.5.2 Fiber-Optic Ports

WARNING
TURN OFF, LOCKOUT, AND TAG POWER TO BOTH THE RACK CONTAINING THE UDC MODULE AND TO ITS CORRESPONDING PMI HARDWARE BEFORE VIEWING THE FIBER-OPTIC CABLE OR TRANSMITTER UNDER MAGNIFICATION. VIEWING A POWERED FIBER-OPTIC TRANSMITTER OR CONNECTED CABLE UNDER MAGNIFICATION MAY RESULT IN DAMAGE TO THE EYE. FOR ADDITIONAL INFORMATION REFER TO ANSI PUBLICATION Z136.1-1981. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Refer to the Fiber-Optic Cabling instruction manual (S-3009) for the procedure required to install and test the fiber-optic cable between the PMI Processor and the UDC module.

The PMI Processor module is shipped with dust caps covering the fiber-optic ports. The dust caps should not be removed until the fiber-optic cables are installed and should be replaced if the cables are disconnected.

7.5.3 Rail Ports

Analog or digital I/O rails are connected to the PMI Processor using an I/O Interconnect Cable (M/N 45C5). Refer to the proper instruction manual for the installation and wiring procedures for your equipment.

Model No.	Description	Manual
--	Digital I/O Rails and Modules	J-3012
61C350	2-In/2-Out 0-10V Analog Rail Module	J-3672
61C351	2-In/2-Out 4-20mA Analog Rail Module	J-3673
61C346	4 Input 0-10V Analog Rail Module	J-3688
61C345	4 Input 4-20mA Analog Rail Module	J-3689
61C366	4 Output 0-10V Analog Rail Module	J-3695
61C365	4 Output 4-20mA Analog Rail Module	J-3694

7.6 Resolver and Drive I/O Module Connections

Two cables are provided with your system for connection to the Resolver Feedback and Drive I/O connectors on the Resolver and Drive I/O module. The cable part numbers are stamped onto the cables and should be compared to the wiring diagrams shipped with your system. The following sections describe the connections to the Resolver and Drive I/O module.

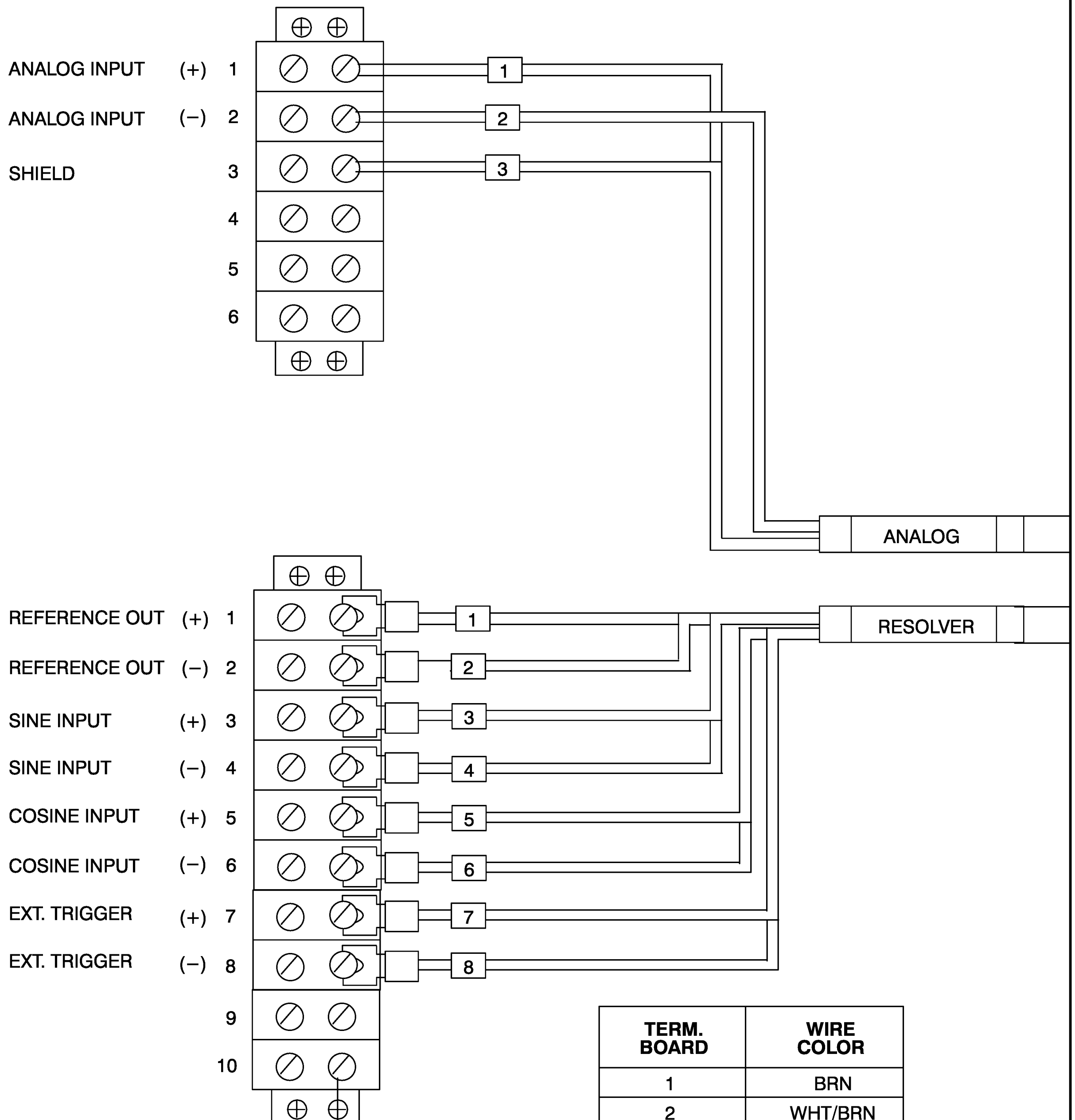
7.6.1 Resolver Feedback Connector

The Resolver and Analog Input cable (612426-S) provides the connection between the Resolver Feedback connector (P1) and eight- and three-point terminal boards. The eight-point terminal board is used for resolver connections. The three-point terminal board is used for analog input connections.

The cable has a 14-pin connector on one end for connection to the Resolver Feedback connector and is divided into two smaller cables which are labeled “ANALOG” and “RESOLVER”. The cable labeled “ANALOG” connects to the three-point terminal board. The cable labeled “RESOLVER” connects to the eight-point terminal board. Near the connector, the cable is labeled “C3-P1”. This indicates this cable connects to the P1 connector of the module located in the third rack slot.

NOTE: The connectors are secured to the module faceplate with two screws. When attaching the cables, alternate tightening each screw a few turns until the connector is securely attached to the faceplate connector. Follow the same procedure to loosen the screws when removing the connector.

Refer to figure 7.7 for the terminal board connections.



TERM. BOARD	WIRE COLOR
1	BRN
2	WHT/BRN
3	RED
4	WHT/RED
5	ORG
6	WHT/ORG
7	YEL
8	WHT/YEL
KEY CONTACT NO WIRE CONNECTION	
1	BLK
2	CLEAR
3	DRAIN (SHIELD)

Figure 7.7 - Terminal Board Connections for Resolver and Analog Input

7.6.1.1 Resolver Input

Resolver					Resolver & Drive I/O Module		
	Conn Pin						
Resolver Winding		613469-1,-2	800123, 800123-1	800123-2	TB	Faceplate Conn Pin	Resolver Module
Ref. Input	R1+	A	1	A	1	A	+ Ref. Output
	R2−	B	2	B	2	B	−
Sine Output	S1+	C	3	D	3	D	+ Sine Input
	S3−	D	4	F	4	C	−
Cosine Output	S2+	E	5	G	6	F	− Cosine Input*
	S4−	F	6	E	5	E	+
					7	H	+ Ext. Strobe*
					8	J	−

* Connections shown give a positive speed signal for counter-clockwise motor rotation (when facing the commutator). To reverse the polarity of this signal, interchange cosine input leads (terminals 5 and 6).

Figure 7.8 - Standard Resolver Connections

Typical voltage levels associated with the resolver are as follows:

- Reference: This is a 2381 Hz sine wave with a typical amplitude of approximately 26V RMS. When measuring any of the resolver signals, make sure that the meter used can respond to 2381 Hz accurately or use an oscilloscope.
- Sine or cosine feedback: This is a 2381 Hz signal with an amplitude that varies with the rotation of the shaft. Maximum amplitude (as the shaft turns) should be approximately 11.8V at the resolver module. Voltages may be different depending on the installation. The system adjusts the signal levels to develop 11.8V maximum at the module input.

Reliance recommends the following cables for resolver connection:

Reliance Part No. 417900−	No. of Twisted Pairs	Length of Twist	Twists Per Inch	Size mm^2 (AWG)	Recommended Maximum Distance Per Resolver Type		
					X1	X2	X5
−207CG	3	12.7-8.5 mm	(2−3)	0.823 (18)	255 m (850 ft)	240 m (800 ft)	150 m (500 ft)
−76EAD	1	12.7-8.5 mm	(2−3)	1.31 (16)	320 m (1050 ft)	310 m (1025 ft)	190 m (625 ft)

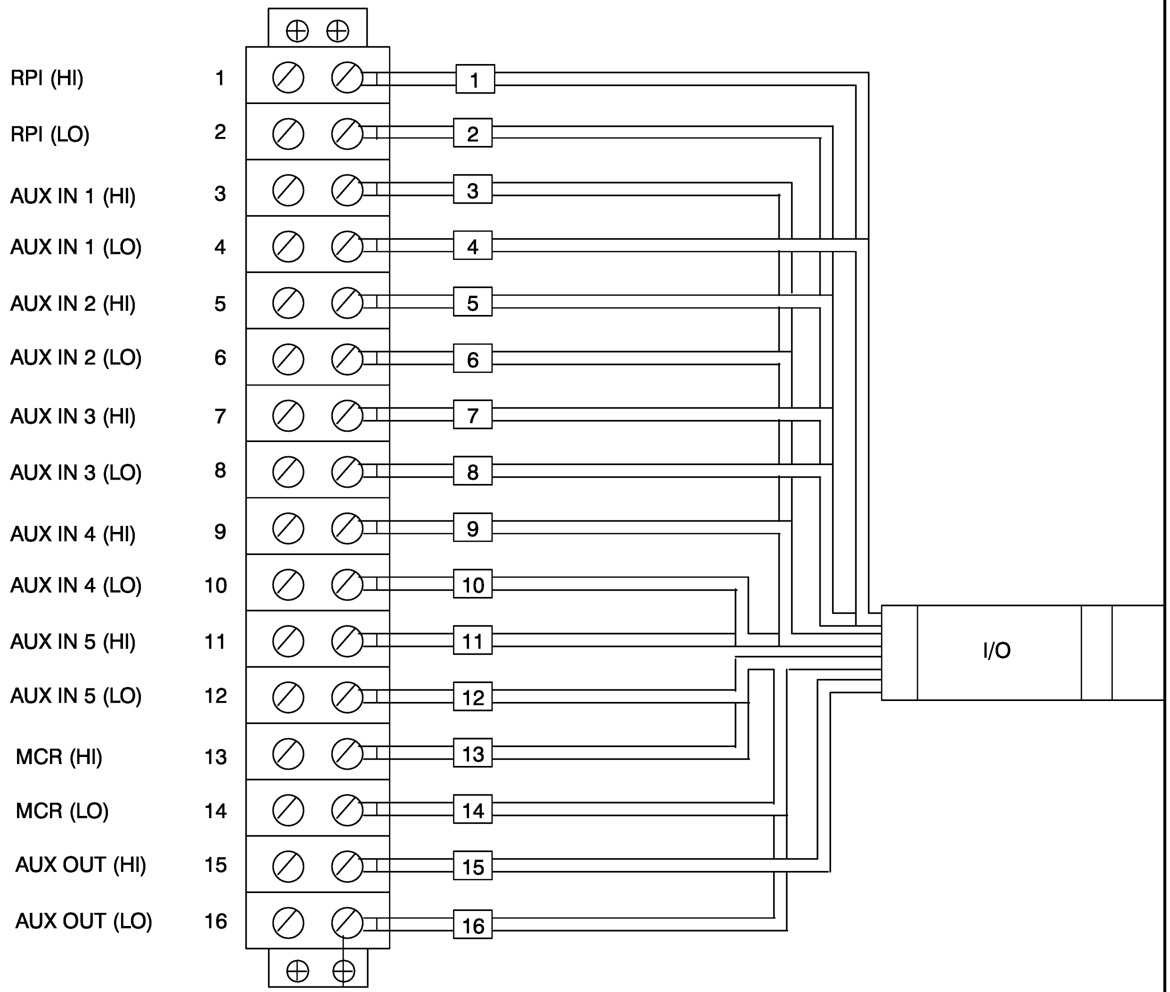
Figure 7.9 - Recommended Resolver Cables

7.6.1.2 Analog Input

Use 0.823-0.326 mm^2 (18-22 AWG) twisted pair shielded cable to connect the analog device to the terminal board. Connect the shield to the SHIELD terminal.

7.6.2 Drive I/O Connector

The Drive I/O Cable (612401-T) provides the connection between the Drive I/O connector (P2) and a 16-point terminal board. The cable has an 18-pin connector on one end for connection to the Drive I/O Connector. Near the connector, the cable is labeled "C3-P2". This indicates that this cable connects to the P2 connector of the module located in the third rack slot. Near the terminal board connections, the cable is labeled "I/O". Refer to figure 7.10 for the terminal board connections.



TERM. BOARD	WIRE COLOR
1	BRN
2	WHT/BRN
3	RED
4	WHT/RED
5	ORG
6	WHT/ORG
7	YEL
8	WHT/YEL
9	GRN
10	WHT/GRN
11	BLU
12	WHT/BLU
13	VIO
14	WHT/VIO
15	GRY
16	WHT/GRY

Figure 7.10 - Terminal Board Connections for Drive I/O

7.7 D-C Power Technology Module

Four cables are provided with your system for connection to the D-C Power Technology module. The cable part numbers are stamped onto the cables and should be compared to the wiring diagrams shipped with your system.

Each cable has a connector on one end for connection to the module's faceplate connector. Near the connector, each cable is labeled "C4-Pn," where n is the module's connector number (i.e., P1, P2, P3, P4). For example, the cable labeled C4-P1 is connected to the P1 connector of the module located in the fourth rack slot. The connectors contain key pins to prevent the cables from being connected to the wrong connector.

NOTE: The connectors are secured to the module faceplate with two screws. When attaching the cables, alternate tightening each screw a few turns until the connector is securely attached to the faceplate connector. Follow the same procedure to loosen the screws when removing the connector.

Refer to the wiring diagrams supplied with your system for the connection instructions for the equipment specific to your installation.

Appendix A

Rack Specifications

Ambient Conditions

- Storage temperature: −30° C to 85° C (−22° F to 185° F)
- Operating temperature: 0° to 60° C (32° F to 140° F)
- Humidity: 5 - 95%, non-condensing

Rack Dimensions

Four Slot Rack

- Height: 243 mm (9.5 inches)
- Width: 180 mm (7.09 inches)
- Depth: 184 mm (7.25 inches)

Four Slot Rack with Fan

- Height: 290 mm (11.5 inches)
- Width: 180 mm (7.09 inches)
- Depth: 184 mm (7.25 inches)

Bus Specifications

- Type: Proprietary

Fan Assembly (805400-5R)

- One per rack when not part of Power Module assembly
- 115 VAC
- 50/60 Hz
- 14/11 watts

Appendix B

Power Supply Specifications

Ambient Conditions

- Storage temperature: −30° C to 85° C (−22° F to 185° F)
- Operating temperature: 0° to 60° C (32° F to 140° F)
- Humidity: 5-95%, non-condensing

Maximum Module Power Dissipation

- 50 watts

Dimensions

- Height: 205 mm (8.063 inches)
- Width: 66.67 mm (2.625 inches)
- Depth: 174 mm (6.813 inches)

Maximum Source KVA

- 10

Short Circuit Limitation

- 10,000VA

System Power Requirements

- Input voltage: 103-126V (115V +/−10%)
- Current: 1 amp maximum
- Frequency: 47-63Hz
- Protection: Fuse (not user-serviceable)

D-C Output

- 5V (+/−5%): 0-4 amps
- Line regulation: .4% (103V-126V)
- Load regulation: .8% (0 to full load)
- Noise ripple: 120mV
- Efficiency: 75%
- Overcurrent protection: 15A maximum
- Overvoltage protection: Inverter drive removal if exceeded
- Holdover time: 30 mSec (max load, low line)
- +/− 17.5V nominal unregulated: 600mA

Appendix C

Power Module Interface Processor Module Specifications

Ambient Conditions

- Storage temperature: −30° C to 85° C (−22° F to 185° F)
- Operating temperature: 0° to 60° C (32° F to 140° F)
- Humidity: 5 to 95%, non-condensing

Maximum Module Power Dissipation

- 12 watts

Dimensions

- Height: 205 mm (8.063 inches)
- Width: 35 mm (1.375 inches)
- Depth: 174 mm (6.813 inches)

System Power Requirements

- +5 Volts @ 1100 MA (3,000 MA maximum with rails attached)
- +18 Volts @ 100 MA
- −18 Volts @ 100 MA

Analog Output Specifications

- Number of outputs: 4
- Number of commons: 1
- Operating range: −10 to +10 VDC
- Maximum output current: 20 mA
- Resolution: 8 bits binary
- Non-linearity: +/− 1 LSB maximum
- Accuracy: 2.4% of maximum at 25° C
- Thermal drift: 120 ppm/degree C
- Type of converter: 4 DACs with output buffer amplifiers and interface logic on a monolithic IC
- Speed of conversion: Scan dependent
- Output settling time: 20 µsec. maximum
- Minimum load resistance: 500 Ohms
- Maximum load capacitance: 10,000 pF

Appendix C

(Continued)

Fiber-Optic Port

- Transmitter: 1
- Receiver: 1
- Data rate: 10 Mbd
- Coding: Manchester
- Protocol: HDLC (compatible with UDC module)

Rail I/O

- Channels: 2
- Analog/digital rails only; no Local Heads

Appendix D

Resolver and Drive I/O Module Specifications

Ambient Conditions

- Storage temperature: −30°C to 85°C (−22°F to 185°F)
- Operating temperature: 0°to 60°C (32°F to 140°F)
- Humidity: 5-95%, non-condensing

Maximum Module Power Dissipation

- 5.25 watts

Dimensions

- Height: 205 mm (8.063 inches)
- Width: 35 mm (1.375 inches)
- Depth: 174 mm (6.813 inches)

Module Power Requirements

- 8 watts

Resolver Interface

- Resolution: 12 or 14 bits (software-selectable)
- Required resolver accuracy (electrical)
  12-bit configuration: 5 arc minutes (typical)
  14-bit configuration: 1 arc minute
- External strobe input:
  Input signal: 24 volt positive pulse
  Maximum pulse frequency: 1 Kilohertz
  Minimum pulse width: 300 microseconds
  Typical transport delay: 250 microseconds

Specifications for Reliance Resolvers

Resolver Part No.	Resolver Type	Accuracy Max. Error Spread (Electrical)	Resolver Mechanical Max. Speed	Resolver & Drive I/O Module Interface LImitation		Resulting Effective Resolver Max. Speed*	
				12-bit	14-bit	12-bit	14-bit
613469-1R,-1S,-2R,-2S	x1	16 arc minutes	8,000 RPM	10,000 RPM	4,200 RPM	8,000 RPM	4, 200 RPM
800123-R, -1R, -2R	x1	10 arc minutes	5,000 RPM	10,000 RPM	4,200 RPM	5,000 RPM	4, 200 RPM
800123-S, -1S, -2S	x2	10 arc minutes	5,000 RPM	5,000 RPM	2,100 RPM	5,000 RPM	2,100 RPM
800123-T, -1T, -2T	x5	5 arc minutes	5,000 RPM	2,000 RPM	840 RPM	2,000 RPM	840 RPM

* Use this value to determine what resolver type to use in DPS applications.

Appendix D

Continued

Analog Input

- Differential input range: +/−10 volt peak
- Common mode input range: +/−30 volt peak
- Input impedance: >1 megohm
- Bandwidth: 300 hertz
- Resolution: 4.88 millivolts
- Accuracy: 2%
- Resistive isolation: 1 megohm (not operating)

Digital Input Specifications

- Number of inputs: 6
- Maximum operating voltage: 132 volts RMS
- Minimum turnon voltage: 92 VAC RMS
- Maximum turnoff voltage: 22 VAC RMS 50/60 Hz
- Maximum off-state current: 3 mA
- Minimum turn on current (except RPI): 14 mA
- Minimum RPI turn on current: 12 mA
- Input to ground isolation: 150 volts RMS
- Input to input isolation: 1500 volts RMS
- Input current at 115V 60 Hz: 23.5 mA
- Maximum input delay @50 Hz: 35 msec
- Maximum input delay @60 Hz: 26 msec

Digital Output Specifications

- Number of outputs: 2 contact closure
- Contact rating: 2 amps
- Maximum operating voltage: 132 volts RMS
- On state voltage drop at rated current: 1.5 volts
- Peak inrush (1 sec): 5 amps
- Maximum leakage current: 4.8 mA
- Output to ground isolation: 150 volts RMS
- Output to output isolation: 1500 volts RMS

Appendix E

D-C Power Technology Module Specifications

Ambient Conditions

- Storage temperature: −30° C to 85° C (−22° F to 185° F)
- Operating temperature: 0° C to 60° C (32° F to 140° F)
- Humidity: 5 to 95%, non-condensing

Dimensions

- Height: 205 mm (8.063 inches)
- Width: 35 mm (1.375 inches)
- Depth: 174 mm (6.813 inches)

Maximum Module Power Dissipation

- 6 watts
- +5V @ 100mA
- +18V @ 150mA
- −18V @ 150mA

Maximum System Power Requirements

- Armature gate power: +18V @ 250mA
- Field gate power: −18V @ 150mA

Coupler Circuit at 17V Gate Supply Voltage

- Open circuit voltage: 10V
- Short circuit current: 420mA

Maximum Armature Gate Burst Firing Period

- 2.778 msec @ 60 Hz
- 3.333 msec @ 50 Hz

Maximum Field Gate Burst Firing Period

- 8.333 msec @ 60 Hz
- 10.00 msec @ 50 Hz

Line Voltage and Field Current

- 12-bit successive approximation, −2048 to +2047 counts
- 2047 = nominal line voltage +10%
- 2047 = 15A field current +10%

Appendix E

(Continued)

Armature Voltage

- Voltage-to-frequency converter #1 @60Hz 2777 counts = (A-C line voltage) * 1.35

Armature Current

- Voltage-to-frequency converter #2 @60Hz 5555 counts = (current limit) + 75%

Armature Bridge Switching Deadtime

- 250 μsec

Single-Phase Field Bridge Switching Deadtime

- 150 msec

Appendix F

PMI Rack/UDC Register Cross-Reference

Power Supply Module

Description	Register	Bit
PMI fan loss	203/1203	12
PWR OK LED		
PMI Power supply fault	202/1202	12

PMI Processor Module

Description	Register	Bit
Rail data	0-23	
Rail faults	4, 10, 16, 22	
PMI-UDC communication status	80-89/1080-1089	
PMI meter port output	106/1106	
P.M. FLT LED		
Shorted SCR fault	202/1202	0
Field loss fault	202/1202	6
EXT FLT LED		
A-C line synchronization fault	202/1202	3
Instantaneous overcurrent fault	202/1202	4
Overspeed fault	202/1202	10
Application program control	101/1101	2
RAIL FLT LED		
Rail communication error	203/1203	13

Appendix F

(Continued)

Resolver and Drive I/O Module

Description	Register	Bit
Resolver scan position data	215/1215	
Resolver strobe position	216/1216	
Enable external strobe	101/1101	8
Enable external strobe falling edge	1011/1101	9
External strobe detected	201/1201	8
External strobe level	201/1201	9
Enable resolver balance calibration test	101/1101	6
Resolver gain calibration test complete	201/1201	6
Resolver balance calibration test complete	201/1201	7
ID test error	203/1203	5
Analog input data	214/1214	
Drive I/O control	101/1101	
Drive I/O status	201/1201	
Resolver fault	202/1202	9
FDBK OK LED		
Tach loss fault		7
Motor speed feedback broken wire	202/1202	8
RPI LED		
RPI input	201/1201	0
MCR LED		
MCR output	101/1101	1
AUX IN1 LED		
Aux input 1/MFDBK	201/1201	1
AUX IN2 LED		
Aux input 2/Inverting fault input	201/1201	2
AUX IN3 LED		
Aux input 3/Power module air loss input	201/1201	3
AUX IN4 LED		
Aux input 4/Motor thermal switch input	201/1201	4
AUX IN5 LED		
Aux input 5	201/1201	5
AUX OUT LED		
Aux output	101/1101	4

Appendix F

(Continued)

D-C Power Technology Module

Description	Register	Bit
OK LED		
Watchdog timeout	202/1202	11

Appendix G

SF3000 Drive

Each Distributed Power D-C Power Module contains a three-phase SCR bridge and a single-phase SCR bridge. In SD3000 drives, the three-phase bridge is used to supply a D-C motor armature, and the single-phase bridge is used to supply a D-C motor field.

In SF3000 drives, the D-C Power Module may be used to supply a large motor or generator field from the three-phase SCR bridge. In this case, the single-phase bridge contained in the Power Module is still available to supply a motor field.

The single-phase SCR bridge may supply a field up to 60 amps. The three-phase SCR bridge may supply a field up to the continuous current rating of the Power Module.

The SF3000 drive can be configured to control the following:

- a single three-phase motor field (S6 or S6R at full current rating). Refer to figure G.1.
- a single three-phase generator field (S6 or S6R at full current rating). Refer to figure G.2.
- a three-phase generator field (S6 or S6R at full current rating) and a single-phase motor field (S2 at 15 amps D-C). Refer to figure G.3.

SF3000 drives use the same PMI rack and modules that are used on SD3000 drives. The connectors on the D-C Power Technology module used for armature feedback and armature forward and reverse gate control are used for three-phase field regulation. Both SD3000 and SF3000 drives use the FIELD FEEDBACK AND GATES connector on the D-C Power Technology module to control a single-phase motor field.

With the exception of the differences described below, the PMI rack described in this manual provides the same mechanical and electrical functions for SF3000 drives as it does for SD3000 drives. This manual, therefore, can be used to describe SF3000 drives by replacing the term “armature” with “three-phase field.” (“Field” is used throughout the manual to refer to the single-phase field for both SD3000 and SF3000 drives.)

Operating System

PMI Processors in SF3000 drives contain a different operating system than PMI Processors in SD3000 drives because the control algorithms for these drives are slightly different. For a complete description of the SF3000 control algorithm, refer to the SF3000 Drive Configuration and Programming manual.

MCR Control

The MCR output on the Resolver & Drive I/O module is controlled by the application task only (register 101/1101, bit 1). Unlike the SD3000 drive, opening and closing the MCR output is not required in drive sequencing. Bit 1 in register 201/1201 is used to indicate the status of whatever is connected to the AUX IN1 input on the Resolver & Drive I/O module. Note that, as in SD3000 drives, if the RPI input is removed, the MCR output is turned off under hardware control within .5 second.

Overspeed and Tach Loss Detection

A resolver and an analog tachometer may both be connected to the Resolver & Drive I/O module. However, the SF3000 drive does not provide built-in overspeed or tach loss detection.

Response to Drive Faults

How the SF3000 drive responds to drive faults depends on the type of fault and how the drive is configured (motor or generator). The drive’s response to each fault is described in the corresponding fault bit descriptions in the SF3000 Drive Configuration and Programming manual (S-3036).

PMI Rack LEDs

See Appendix F in this manual.

Appendix G

Continued

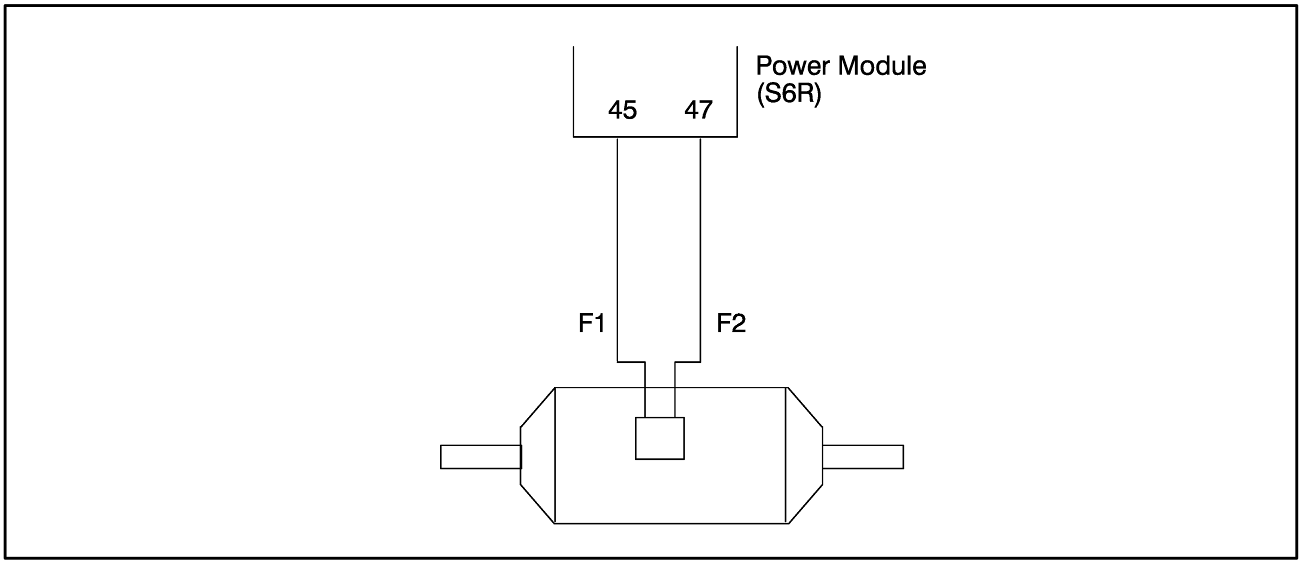


Figure G.1 - Three-Phase Motor Field Configuration

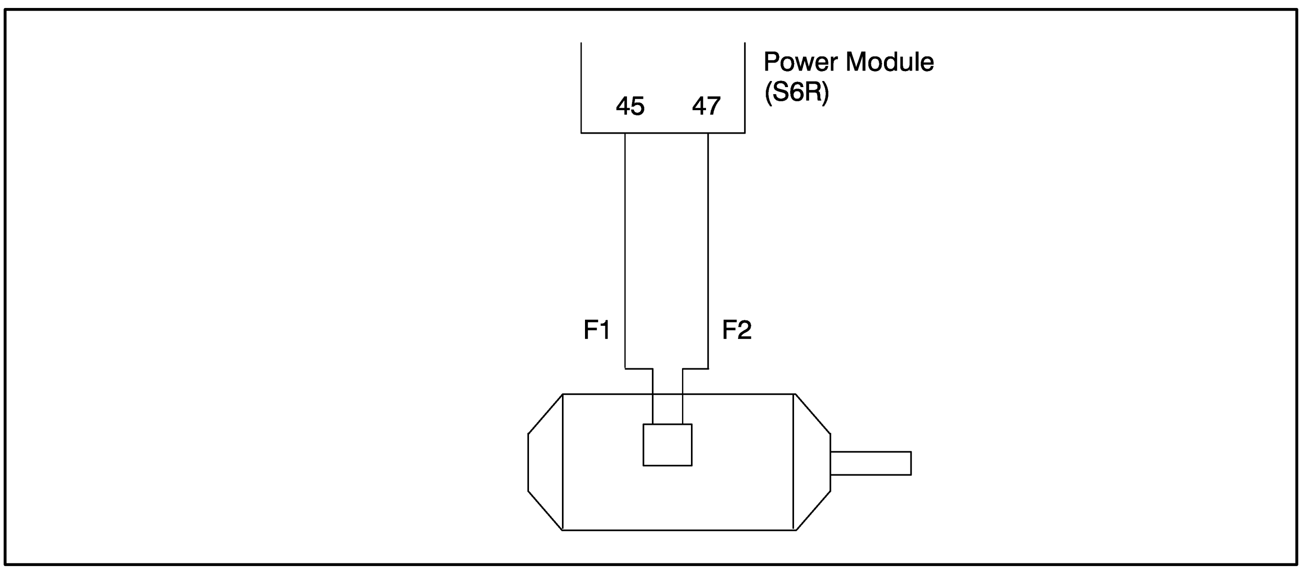


Figure G.2 - Three-Phase Generator Field Configuration

Appendix G

Continued

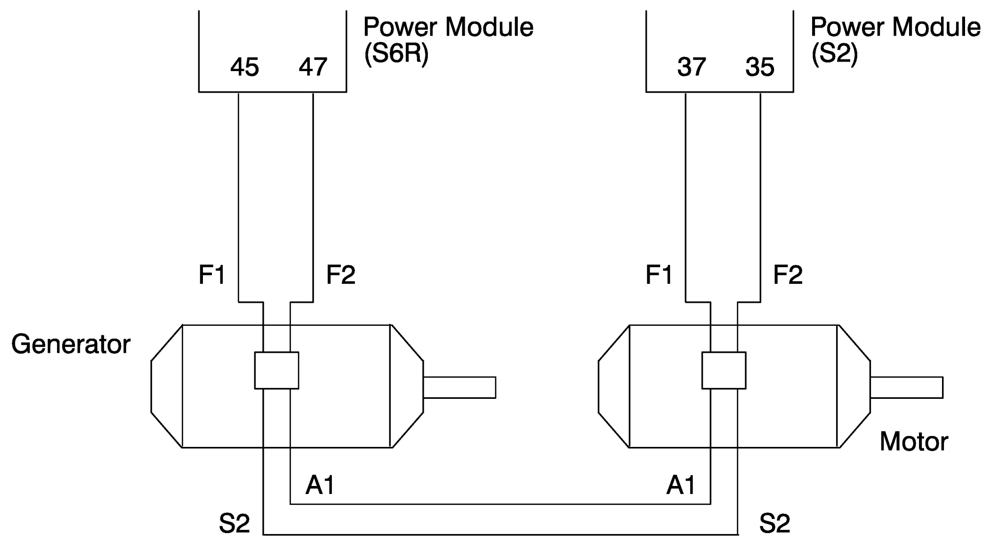


Figure G.2 - Three-Phase Motor Field and Single-Phase Motor Field Configuration

Appendix H

Module Versions

PMI Processor Module

M/N 60000 - 14MHz Microprocessor

M/N 60021 - 16MHz Microprocessor

Resolver and Drive I/O Module

M/N 60001 - 12-bit resolver data resolution

M/N 60031 - 14-bit resolver data resolution, strobe-edge selectable, operates as a 12-bit module in V3.3 and older installations, V3.4 or later software is required to utilize the 14-bit feature

For DPS hardware and software compatibility information, refer to Appendix C of the DPS Universal Drive Controller Module manual, S-3007.

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