WOODWARD

Product Manual 26166V2
(Revision W, 1/2016)
Original Instructions

MicroNet™ Simplex Digital Control
MicroNet™ Plus Digital Control

This manual replaces manual 85584 for the MicroNet Simplex.

Manual 26166 consists of 2 volumes (26166V1 & 26166V2).

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

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Proper Use

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

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311*, *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Manual 26166V2

Contents

This manual is divided into two volumes:
- Volume 1 contains chapters 1–9 (manual 26166V1).
- Volume 2 contains chapters 10–16 and the appendixes (manual 26166V2).

Illustrations and Tables

Warnings and Notices

Important Definitions

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

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

⚠WARNING

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

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

The IOLOCK state is asserted under various conditions including:

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

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

⚠WARNING

Overspeed / Overtemperature / Overpressure

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

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

WARNING

Personal Protective Equipment

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

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

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

WARNING

Start-up

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

WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

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

Follow these precautions when working with or near the control.

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

Chapter 10.
Actuator Modules

10.1—Introduction

A Smart I/O module has its own on-board microcontrollers. The modules described in this chapter are Smart I/O modules.

During initialization of a smart module, the module's microcontroller turns the LED off after power-on self-tests have passed and the CPU has initialized the module. The LED is illuminated to indicate an I/O fault.

The CPU also tells this module in which rate group each channel is to run, as well as any special information (such as the type of thermocouple in the case of a thermocouple module). At run time, the CPU then periodically broadcasts a "key" to all I/O cards, telling them which rate groups are to be updated at that time. Through this initialization/key broadcast system, each I/O module handles its own rate-group scheduling with minimal CPU intervention.

These smart I/O modules also have on-card on-line fault detection and automatic calibration/compensation. Each input channel has its own precision voltage reference. Once per minute, while not reading inputs, the on-board microcontroller reads this reference. The microcontroller then uses this data read from the voltage reference for both fault detection and automatic temperature compensation/calibration.

Limits have been set for the expected readings when the on-board microcontroller reads each voltage reference. If the reading obtained is outside these limits, the system determines that the input channel, A/D converter, or the channel's precision-voltage reference is not functioning properly. If this happens, the microcontroller flags that channel as having a fault condition. The CPU will then take whatever action the application engineer has provided for in the application program.

A smart output module monitors the output voltage or current of each channel and alerts the system if a fault is detected.

Each I/O module has a fuse on it. This fuse is visible and can be changed through a cutout in the plastic cover of the module. If the fuse is blown, replace it with a fuse of the same type and size.

NOTICE

Do not apply power to the unit until all the cables are connected. If you have the unit powered on before the cables are connected, you can blow the fuses on the output modules when the bare ends of the cables short together.

10.2—Two Channel Actuator Controller

10.2.1—Module Description

Figure 10-3 is a block diagram of the two-channel actuator controller module. Each channel controls an integrating or proportional, hydromechanical or pneumatic actuator. Each actuator may have up to two position feedback devices. There are several versions available, and the module part number indicates the module's maximum output current capability. A MicroNet low-density discrete (gray) cable must be used with this module. Do not use an analog (black) cable.

Figure 10-1—Two Channel Actuator Controller Module

10.2.2—Module Specification

General:

Number of Channels	2
Actuator Type	Proportional or integrating, hydro-mechanical or pneumatic actuators
Power requirements	+5 V @ 0.5 A, +24 V @ 1 A

Driver:

Current range	(range is determined by part number)
10 mA Version	±12.25 mA max
25 mA Version	±30 mA max
50 mA Version	±60 mA max
100 mA Version	±120 mA max
200 mA Version	±245 mA max
Dither Current	25 Hz, 25% duty cycle, tunable amplitude
Max Load Resistance	10/(maximum current required, in amps)

Position Feedback:

Feedback Devices	1 or 2 per channel
Device Types	LVDT, RVDT
Excitation	3 kHz sine wave, amplitude programmable from 2 to 8 Vrms, 120 mA maximum, 1% THD maximum.
Input Impedance of Feedback Circuit	200 kΩ

Fault Detection:

Driver	Alarm if current error > 10% Alarm if open Alarm if shorted
Excitation	Alarm if voltage error > 10% or if in current limit
Feedback	Alarms for: open-wire, voltage-out-of-range, computed position out-of-range; ranges are programmable
Position Error	Programmable threshold and delay
Microcontroller	Software watchdog is monitored by the CPU module. Hardware watchdog monitors logic power, microcontroller activity.
System	Outputs turn off if communications with the CPU module are lost

Performance:

Position Accuracy	0.25% of full-scale @ 25 °C, does not include transducer error
Position Drift	150 ppm/°C, does not include transducer drift
Output Current Tolerance	±1% of full scale
Current Read back Tolerance	±5% of full scale

10.2.3—Installation

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws, one at the top and one at the bottom of the front panel. Also at the top and bottom of the module are two handles which, when toggled (pushed outward), move the modules out just far enough for the boards to disengage the motherboard connectors.

Figure 10-2 shows examples of the field wiring for various transducer types.

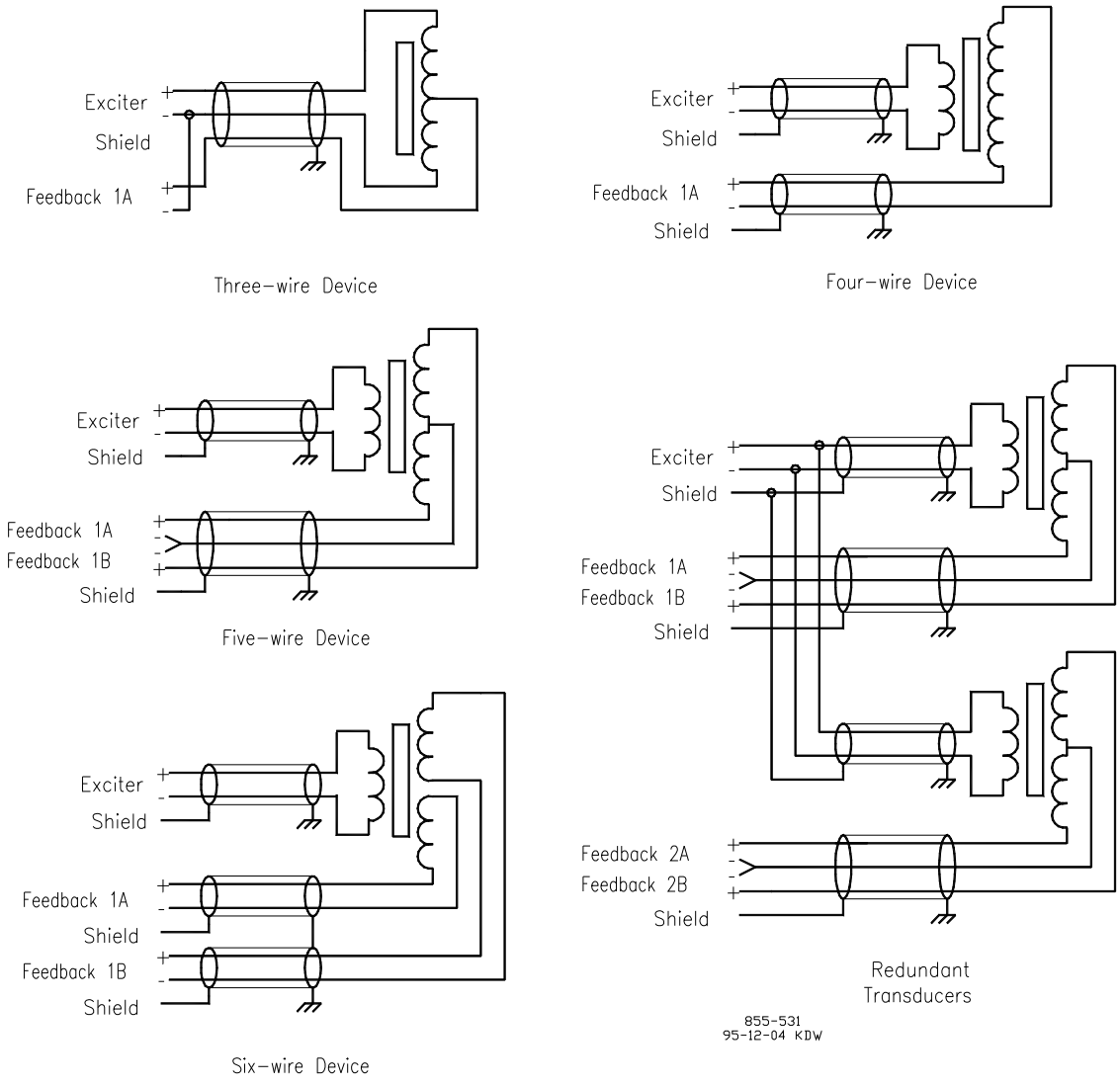


Figure 10-2—Two Channel Actuator Controller Module, Wiring Example

10.2.4—FTM Reference

See Chapter 13 for complete field wiring information for the Two Channel Actuator Controller FTM. See Appendix A for part number cross reference for modules, FTMs, and cables.

10.2.5—Woodward Notch Filter

- Reference Part Number: 5437-845
- Reference Drawing Number: 9933-651
- 2 Channel Actuator Controller Modules 5501-428, -429, -430, -431, -432

NetCon, MicroNet, and MicroNet Plus control systems with multiple 2 CH Actuator modules (part numbers 5501-428, -429, -430, -431, -432), have a potential for a 'beat' frequency to be created around 3000 Hz. This signal may create noise within the chassis and has been known to cause fluctuations in low amplitude signals such as RTDs and thermocouples. It may cause increased noise on other analog signals as well.

The source of the problem is that each actuator module produces a feedback (either LVDT or RVDT) excitation signal that is independent and asynchronous to the other actuator modules generating this same output. Since these signals are likely to be slightly offset in frequency and amplitude, it is possible that a corresponding beat frequency can develop on the chassis backplane and develop on the analog common line.

In 1997, Woodward created a small DIN-rail-mountable filter that is specifically designed to eliminate noise created by the actuator excitation within a tight frequency band (notch) around 3000 Hz. The unit requires about 1 inch (25 mm) of DIN rail space under the actuator FTM, and has two wire connections. One wire is connected from TB 1 to the actuator excitation (–), which on Woodward FTM 5437-672 is terminal TB 6. The second wire is connected from TB 4 to ground.

Woodward's engineering services group recommends the use of one Notch Filter per chassis for all chassis that utilize two or more actuator modules. In the case of a redundant system, two filters can be installed to ensure that this protection is available during all running conditions. If a control system has multiple chassis, each chassis meeting these criteria should have a filter.

Figure 10-3—Notch Filter (part number 5437-845)

10.2.6—Troubleshooting

Each I/O module has a red fault LED, which indicates the status of the module. This LED will help with troubleshooting if the module should have a problem. A solid red LED indicates that the actuator controller is not communicating with the CPU module. Flashing red LEDs indicate an internal problem with the module, and module replacement is recommended.

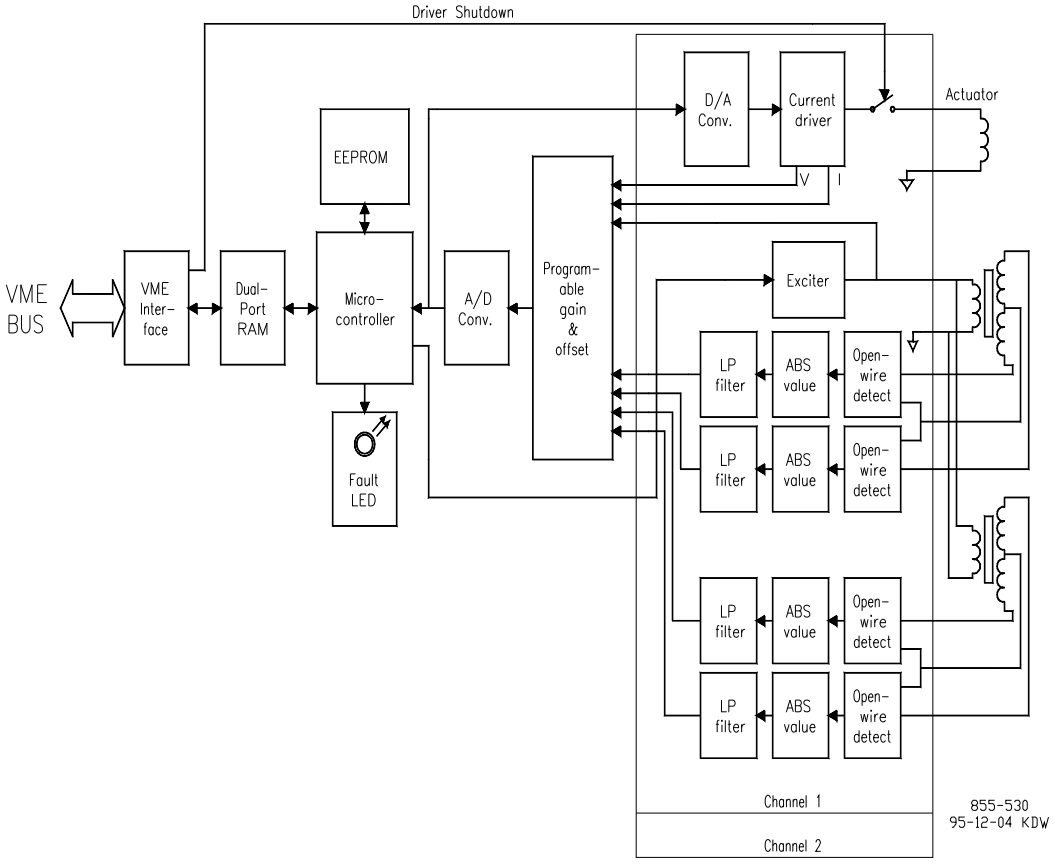


Figure 10-4—Two Channel Actuator Controller Module Block Diagram

10.3—Four Channel Actuator Module

10.3.1—Module Description

This Actuator Driver module receives digital information from the CPU and generates four proportional actuator-driver signals. These signals are proportional and their maximum range is 0 to 25 mAdc or 0 to 200 mAdc.

Figure 10-5 is a block diagram of the four-channel Actuator Driver module. The system writes output values to dual-port memory through the VME-bus interface. The microcontroller scales the values using calibration constants stored in EEPROM, and schedules outputs to occur at the proper time.

The microcontroller monitors the output voltage and current of each channel and alerts the system of any channel and load faults. The system can individually disable the current drivers. If a fault is detected which prevents the module from operating, by either the microcontroller or the system, the FAULT LED will illuminate.

This module requires no calibration; an actuator may be replaced with a like actuator without any module or software adjustment.

Figure 10-5—Four Channel Actuator Driver Module

10.3.2—Module Specification

Output Current Ranges:	0–25 mA, 0–200 mA
Resolution:	12 bits
Accuracy @ 25 °C:	0.1% of full scale
Drift:	150 ppm/°C
Maximum Actuator Resistance:	45 Ω @ 200 mA, 360 Ω @ 25 mA
Maximum Actuator Inductance:	1 H
Dither:	Tunable amplitude, 25 Hz square wave
Analog Driver Bandwidth:	50 Hz minimum
Fault Detection:	
Load Faults:	Module monitors actuator impedance
Driver Faults:	Actuator current is interrupted if fault is detected
Microcontroller Faults:	System monitors a software watchdog
System Faults:	Actuator current is interrupted if communications with CPU are lost
Shutdowns:	Current in each channel may be individually interrupted

10.3.3—Installation

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws, one at the top and one at the bottom of the front panel. Also at the top and bottom of the module are two handles which, when toggled (pushed outward), move the modules out just far enough for the boards to disengage the motherboard connectors.

10.3.4—FTM Reference

See Chapter 13 for complete field wiring information for the Four Channel Actuator Module FTM. See Appendix A for part number cross reference for modules, FTMs, and cables.

10.3.5—Troubleshooting

Each I/O module has a red fault LED, which indicates the status of the module. This LED will help with troubleshooting if the module should have a problem. A solid red LED indicates that the actuator controller is not communicating with the CPU module. Flashing red LEDs indicate an internal problem with the module, and module replacement is recommended.

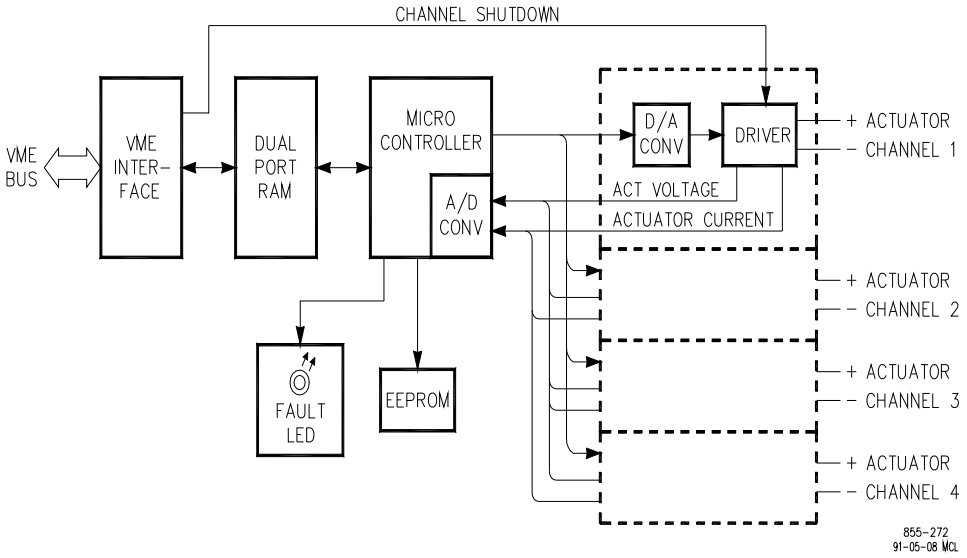


Figure 10-6—Four Channel Actuator Driver Module Block Diagram

10.4—Simplex Real Time SIO

10.4.1—Module Description

Each Real Time SIO Module contains the circuitry for three RS-485 ports. Each port is designed to communicate with EM or GS/LQ Digital Actuator Drivers. For each port, one driver is allowed for every 5 ms. Each driver is identified by its address switches, which must match the driver number in the GAP application program. The RS-485 communications to the Universal Digital Drivers can be used for monitoring or control purposes.

The Real Time SIO Module features:

- 5 ms update rate for critical parameters, with one driver per port
- Digital Actuator Driver interface

- Each RS-485 port may run in a different rate group
- Communication fault detection for each driver, drivers with comm faults are disabled
- Monitoring of driver parameters remotely
- Configuration of driver parameters remotely
- Allows a fast and very accurate position command (16 bits, no noise) for the drivers

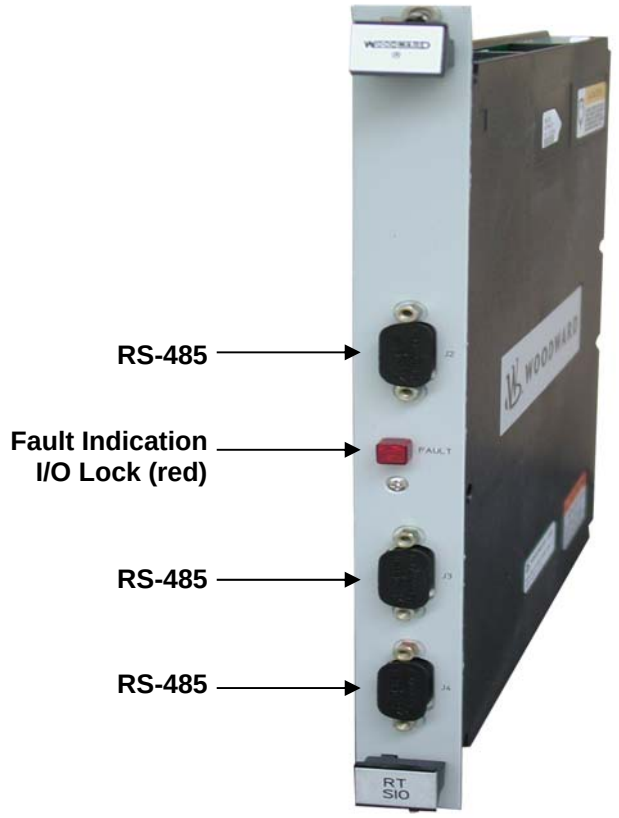


Figure 10-7—Real Time SIO Module

10.4.2—Module Specification

RS-485 Ports	
Rate Group	One driver per port, 5 milliseconds
Protocol	RS-485 UART, Woodward proprietary protocol
Baud Rate	417 kbaud
Parity	None
Data Bits	8
Stop Bit	1

10.4.3—Module Application

This module is designed to be used with Digital Drivers. Each Real Time SIO module contains three RS-485 ports. The units should have their termination resistors installed, to prevent reflections.

The RS-485 interface may be used in one of three ways:

- It can be used to send the position demand and configuration information to the driver, as well as monitor the driver status outputs.

- It can be used to configure the driver and monitor the status outputs, but not to send a position demand. The driver position demand would be from a 4–20 mA input or the CAN bus interface.
- It can be used to monitor the driver status outputs, but not configure the driver or send a position demand to the driver. The driver position demand could be from a 4–20 mA input or from the CAN bus interface, and the configuration input could be from RS-232 or from the CAN bus interface.

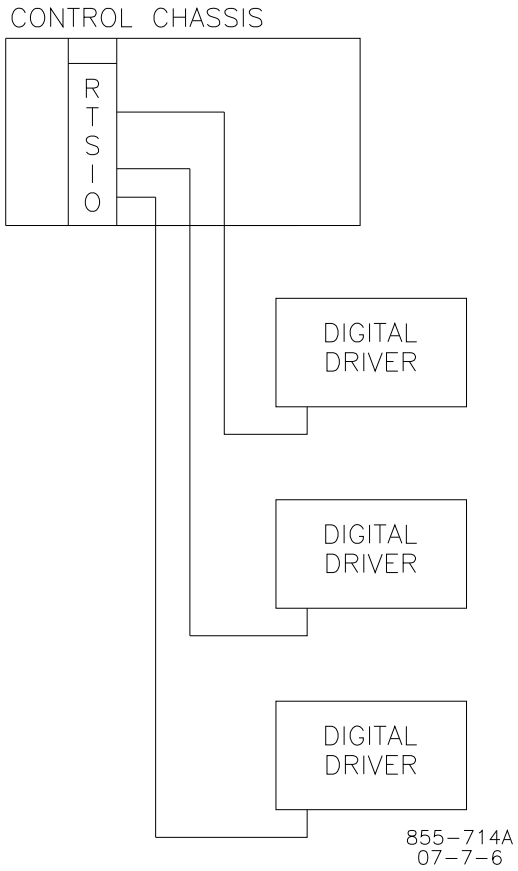


Figure 10-8—Sample System Configuration

10.4.4—Installation

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws, one at the top and one at the bottom of the module. Also at the top and bottom are two handles which, when toggled, move the modules out just far enough for the boards to disengage the motherboard connectors.

The drivers have address switches on the control circuit board. These switches allow up to 99 drivers, although the Real Time SIO module can support a maximum of one driver per channel. During initialization, the driver reads these switches, and this becomes its address. It responds to data to this address and sends data with this driver address. The GAP application has an input field for address, which should be configured by the customer or application engineer to match the driver address switches.

The Real Time SIO Module and the Digital Driver contain optional termination resistors, which should be installed in the module.

10.4.5—Field Wiring

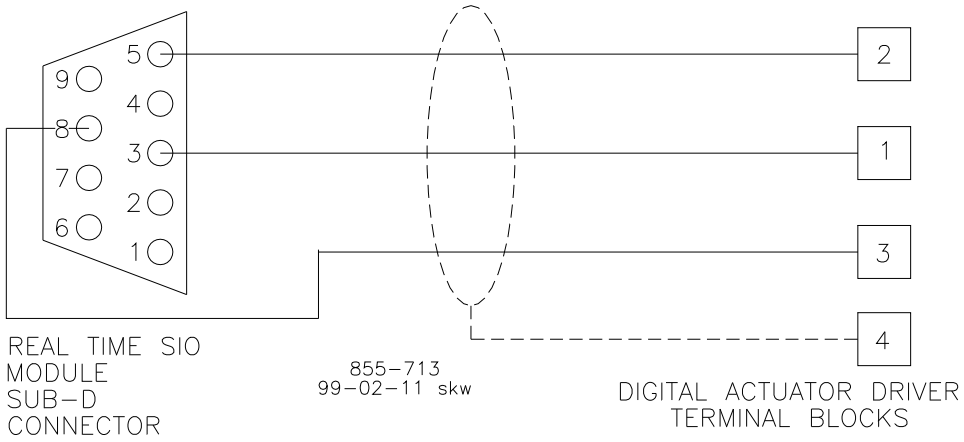


Figure 10-9—Wiring Diagram for the Real Time SIO Module

- Shields should be connected to earth ground at all intermediate terminal blocks, as well as terminated at the control terminal block. The exposed wire length beyond the shield should be limited to 25 mm (1 inch).
- Do not place shielded wires in the same cable conduit with high-voltage or large-current-carrying cables.
- Cable shields must be electrically continuous from the signal source to the point the signal wire enters the field terminal module.
- The address switches on the Digital Drivers should be set to match the addresses in the GAP application program.

The termination resistors should be installed on the last unit on each end of the network. On the Real Time SIO module, the termination resistor is installed by closing switches 3 and 4, and leaving switches 1 and 2 open, for each channel. On the Digital Driver, the termination resistor is installed by moving the RS-485 termination jumpers to the “IN” position.

Wiring Specifications	The RS-485 wiring should meet the requirements in the EIA RS-485 standard document for a 500 kbps network.

Table 10-1-Cable Specifications

Cable Specifications:	
0.2 mm² (24 AWG) or larger standard, shielded, twisted-pair cable	30 m (100 ft.) absolute maximum
0.3 mm² (22 AWG), low-capacitance cable (36 pF/m or 11 pF/ft.)	120 m (400 ft.) absolute maximum
0.5 mm² (20 AWG), low-capacitance cable (46 pF/m or 14 pF/ft.)	150 m (500 ft.) absolute maximum
For cable lengths longer than 150 m (500 ft.), optical repeaters and fiber optic cable should be used.	up to limits of fiber optic cables/transceivers

NOTICE

To assure reliable communications when using copper RS-485 cable, do not use any intervening devices such as relays or terminal blocks. The cable should run directly from one RS-485 device to the next device.

All cable lengths are calculated based on ideal conditions. It is recommended that installations attempt to minimize network problems due to harsh conditions and unforeseen circumstances by keeping the network length under 50% of the absolute maximum ratings.

10.4.6—Shields and Grounding

If the panel that the control chassis is mounted on is not at earth ground potential, connect it to earth ground via a 3.0 mm² (12 AWG) green/yellow wire or braid, keeping the braid or wire as short as possible.

The RS-485 wiring should be shielded, and the shield should be directly grounded to earth at the Digital Driver end of the cable. The shield should be AC coupled to earth at the MicroNet chassis and the entry point into the cabinet. If the shield is not directly grounded at the Digital Driver end of the cable, it should be connected directly to earth at the MicroNet chassis and the entry point into the cabinet. The shield should be continuous through the intermediate terminal blocks and not connected directly to earth at the intermediate terminal blocks. The exposed wire length, beyond the shield, should be limited to 25 mm (1 inch).

For compliance with EMC standards, it is required that all communications wiring be separated from all power wiring.

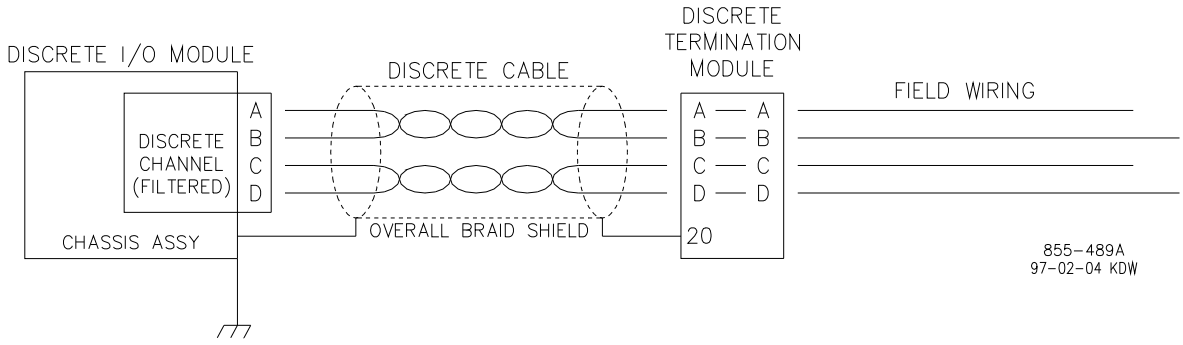


Figure 10-10—Shield Termination Diagram

10.4.7—Troubleshooting

Each I/O module has a red Fault LED controlled by the CPU, which is turned on when the system is reset. During initialization of a Real Time SIO Module, which occurs after every CPU reset, the CPU turns the Fault LED on. The CPU then tests the module using diagnostic routines built into software. If the diagnostic test is not passed, the LED remains on or blinks. If the test is successful, the LED turns off. If the Fault LED on a Real Time SIO Module is illuminated after the diagnostics and initialization have been run, the module may be faulty or in the wrong slot.

Table 10-2. Fault LED Definitions

Number of LED flashes	Failure
1	External RAM test failure
2	Module watchdog time-out
3	Dual Port RAM test failure
7	VME Communications watchdog time out

If during normal control operation, all of a rack's I/O modules have their Fault LEDs on, check the rack CPU for a failure. If during normal control operation, only the Real Time SIO Module's Fault LED is turned on or is flashing, replace that module. When a module fault is detected, its outputs are disabled or de-energized.

In addition to the module hardware detection fault, the Real Time SIO Module detects I/O faults:

Table 10-3. Real-Time SIO Module Detected I/O Faults

RS-485 communication faults:	**The GAP block output "comm fault" is set true, for any RS-485 faults. These include:**
Break Received	
Framing Error	
Parity Error	
Receive Overrun Error	
Carrier Detect Lost	
CRC Error	
Stop Transmit Receive	
Transmitter Overrun	
Address error	
No response	
Actuator or Driver faults:	The applicable GAP block outputs are set true for any Actuator or driver faults. See the Digital Driver manual for a detailed list of alarms and faults.

10.5—EM/TM Position Controller

10.5.1—Module Description

Figure 10-12 is a block diagram of the Position Controller Module (PCM). The microcontroller executes a position controller which receives a reference input from the CPU across the VME bus. It receives a feedback input from a remote driver via a serial link. The controller output is sent to the remote driver serially. Shutdown, reset, and fault signals are passed between the PCM and the remote driver using discrete lines.

The feedback input from the remote driver is a 16 bit value from the digitized output of a resolver. This gives the PCM the ability to control position with high accuracy and resolution. Consequently, the PCM is used primarily with Dry Low Emissions (DLE) systems or other systems where high accuracy is required.

The PCM can be used with various remote drivers as shown by Figure 10-11. For more information on using the position controller module with specific remote drivers, see the remote driver manual.

Figure 10-11—EM/TM Position Control Module

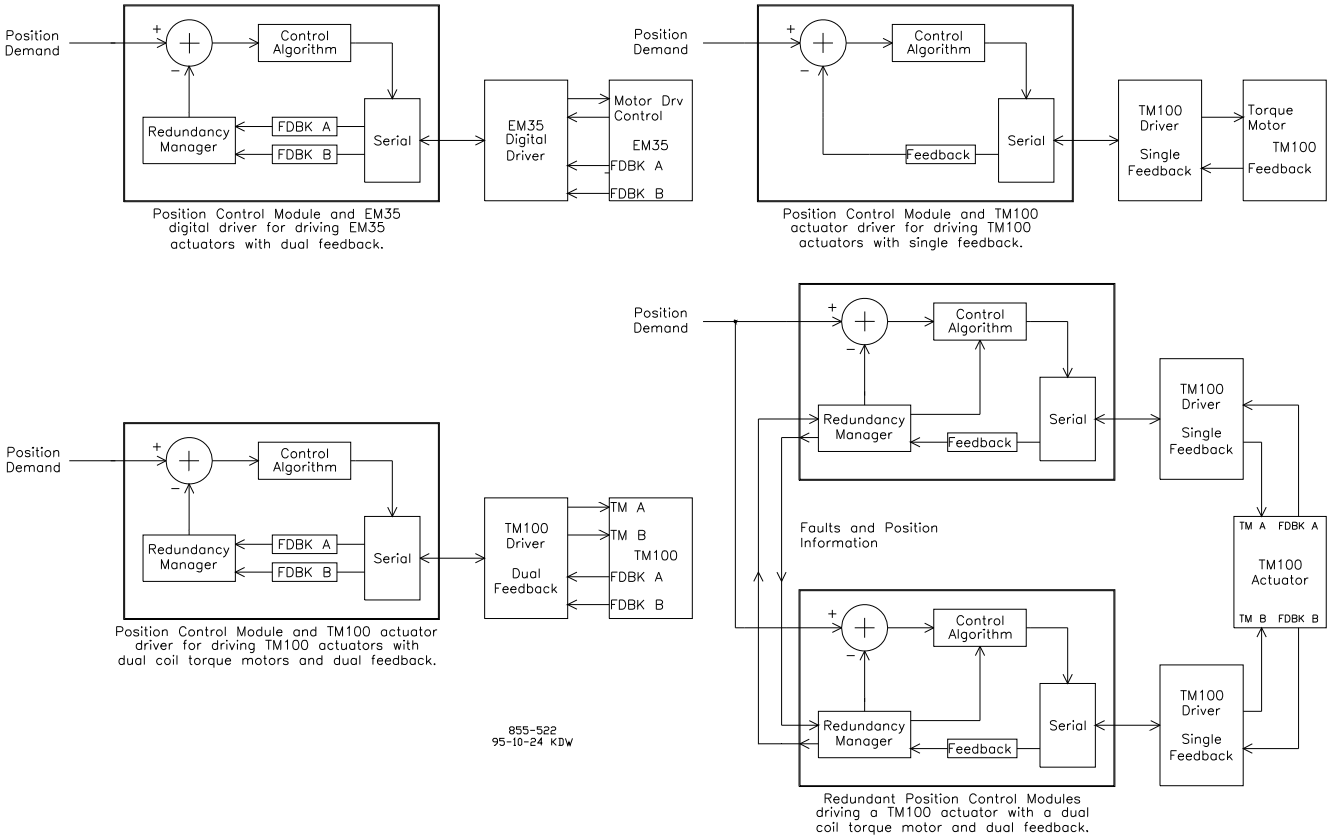


Figure 10-12—Position Control Module as used with various Remote Drivers

10.5.2—Module Specification

Controller Type:	model-based
Execution time:	1.67 ms
Dither:	Tunable amplitude, 50% duty cycle
Frequency:	40 Hz with TM100 DFB and EM35 drivers, 25 Hz with TM100 SFB

Communications

Type:	Synchronous
Interface:	RS-485
Data length:	16 bits +1 bit parity
Error detection:	Odd parity
PCM Detectable Faults Parity:	Shutdown if parity error exist four consecutive times
Feedback:	Shutdown if feedback angle > 90°
Position error:	Alarm if feedback differs from demand by tunable amount for tunable delay
Null fault:	Alarm if null current moves outside settable limits

(TM100 drivers only)

Fdbk spread fault: Alarm if feedback signals differ by settable amount. Control from higher/lower feedback selectable.

10.5.3—Installation

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws, one at the top and one at the bottom of the front panel. Also at the top and bottom of the module are two handles which, when toggled (pushed outward), move the modules out just far enough for the boards to disengage the motherboard connectors.

10.5.4—FTM Reference

See Chapter 13 for complete field wiring information for the EM/TM Position Control Module FTM. See Appendix A for part number cross reference for modules, FTMs, and cables.

10.5.5—Troubleshooting

Following being reset, the PCM will perform a series of self-tests. The PCM will also check for run-time errors. This includes checking for the presence of the Minor Frame Timer (MFT) signal along with insuring that proper communications exists between itself and the CPU. If a self-test has failed or if a run-time fault exists, the LED will blink according to the following chart:

Table 10-4. Troubleshooting – Self-Test Failures

Error Type	Number of Blinks	Meaning
Self-test Errors	1	Internal register test failure
	2	RAM test failure—both bytes
	3	RAM test failure—high byte
	4	RAM test failure—low byte
	5	EPROM checksum error
	6	EEPROM read/write failure
	7	EEPROM checksum error
Run-time Errors	8	MFT signal absent > 200 ms
	9	Invalid command received
	10	Loss of communication with CPU

A fault LED that is constantly lit may indicate that the PCM did not get a proper reset or that it is unable to execute its program.

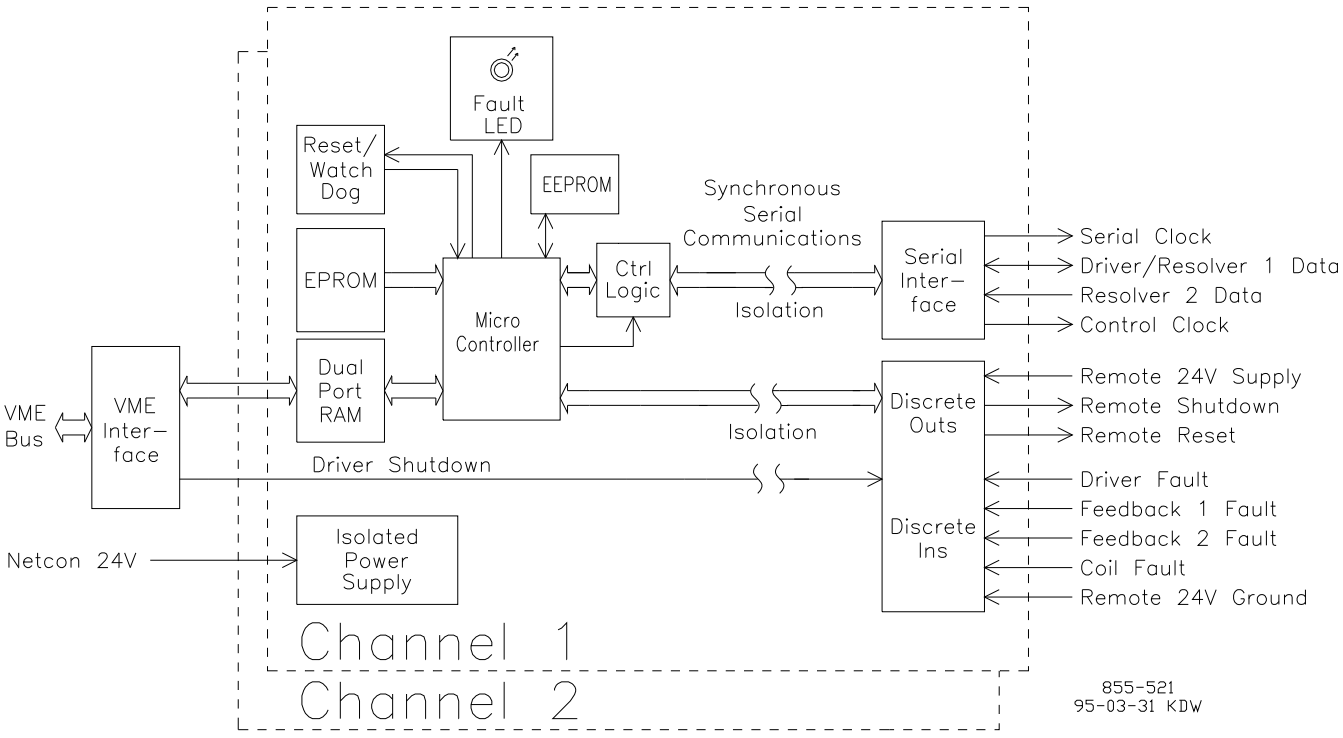


Figure 10-13—Position Controller Module Block Diagram

Chapter 11.
LINKnet I/O Network

11.1—Regulatory Compliance

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

EMC Directive:	Declared to 2004/108/EC COUNCIL DIRECTIVE of 15 December on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.
ATEX – Potentially Explosive Atmospheres Directive:	Declared to 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Zone 2, Category 3, Group II G, Ex nA [nL] IIC T4 X

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

UL:	UL Listed for Class I, Division 2, Groups A, B, C, & D, T4 at 55 °C surrounding air temperature. For use in Canada and the United States. UL File E156028

Marine:

American Bureau of Shipping:	ABS Rules 2002 SVR 4-2-1/7.3, 4-2-1/7.5.1, 4-9-3/17, 4-9-7/13, 4-9-2/11.7 & 4-9-4/23
Det Norske Veritas:	Standard for Certification No. 2.4, 2006: Temperature Class A, Humidity Class B, Vibration Class B, and EMC Class A
Lloyd's Register of Shipping:	LR Type Approval Test Specification No. 1, 2005 for Environmental Categories ENV1 and ENV2

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D T4A at 55 °C surrounding air temperature per UL for Canada and US or non-hazardous locations only.

This equipment is suitable for use in European Zone 2, Group IIC environments when installed in an IP54 minimum rated enclosure per self-declaration to EN 60079-15.

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

Product listings are limited only to those units bearing the UL or CE logos.

Special Conditions for Safe Use
Field wiring must be suitable for at least 80 °C for operating ambient temperatures expected to exceed 55 °C.

For hazardous locations, this equipment must be installed in an area providing adequate protection against the entry of dust or water. A minimum ingress protection rating of IP54 is required for the enclosure.

For ATEX compliance, the user-provided enclosure must withstand the thermal and mechanical impact requirements of EN60079-15: 2005

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

LINKnet modules contain internal energy limited circuits. These circuits have no external connections and are not affected by module loading.

⚠WARNING

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

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

⚠AVERTISSEMENT

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

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

11.2—Introduction

The LINKnet option provides distributed I/O capabilities for the MicroNet control system. The LINKnet I/O modules, while slower and less powerful than MicroNet I/O modules, are well suited for non-turbine control functions like sequencing and monitoring.

11.3—Network Architecture

An I/O network consists of a single 4Ch LINKnet Controller Module, which provides four independent network trunks of up to 60 I/O modules each. The LINKnet I/O modules, or nodes, on each trunk are attached to the LINKnet controller module via a single twisted pair wire. One 4Ch LINKnet Controller Module can therefore, interface with as many as 240 LINKnet I/O modules, each having multiple channels, through four twisted pair wires.

Each of the four channels, or groups, on the LINKnet controller module may run in a different rate group. The rate group for each channel is defined in the application program. The controller module scans all of the nodes asynchronously to the channel rate groups.

Each LINKnet I/O module has two rotary switches that are used to set its network address. On installation, these switches must be dialed so that the I/O module's number, 1-60, matches the network address defined for this I/O module in the application program. The I/O modules may be placed in any order on the network, and gaps are allowed in the address sequence.

11.4—Hardware

Each network consists of one channel of a LINKnet controller module and many I/O modules. The I/O modules include thermocouple, RTD, 4-20 mA, and discrete input modules, as well as 4-20 mA and relay output modules. All of the analog modules consist of six channels per module. The relay output module contains eight channels and the discrete input module has 16 channels.
Each I/O module is housed in a plastic, field termination module type package for DIN rail mounting. The LINKnet I/O modules can be mounted in the control cabinet or in any convenient location in the vicinity of the prime mover that meets the temperature and vibration specifications. The LINKnet system accommodates hot-replacement of faulty nodes.

11.5—Four Channel LINKnet Controller Module

11.5.1—Module Description

The Four Channel LINKnet Controller module acts as a network master for each network channel. It performs various scaling and linearization operations and controls the flow of data between the CPU module and the I/O nodes. It determines the health of the nodes by comparing read back values to requested values on output nodes, and by checking the reference test value on analog input nodes.

Figure 11-1—Four Channel LINKnet Controller Module

11.5.2—Module Specification

Table 11-1. Four Channel LINKnet Controller Module Specification

Number of channels:	4
Number of Nodes per Ch.:	60
Scan Rate	
Less than 7 output modules:	(# of I/O modules x 6 + 75) ms typical (# of I/O modules x 6 + 100) ms max
7 or more output modules:	(# of I/O modules x 6 + # of output modules x 3 + 55) ms typical (# of I/O modules x 6 + # of output modules x 3 + 80) ms max

11.5.3—Installation

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws, one at the top and one at the bottom of the front panel. Also at the top and bottom of the module are two handles which, when toggled (pushed outward), move the modules out just far enough for the boards to disengage the motherboard connectors.

All LINKnet I/O modules communicate with the LINKnet controller module through shielded twisted pair wiring. The specifications for the LINKnet system require that listed level V type cable be used. The network may be wired directly from I/O module to I/O module, as shown in Figure 11-2, or the I/O modules may be connected to the network via stubs as in Figure 11-3. A LINKnet Termination Module (Figure 11-4) must be installed as the last LINKnet module on the network. Connections are provided at both ends of the LINKnet Termination Module. Connect network to either terminals 1,2,3 or 4,5,6, but not both. There is no polarity associated with the network wiring.

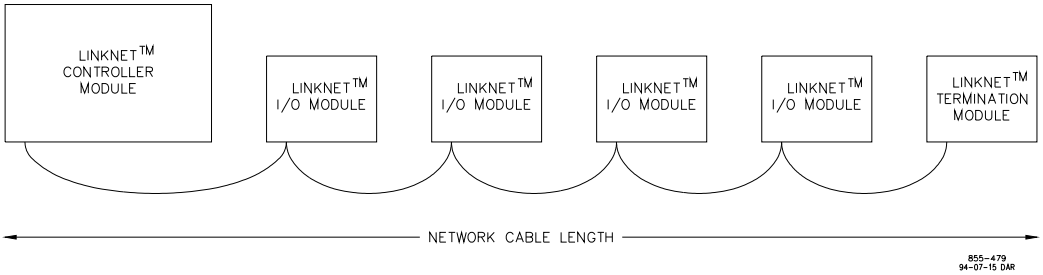


Figure 11-2—Direct Wired Network

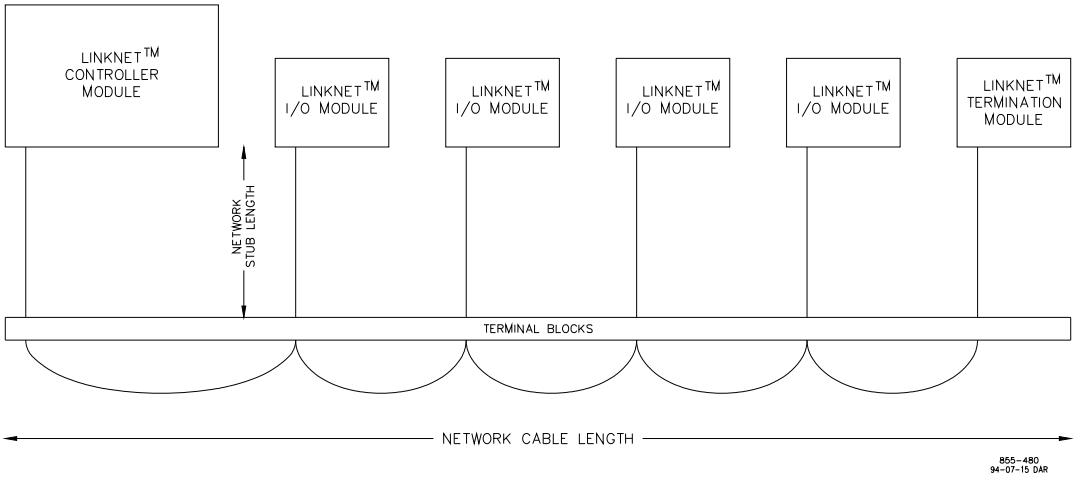


Figure 11-3—Network Wired Via Stubs

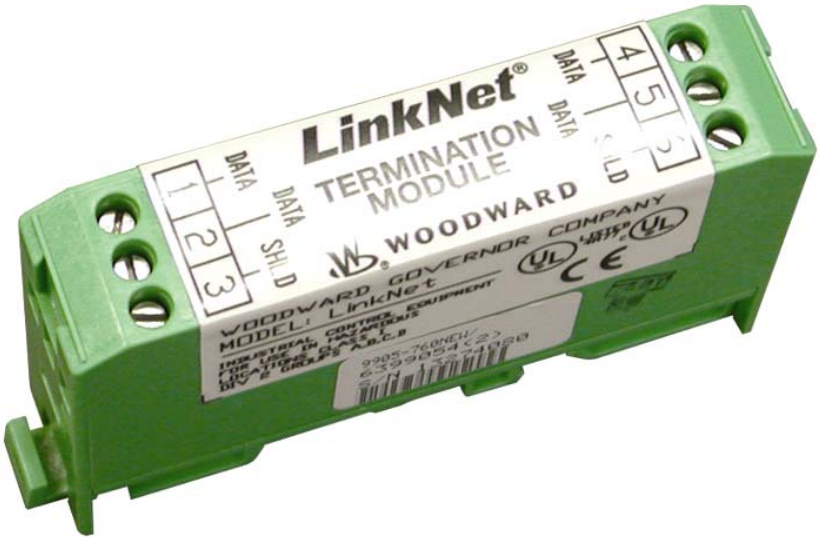


Figure 11-4—LINKnet Termination Network Module

For optimum EMC performance, the network cable shield should be landed at each I/O module, and the exposed wire length limited to one inch. At the MicroNet control, the outer insulation should be stripped and the bare shield tie-wrapped to the chassis, along with the other MicroNet I/O module wiring shields. See Table 11-1 for cable length and number of LINKnet I/O modules limitations per network connection.

All field wiring should be shielded. The shield should be landed in the terminal block provided, and the exposed wiring, after the shield is separated, should be limited to one inch.

IMPORTANT **The LINKnet modules should always be mounted in a cabinet, or be otherwise operator inaccessible. The modules should only be accessed for maintenance purposes, in which case, the Electrostatic Discharge procedures on page v of volume 1 should be followed.**

Table 11-2—Cable Length and Number of LINKnet I/O Modules

Specification	0 to 55 °C	–20 to 55 °C	–40 to 55 °C
Maximum network cable length	150 meters	150 meters	50 meters
Maximum number of I/O modules	60	32	20
Maximum stub length	300 mm	300 mm	300 mm

11.5.4—FTM Reference

The 4Ch LINKnet controller module doesn't utilize FTMs. The Controller module interfaces to LINKnet I/O modules. Information on the LINKnet I/O modules follows later in this chapter.

11.5.5—Troubleshooting

A 68030 microprocessor communicates with the CPU module through dual-ported RAM connected to the VME bus interface. Each of the four network communications processors communicate with the 68030 through a dual-port RAM.

The LINKnet controller module performs self-tests after a MicroNet system reset. If all tests pass, the Fault LED will go out. If the Fault LED remains on or begins blinking, the module is faulty. The 68030 initializes the four communications processors after the self-tests. The Network Fault LEDs turn off after each communications processor has been initialized. If any of the Network Fault LEDs remains on, the module is faulty. After the Network Fault LEDs have turned off, the controller module initializes the I/O nodes. Node initialization can take up to several seconds for a large network.

The fault status of the module and each network channel may be annunciated through the application program. See Figure 11-5 for block diagram of the 4Ch LINKnet module.

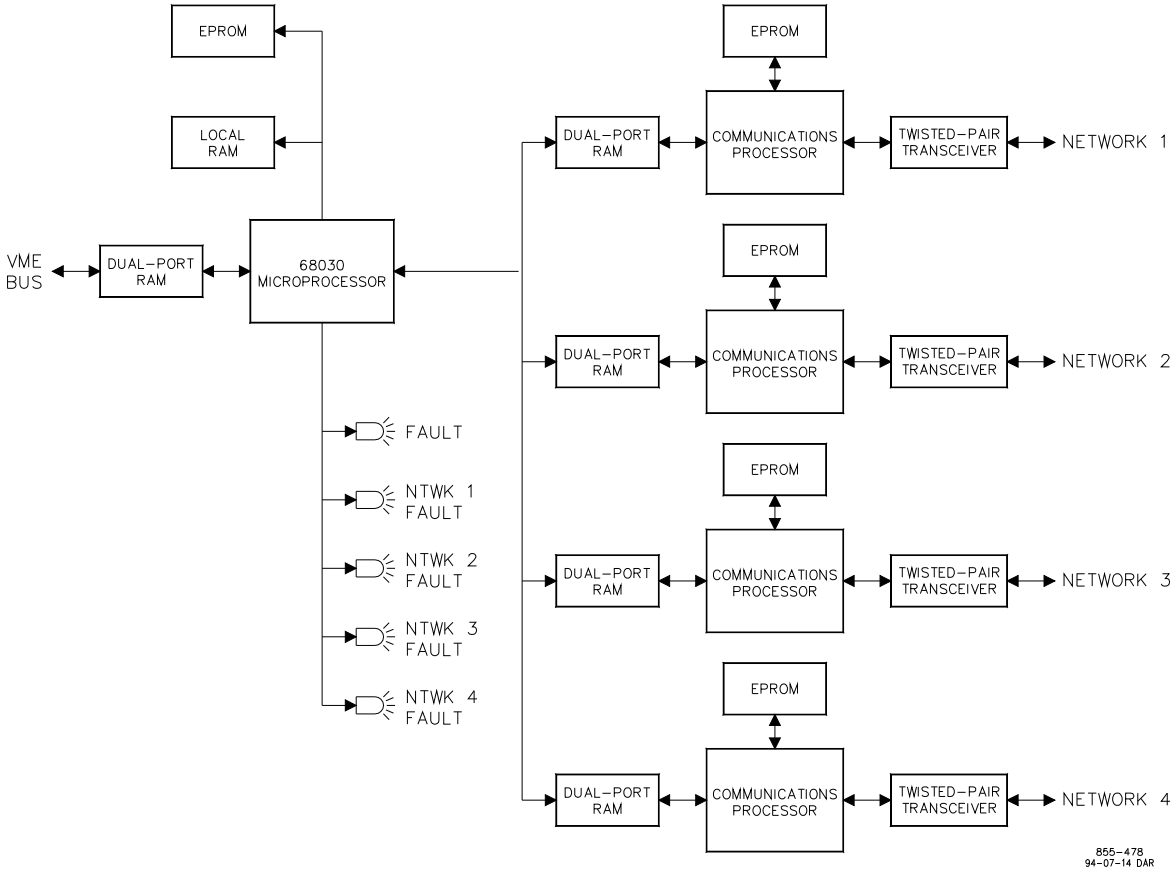


Figure 11-5—4Ch LINKnet Module Block Diagram

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

11.6—LINKnet 6Ch RTD Module

11.6.1—Module Description

The LINKnet 6Ch RTD Module interfaces to six temperature sensing three wire RTD transducers. The module comes in two different RTD resistance ranges (100 and 200 Ω). Both types of modules have unique part numbers and interface to one of the four channels on the 4Ch LINKnet Controller Module through a serial network cable. See Appendix A for desired part numbers. The module has a built-in reference voltage that is used to verify proper operation of the A/D converter. Appropriate faults are annunciated through the application program. Up to 60 nodes or LINKnet I/O modules can be connected to each channel of the LINKnet Controller Module.

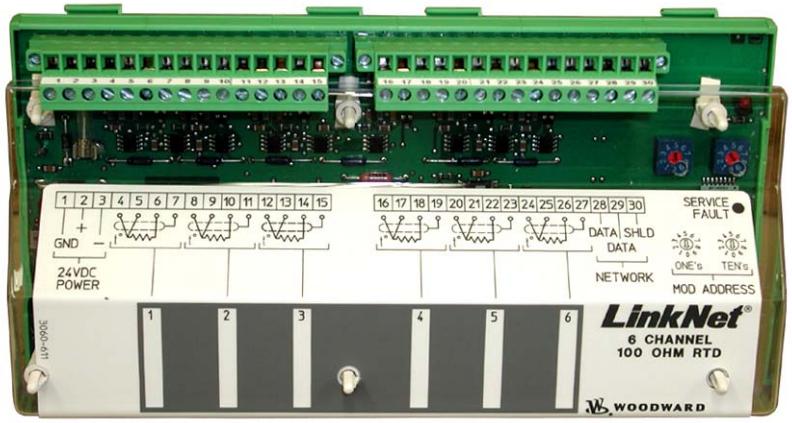


Figure 11-6—LINKnet 6Ch RTD Module

11.6.2—Module Specification

Table 11-3. LINKnet 6Ch RTD Module Specification

Number of Inputs:	6
Input type:	100 or 200 Ω 3-wire RTDs
Temperature Measurement Range	
European Curve:	–65 to +649 °C (–85 to +1200 °F)
American Curve:	–65 to +457 °C (–85 to +854 °F)
RTD source current:	2 mA max

Note: Must conform to (Deutsche Institut für Normung) DIN standard for 100 or 200 Ω European curve (Alpha = .00385) or American curve 100 or 200 Ω curve (Alpha = .00392)

Resolution:	12 bits
Temp Coefficient (ppm/□°C):	290
Accuracy:	1% at 25 °C (factory calibrated)
Input Impedance:	2.2 MΩ
Power Supply Input:	18 to 32 Vdc
Power Required:	3.1 W at 24 Vdc

11.6.3—Isolation

Table 11-4. LINKnet 6Ch RTD Module Isolation

Network to I/O channel:	277 Vac
Power supply input to network:	277 Vac
I/O channel to I/O channel:	0 V
PS input to I/O channel:	500 Vdc
Field Wiring:	14 AWG maximum wire size
Ambient Temperature Range:	–40 to +55 °C

11.6.4—Shock and Vibration

Mil-Std-810, 30 G's sine wave at 11 ms
Mil-Std-167, 18-50 Hz

11.6.5—EMC

Emissions:	EN 61000-6-4
Immunity:	EN 61000-6-2

11.6.6—Installation

Install the LINKnet 6CH RTD Module on the DIN rail and connect to the appropriate LINKnet network and 24 Vdc power. Wire the RTD connection per Figure 11-7. Set module address one’s and ten’s rotary switches per application setup.

The LINKnet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on to the DIN rail, and the terminal blocks pushed into the headers. It is then necessary to reset the node through the application program to reinitiate communications with the LINKnet controller module and to clear the "no message" fault.

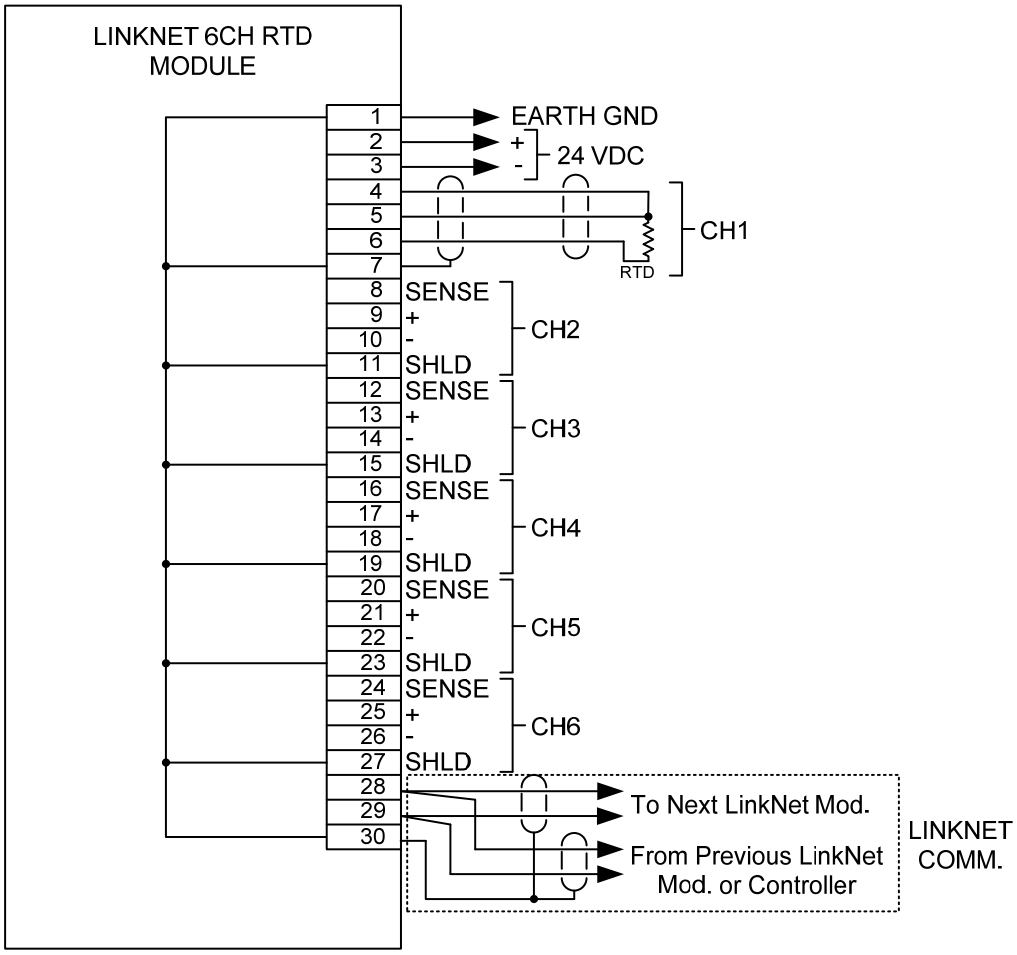


Figure 11-7—LINKnet 6CH RTD Module Wiring

11.6.7—Troubleshooting

Each RTD input utilizes a 1 or 2 mA source. The module receives voltages from six 100 or 200 Ω, 3 wire RTDs. Each voltage is compensated for line resistance, and then is multiplexed to a voltage-to-frequency converter. The module processor reads the period of this signal and converts it to a count, which it transmits through the transceiver to the LINKnet controller module. See Figure 11-8 for block diagram of the RTD input module.

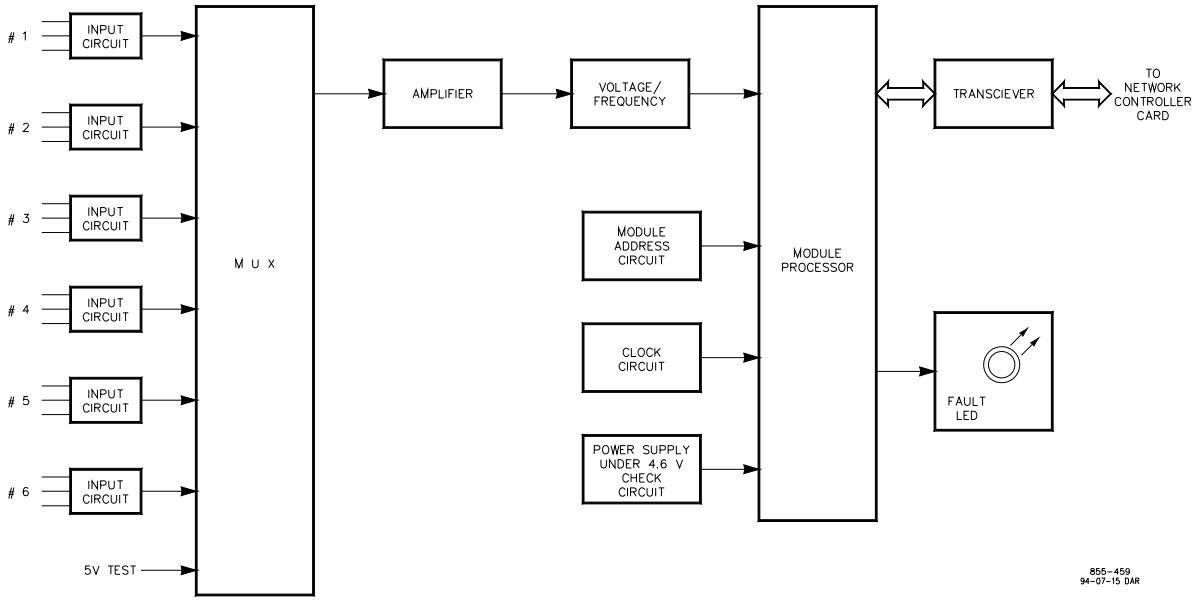


Figure 11-8—RTD Input Module Block Diagram

The fault LED denotes the status of the module processor, and will be off during normal operation. If the fault LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the LINKnet controller module, and a "no message" fault will be annunciated through the application program. If two nodes are set to the same address, an "address" fault will be annunciated through the application program, and both nodes will not function. If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.

A "type" fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the "off" state when its watchdog timer times out.

No message faults, address faults, and type faults are non-latching. When these faults occur for an input module, the application program will give default values for each channel.

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

11.7—LINKnet 6Ch T/C Module

11.7.1—Module Description

The LINKnet 6Ch T/C Module connects to six Type J or K thermocouples. The thermocouple type is selected in the application program. There is a fail high and a fail low version of the module, which allow the input channels to be pulled high or low on an open input. See Appendix A for desired part numbers. The modules have an AD592 ambient temperature sensor mounted on them for cold junction temperature sensing. The cold junction compensation is performed in software. The module has a built-in reference voltage that is used to verify proper operation of the A/D converter. Appropriate faults are annunciated through the application program. Up to 60 nodes or LINKnet I/O modules can be connected to each channel of the LINKnet Controller Module.

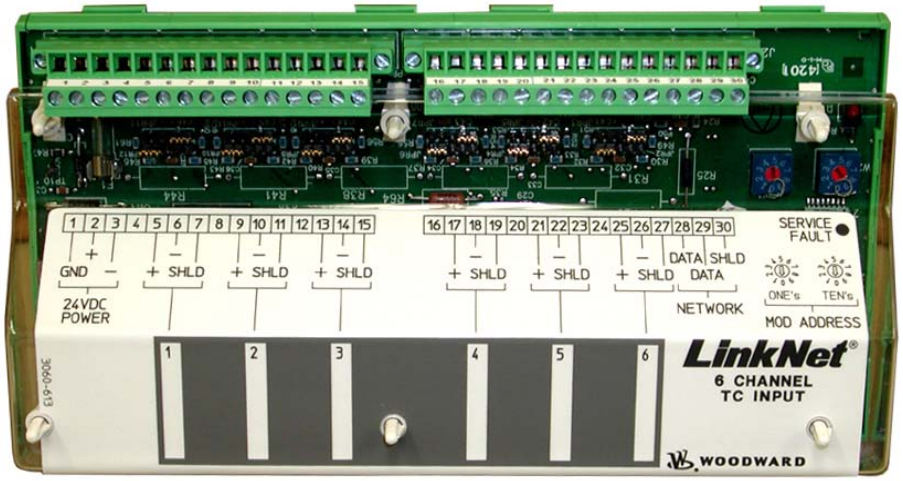


Figure 11-9—LINKnet 6Ch T/C Module

11.7.2—Module Specification

Table 11-5. LINKnet 6Ch T/C Module Specification

Number of Inputs:	6 internal +1 cold junction

Note: Type J and K thermocouples must conform to the common commercial specifications published in the Annual Book of ASTM Standards with voltage predictions in line with N.I.S.T. Monograph 175 or ITS-90.

Open thermocouple detection:	Fail Low and Fail High depending on P/N
Cold Junction:	AD590
Resolution:	12 bits
Temp Coefficient (ppm/□□C):	235
Accuracy:	1% at 25 °C (factory calibrated)
Input Impedance:	2.0 MΩ
Power Supply Input:	18 to 32 Vdc
Power Required:	2.4 W at 24 Vdc

11.7.3—Isolation

Table 11-6. LINKnet 6Ch T/C Module Isolation

Network to I/O channel:	277 Vac
Power supply input to network:	277 Vac
I/O channel to I/O channel:	0 V
PS input to I/O channel:	500 Vdc
Field Wiring:	14 AWG maximum wire size
Ambient Temperature Range:	–40 to +55 °C

11.7.4—Shock and Vibration

Mil-Std-810, 30 G's sine wave at 11 ms
Mil-Std-167, 18-50 Hz

11.7.5—EMC

Emissions:	EN 61000-6-4
Immunity:	EN 61000-6-2

11.7.6—Installation

Install the LINKnet 6CH TC Module on the DIN rail and connect to the appropriate LINKnet network and 24 Vdc power. Wire the thermocouple connection per Figure 11-10. Set module address one’s and ten’s rotary switches per application setup.

The LINKnet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on to the DIN rail, and the terminal blocks pushed into the headers. It is then necessary to reset the node through the application program to reinitiate communications with the LINKnet controller module and to clear the "no message" fault.

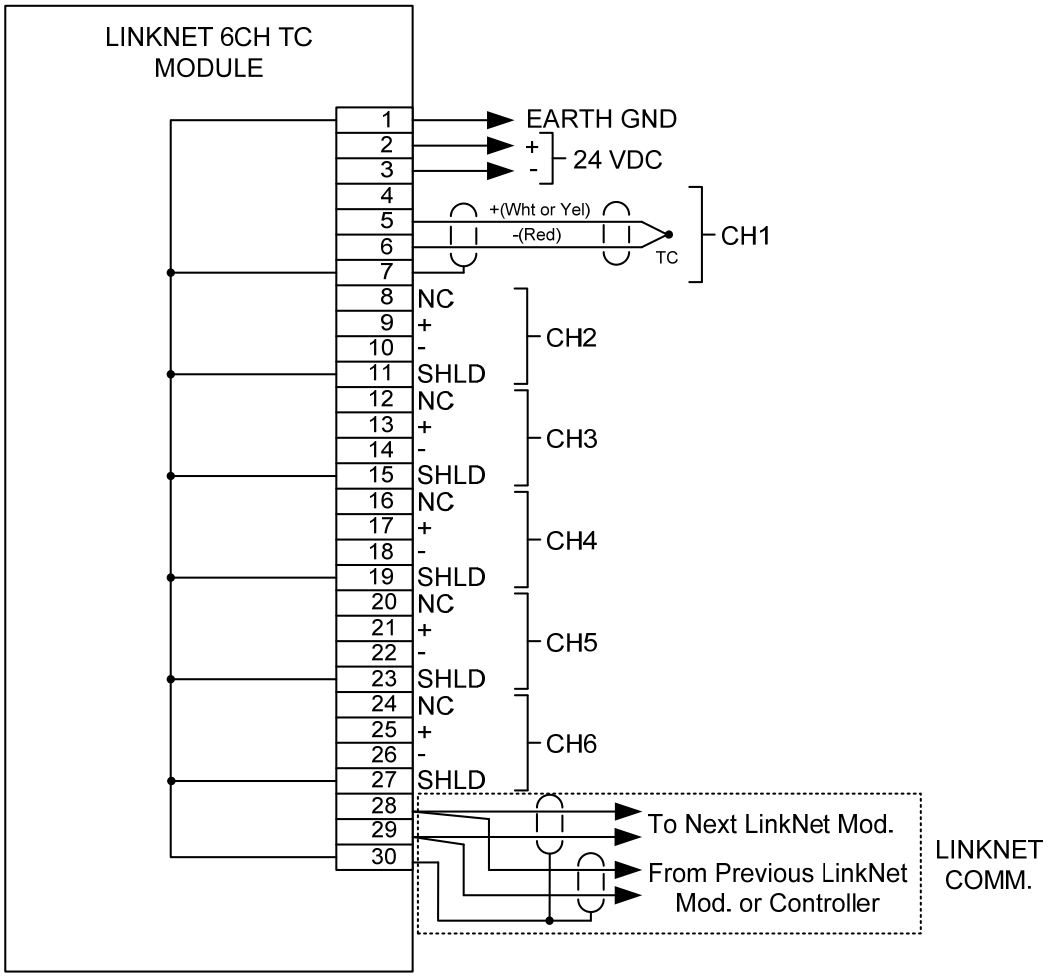


Figure 11-10—LINKnet 6CH TC Module Wiring

11.7.7—Troubleshooting

The module receives information from thermocouples, which can be either J or K type. The type is selected in the application program. It also has an AD592 ambient temperature sensor mounted on the module for cold junction temperature sensing. The cold junction compensation is performed in software. There is a fail high and a fail low version of the module, selected by jumpers on the board, which allow the input channels to be pulled high or low on an open input. Each input is multiplexed to a voltage-to-frequency converter. The module processor reads the period of this signal and converts it to a count, which it transmits through the transceiver to the LINKnet controller module. See Figure 11-11 for block diagram of the thermocouple input module.

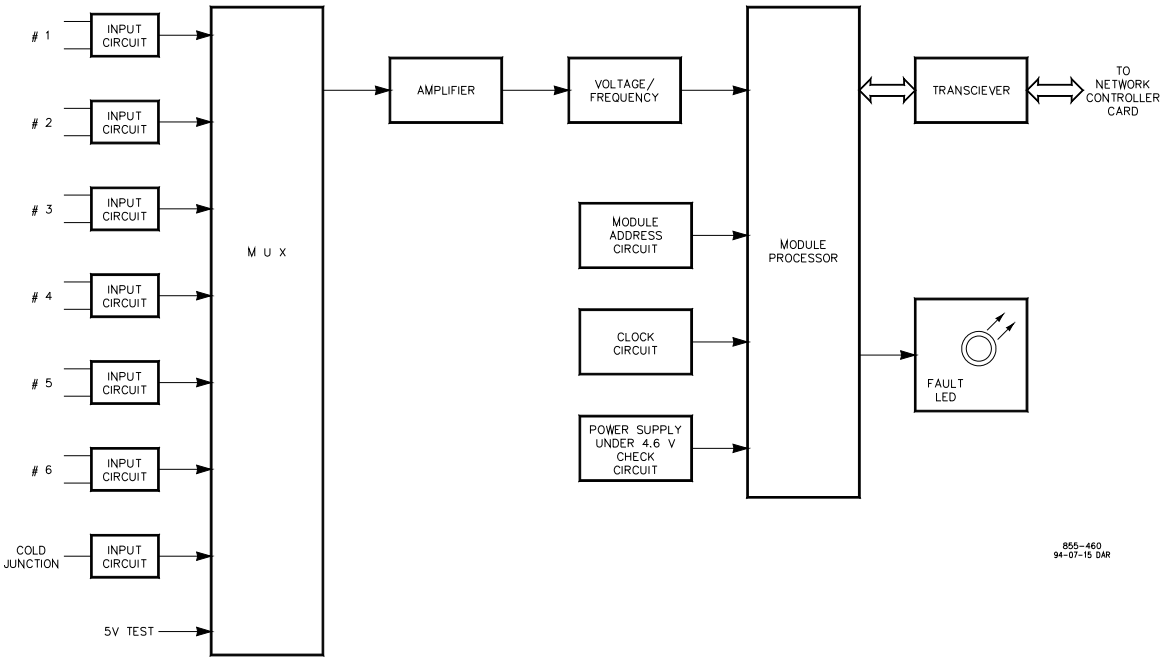


Figure 11-11—Thermocouple Input Module Block Diagram

The fault LED denotes the status of the module processor, and will be off during normal operation. If the fault LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the LINKnet controller module, and a "no message" fault will be annunciated through the application program. If two nodes are set to the same address, an "address" fault will be annunciated through the application program, and both nodes will not function. If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.

A "type" fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the "off" state when its watchdog timer times out.

No message faults, address faults, and type faults are non-latching. When these faults occur for an input module, the application program will give default values for each channel.

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

11.8—LINKnet 6Ch Current Input Module

11.8.1—Module Description

The LINKnet 6Ch Current Input Module interfaces to six 4–20 mA transducers. There are two version of the module; one for loop powered transducers and the other for self-powered transducers. Mixing self-powered and loop powered transducers on the same module is not an option. See Appendix A for desired part numbers. The module has a built-in reference voltage that is used to verify proper operation of the A/D converter. Appropriate faults are annunciated through the application program.

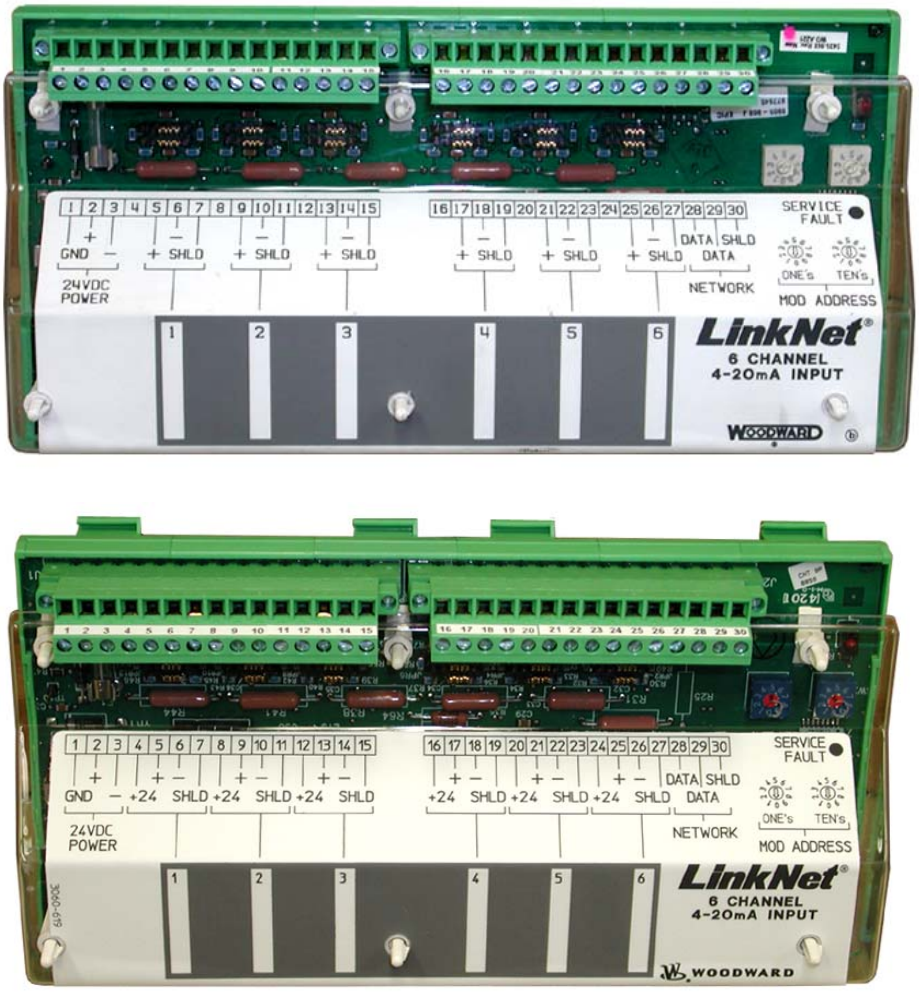


Figure 11-12—Both LINKnet 6Ch Current Input Modules

11.8.2—Module Specification

Table 11-7. LINKnet 6Ch Current Input Module Specification

Number of Inputs:	6
Input range:	0–25 mA
Resolution:	12 bits
Temp Coefficient (ppm/□°C):	235
Accuracy:	1% at 25 °C (factory calibrated)
Input Impedance:	250 Ω
Power Supply Input:	18 to 32 Vdc
Power Required:	2.4 Watts at 24 Vdc (self-powered version) 5.3 Watts at 24 Vdc (loop powered version)

11.8.3—Isolation

Table 11-8. LINKnet 6Ch Current Input Module Isolation

Network to I/O channel:	277 Vac
Power supply input to network:	277 Vac
I/O channel to I/O channel:	0 V
PS input to I/O channel:	500 Vdc
Field Wiring:	14 AWG maximum wire size
Ambient Temperature Range:	–40 to +55 °C

11.8.4—Shock and Vibration

Mil-Std-810, 30 G's sine wave at 11 ms
Mil-Std-167, 18-50 Hz

11.8.5—EMC

Emissions:	EN 61000-6-4
Immunity:	EN 61000-6-2

11.8.6—Installation

Install the LINKnet 6CH Current Input Module on the DIN rail and connect to the appropriate LINKnet network and 24 Vdc power. Wire the loop or self-powered transducers per Figure 11-13 depending on which module is used. Set module address one’s and ten’s rotary switches per application setup.

The LINKnet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on to the DIN rail, and the terminal blocks pushed into the headers. It is then necessary to reset the node through the application program to reinitiate communications with the LINKnet controller module and to clear the "no message" fault.

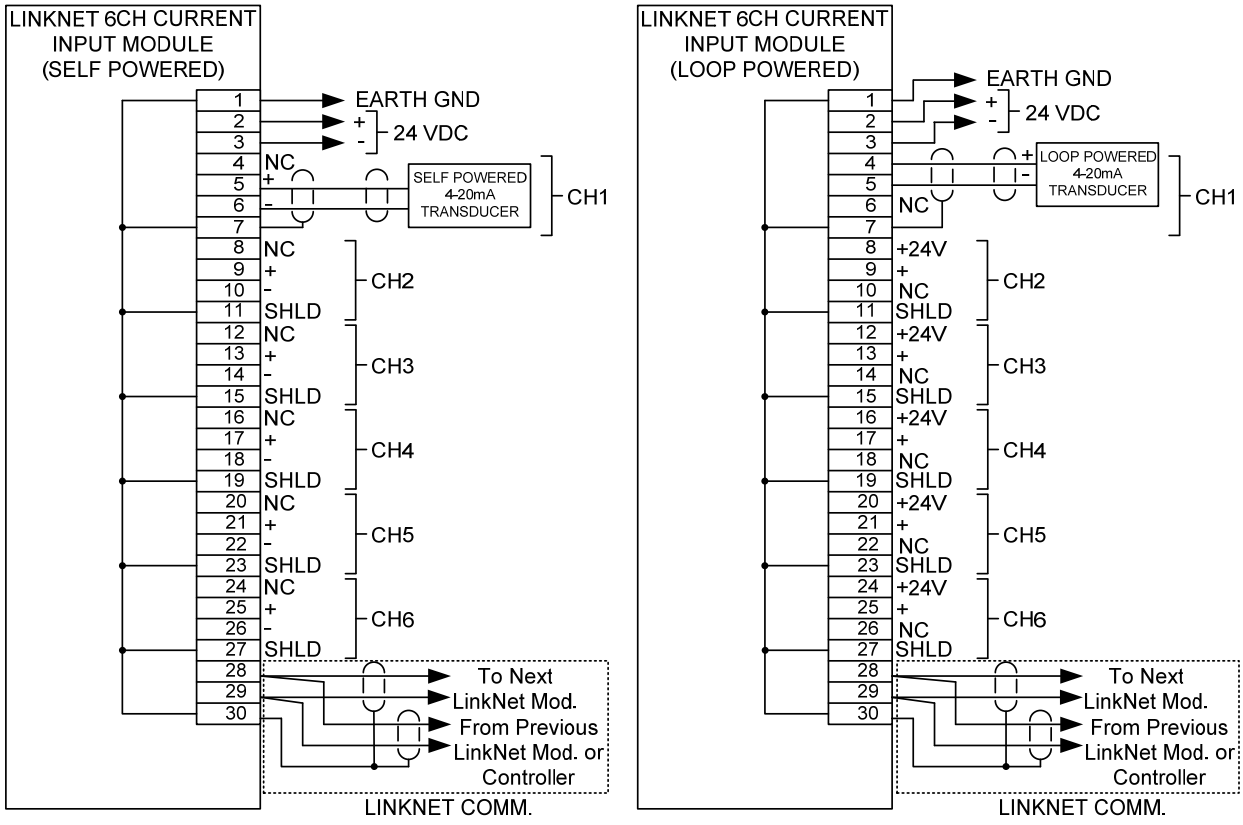


Figure 11-13—LINKnet 6CH Current Input Module Wiring

11.8.7—Troubleshooting

The module receives information from 4-20 mA sources, such as transducers. Power is provided for these transducers on one version of the module, but all module inputs must use the power provided. No inputs may use a separate power source, as all of the negatives are tied together and to 24 V common. The advantage of this module version is that it simplifies wiring to devices such as transducers that require external power. Each input is converted to a 0-5 V signal, and then multiplexed to a voltage-to-frequency converter. The module processor reads the period of this signal and converts it to a count, which it transmits through the transceiver to the LINKnet controller module. See Figure 11-14 for block diagram of the 4-20 mA input module.

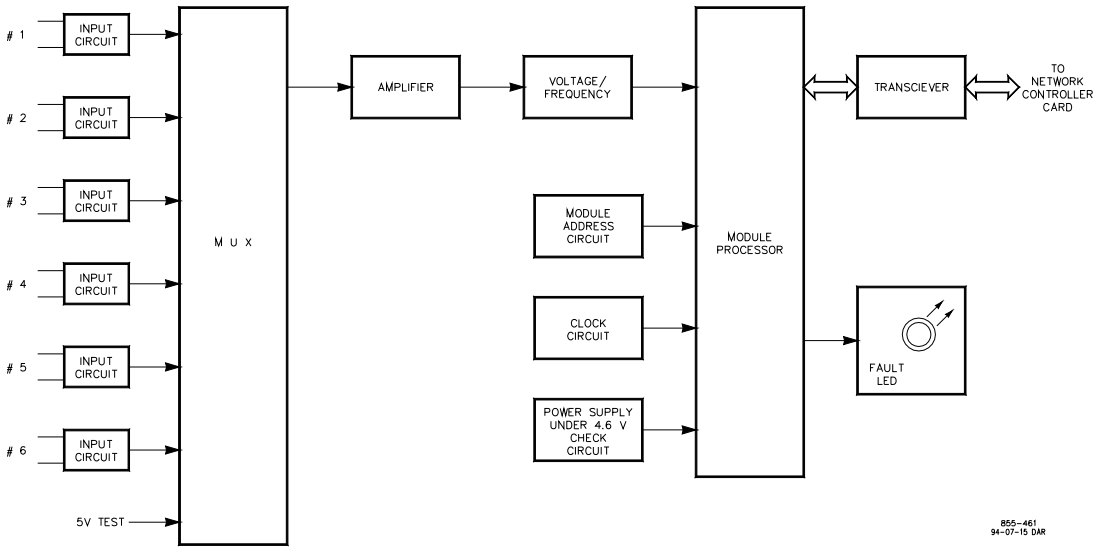


Figure 11-14—4-20 mA Input Module Block Diagram

The fault LED denotes the status of the module processor, and will be off during normal operation. If the fault LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the LINKnet controller module, and a "no message" fault will be annunciated through the application program. If two nodes are set to the same address, an "address" fault will be annunciated through the application program, and both nodes will not function. If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.

A "type" fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the "off" state when its watchdog timer times out.

No message faults, address faults, and type faults are non-latching. When these faults occur for an input module, the application program will give default values for each channel.

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

11.9—LINKnet 16 Channel Discrete Input Module

11.9.1—Module Description

The LINKnet 16 Channel Discrete Input (DI) Module provides sixteen discrete input for field switches or relay contacts. All sixteen inputs require a +24 Vdc source. A filtered and fused internal power source is provided or an external +24 Vdc source referenced to the 24 V Common of the module may be used to sense the state of the contact or switch.

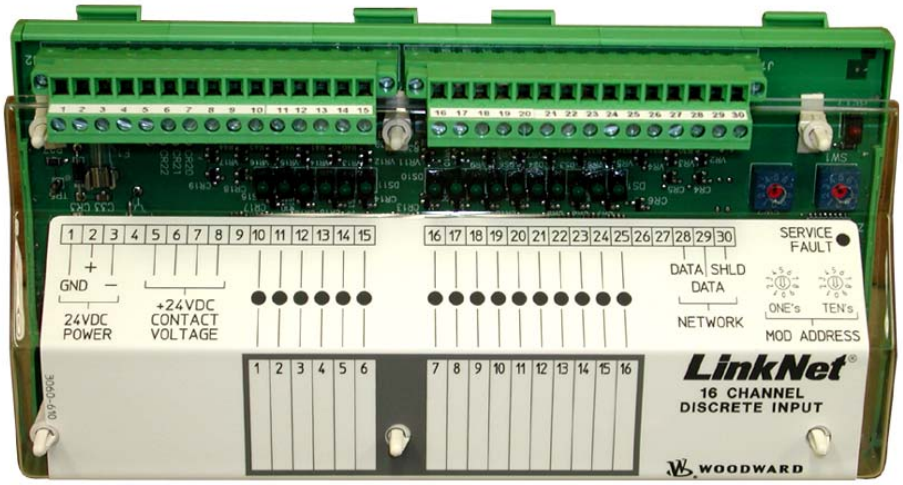


Figure 11-15—LINKnet 6Ch DI Module

11.9.2—Module Specification

Table 11-9. LINKnet 6Ch DI Module Specification

Number of Inputs:	16
Input thresholds:	
Low voltage:	<8 Vdc = “OFF”
	>16 Vdc = “ON”
Discrete Input Current:	13.1 mA per channel when "on" (@ 24 V)
External input voltage:	18 to 32 Vdc
Power Supply Input:	18 to 32 Vdc
Power Required:	6.5 Watts at 24 Vdc

11.9.3—Isolation

Table 11-10. LINKnet 6Ch DI Module Isolation

Network to I/O channel:	277 Vac
Power supply input to network:	277 Vac
I/O channel to I/O channel:	0 V
PS input to I/O channel:	500 Vdc
Field Wiring:	14 AWG maximum wire size
Ambient Temperature Range:	–40 to +55 °C

11.9.4—Shock and Vibration

Mil-Std-810, 30 G's sine wave at 11 ms
Mil-Std-167, 18-50 Hz

11.9.5—EMC

Emissions: EN 61000-6-4
Immunity: EN 61000-6-2

11.9.6—Installation

Install the LINKnet 16CH Discrete Input Module on the DIN rail and connect to the appropriate LINKnet network and 24 Vdc power. The inputs can be wired using the internal +24 V connections or an external 24 V power source if desired. Wire the discrete inputs per Figure 11-16. Set module address one's and ten's rotary switches per application setup.

The LINKnet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on to the DIN rail, and the terminal blocks pushed into the headers. It is then necessary to reset the node through the application program to reinitiate communications with the LINKnet controller module and to clear the "no message" fault.

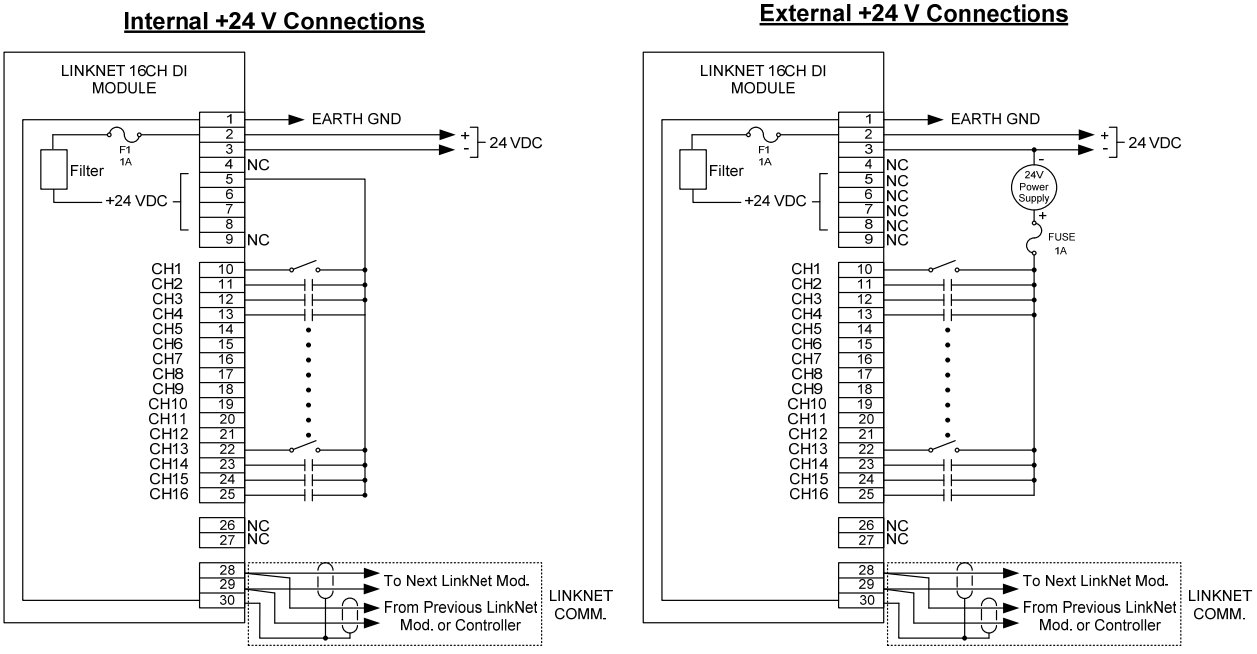


Figure 11-16—LINKnet 16CH DI Module Wiring

11.9.7—Troubleshooting

The module receives information from field switches and relays. Power is provided for these contacts, on four terminal blocks, TB-5 through TB-8. The input power on TB-2 may also be used, but does not have the benefit of an internal fuse and some filtering, therefore external fusing should be provided. The state of each discrete input is passed through an optoisolator and an LED to the shift register. In this manner, the LED's will light when a contact is closed. The module processor receives this information and transmits it through the transceiver to the LINKnet controller module. See Figure 11-17 for block diagram of the Discrete Input module.

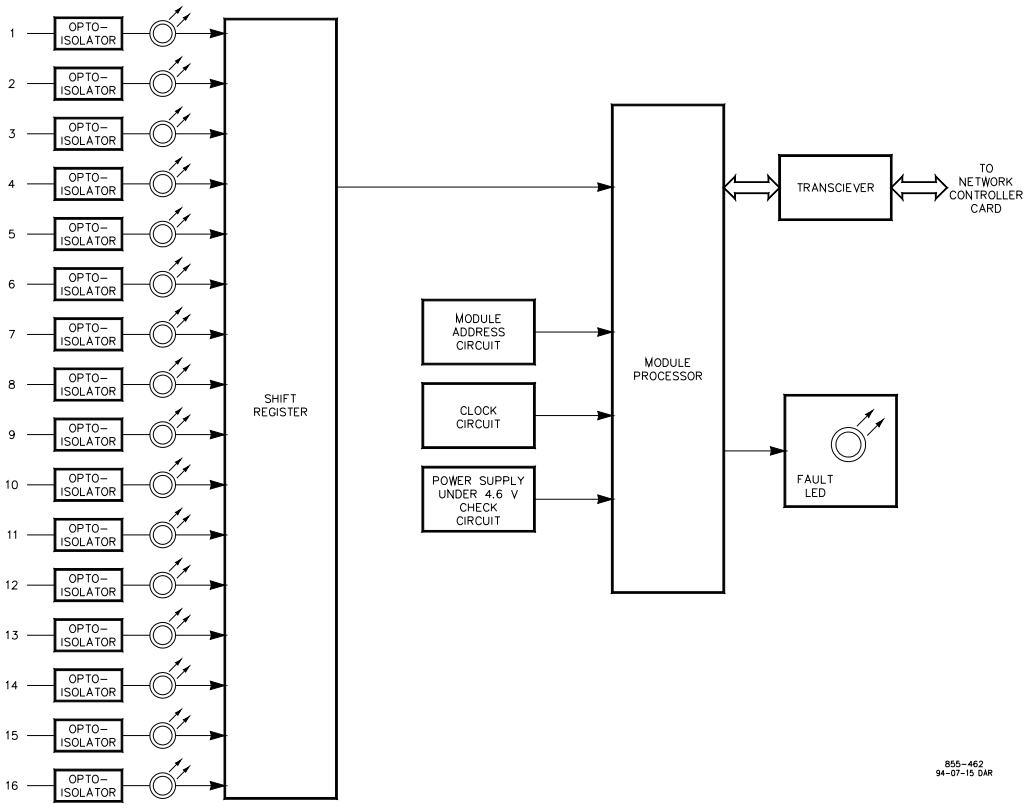


Figure 11-17—Discrete Input Module Block Diagram

The fault LED denotes the status of the module processor, and will be off during normal operation. If the fault LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the LINKnet controller module, and a "no message" fault will be annunciated through the application program. If two nodes are set to the same address, an "address" fault will be annunciated through the application program, and both nodes will not function. If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.

A "type" fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the "off" state when its watchdog timer times out.

No message faults, address faults, and type faults are non-latching. When these faults occur for an input module, the application program will give default values for each channel.

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

11.10—LINKnet 6 Channel Analog Output Module

11.10.1—Module Description

The LINKnet 6 Channel Analog Output (AO) Module provides six 4-20 mA analog outputs. The output current is monitored by the module processor through an A/D converter. The read back value and status are available through the application program. The 4-20 mA output module has a watchdog that monitors the communications from the module processor to the D/A converter, and disables the current drivers upon a loss of communications of more than 1.2 seconds.

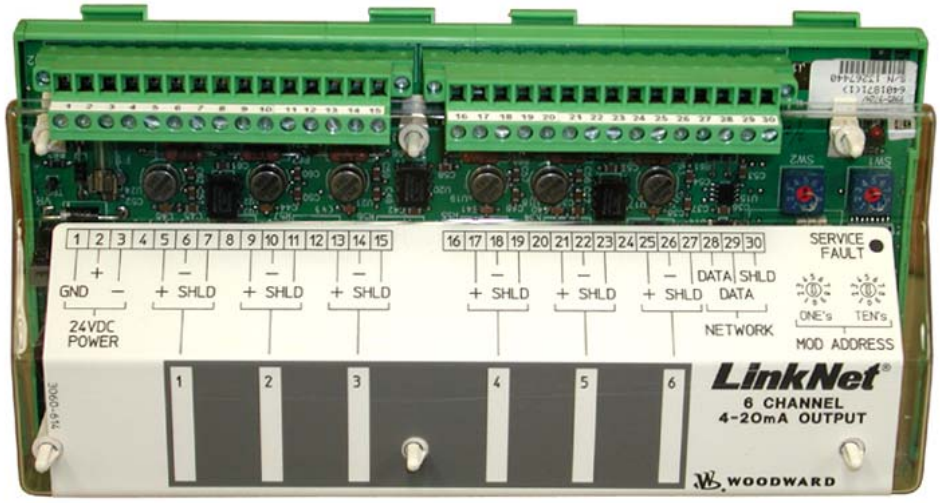


Figure 11-18—LINKnet 6 Channel Analog Output Module

11.10.2—Module Specification

Table 11-11. LINKnet 6 Channel Analog Output Module Specification

Number of Outputs:	6
Current output range:	0–25 mA
Power Supply Input:	18 to 32 Vdc
Power Required:	6.0 Watts at 24 Vdc

11.10.3—Isolation

Table 11-12. LINKnet 6 Channel Analog Output Module Isolation

Network to I/O channel:	277 Vac
Power supply input to network:	277 Vac
I/O channel to I/O channel:	0 V
PS input to I/O channel:	500 Vdc
Field Wiring:	14 AWG maximum wire size
Ambient Temperature Range:	–40 to +55 °C

11.10.4—Shock and Vibration

Mil-Std-810, 30 G's sine wave at 11 ms
Mil-Std-167, 18-50 Hz

11.10.5—EMC

Emissions:	EN 61000-6-4
Immunity:	EN 61000-6-2

11.10.6—Installation

Install the LINKnet 6CH Analog Output Module on the DIN rail and connect to the appropriate LINKnet network and 24 Vdc power. Wire the analog outputs per Figure 11-19. Set module address one’s and ten’s rotary switches per application setup.

The LINKnet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on to the DIN rail, and the terminal blocks pushed into the headers. It is then necessary to reset the node through the application program to reinitiate communications with the LINKnet controller module and to clear the "no message" fault.

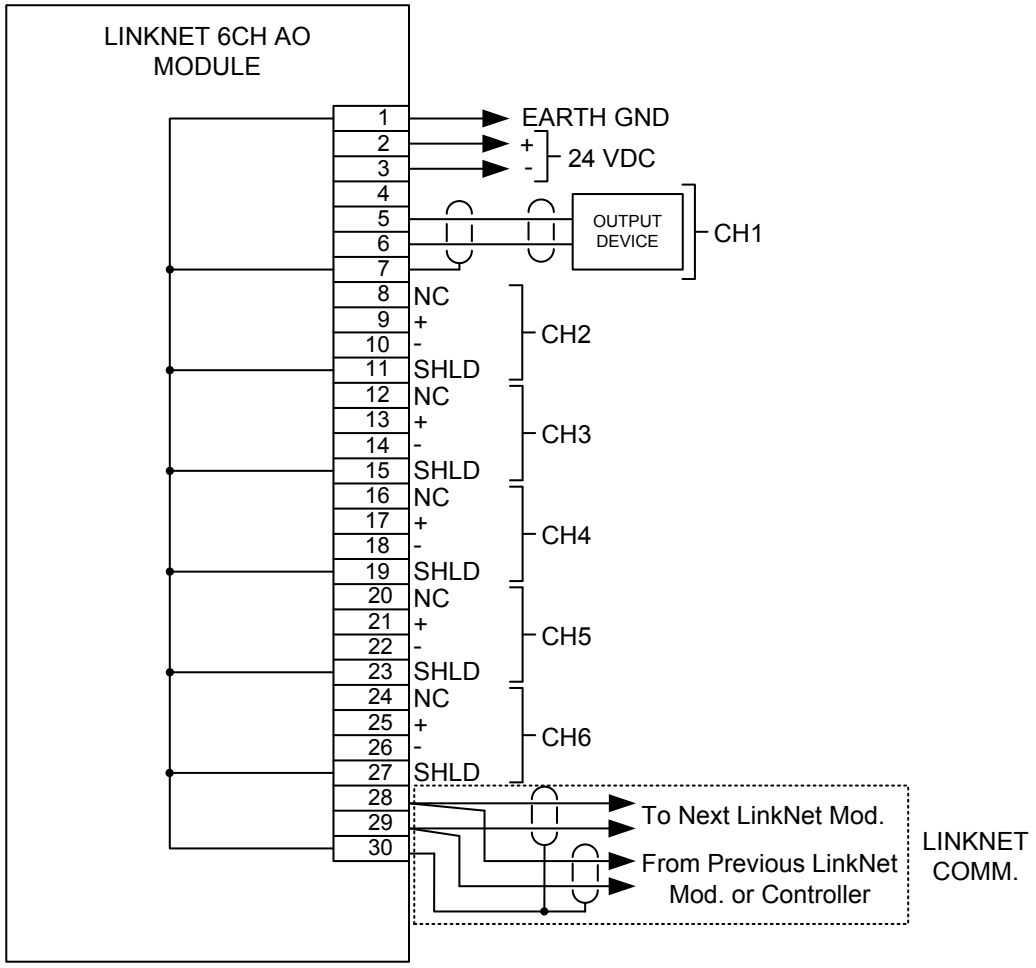


Figure 11-19—LINKnet 6CH AO Module Wiring

11.10.7—Troubleshooting

The 4-20 mA output module processor receives information through the transceiver, from the LINKnet controller module. The 4-20 mA output module then updates the status of the D/A converter which outputs voltages to the current drivers. The output current is monitored by the module processor through an A/D converter. The read back value and status are available through the application program. The 4-20 mA output module has a watchdog that monitors the communications from the module processor to the D/A converter, and disables the current drivers upon a loss of communications of more than 1.2 seconds. The module will not function after a watchdog timeout until its power is cycled or the MicroNet system is reset. See Figure 11-20 for block diagram of the 4-20 mA Output module.

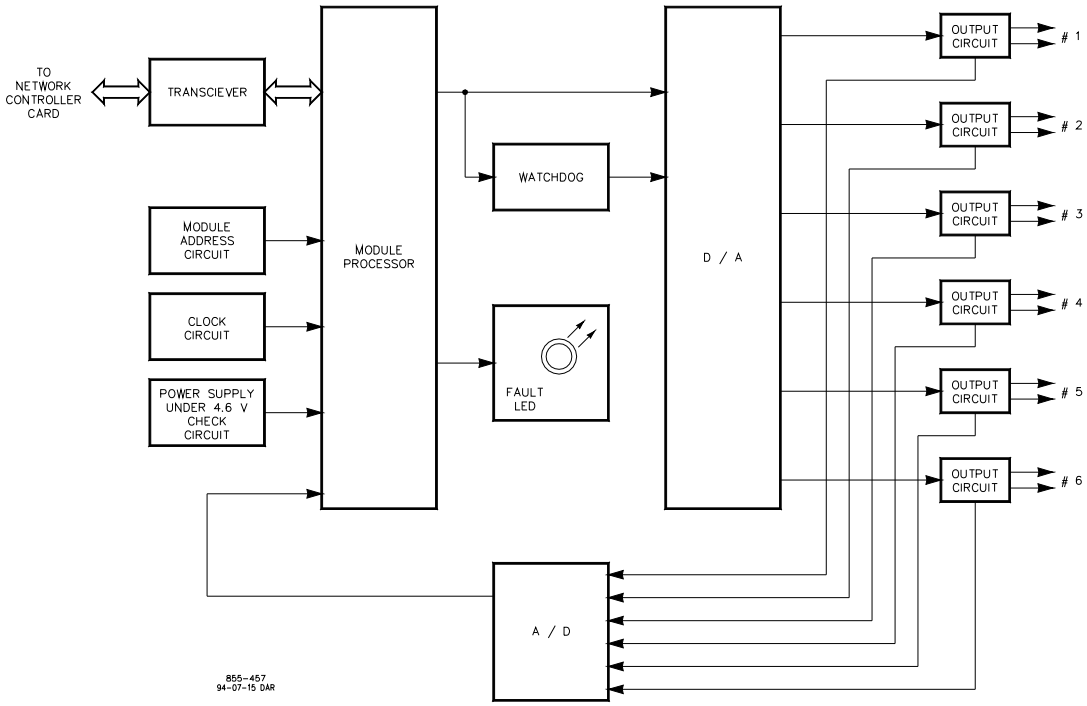


Figure 11-20—4-20 mA Output Module Block Diagram

The fault LED denotes the status of the module processor, and will be off during normal operation. If the fault LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the LINKnet controller module, and a "no message" fault will be annunciated through the application program. If two nodes are set to the same address, an "address" fault will be annunciated through the application program, and both nodes will not function. If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.

A "type" fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the "off" state when its watchdog timer times out.

The no message fault, address fault, and type fault are non-latching.

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

11.11—LINKnet 8 Channel Discrete Output Module

11.11.1—Module Description

The LINKnet 8 Channel Discrete Output (DO) Module provides eight 5 amp form C relay outputs. An internal set of relay contacts is fed back to the module processor, for read back status. The read backs are compared with the desired outputs, and a status annunciated for each relay in the application program. The relay output module has a watchdog that monitors the communications with the module processor, and disables the relay drivers upon a loss of communications of more than 1.2 seconds.

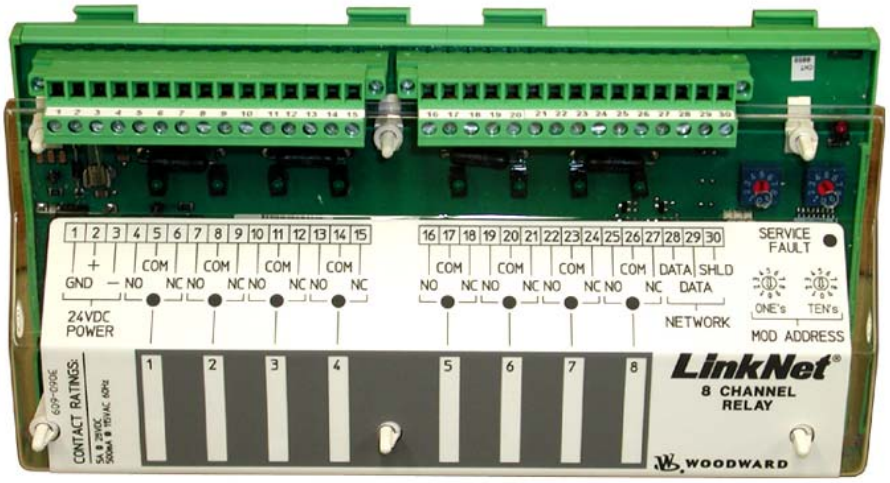


Figure 11-21—LINKnet 8 Channel Discrete Output Module

11.11.2—Module Specification

Table 11-13. LINKnet 8 Channel Discrete Output Module Specification

Number of Outputs:	8 (form C relay outputs)
Ratings:	5.0 A @ 28 Vdc resistive
	0.5 A @ 115 Vac resistive

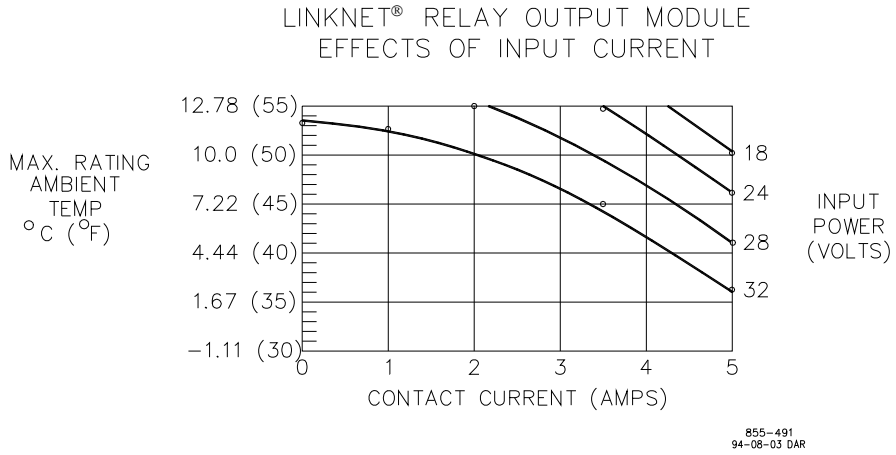


Figure 11-22—LINKnet Relay Contacts

Power Supply Input:	18 to 32 Vdc
Power Required:	5.0 Watts at 24 Vdc

11.11.3—Isolation

Table 11-14. LINKnet 8 Channel Discrete Output Module Isolation

Network to I/O channel:	277 Vac
Power supply input to network:	277 Vac
PS input to I/O channel:	500 Vdc
Field Wiring:	14 AWG maximum wire size
Ambient Temperature Range:	–40 to +55 °C

11.11.4—Shock and Vibration

Mil-Std-810, 30 G's sine wave at 11 ms
Mil-Std-167, 18-50 Hz

11.11.5—EMC

Emissions:	EN 61000-6-4
Immunity:	EN 61000-6-2

11.11.6—Installation

Install the LINKnet 8CH Discrete Output Module on the DIN rail and connect to the appropriate LINKnet network and 24 Vdc power. Wire the discrete outputs per Figure 11-23. Set module address one’s and ten’s rotary switches per application setup.

The LINKnet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on to the DIN rail, and the terminal blocks pushed into the headers. It is then necessary to reset the node through the application program to reinitiate communications with the LINKnet controller module and to clear the "no message" fault.

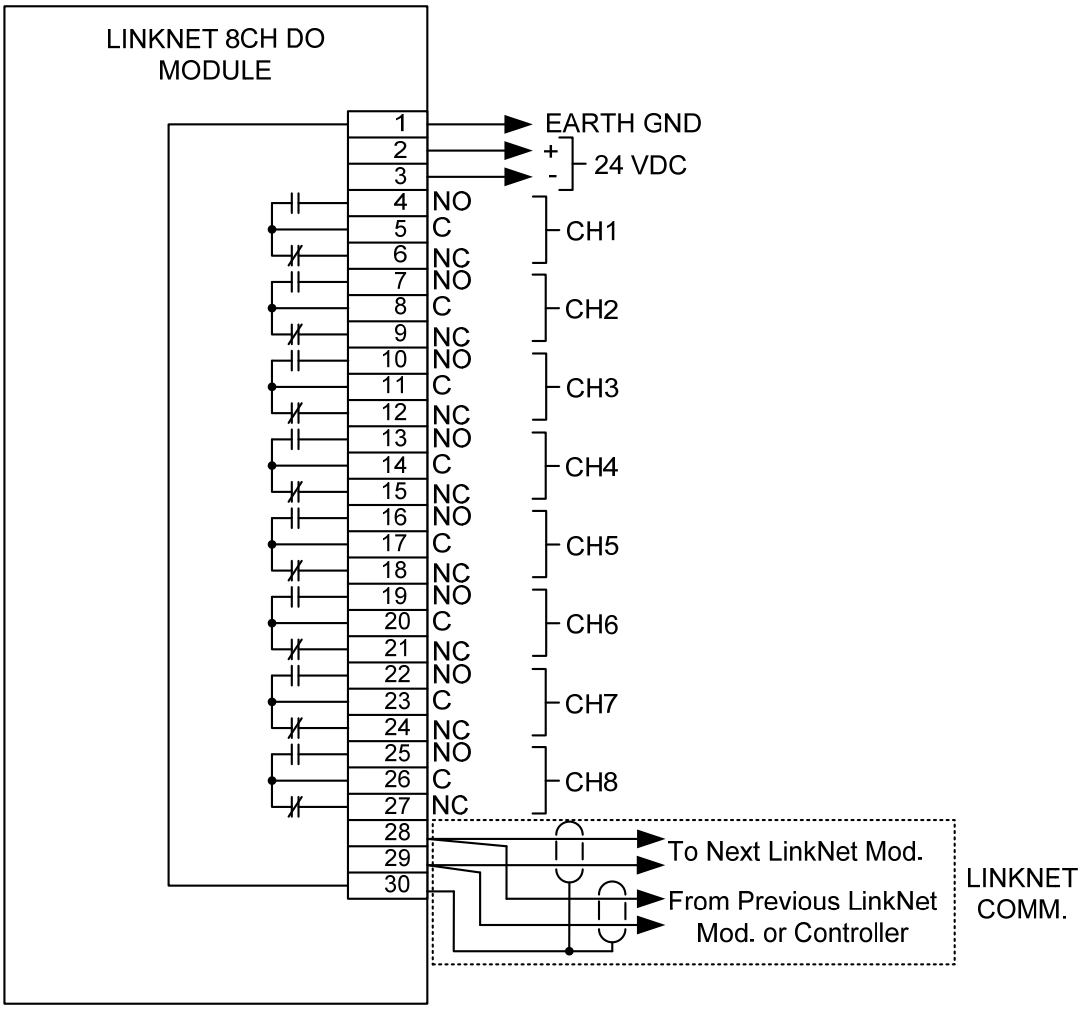


Figure 11-23—LINKnet 8CH DO Module Wiring

11.11.7—Troubleshooting

The module outputs information through eight 5 amp form C relays. The relay output module processor receives information through the transceiver, from the LINKnet controller module. The node then updates the status of the shift register which updates the relays and a status LED. The second set of relay contacts is input back into the module processor through a shift register, for read back status. The read backs are compared with the desired outputs, and a status annunciated for each relay in the application program. The relay output module has a watchdog that monitors the communications from the module processor to the shift register, and disables the relay drivers upon a loss of communications of more than 1.2 seconds. The node will not function after a watchdog timeout, until its power is cycled or until the MicroNet system is reset. See Figure 11-24 for block diagram of the Relay Output module.

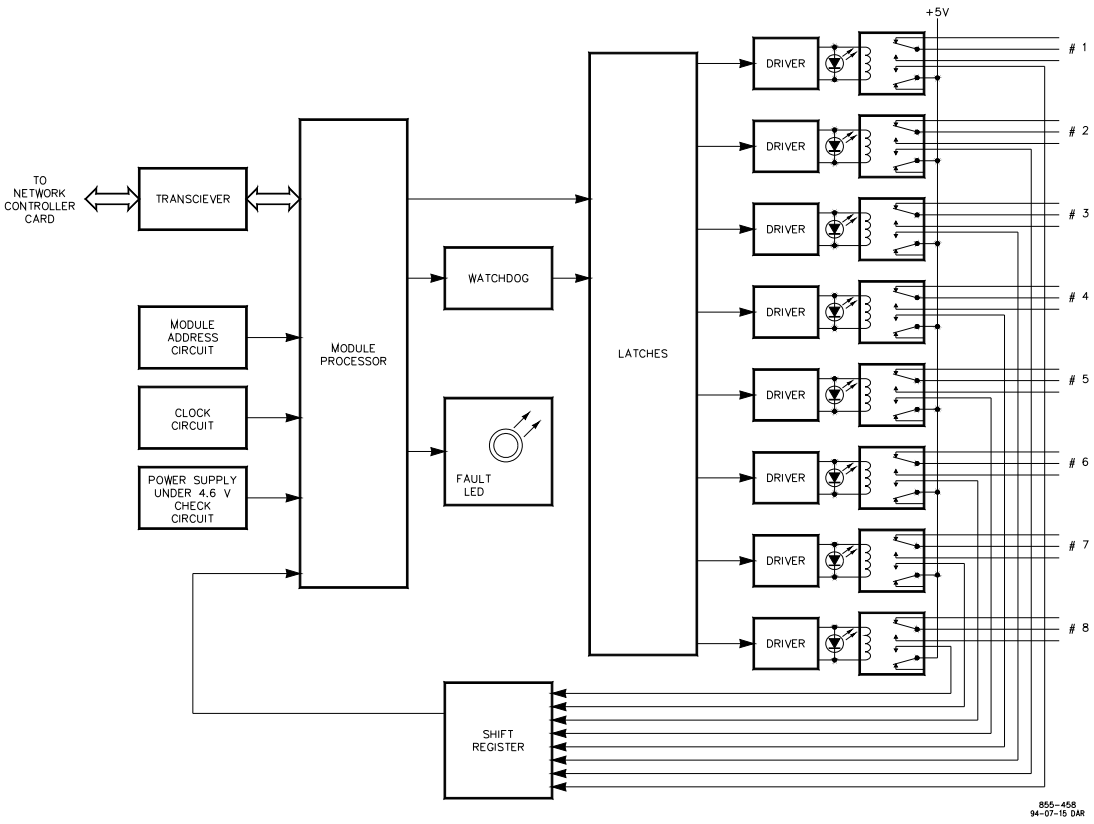


Figure 11-24—Relay Output Module Block Diagram

The fault LED denotes the status of the module processor, and will be off during normal operation. If the fault LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the LINKnet controller module, and a "no message" fault will be annunciated through the application program. If two nodes are set to the same address, an "address" fault will be annunciated through the application program, and both nodes will not function. If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.

A "type" fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the "off" state when its watchdog timer times out.

The no message fault, address fault, and type fault are non-latching.

Troubleshooting Flowchart

If a problem occurs with the LINKnet network, use Figure 11-25 (Troubleshooting Flowchart) as a guide to find and repair the problem.

Follow the flowchart down from the title block to the next block. This block may be a rectangular suggestion block, or a diamond shaped decision block. When a suggestion block is entered, perform the check suggested. A suggestion block may refer you to the Control Wiring Diagram, the application program, or the module field wiring.

If this check does no find the problem, continue down the flowchart.

When a decision block is entered, the question asked inside it must be answered. This answer then determines the proper exit from that block. The exit taken will lead you to another point on the flowchart.

By following the flowchart in this manner, you should be able to determine a course of action for most problems.

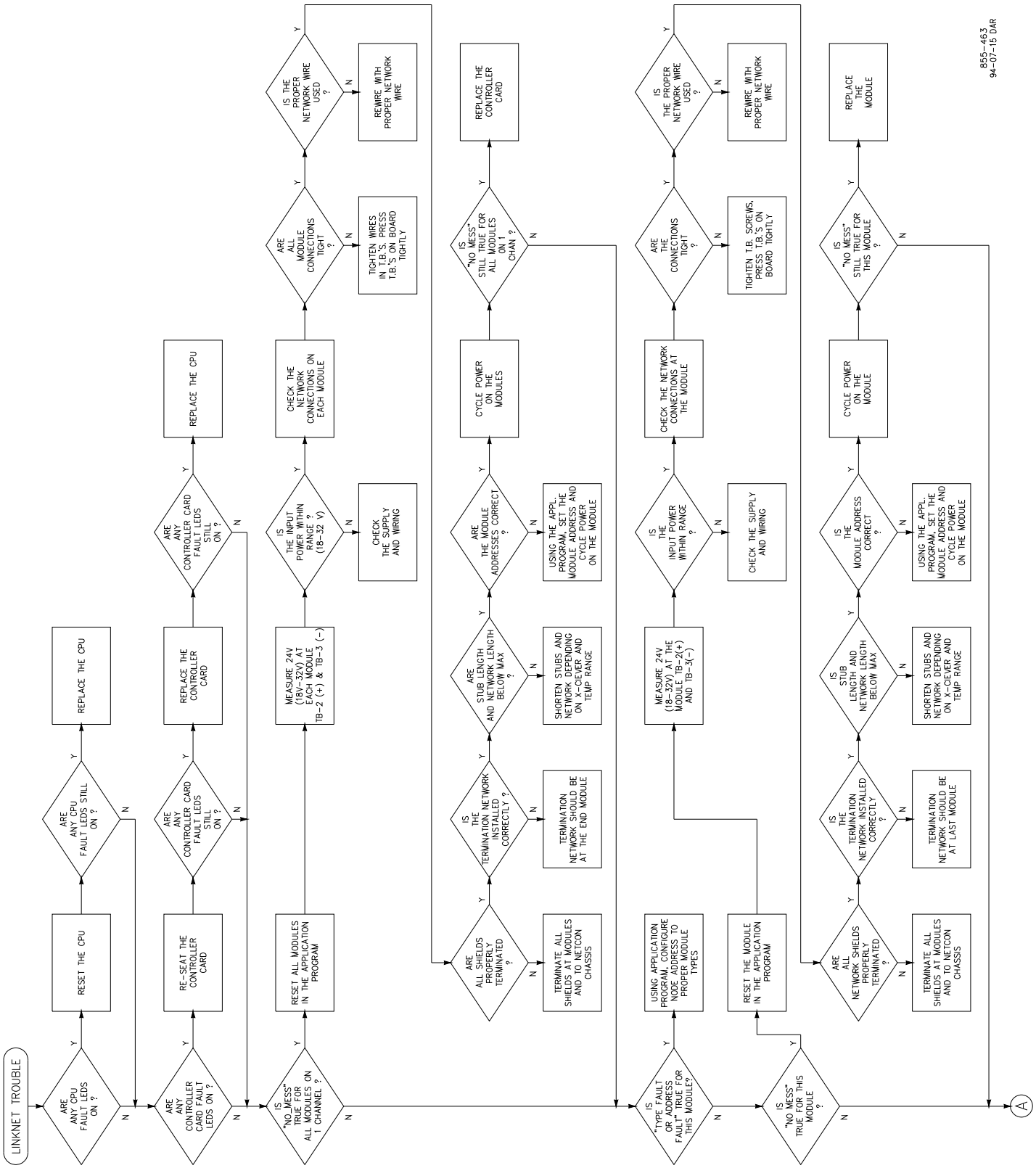


Figure 11-25-Troubleshooting Flowchart Pg. 1

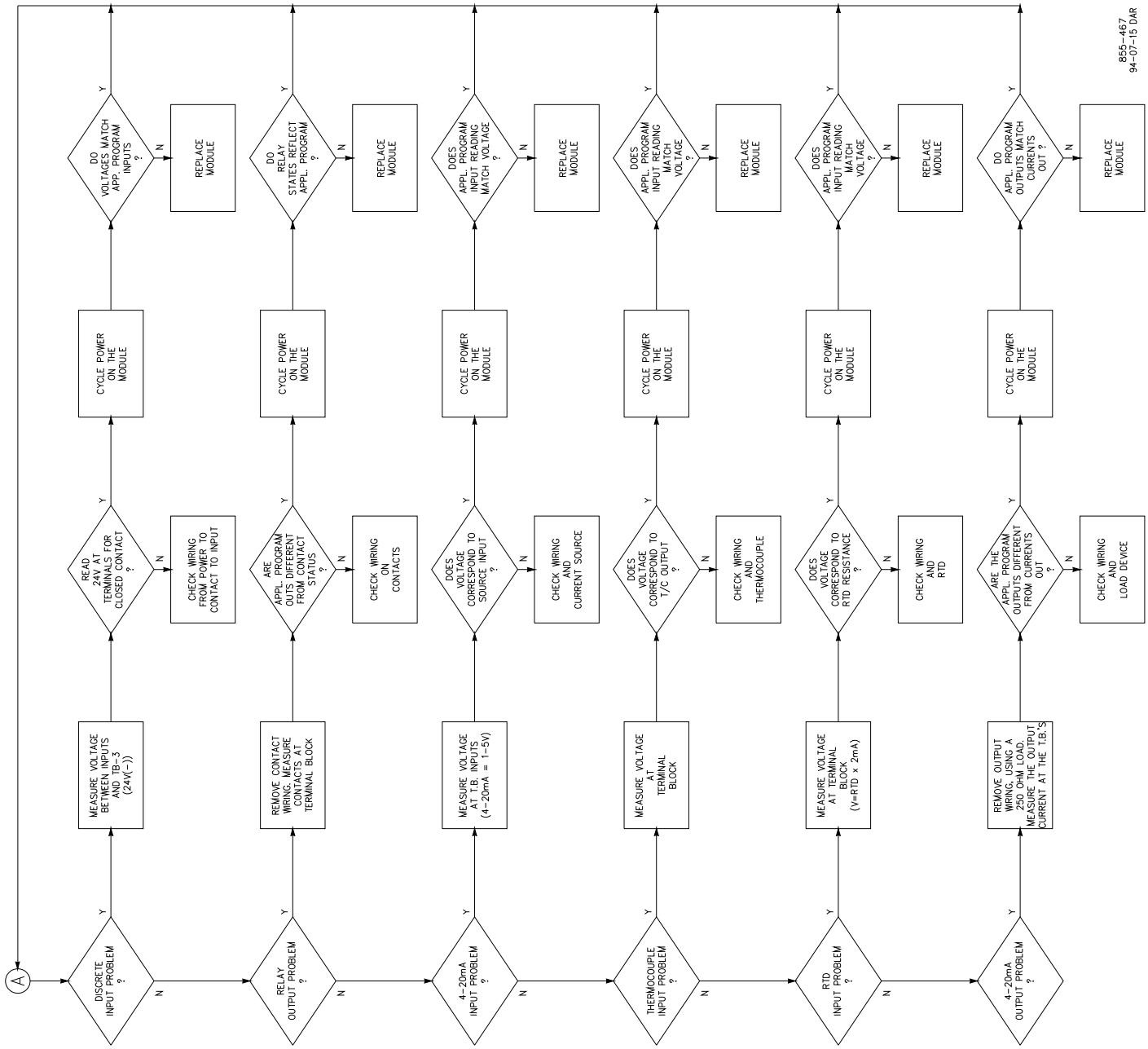


Figure 11-26—Troubleshooting Flow Chart Pg. 2

Chapter 12.
Specialty Function Modules

12.1—Pressure Transducer Interface Module

12.1.1—Module Description

The pressure transducer interface module is an input module that communicates with external pressure transducers.

This module has two isolated RS-422 communication ports. Each RS-422 communication port contains a pair of differential transmit lines, a pair of differential receive lines, and +15 V power connections. These two ports are electrically isolated from each other and from the rest of the module.

Pressure data received from external sources is shared with the main CPU module through dual-port RAM on the VME bus. Up to eight pressure transducers may be connected to one pressure transducer interface module.

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws: one at the top and one at the bottom of the module. Also at the top and bottom are two handles which, when toggled, move the modules out just far enough for the boards to disengage the motherboard connectors.

Figure 12-1—Pressure Transducer Interface Module

12.1.2—Module Specification

Table 12-1. Pressure Transducer Interface Module Specification

Protocol	RS-422 UART, Honeywell proprietary protocol
Isolated RS-422 Ports	2
Isolated +15 V Power Supply Connections	2

Wiring Specifications
The RS-422 wiring should meet the requirements in the EIA RS-422 standard document for a 500 kbps network.

NOTICE

To assure reliable communications when using copper RS-422 cable, do not use any intervening devices such as relays or terminal blocks. The cable should run directly from one RS-422 device to the next device.

All cable lengths are calculated based on ideal conditions. It is recommended that installations attempt to minimize network problems due to harsh conditions and unforeseen circumstances by keeping the network length under 50% of the absolute maximum EIA RS-422 ratings.

12.1.3—Installation

The Pressure Transducer Interface Module contains optional termination resistors, which should be installed on the RS-422 receive ports.

The termination resistors should be installed on the last unit on each end of the network. On the Pressure Transducer Interface Module, the termination resistor is installed by closing switches 3 and 4, and leaving switches 1 and 2 open, for each channel.

The modules slide into card guides in the control's chassis and plug into the motherboard. The modules are held in place by two screws, one at the top and one at the bottom of the front panel. Also at the top and bottom of the module are two handles which, when toggled (pushed outward), move the modules out just far enough for the boards to disengage the motherboard connectors.

See the appropriate Smart Pressure Transducer manual for the wiring diagram (manual 26080 or 85555).

12.1.4—Troubleshooting

The Pressure Transducer Interface Module contains a communications processor, which sends outputs and receives inputs from the RS-422 ports. The CPU module communicates with the Pressure Transducer Interface Module, through the VME bus, and dual port RAM. See Figure 12-2 for a module block diagram.

Each module contains two RS-422 ports, for communication to the pressure transducers.

RS-422 is a standard electrical interface for serial data communications. It is similar to RS-232 but with multi-node functionality versus point to point functionality. RS-422 can communicate with pressure transducers from lengths of up to 328 meters (1000 feet).

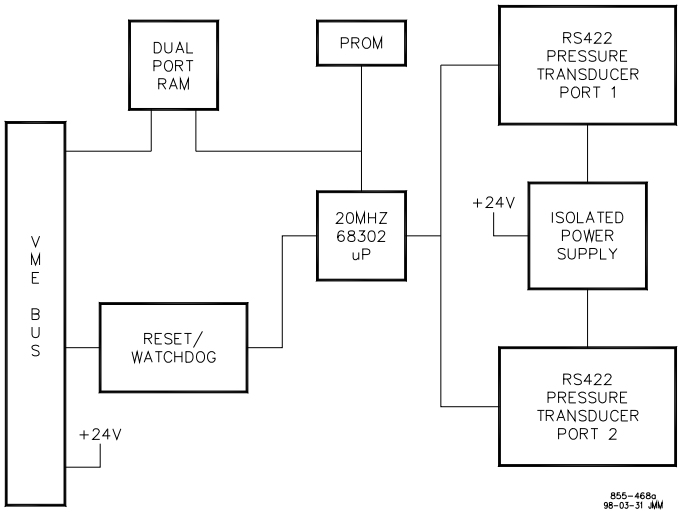


Figure 12-2—Module Block Diagram

Each I/O module has a red Fault LED controlled by the CPU, which is turned on when the system is reset. During initialization of a Pressure Transducer Interface Module, which occurs after every CPU reset, the CPU turns the Fault LED on. The CPU then tests the module using diagnostic routines built into software. If the diagnostic test is not passed, the LED remains on or blinks. If the test is successful, the LED goes off. If the Fault LED on a Pressure Transducer Interface Module is illuminated after the diagnostics and initialization have been run, the module may be faulty or in the wrong slot.

Table 12-2. Fault LED Definitions

Number of LED Flashes	Failure
1	External RAM test failure
2	Unexpected Exception
3	Dual Port RAM test failure
4	Module watchdog time-out

If during normal control operation all a rack's I/O modules have their Fault LEDs on, check the rack CPU for a failure. If during normal control operation, only the Pressure Transducer Interface Module's Fault LED is turned on or is flashing, replace that module.

In addition to the module hardware detection fault, the Pressure Transducer Interface Module detects I/O faults:

FAULT DETECTION

RS-422 communication faults: The GAP block output "comm fault" is set true, for any RS-422 faults. These include:

- Parity Error
- Address error
- No response

Pressure Transducer faults: The GAP block output"env_fault" is set true for a pressure transducer fault.

12.2—Dual Overspeed Module

12.2.1—Module Description

The Dual Overspeed module is used to monitor two independent frequency (shaft speed) inputs and detect for a board configured overspeed and input failed trips. The module uses discrete and analog components, to minimize the time to detect and output signals, when an event occurs. This module is used primarily for General Electric LM (Land & Marine) gas turbines. This module is typically used in conjunction with a Dual Solenoid Monitor Module in order to meet the overspeed to fuel shutoff requirements of the gas turbine manufacturer. The Dual Solenoid Monitor module is used to directly interface with the gas turbine fuel shutoff valve solenoids.

Figure 12-3—Dual Overspeed Module

The components for each channel are completely independent of each other, so that a chip or component failure will only affect one channel and not both. The module has a test feature for each channel that will inject a high frequency directly into the inputs of either channel. In this manner the entire channel is verified from the input to output. The module has configurable jumper settings, which define the overspeed and input failed setpoints. The module has 6 potentiometers for factory adjustments that are used in conjunction with the configuration jumpers. Four of the potentiometers are for adjusting the overspeed trip points and two are for adjusting the input failure points.

This module will plug directly into any slot of a MicroNet rack, but it has no interface to the data or address busses of the MicroNet. The only interface to the back plane is for power supply inputs, therefore care should be taken when interfacing the module circuit common to external devices to prevent potential ground loops. The module utilizes the standard analog cable and FTM (see Appendix A).

Input/Output

The module I/O has been designed to minimize the interconnection to external power sources and/or circuit commons. All of the input signals are set by allowing the input to float (pulled high to +5 Vdc) or by connecting to the module circuit common through a dry relay contact (pulled low to circuit common).

The module has two types of output signals that provide an interface to the MicroNet Dual Solenoid Monitor module, and a MicroNet discrete input module or interposing relay coil (indication outputs).

12.2.2—Installation

The module input signals are described below. Note: FTM TB's are based on using an analog cable.

Table 12-3. Installation Module Input Signals

INPUT	DESCRIPTION	PIN(S)	FTM TB(S)	LOGIC STATE
MPU No. 1	Channel No. 1 frequency input signal	PIN 37 PIN 36	TB 20 TB 21	AC signal input.
MPU No. 2	Channel No. 2 frequency input signal	PIN 35 PIN 34	TB 22 TB 23	AC signal input.
Overspeed Test No. 1 Select	Channel No. 1 static overspeed test selection input, must be used in conjunction with Test Activate input.	PIN 27	TB 30	PIN 27 "high" = ON state, OFF state requires PIN 27 pulled "low" to circuit common.
Overspeed Test No. 2 Select	Channel No. 2 static overspeed test selection input, must be used in conjunction with Test Activate input.	PIN 31	TB 26	PIN 31 "high" = ON state, OFF state requires PIN 31 pulled "low" to circuit common.
Test Activate	Input is used as a permissive or activation medium for the static Overspeed Test function	PIN 26	TB 31	PIN 26 "high" = ON state which permits Overspeed Test function, OFF state requires PIN 26 pulled "low" to circuit common which disables Overspeed Test function.
Reset	Input is used to clear overspeed and input failed latch circuits. The reset function is edge triggered and requires the input to be cycled from "low" to "high".	PIN 25	TB 32	PIN 25 transition from "low" to "high" activates reset command.
Input Failed Override	Input overrides the input failed detection circuits. Input must be pulled	PIN 23	TB 34	PIN 23 "high" = OFF state for the input failed override, PIN

	"low" to activate override.			23 "low" = ON state for input failed override.

The module output signals are below. Note: FTM TB's are based on using an analog cable.

Table 12-4. Instalation Module Output Signals

OUTPUT	DESCRIPTION	PIN(S)	FTM TB(S)	LOGIC STATE
Input Failed No. 1 Indication	Indicates Channel No. 1 input failed (input below input failed setpoint). Output can be used to drive a MicroNet discrete input module directly or to drive an interposing relay coil.	PIN 29	TB 28	PIN 29 "low" = input failed state TRUE. Will illuminate module LED DS1.
Input Failed No. 2	Indicates Channel No. 2 input failed (input freq. below input failed setpoint). Output can be used to drive a MicroNet discrete input module directly or to drive an interposing relay coil.	PIN 33	TB 24	PIN 33 "low" = input failed state TRUE. Will illuminate module LED DS2.
Overspeed No. 1	Indicates Channel No. 1 overspeed detected (input freq. above overspeed trip setpoint). Output can be used to drive a MicroNet discrete input module directly or to drive an interposing relay coil.	PIN 28	TB 29	PIN 28 "low" = overspeed detected TRUE. Will illuminate LED DS3.
Overspeed No. 1 Logic	Provides direct connection to the MicroNet Solenoid Monitor module to de-energize the solenoid on when overspeed detected.	PIN 13	TB 7	PIN 13 "low" = overspeed detected TRUE. Will cause solenoid driver to de-energize if connected to the MicroNet Solenoid Monitor module.
Overspeed No. 2	Indicates Channel No. 2 overspeed detected (input freq. above overspeed trip setpoint). Output can be used to drive a MicroNet discrete input module directly or to drive an interposing relay coil.	PIN 32	TB 25	PIN 32 "low" = overspeed detected TRUE. Will illuminate LED DS4.
Overspeed No. 2 Logic	Provides direct connection to the MicroNet Solenoid Monitor module to de-energize the solenoid on when overspeed detected.	PIN 9	TB 11	PIN 9 "low" = overspeed detected TRUE. Will cause solenoid driver to de-energize if connected to the MicroNet Solenoid Monitor module.

Table 12-4. Instalation Module Output Signals (Continued)

Alarm Bus	Output indicates Channel No. 1 or 2 overspeed active or both Channel No. 1 and 2 inputs failed. Output should be connected directly to the Alarm Bus input on the MicroNet Dual Solenoid Monitor module. No other connections to this output should be made.	PIN 30	TB 27	PIN 30 “low” = fault condition TRUE.
Shutdown	Similar to the Alarm Bus, the output indicates Channel No. 1 or 2 overspeed active or both Channel No. 1 and 2 inputs failed. Output should be connected directly to the Shutdown input on the MicroNet Dual Solenoid Monitor module. No other connections to this output should be made. Duplicates functionality of the Alarm Bus input.	PIN 24	TB 33	PIN 24 “low” = fault condition(s) TRUE.

12.2.3—Configuration Settings/Calculations

The module has two configuration options (per channel) that the application engineer must determine based on the system level design criteria. The two configurations are the overspeed trip setpoint and the low speed input failed setpoint. Both settings use a combination of jumper settings and potentiometer adjustments to achieve the modules range of settings.

12.2.4—Overspeed Frequency Trip Setpoint Calculation

The following equation can be used to determine range of frequency adjustment for the overspeed setpoint based on the jumper configurations (three per channel):

Channel No. 1 Example
FTRIP = 10 / (1.1 * R23 * C23) + (1.1 (RADJ + REQUIV) * C17

where:

Table 12-5. Overspeed Frequency Trip Setpoint Calculation Example

Channel No. 1	Channel No. 2
R23 = 46.4 kΩ	R69 = 46.4 kΩ
C23 = 0.01 microfarads	C54 = 0.01 microfarads
C17 = 0.10 microfarads	C45 = 0.10 microfarads
RADJ = R13 = 0-20 kΩ potentiometer	RADJ = R58 = 0-20 kΩ potentiometer
REQUIV =	REQUIV =
R20 (JR11) = 7.50 kΩ	R61 (JR26) = 7.50 kΩ
R21 (JR12) = 23.2 kΩ	R59 (JR24) = 23.2 kΩ
R22 (JR13) = 9.75 kΩ	R60 (JR25) = 9.75 kΩ
Any individual JR or combinations (parallel resistance) can be selected to achieve required REQUIV.	Any individual JR or combinations (parallel resistance) can be selected to achieve required REQUIV.

12.2.5—Overspeed Trip Setpoint Jumper Configuration Options

The jumper settings are used to determine the needed frequency range for the overspeed trip setpoint should take into account the min-max frequency range based on the adjustment of the respective potentiometers for each channel.

Potentiometers R13 (Channel No. 1) and R58 (Channel No. 2) are used to set the “coarse” adjustment of the overspeed trip setpoint and potentiometers R14 (Channel No. 1) and R62 (Channel No. 2) are used to set the “fine” adjustment.

Listed below are the base frequency ranges for the each of the individual “overspeed trip” setpoint jumpers (and an example of parallel jumper configuration):

Table 12-6. Overspeed Trip Setpoint Jumper Configuration Options

Channel No. 1	Channel No. 2	REQUIV	Freq @ RADJ Min	Freq @ RADJ Max
JR11	JR26	7.50 kΩ	7488 Hz	2828 Hz
JR12	JR24	23.2 kΩ	3265 Hz	1900 Hz
JR13	JR25	9.75 kΩ	6313 Hz	2642 Hz
JR11 & JR13	JR26 & JR 25	4.24 kΩ	10,240 Hz	3148 Hz

12.2.6—Low Frequency Input Failed Setpoint Calculation

The following equation can be used to calculate the input failed frequency setpoint based on the module jumper settings. The jumper settings determine a binary equivalent number (QCNT) that is used in the calculation/setting of the input failed frequency setpoint. The equation can be manipulated to back calculate the needed QCNT binary number which can be achieved by subtracting the individual binary equivalents of each jumper setting, starting with the highest equivalent number that is less than or equal to the target QCNT.

Potentiometers R12 (Channel No. 1) and R57 (Channel No. 2) are used for the precision adjustment of the low frequency input failed setpoint.

FFAIL = FOUT / QCNT

where:

Table 12-7. Low Frequency Input Setpoint Calculation

Channel No. 1	Channel No. 2
FOUT = 20 KHz QCNT = Summation of QJPR1. 3. 5. 7, 9 Binary Equivalent of QJPRX = QJPR1 = 4 QJPR3 = 8 QJPR5 = 16 QJPR7 = 32 QJPR9 = 64	FOUT = 20 KHz QCNT = Summation of QJPR14. 16. 18. 20, 22 Binary Equivalent of QJPRX = QJPR14 = 4 QJPR16 = 8 QJPR18 = 16 QJPR20 = 32 QJPR22 = 64

Channel No. 1 Example with all Q jumpers installed
FFAIL = FOUT / QCNT
∴FFAIL = 20 KHz / QJPR1 + QJPR3 + QJPR5 + QJPR7 + QJPR9
∴FFAIL = 20 KHz / 4 + 8 + 16 + 32 + 64
∴FFAIL = 161 Hz

Channel No. 1 Example with QJPR1 jumpers installed
FFAIL = FOUT / QCNT
∴FFAIL = 20 KHz / QJPR1
∴FFAIL = 20 KHz / 4
∴FFAIL = 5000 HZ

12.3—Dual Solenoid Monitor Module

This module is used to monitor and control two independent solenoid current inputs for low or high current failed trips. The module uses discrete and analog components, to minimize the time to detect and output signals, when an event occurs. This module is used primarily for GE LM (Land & Marine) gas turbines and is usually used in conjunction with a Dual Overspeed Module. The Dual Solenoid Monitor module is used to directly interface with the gas turbine fuel inlet solenoid valves. This module requires external solenoid driver components to interface to the fuel valve solenoid. The drivers are mounted external from the module for heat dissipation purposes. The components for each channel are completely independent of each other, so that a chip or component failure will only affect one channel and not both. The module has test features to allow each channel to be tested. This module will plug directly into any slot of a MicroNet rack, but it has no interface to the data or address busses of the MicroNet. The only interface to the MicroNet back plane is for power supply inputs. The module has 2 potentiometers for factory adjustments. The potentiometers are for adjusting the under current trip points for the solenoid currents.

12.3.1—Module Description

Figure 12-4—Dual Solenoid Monitor Module

The module I/O has been designed to minimize the interconnection to external power sources and/or circuit commons. All of the input signals are set by allowing the input to float (pulled high to +5 VDC) or by connection to the module circuit common through a dry relay contact (pulled low to circuit common).

The module has two types of output signals that provide an interface to MicroNet discrete input modules or interposing relay coils (indication outputs).

The module input signals are described in the following table:

Table 12-8. Dual Solenoid Monitor Module Input Signals

INPUT	DESCRIPTION	PIN (S)	FTM TB(S)	LOGIC STATE
#1 MPU Overspeed	Discrete input showing when an Overspeed has been detected for MPU input #1. This input is usually tied to the Dual Overspeed module and is normally high. A low on this input indicates an overspeed condition, which will shutdown the #1 solenoid.	PIN 25	TB 32	"High" = no Overspeed; "Low" = Overspeed.
#2 MPU Overspeed	Discrete input showing when an Overspeed has been detected for MPU input #2. This input is usually tied to the Dual Overspeed module and is normally high. A low on this input indicates an overspeed condition, which will shutdown the #2 solenoid.	PIN 24	TB 33	"High" = no Overspeed; "Low" = Overspeed.

INPUT	DESCRIPTION	PIN (S)	FTM TB(S)	LOGIC STATE
Solenoid Test No. 1 Select	Discrete input used to test the #1 Solenoid trip circuit. When this input is activated, it will cause the #1 solenoid to de-energize; when it is deactivated it will then cause the #2 solenoid to de-energize. The solenoid test is used to check that the solenoids turn off. To conduct a test, energize or turn on the solenoids first. NOTE: For the Test to be conducted, the Test Activate discrete input must also be 'TRUE'.	PIN 32	TB 25	"High" = ON state. Pull low to circuit common for OFF.
Solenoid Test No. 2 Select	Discrete input used to test the #2 Solenoid trip circuit. When this input is activated, it will cause the #2 solenoid to de-energize; when it is deactivated it will then cause the #1 solenoid to de-energize. The solenoid test is used to check that the solenoids turn off. To conduct a test, energize or turn on the solenoids first. NOTE: For the Test to be conducted, the Test Activate discrete input must also be 'TRUE'.	PIN 26	TB 31	"High" = ON state. Pull low to circuit common for OFF.
Emergency Shutdown	Discrete input used to shutdown both solenoids. When this input is activated it will turn on LED DS3.	PIN 22	TB 35	"High" = ON state. Pull low to circuit common for OFF.
Reset	This input is used to clear the over and under current failed latches. To activate, this input must be pulled low to common and then released. When the input is released, the pull up resistor on the input will generate the reset. The input circuit has a built in one shot, so it is not required for the input to be toggled a second time.	PIN 21	TB 36	Transition from "Low" to "High" activates reset.
Solenoid Failure Override	This discrete input is used to override both under and over current failed detection circuits. IMPORTANT NOTE: Before attempting to turn on the solenoids, this contact must be active before the reset is initiated, for the solenoids to energize.	PIN 19	TB 1	"High" = ON state. Pull low to circuit common for OFF.
Alarm Bus	Discrete input used to shutdown both solenoids. This input is a normally 'HIGH' signal, which causes the solenoids to shutdown when it is pulled low. This input should be connected directly to the alarm bus output of the Dual Overspeed module.	PIN 13	TB 7	Normally "High" = run mode. "Low = Fault.
Turn Off Solenoids	Discrete input used to turn off both solenoids. This input must be pulled 'LOW' (Contacts closed) in order for the solenoids to be turned on. On power up of the module, this input is momentarily set to a 'TRUE'.	PIN 15	TB 5	"High" = ON state. Pull low to circuit common for OFF.
Turn On Solenoids	Discrete input used to turn on both solenoids. This input is normally 'TRUE', so to initiate turning on the solenoids, the contacts to this input should be left open. To prevent energizing of the solenoids, the Turn On solenoids contact can be closed, or the Turn Off contacts can be left open.	PIN 17	TB 3	"High" = ON state. Pull low to circuit common for OFF.

INPUT	DESCRIPTION	PIN (S)	FTM TB(S)	LOGIC STATE
Test Activate	Discrete input used to allow the solenoid circuits to be tested. This input is normally 'TRUE', so to prevent a test the contacts to this input must be closed. The solenoid test is used to check that the solenoids turn off. To conduct a test, energize or turn on the solenoids first. Start the turbine and run up to idle. The Test Activate input can then be tied to a speed switch based on idle speed. Initiating either test should shutdown the turbine provided the solenoid fuel valves are in series. If the solenoid being tested fails to close, the second solenoid should shutdown the turbine when the test discrete input is opened.	PIN 3	TB 17	"High" = ON state. Pull low to circuit common for OFF.
+ 24 Vdc Externally Supplied	+ 24 Vdc input that is used to power the solenoid drive circuits as well as the over and under current circuits. This source is usually supplied by the customer and is tapped off of the power supply for solenoids. This input supply is isolated from all of the MicroNet power supplies through optoisolators. NOTE: Use both pins to distribute current demand.	PIN 7 PIN 5	TB 13 TB 15	External isolated power supply (+) input.
24 Vdc External Common	24 Vdc common from an external source used for the solenoids. NOTE: Use both pins to distribute current demand.	PIN 9 PIN 11	TB 11 TB 9	External isolated power supply (-) input.

Table 12-9. Dual Solenoid Monitor Module Output

OUTPUT	DESCRIPTION	PIN (S)	FTM TB(S)	LOGIC STATE
#1 Undercurrent	Discrete output that can be used to drive a relay or feed directly into a MicroNet discrete input. This output can be tied together with other outputs if only one relay output is desired. The output is diode isolated to prevent other outputs from turning on LED DS2.	PIN 33	TB 24	"Low" = under current cond. of #1 solenoid.
#2 Undercurrent	Discrete output that can be used to drive a relay or feed directly into a MicroNet discrete input. This output can be tied together with other outputs if only one relay output is desired. The output is diode isolated to prevent other outputs from turning on LED DS6.	PIN 27	TB 30	"Low" = under current cond. of #2 solenoid.
#1 Overcurrent	Discrete output that can be used to drive a relay or feed directly into a MicroNet discrete input. This output is 'TRUE' (relay energized) when LED DS1 is 'ON'. This output can be tied together with other outputs if only one relay output is desired. The output is diode isolated to prevent other outputs from turning on LED DS1.	PIN 34	TB 23	"Low" = over current cond. of #1 solenoid.
#2 Overcurrent	Discrete output that can be used to drive a relay or feed directly into a MicroNet discrete input. This output is 'TRUE' (relay energized) when LED DS5 is 'ON'. This output can be tied together with other outputs if only one relay output is desired. The output is diode isolated to prevent other outputs from turning on LED DS5.	PIN 28	TB 29	"Low" = over current cond. of #2 solenoid.

OUTPUT	DESCRIPTION	PIN (S)	FTM TB(S)	LOGIC STATE
Solenoid Current Sensor #1	Discrete connection that is actually an input, but is shown with the Driver (-) and (+) connections. This signal should be connected to the current sense resistor on the external solenoid driver. The external solenoid driver is a transistor drive circuit that is mounted off of the module because of the heat sink requirements. This input is used to check the current being passed through the solenoid, for over and under current conditions.	PIN 35	TB 22	Solenoid current from #1 driver circuit. Usually across 1 Ω resistor. 1 A = 1 V
Driver #1 (-)	This signal should be connected to the (-) input of the #1 external solenoid driver. See diagram 1.0 for the external solenoid driver wiring connections.	PIN 36	TB 21	Solenoid # 1 (-) conn. to driver circuit.
Driver #1 (+)	This signal should be connected to the (+) input of the #1 external solenoid driver. See diagram 1.0 for the external solenoid driver wiring connections.	PIN 37	TB 20	Solenoid # 1 (+) conn. to driver circuit.
Solenoid Current Sensor #2	Discrete connection that is actually an input, but is shown with the Driver (-) and (+) connections. This signal should be connected to the current sense resistor on the external solenoid driver. The external solenoid driver is a transistor drive circuit that is mounted off of the module because of the heat sink requirements. This input is used to check the current being passed through the solenoid, for over and under current conditions.	PIN 29	TB 28	Solenoid current from #2 driver circuit. Usually across 1 Ω resistor. 1 A = 1 V
Driver #2 (-)	This signal should be connected to the (-) input of the #2 external solenoid driver. See diagram 1.0 for the external solenoid driver wiring connections.	PIN 30	TB 27	Solenoid # 2 (-) conn. to driver circuit.
Driver #2 (+)	This signal should be connected to the (+) input of the #2 external solenoid driver. See diagram 1.0 for the external solenoid driver wiring connections.	PIN 31	TB 26	Solenoid # 2 (+) conn. to driver circuit.
Current Faults Cleared	This output is used to indicate when all of the faults have cleared and the current to the solenoids are in their respective operating ranges. This output can be connected directly to a discrete input or to a relay, and can be used to turn off the Solenoid Failure Override input.	PIN 2	TB 18	“Low” = all faults cleared on both channels.
Common	Internal +5 or +24 Vdc Common.	PIN 23	TB 34	Common

IMPORTANT

See the board layout and schematic listed in Appendix A.

12.3.2—Configuration Settings/Calculations

- R44 Optional resistor to set the overcurrent fault point for solenoid #1. To Determine the value for this resistor use the following:
Imax = Overcurrent trip value in amps
Rsense = Value of sense resistor on the external solenoid driver
Vmax = Imax*Rsense
Vtrip = Overcurrent trip setting on U9-A
Set Vtrip = Vmax
Vzener = Voltage across VR6 ∴ 18 Vzener ∴ Range of 17.1 to 18.9 Vdc
Vtrip = Vzener*R44/(R44 + R45)
Solving for R44
R44 = R45*Vtrip/(Vzener - Vtrip) ∴ R45 = 75K*Vtrip/(18 - Vtrip)
Range of Vtrip will vary +/- 5 % based on range of Vzener.
Most common selection: '12.1 K' (BOM 1648-885).
If Rsense = 1.0 Ω, Vtrip = 2.5 A

- R72 Optional resistor to set the overcurrent fault point for solenoid #2. To Determine the value for this resistor use the following:
Imax = Over current trip value in amps
Rsense = Value of sense resistor on the external solenoid driver
Vmax = Imax*Rsense
Vtrip = Over current trip setting on U17-A
Set Vtrip = Vmax
Vzener = Voltage across VR9 ∴ 18 Vzener ∴ Range of 17.1 to 18.9 Vdc
Vtrip = Vzener*R72/(R72 + R73)
Solving for R72
R72 = R73*Vtrip/(Vzener - Vtrip) ∴ R73 = 75K*Vtrip/(18 - Vtrip)
Range of Vtrip will vary +/- 5 % based on range of Vzener.
Most common selection: '12.1 K' (BOM 1648-885).
If Rsense = 1.0 Ω, Vtrip = 2.5 A

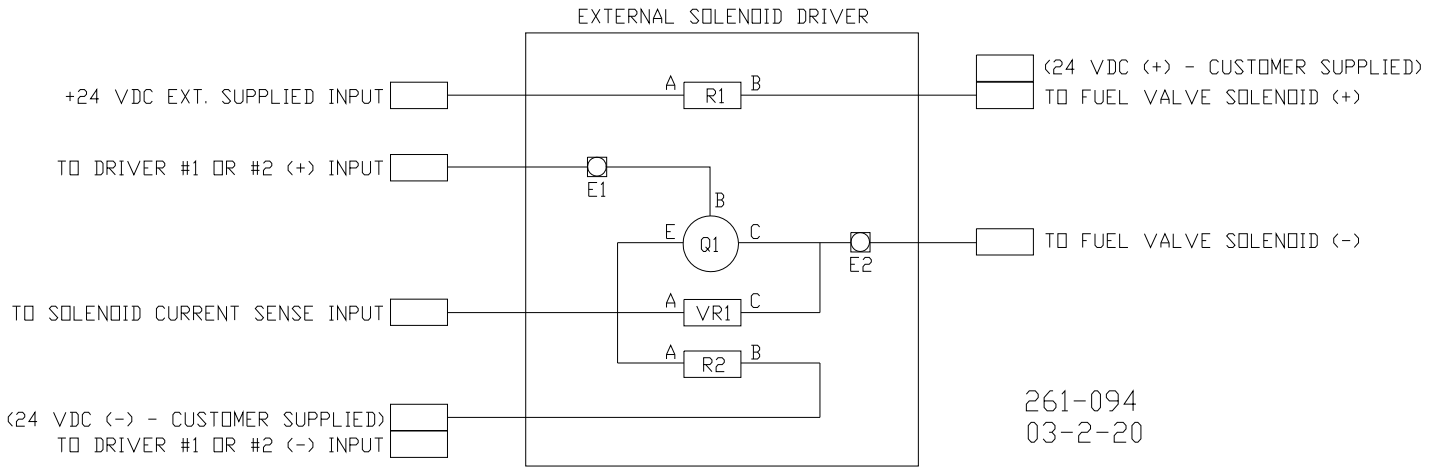


Figure 12-5—External Solenoid Driver

Chapter 13.
Field Termination Modules (FTMs)

13.1—Introduction

Field Termination Modules (FTM) are used to connect field wiring to the front of the MicroNet control's I/O Modules. They connect to the subminiature D-type connectors on the front of the I/O modules and provide cage-clamp terminal connection points for field wiring. They also provide shield termination and EMI protection. All FTMs can be mounted on 35 mm DIN Rails and take the place of interposing terminal blocks to field wiring.

The cage-clamp terminals on the FTMs and relay modules accept a maximum of one #12 AWG wire or two #18 AWG wires. Field wiring hookup is performed by stripping the wire back 0.312 inches (8 mm), inserting into the cage clamp and tightening the screw.

13.2—Analog I/O FTMs

13.2.1—34Ch HDVIM FTM (AI/RTD/TC)

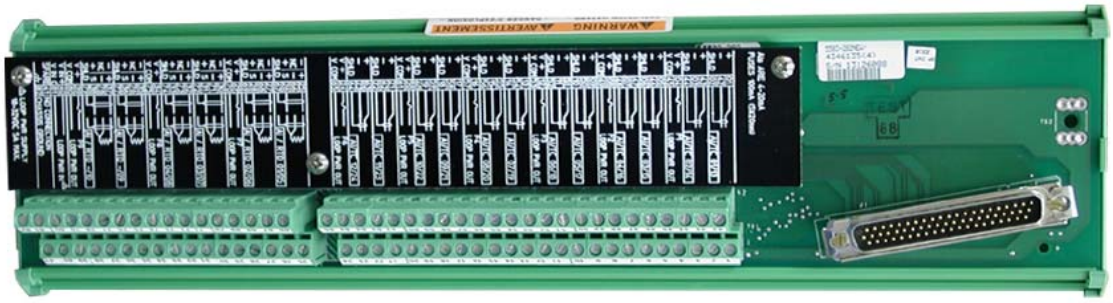


Figure 13-1-34Ch HDVIM FTM (AI/RTD/TC)

The 34Ch HDVIM FTM is used with the 34Ch HDVIM Module (see Chapter 9 MicroNet module information and Appendix A for FTM part number). One MicroNet High Density Analog/Discrete cable is use to connect the FTM with the 34Ch HDVIM Module (see Appendix A for part numbers). There are nine +24 Vdc connections available for sourcing 4-20 mA inputs. Each connection is protected with a 0.1 A fuse.

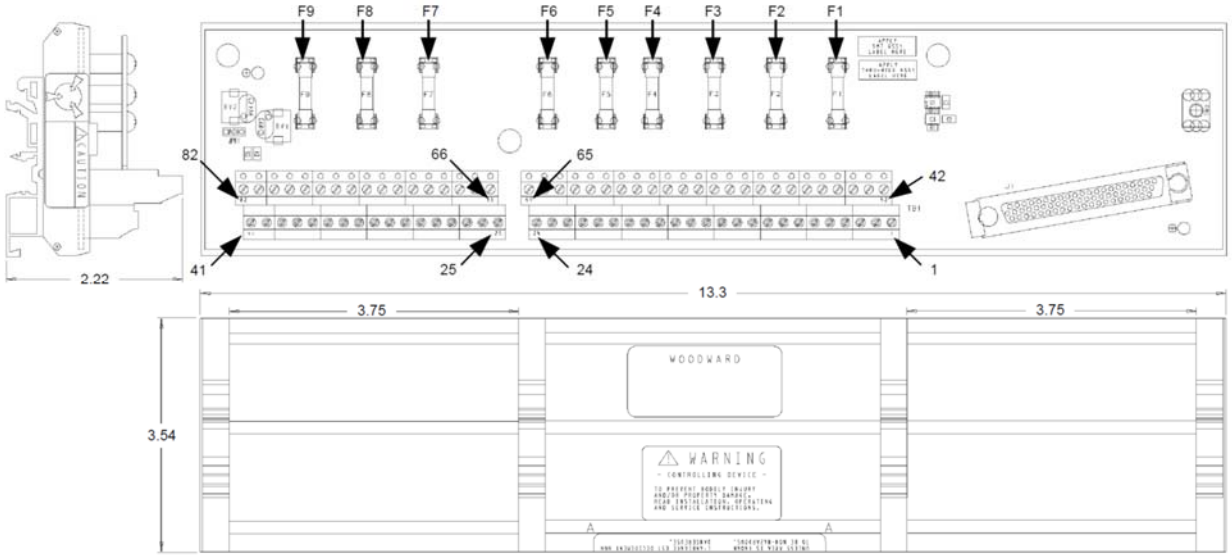


Figure 13-2—34Ch HDVIM FTM Outline Dimensions

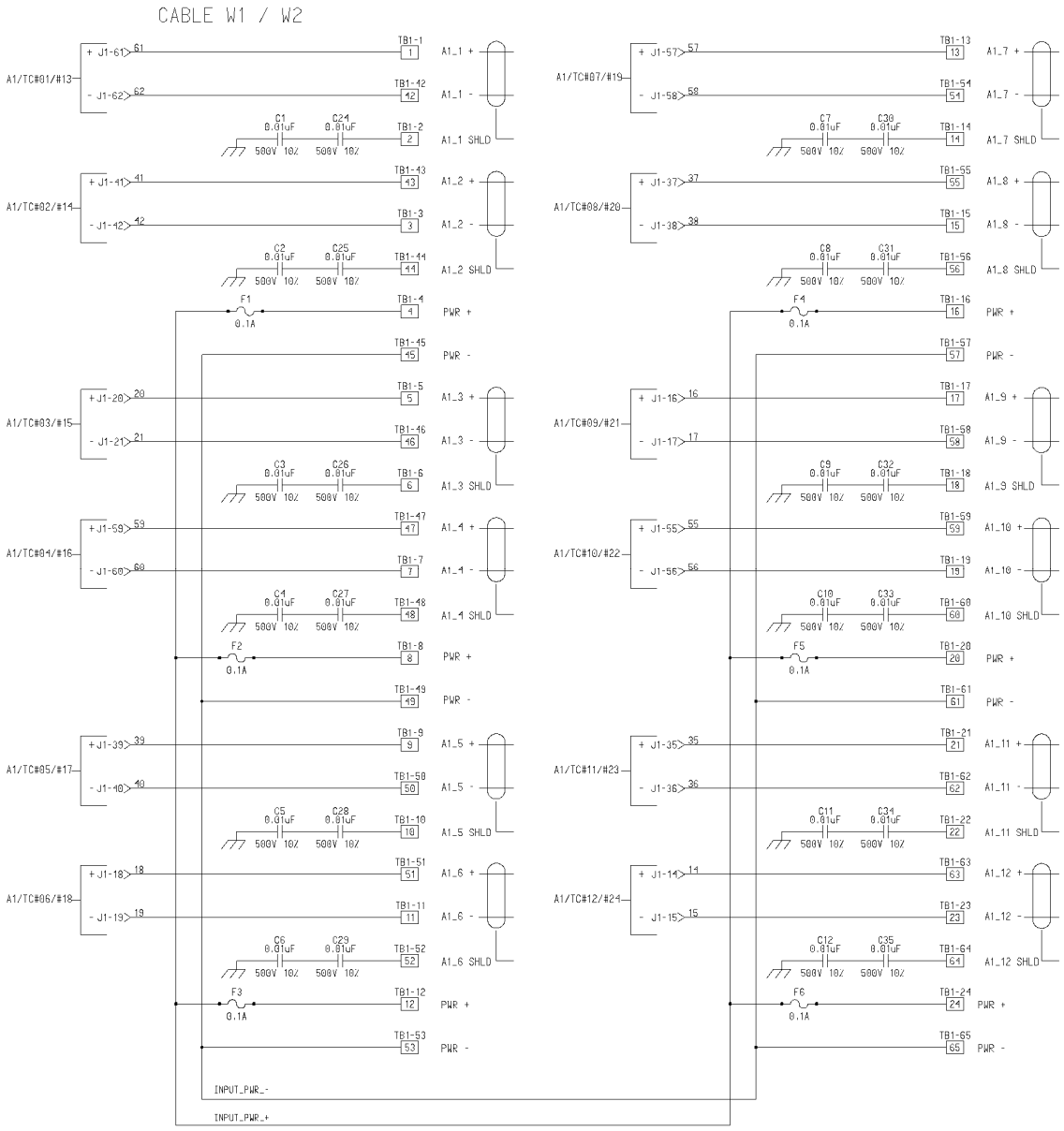


Figure 13-3a—34Ch HDVIM FTM Schematic (part 1)

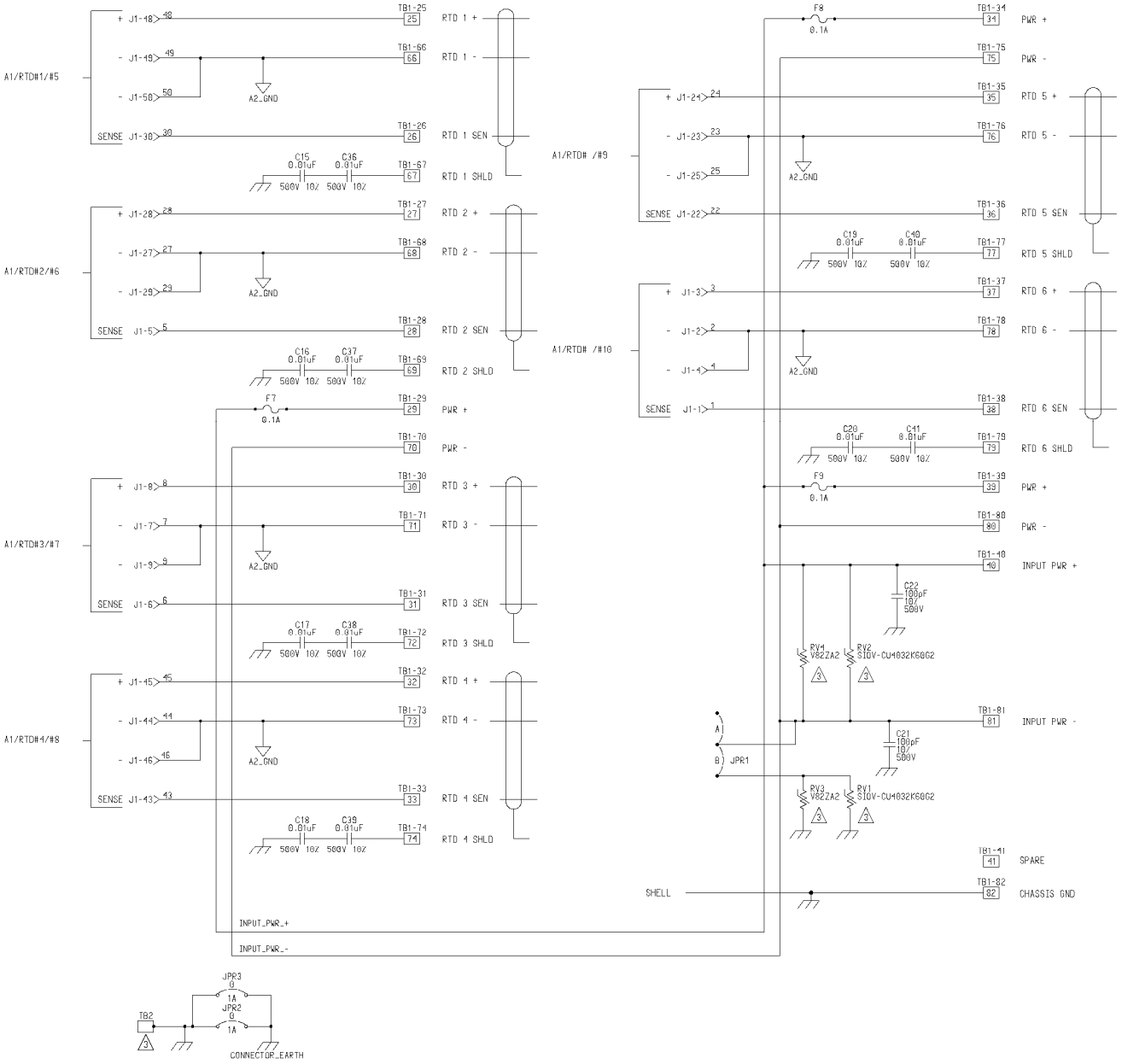


Figure 13-3b—34Ch HDVIM FTM Schematic (part 2)

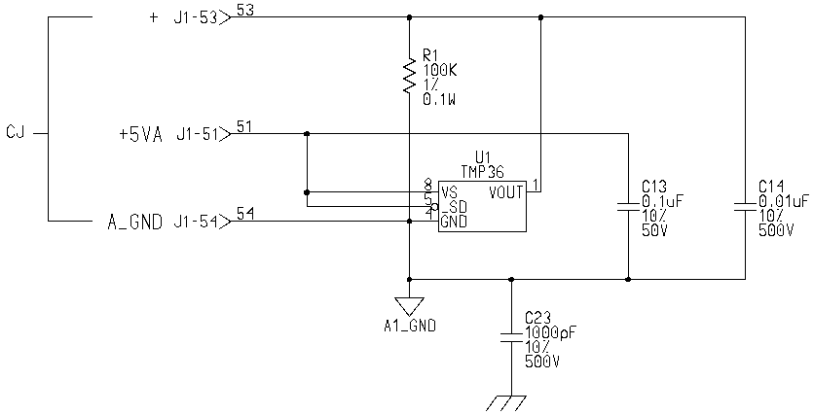


Figure 13-4—34Ch HDVIM FTM Cold Junction Sensor Schematic

13.2.2—24/8 Analog FTM

Figure 13-5—24/8 Analog FTM

Two 24/8 Analog FTMs are used with the 24/8 Analog Modules (see Chapter 9 MicroNet module information and Appendix A for FTM part number). One MicroNet High Density Analog/Discrete cable is used to connect each FTM to the 24/8 Analog Module (see Appendix A for part numbers). There are twelve +24 Vdc connections available for sourcing 4–20 mA inputs. Each connection is protected with a 0.1 A fuse.

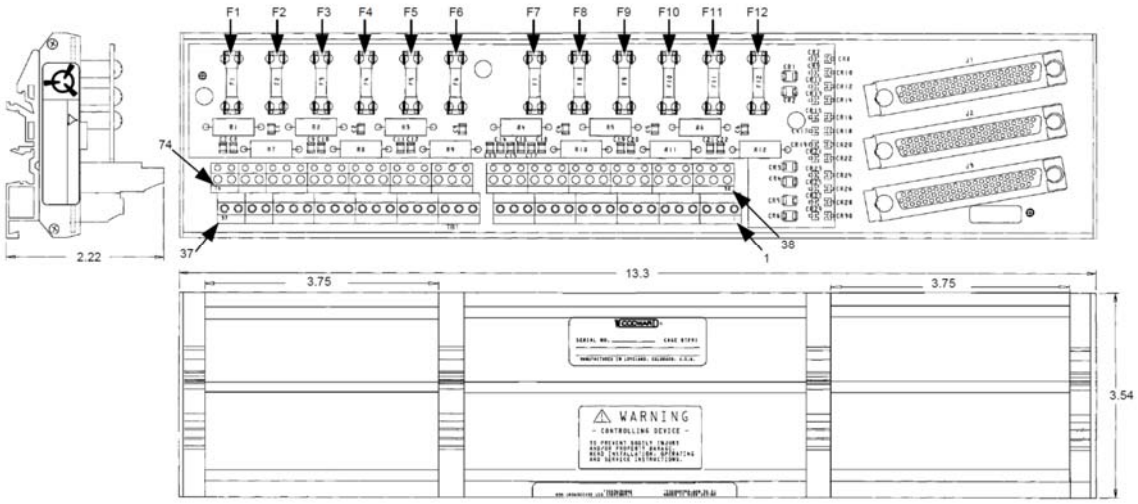


Figure 13-6—24/8 Analog FTM Outline Dimensions

Replacing a Fuse on the Field Termination Module (FTM)

1. Verify that the condition that caused the fuse to blow has been corrected.

⚠WARNING **If power has not been removed from the control system, power will be active at the module and also at the FTM. Shorting of protected circuitry could cause a control system shutdown.**

2. Remove the FTM cover carefully, to prevent contact with any FTM circuitry under the cover. To remove the FTM cover, pinch the retaining barb and lift the cover.
3. Locate and replace the fuse with another fuse of the same size, type, and rating, See Figure 13-4 for channel fuse location.
4. Replace the FTM cover.

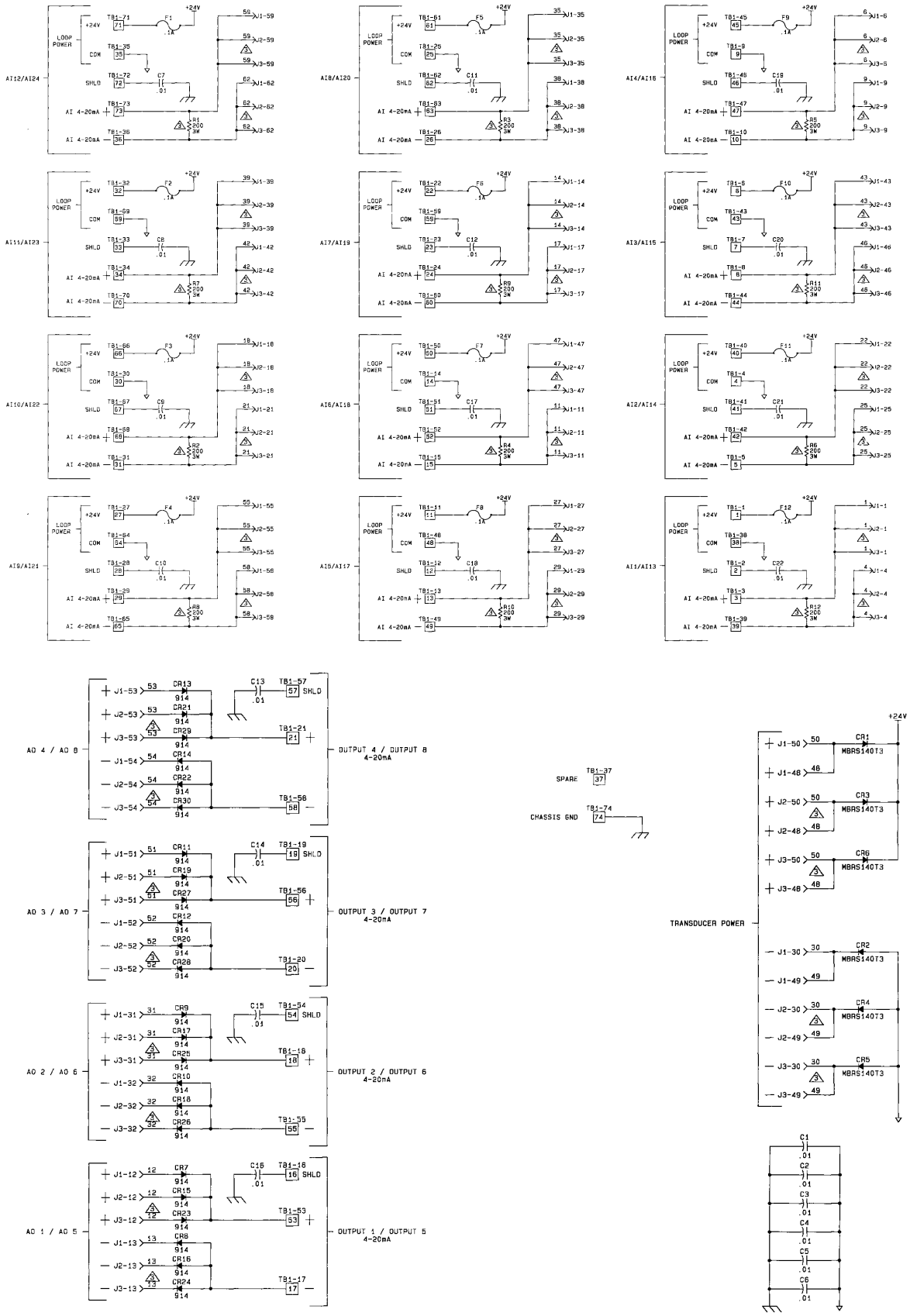


Figure 13-6—24/8 Analog FTM Schematic

13.2.3—Dataforth FTM

[Shown without I/O modules installed]

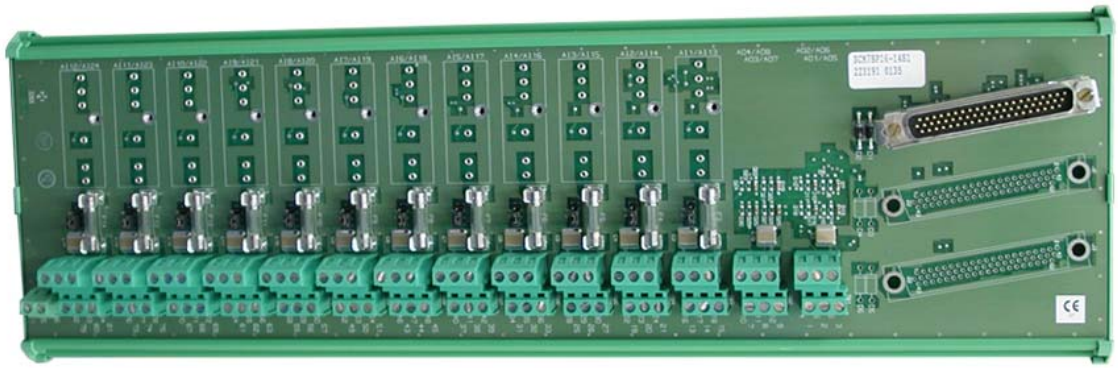


Figure 13-7—Dataforth FTM

The Dataforth FTM is used with the Dataforth Module (see Chapter 9 MicroNet module information and Appendix A for FTM part number). One MicroNet High Density Analog/Discrete cable is use to connect the FTM with the Dataforth Module (see Appendix A for part numbers). Each FTM has twelve analog input and four analog output channels. Each input channel is individually configurable via a plug-in standard isolated Dataforth SCM7B converter that has been modified to meet Woodward's bandwidth and input temperature range requirements. Each module can plug into any of the 12 channels on the FTM. Each plug-in module converts the incoming signal to a 1 to 4 volt signal. No Calibration is required on the FTM or its plug-in modules. The plug-in modules are powered directly through the cable connector; resulting in no need for external power connections to the FTM. There are twelve +24 Vdc connections available for sourcing 4–20 mA inputs. Each connection is protected with a 0.1 A fuse (F3 – F14). Jumpers P3 through P1 are used to configure the module for self-powered or loop-powered setups. See Chapter 9 for proper jumper configurations.

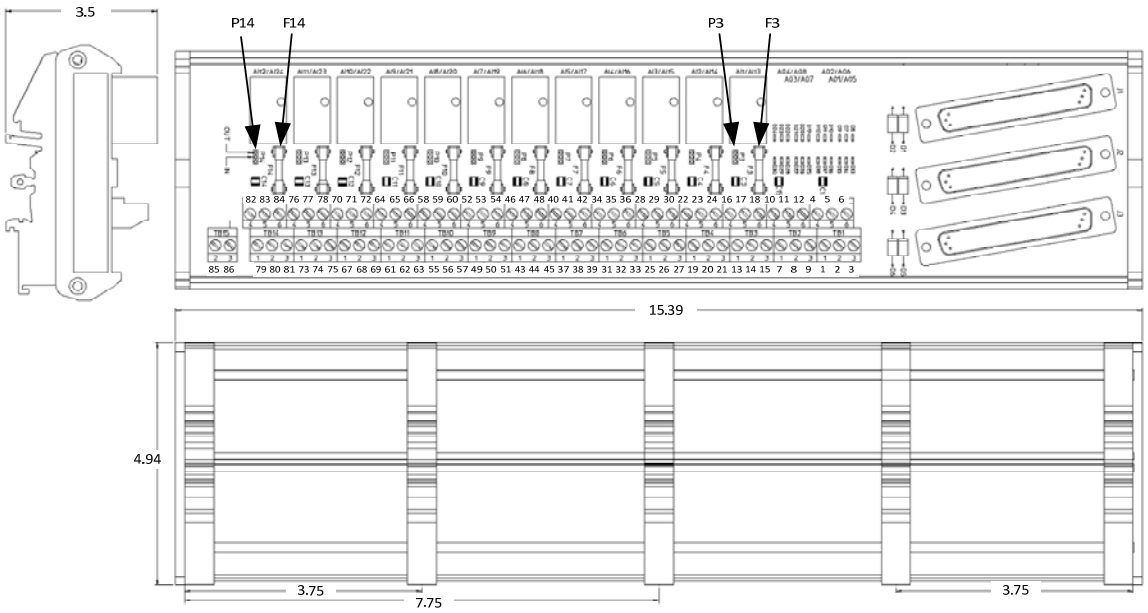


Figure 13-8—Dataforth FTM Outline Dimensions

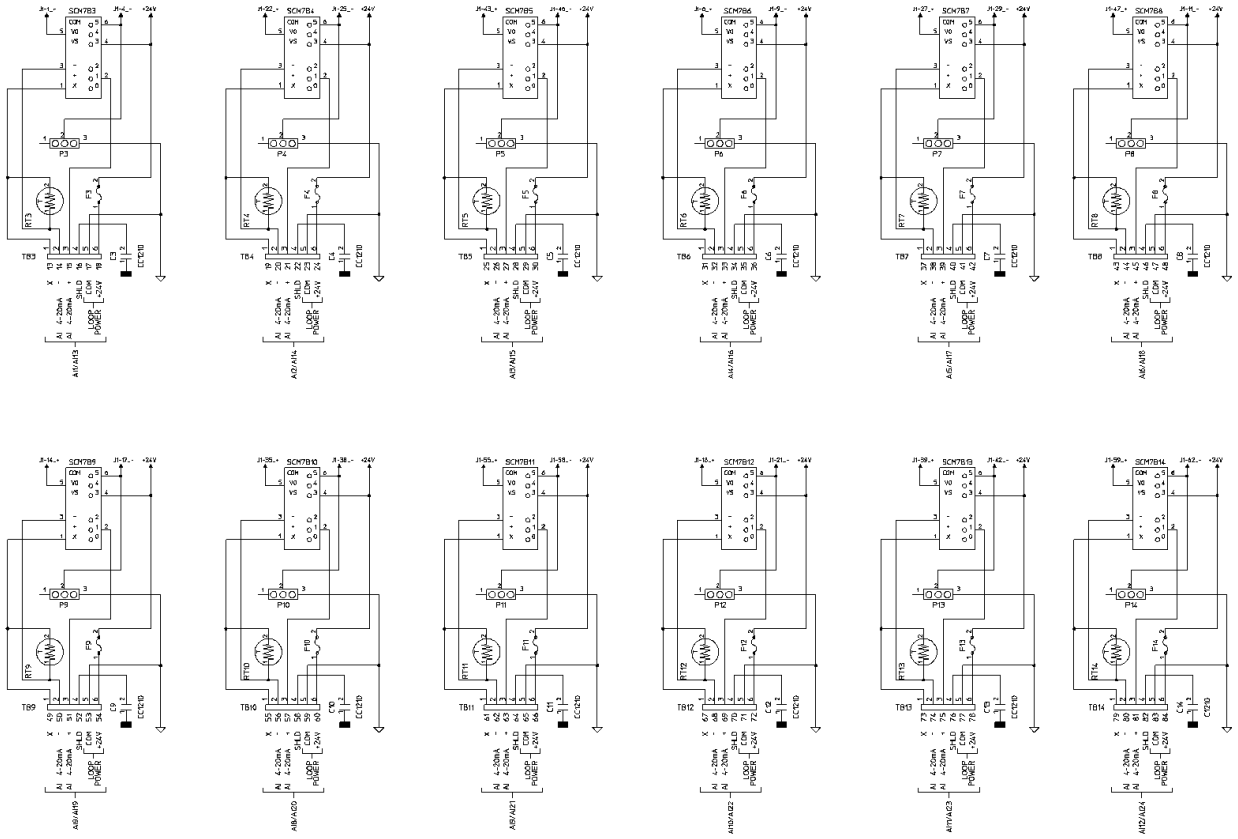


Figure 13-9—Dataforth FTM Schematic (Inputs)

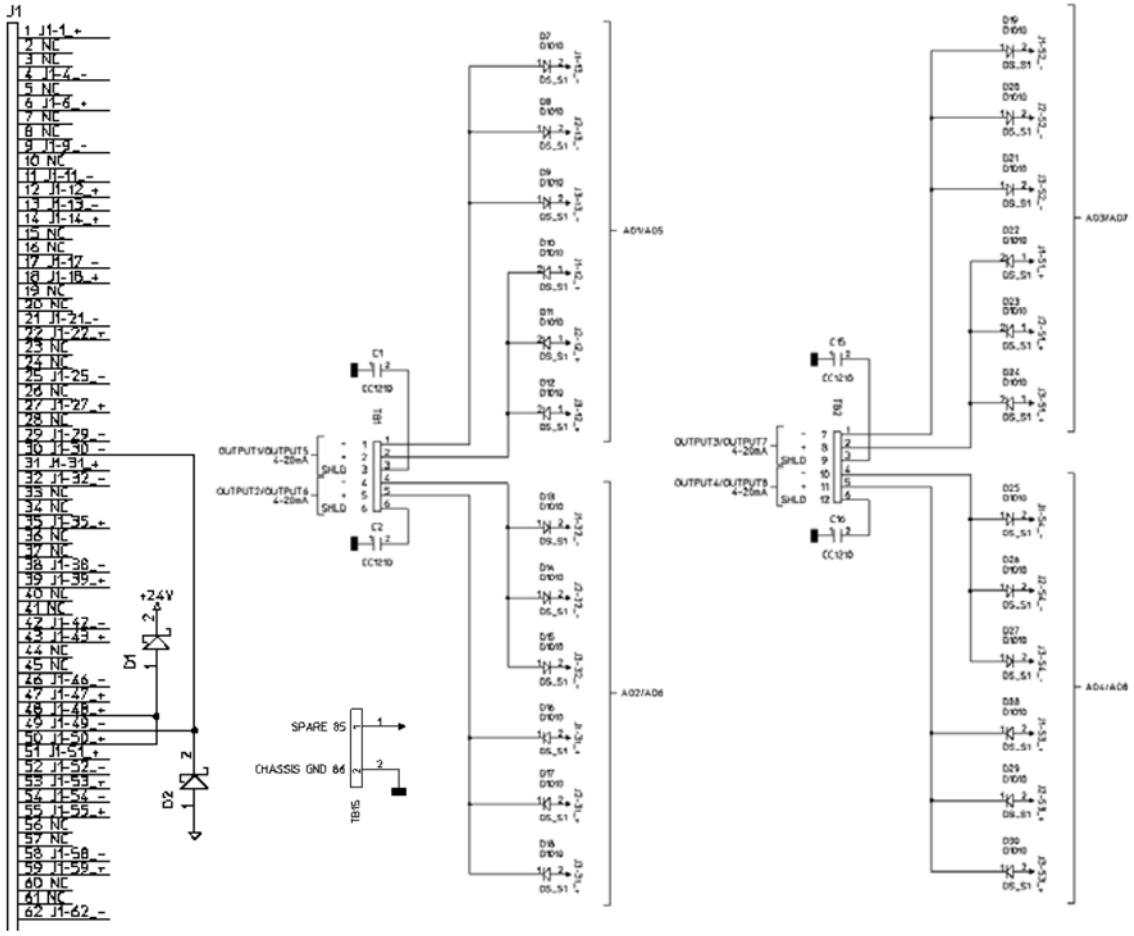


Figure 13-10—Dataforth FTM Schematic (Outputs)

There are currently five SCM7B signal conditioning modules available for the Dataforth FTM. See Table 13-1 for available signal conditioning modules.

Table 13-1—Dataforth Module Types

Type Module	**Description**	**Dataforth P/N**
4–20 mA Input Module	Pass Through Module	SCM7BPT-1460
0–5 Vdc Input Module	Pass Through +200Ω Module	SCM7BPT
RTD (100Ω) Module	European Curve	SCM7B34-1459
RTD (200Ω) Module	European Curve	SCM7B34-1472
TC Module	Type K	SCM7B47K-1458

Figure 13-11—Example of Dataforth SCM7B Modules

For additional information on the Dataforth SCM7B Modules, go to www.dataforth.com.

13.2.4—Four Channel Actuator Driver FTM

The Four Channel Actuator FTM is used with either the 4Ch Actuator (200 mA) or (25 mA) Module (see Chapter 10 MicroNet module information and Appendix A for FTM part number). One MicroNet Low Density Analog cable is use to connect the FTM with the 4Ch Actuator module (see Appendix A for part numbers).

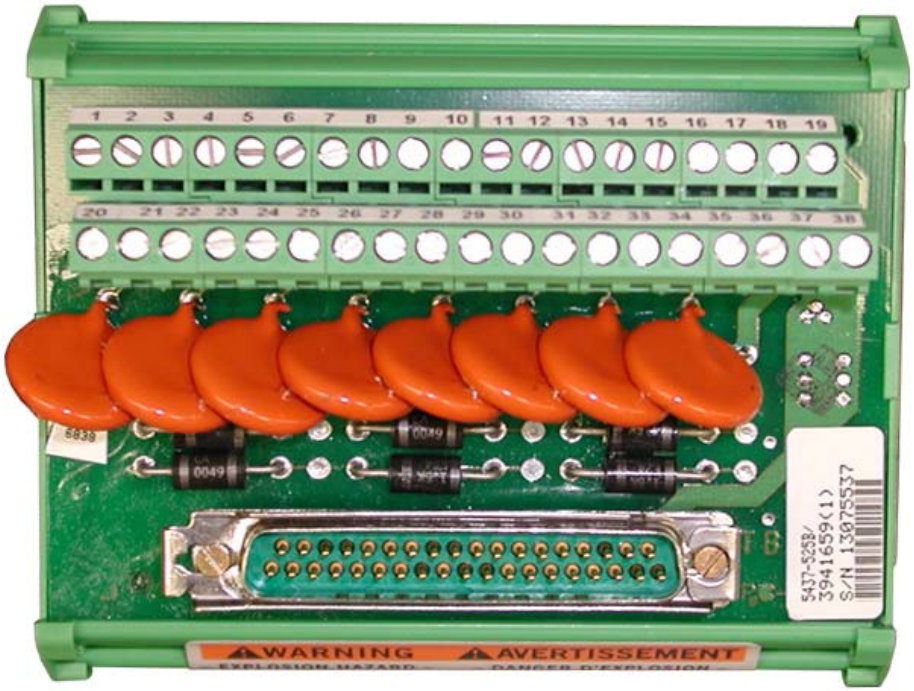


Figure 13-12— Four Channel Actuator Driver FTM

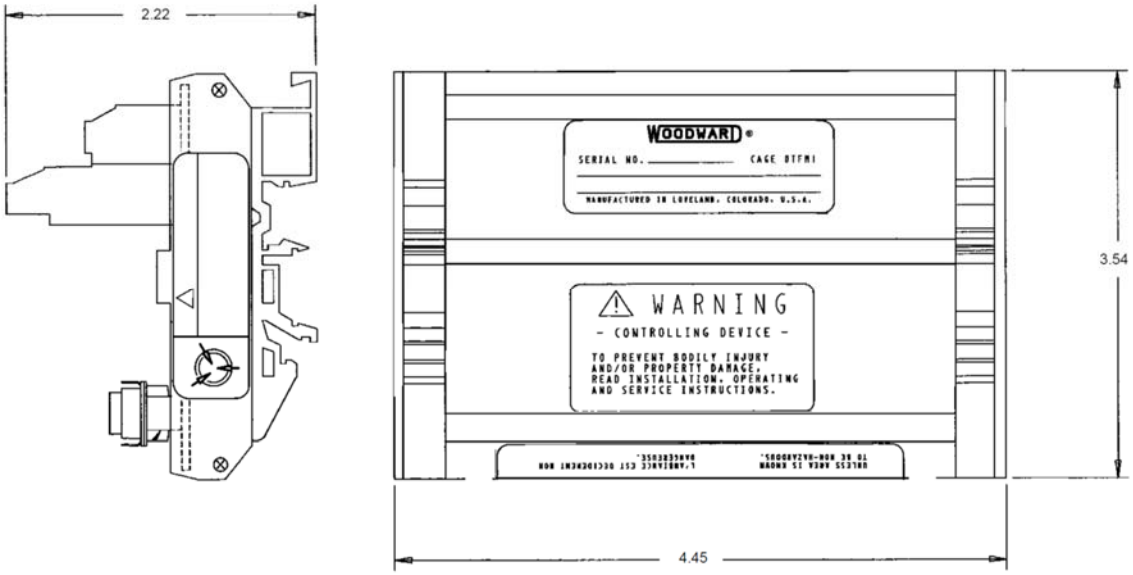


Figure 13-13—Four Channel Actuator Driver FTM Outline Dimensions

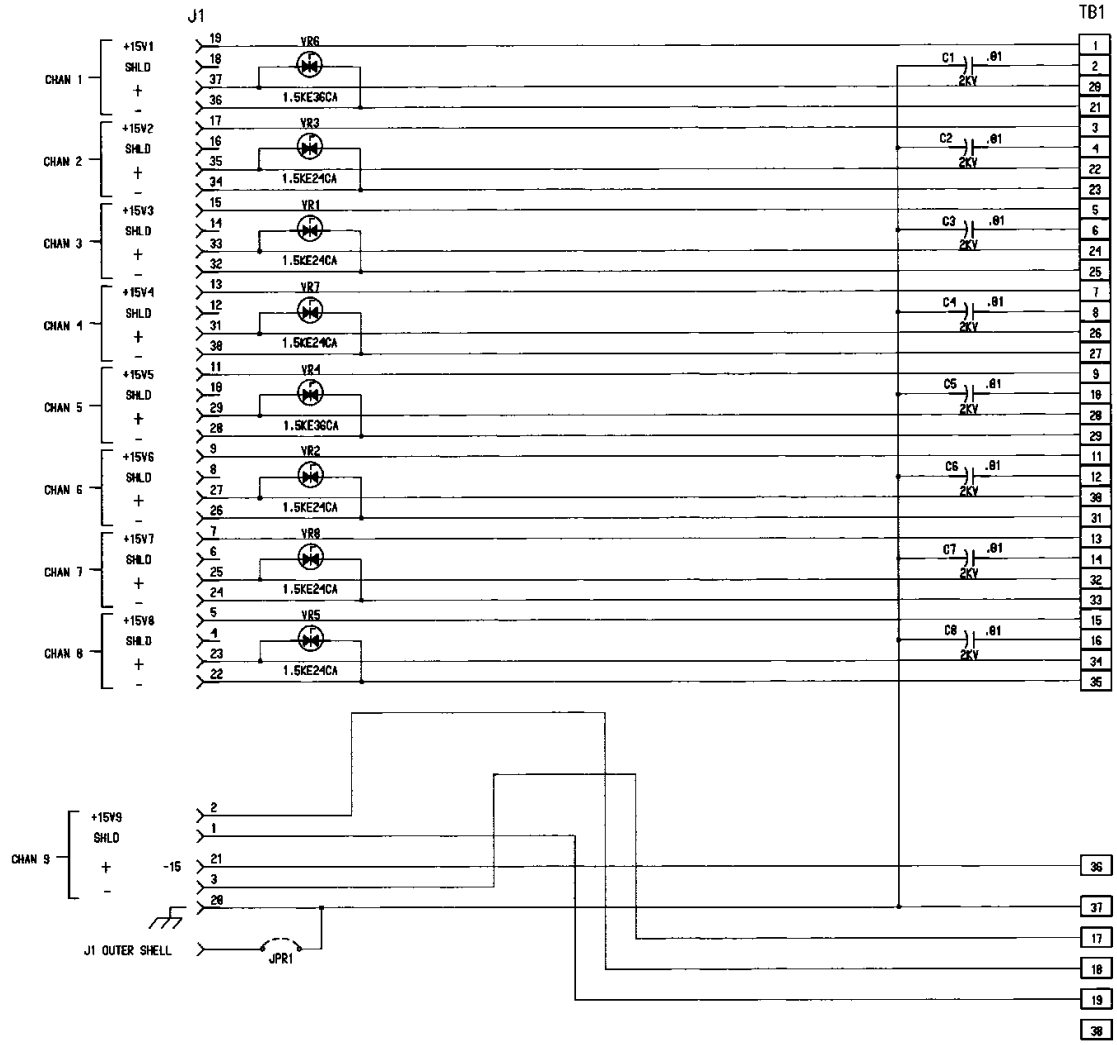


Figure 13-14—Four Channel Actuator Output FTM Schematic

13.2.5—Two Channel Actuator Controller FTM

The Two Channel Actuator Controller FTM is used with the 2Ch Actuator (200, 100, 50, 25, or 10 mA) Modules (see Chapter 10 MicroNet module information and Appendix A for FTM part number). One MicroNet Low Density Discrete cable (gray) is used to connect the FTM with the 2Ch Actuator module (see Appendix A for part numbers). Do not use an analog (black) cable.

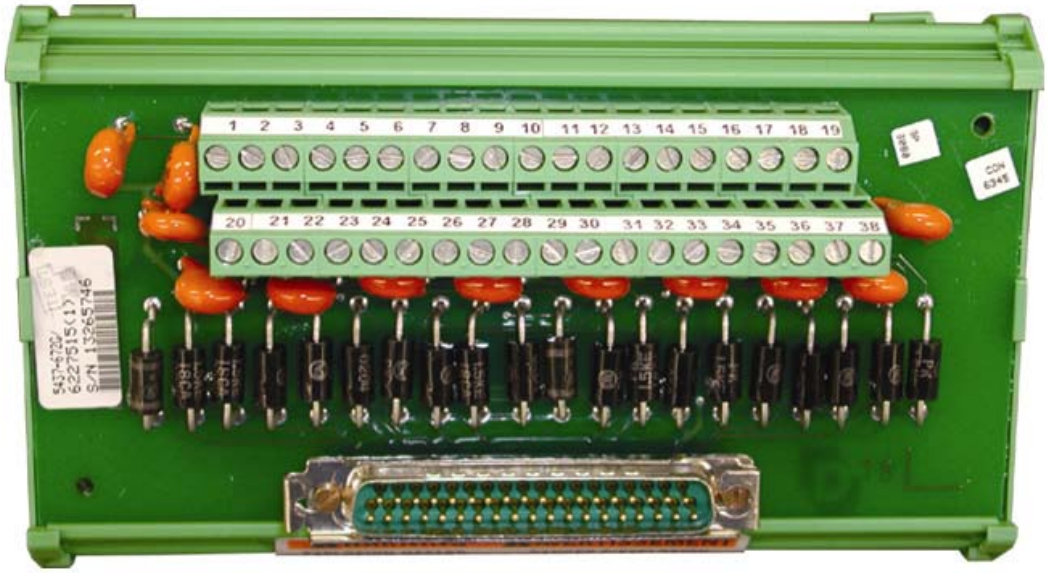


Figure 13-15— Two Channel Actuator Controller FTM

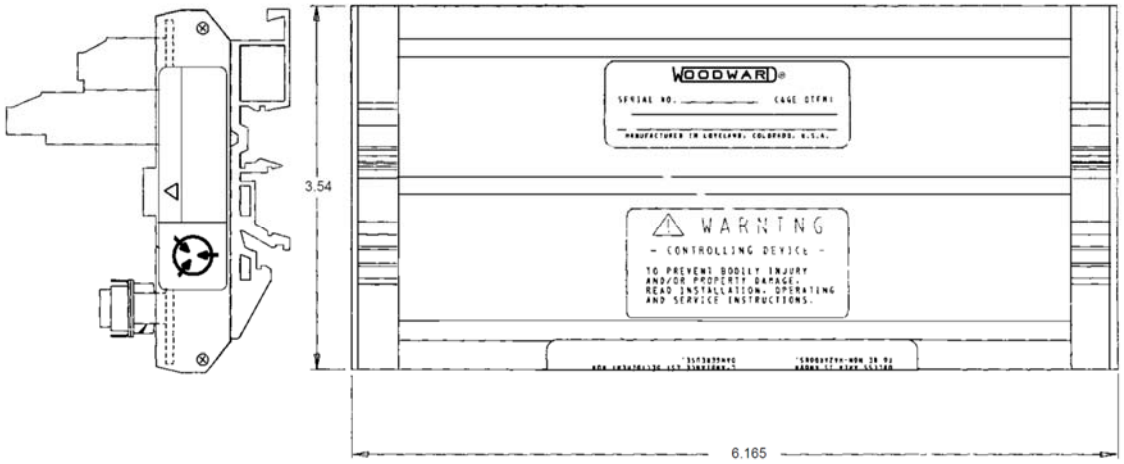


Figure 13-16—Two Channel Actuator Controller FTM Outline Dimensions

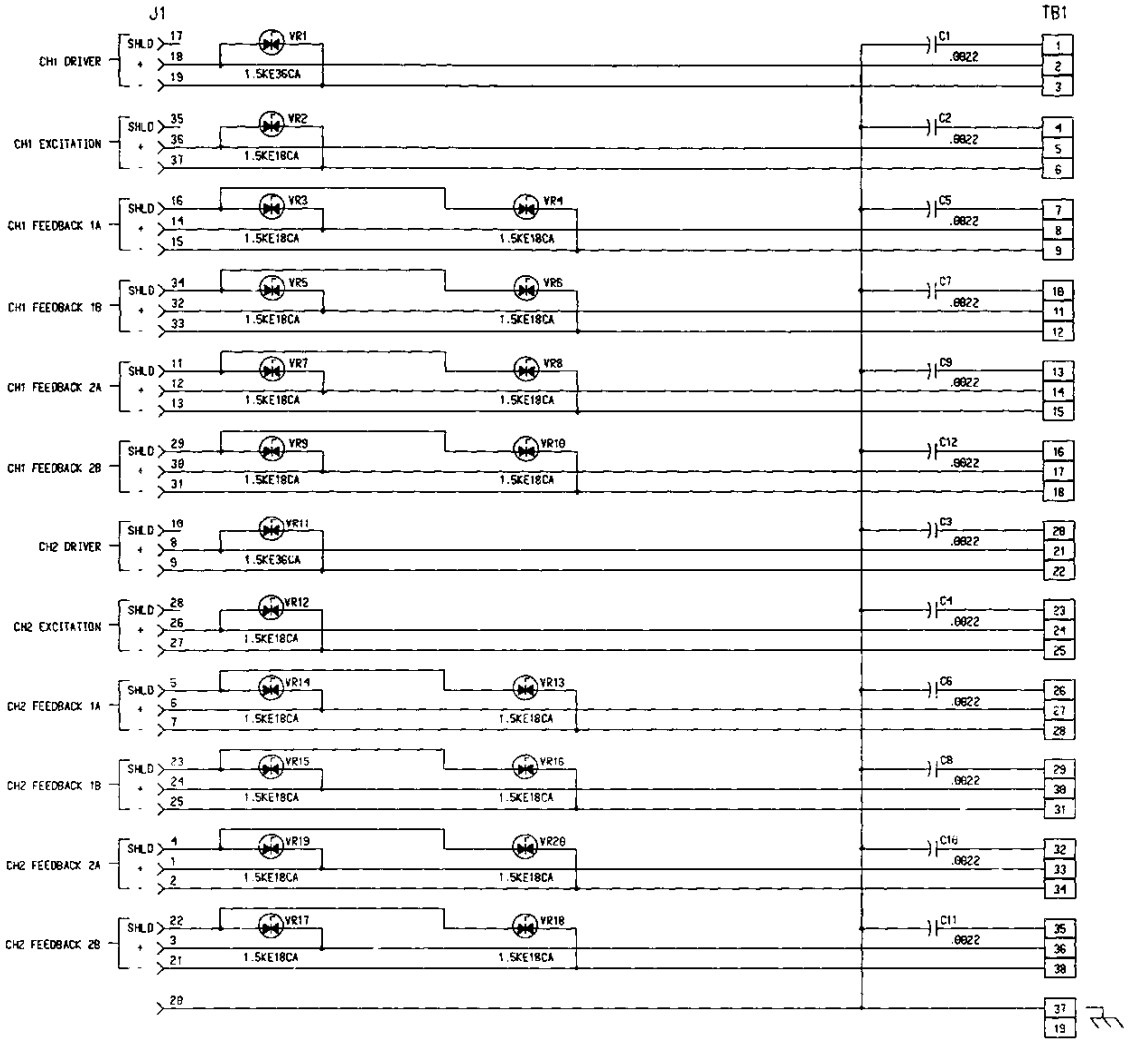


Figure 13-17—2Ch Actuator Output FTM Schematic

13.2.6—Analog Input FTM

The Analog Input FTM is used with MPU, 4-20 mA input, 4-20 mA output, voltage input, voltage output, RTD, Pressure input, and overspeed switch modules. (See Chapter 9 MicroNet module information and Appendix A for FTM part number). One MicroNet Low Density Analog cable is use to connect the FTM with the Analog modules (see Appendix A for part numbers).

Figure 13-18— Analog Input FTM

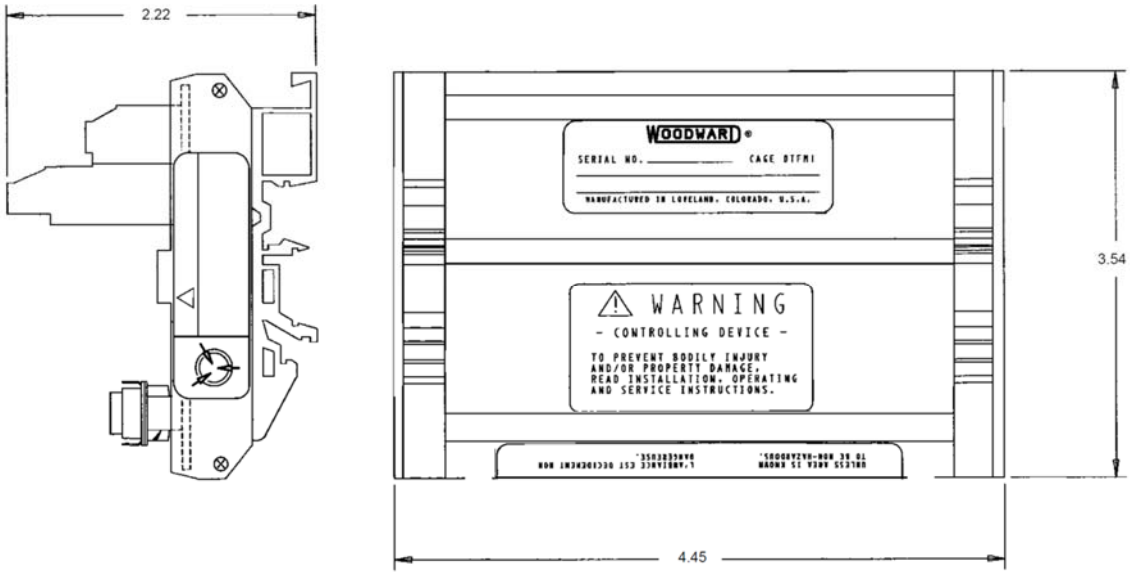


Figure 13-19—Analog Input FTM Outline Dimensions

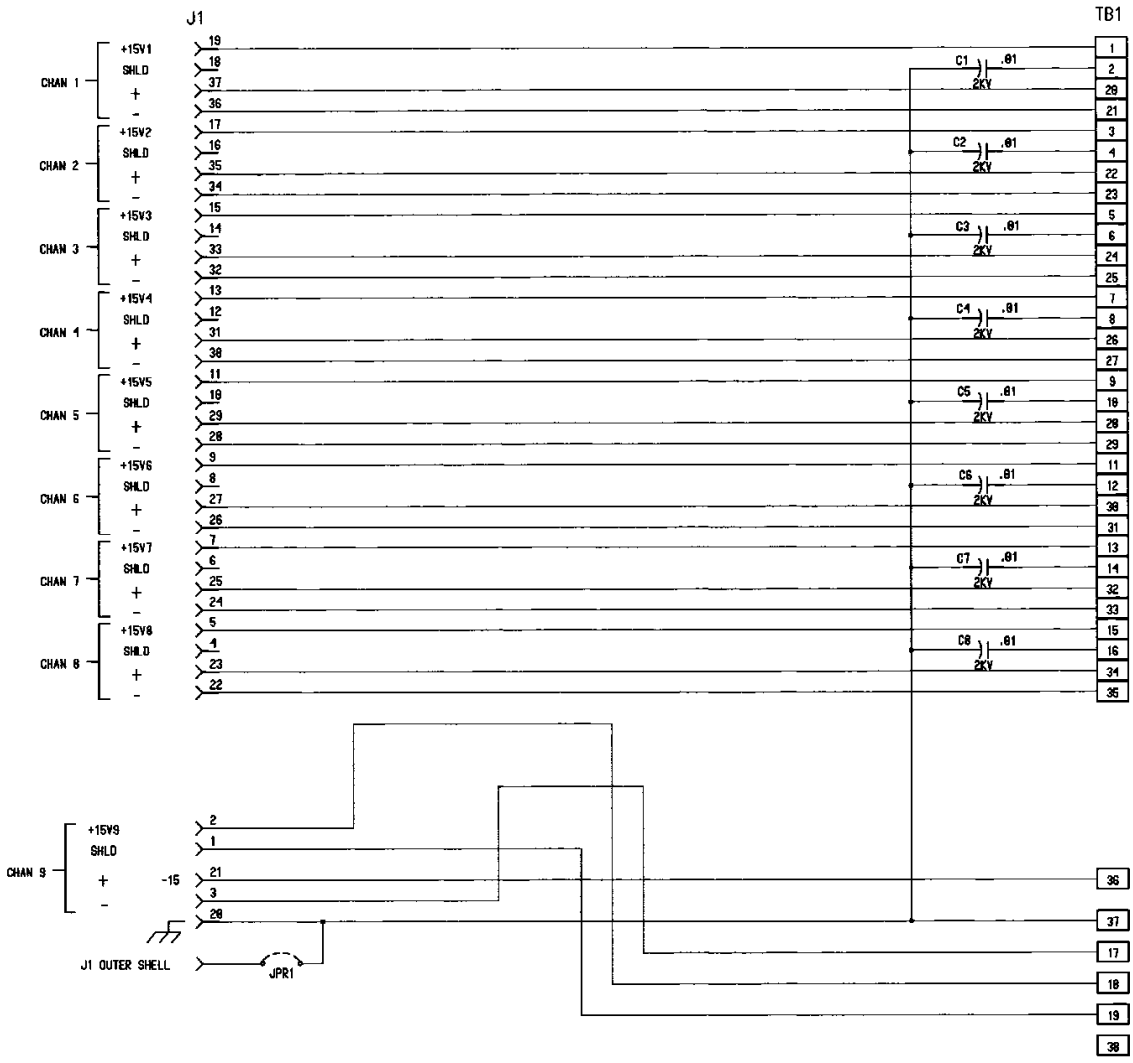


Figure 13-20—Analog Input FTM Schematic

13.2.7—TC Input FTM

The TC Input FTM is used with 8Ch TC Fail Low, Fail High, and Non-standard modules. (See Chapter 9 MicroNet module information and Appendix A for FTM part number). One MicroNet Low Density Analog cable is use to connect the FTM with the 8Ch TC modules (see Appendix A for part numbers). Each FTM utilizes an AD590 Temperature sensor to measure the thermocouple junction temperature. This temperature is used as the reference junction temperature in correcting for the thermocouple wire to copper/copper junction error. Channel 9 is used for this purpose.

Figure 13-21— TC Input FTM

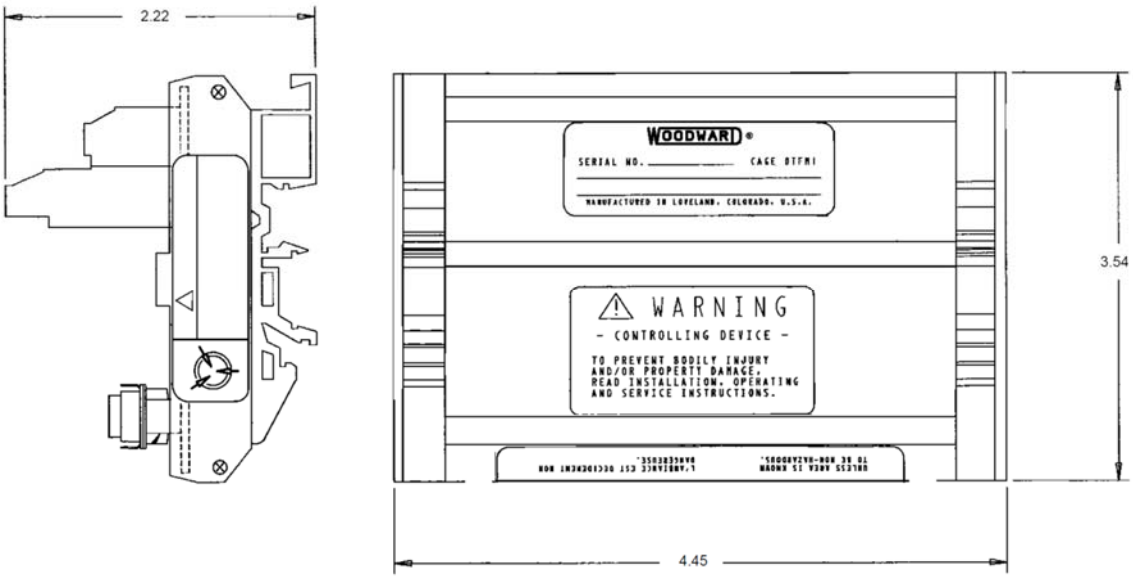


Figure 13-22—TC Input FTM Outline Dimensions

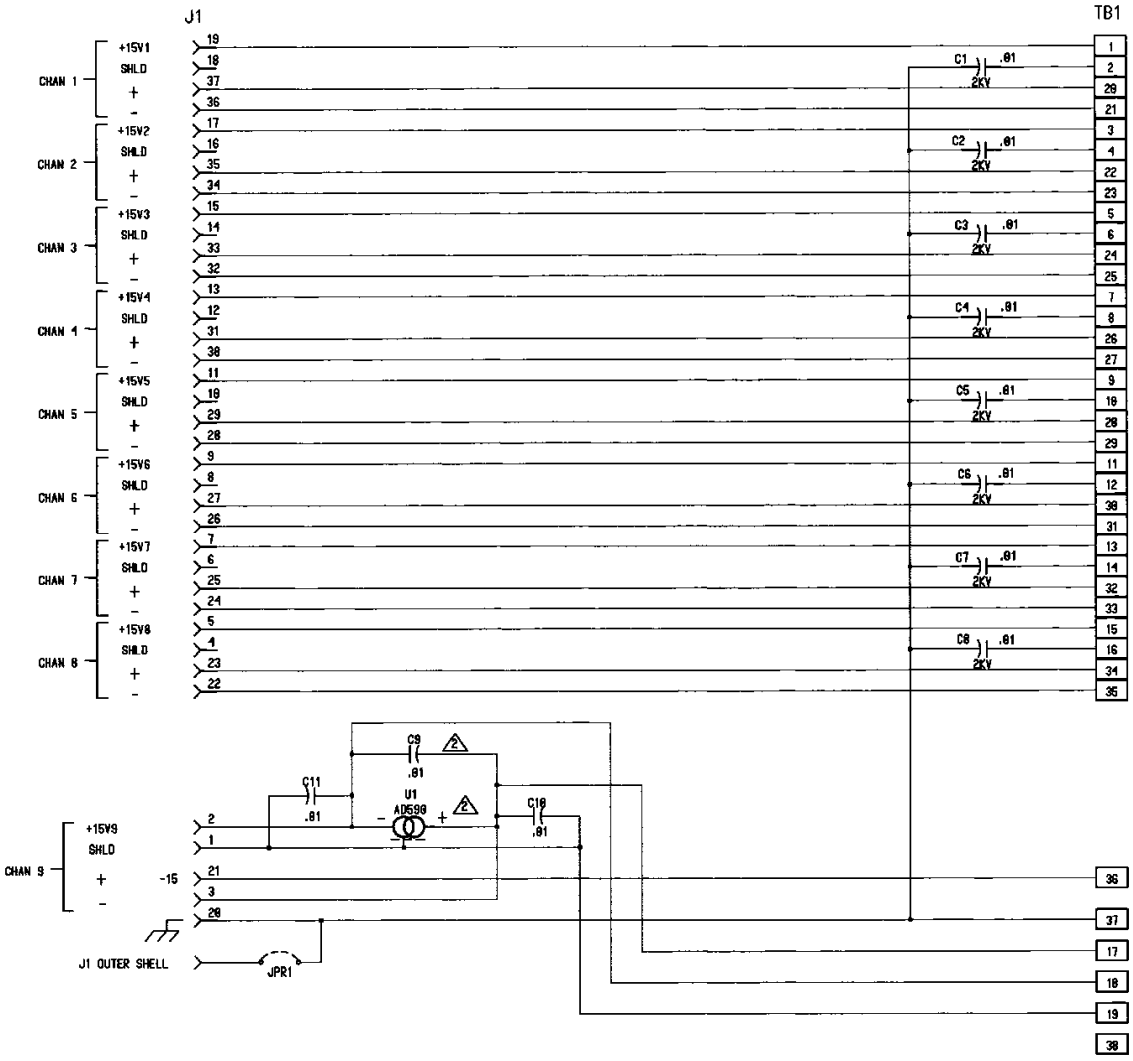


Figure 13-23—TC Input FTM Schematic

13.2.8—Analog Combo I/O

The Analog Combo FTM is used with Analog Combo module (see Chapter 9 MicroNet module information and Appendix A for FTM part number). The FTM can connect to four speed sensor inputs, eight analog inputs, four analog outputs, and two proportional actuator driver outputs. Two MicroNet Low Density Analog cable are used to connect the FTM with the Analog Combo module (see Appendix A for part numbers). There are eight +24 Vdc connections available for sourcing 4–20 mA inputs. Each connection is protected with a 0.1 A fuse (F1-F8). There are four +24/12 Vdc output connections available for powering four proximity sensors. Each of these connections are protected with a 0.1 A fuse (F9-F12).

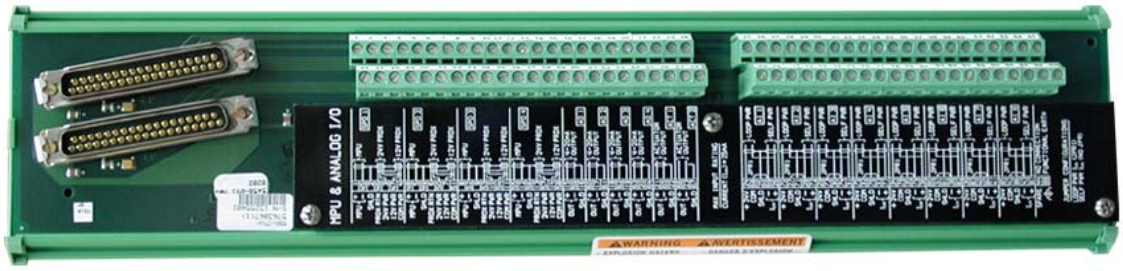


Figure 13-24— Analog Combo FTM

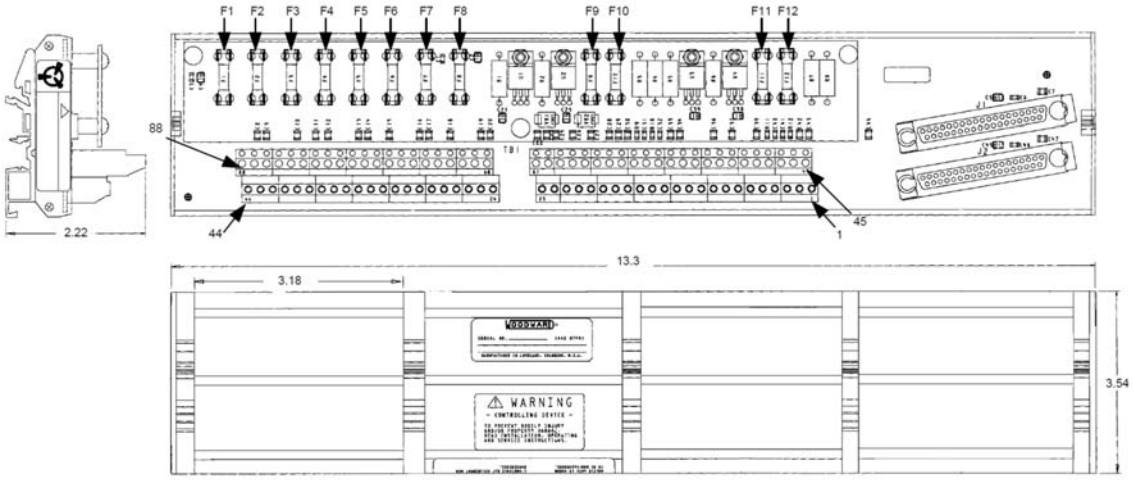


Figure 13-25—Analog Combo FTM Outline Dimensions

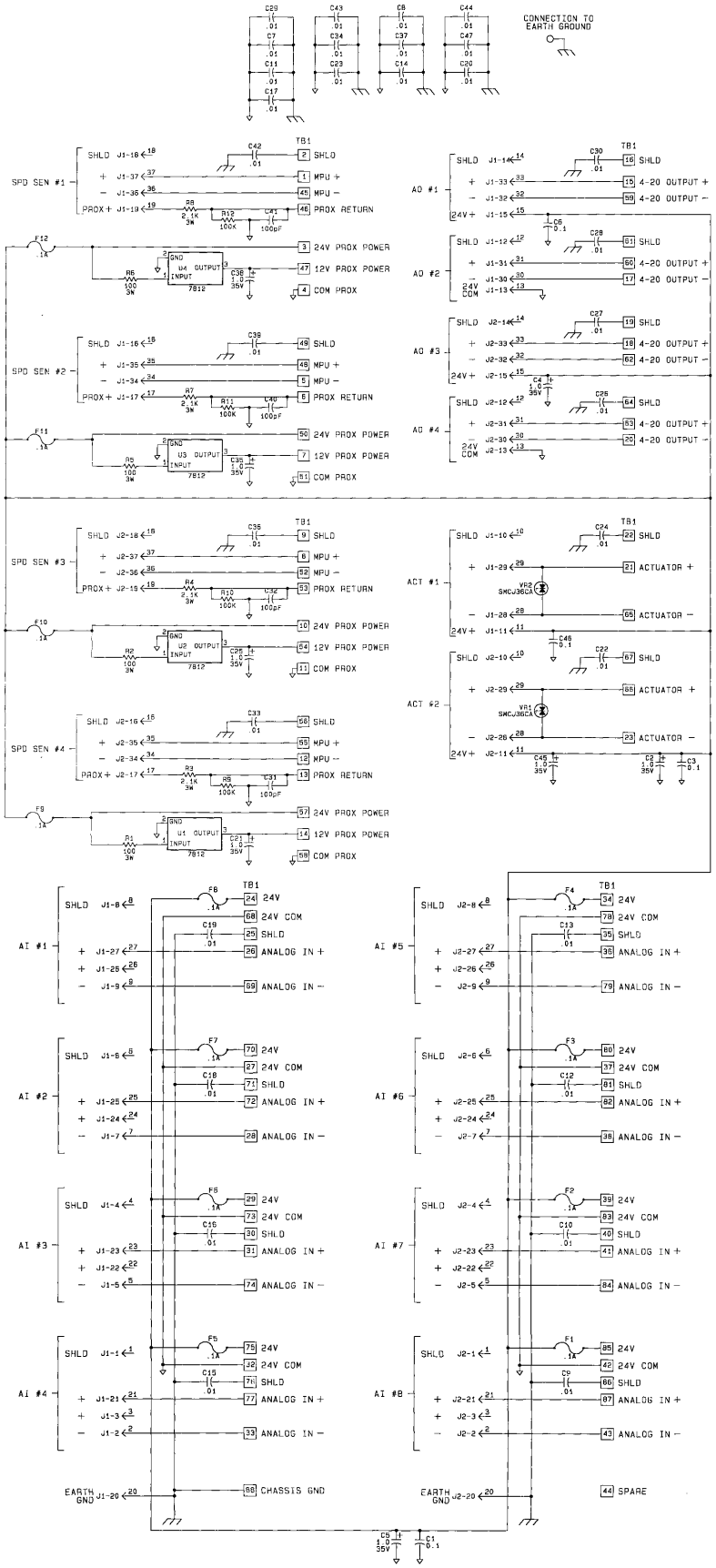


Figure 13-26—Analog Combo FTM Schematic

13.2.9—Non-Standard Analog Input FTM

The Non-Standard Analog Input FTM is used with Non-Standard 8Ch Current Input module (see Chapter 9 MicroNet module information and Appendix A for FTM part number). The FTM has 8 current input channels with the output of channel 7 feeding a derivative circuit which in-turn is fed back into channel 8's input. Originally, this derivative signal was used for detection of Combustor Discharge stall Pressures in turbines, but can be used for monitoring other rate of changes in the channel 7 input transducer. The first seven channels may be connected to current transducers. Channels 1 through 6 are standard 0–25 mA inputs with standard frequency response. The derivative circuit consists of two adjustable potentiometers that are factor set. Do not adjust these potentiometers. One MicroNet Low Density Analog cable is used to connect the FTM with the Non-Standard 8Ch Current Input module (see Appendix A for part numbers).

Figure 13-27— Non-Standard Analog Input FTM

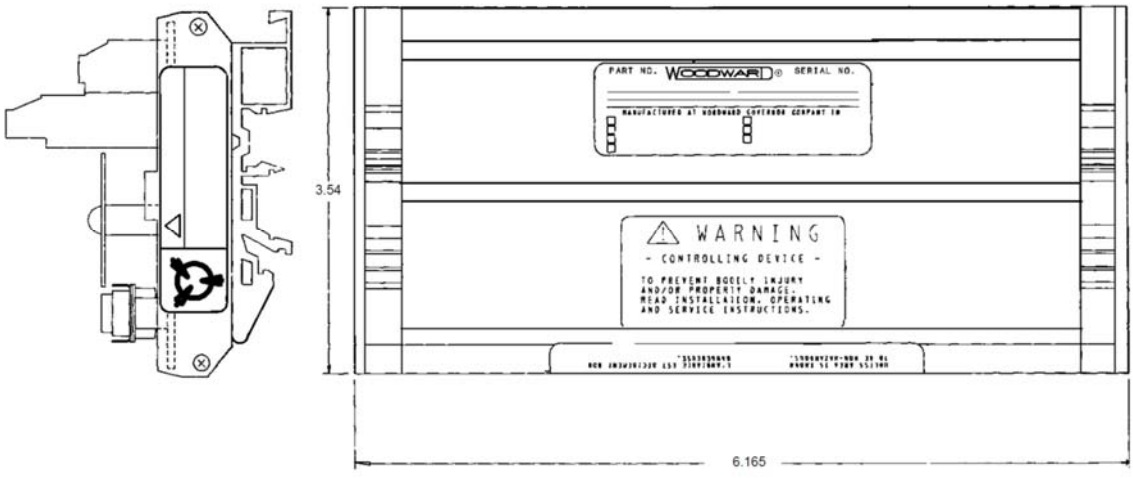


Figure 13-28—Non-Standard Analog Input FTM Outline Dimensions

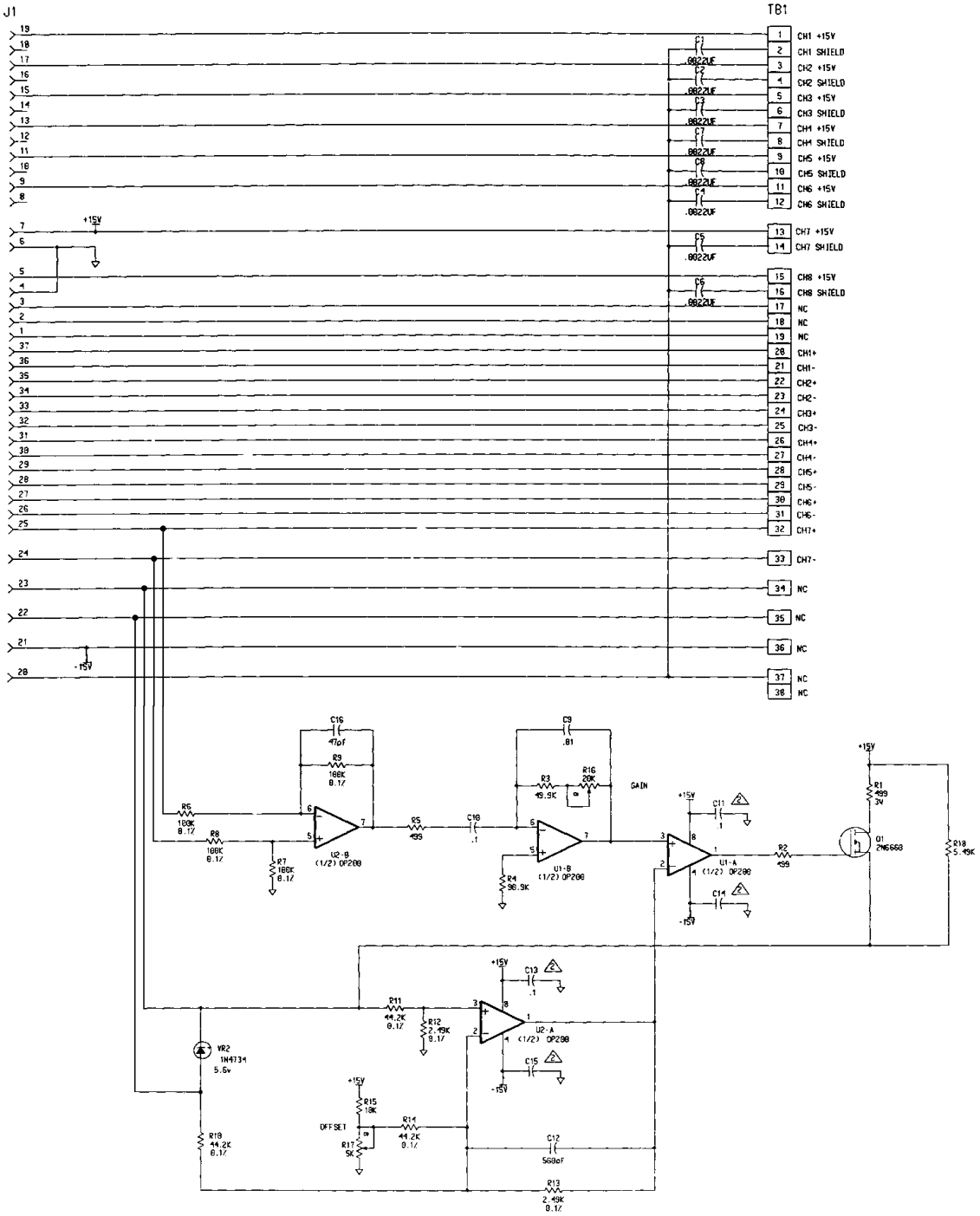


Figure 13-29—Non-Standard Analog Input FTM Schematic

13.3—Discrete I/O FTM

13.3.1—24 Vdc Discrete Input/Output FTM

The 24 Vdc Discrete Input/Output FTM is used with 48Ch DI, the 32Ch DO, and the 64Ch DO Modules (see Chapter 8, MicroNet module information and Appendix A for FTM part number). The FTM has 24 discrete input or output channels per module. The 48Ch DI modules utilizes two FTMs, the 32Ch DO module utilizes two FTMs, and the 64Ch DO module utilizes four FTMs for their I/O connections. Two MicroNet Low Density Discrete cables are used to connect the 48Ch DI and 32Ch DO modules with their FTMs. Four MicroNet Low Density Discrete cables are used to connect the 64Ch DO Module with its four FTMs (see Appendix A for part numbers).

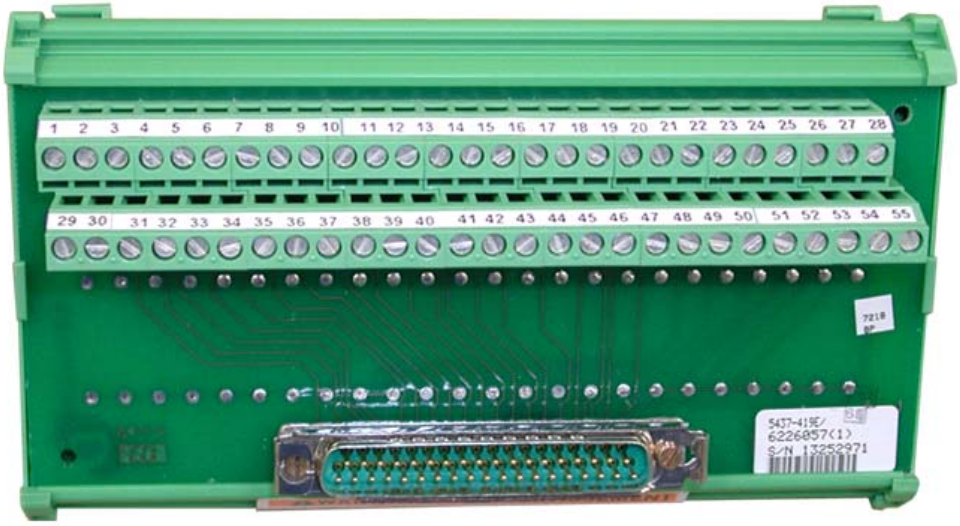


Figure 13-30—24 Vdc Discrete Input/Output FTM

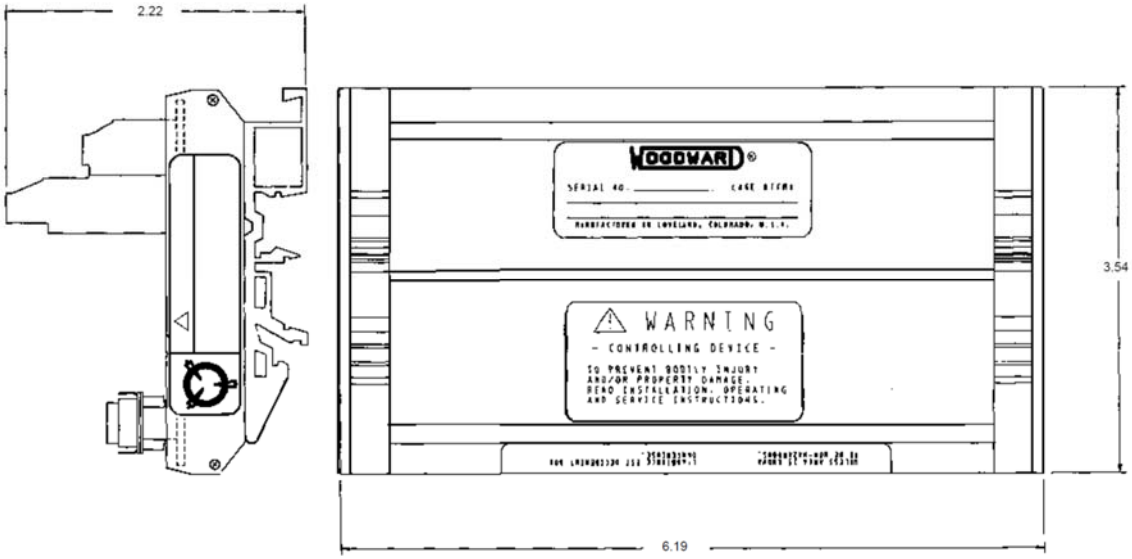


Figure 13-31—24 Vdc Discrete Input/Output FTM Outline Dimensions

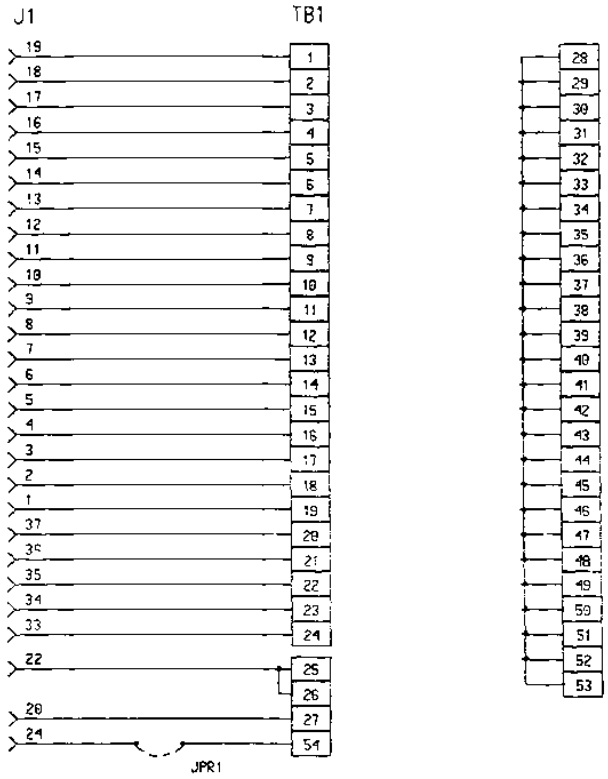


Figure 13-32—24 Vdc Discrete Input/Output FTM Schematic

13.3.2—Position Controller FTM

The Position Controller FTM is used with 2Ch TM100 Modules, and the 2Ch EM-35 Modules (see Chapter 10 for MicroNet module information and Appendix A for FTM part number). One MicroNet Low Density Discrete cable is used to connect each of the 2Ch TM100 Modules, and the 2Ch EM-35 Modules with their FTMs (see Appendix A for part numbers).

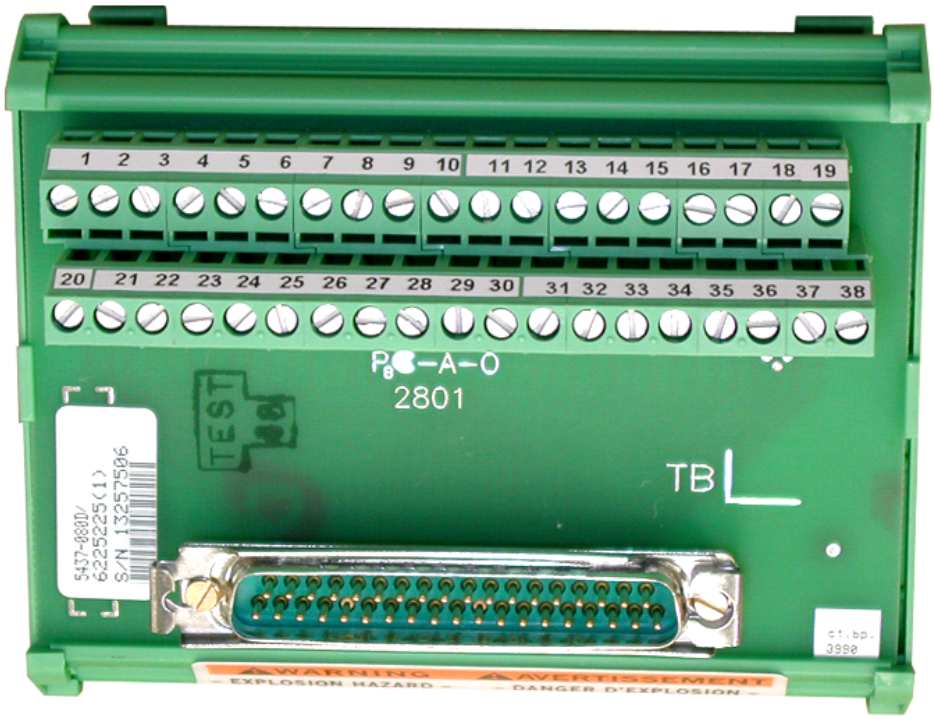


Figure 13-33— Position Controller FTM

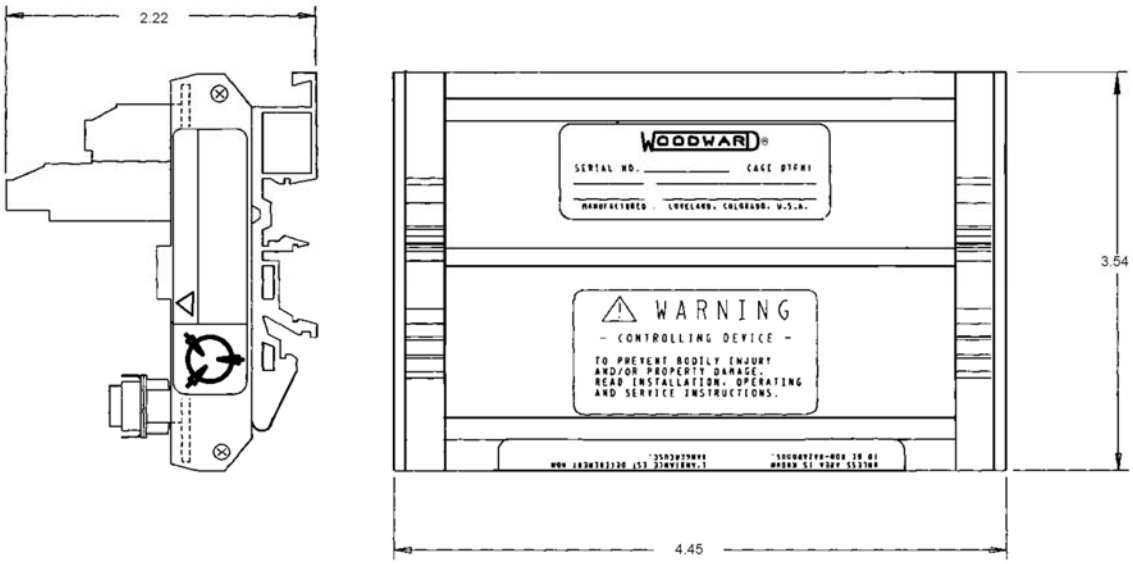


Figure 13-34—Position Controller FTM Outline Dimensions

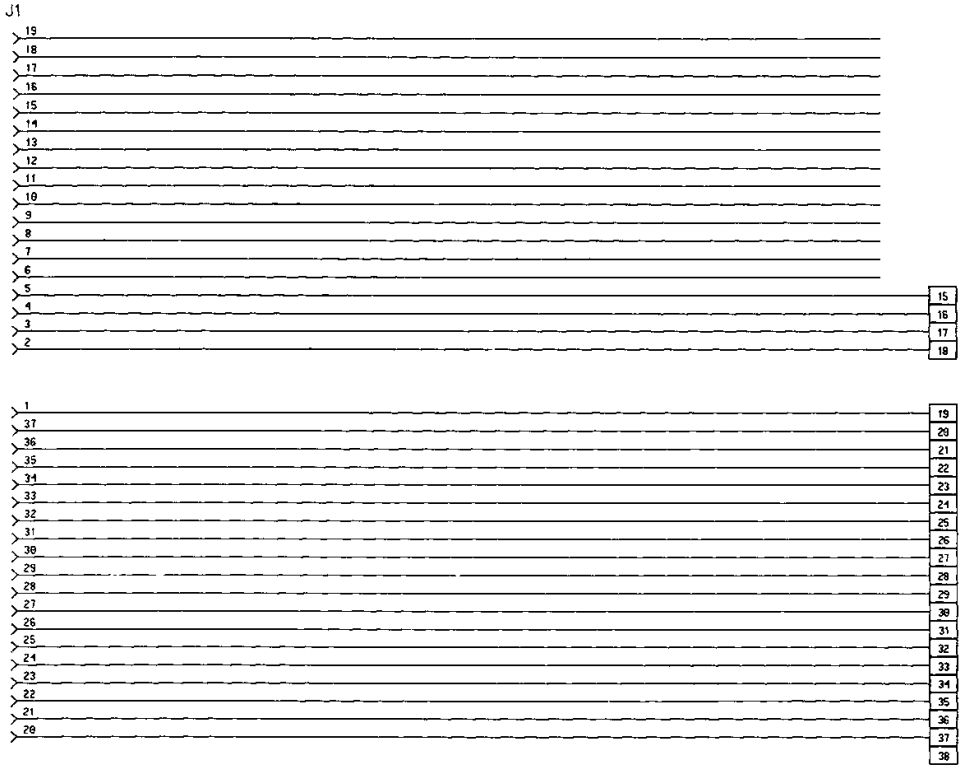


Figure 13-35—Position Controller FTM Schematic

13.3.3—24/12 Discrete Module (Phoenix Contact)

IMPORTANT **This relay module is for use in ordinary or non-hazardous locations only.**

The 24/12 Discrete Module is used with 48/24 Discrete Combo Module (see Chapter 8 MicroNet module information and Appendix A for FTM part number). The 24/12 Discrete Module has 24 discrete inputs connections and 12 SPDT relay outputs. Two relay modules connect to one 48/24 Discrete Combo Module. Each FTM uses one MicroNet High Density Analog/Discrete cable to connect it with the 48/24 Discrete Combo Module (see Appendix A for part numbers). This relay module incorporates an I/O lockout relay that will de-energize all of the relays if de-activated by the I/O lock signal from the DO module. All field connections use removable connectors for ease in replacing module in the field. All relays are field replaceable.

Relays (see Appendix A)
Output Rating:
10 A @ 28 Vdc Resistive
3 A @ 150 Vdc Resistive
10 A @ 115 Vac Resistive
10 A @ 240 Vac Resistive
3 A @ 28 Vdc Inductive
1.2 A @ 150 Vdc Inductive
6 A @ 115 Vac Inductive
3 A @ 240 Vac Inductive

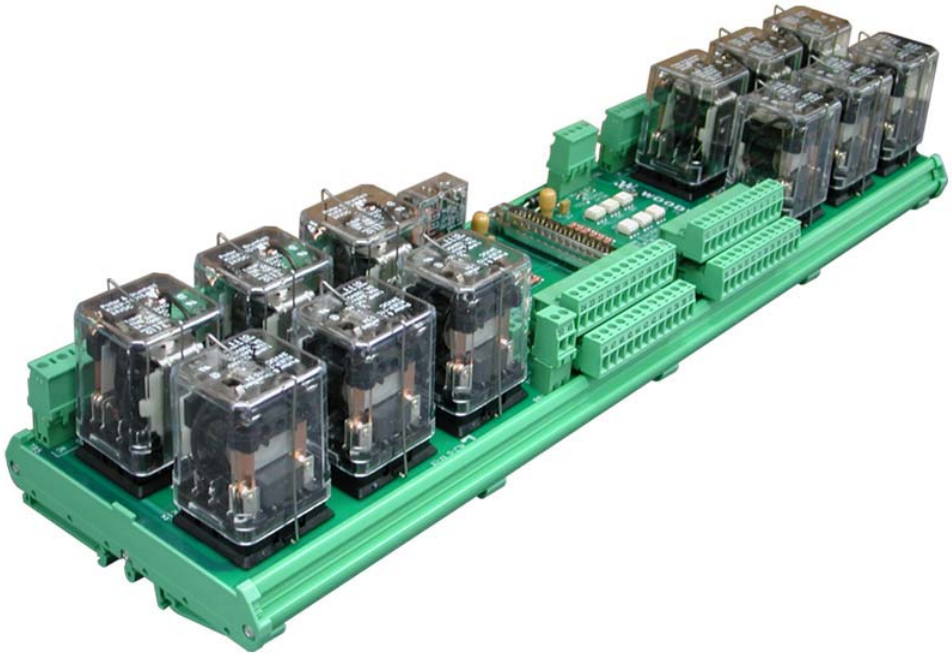


Figure 13-36—24/12 Discrete Module

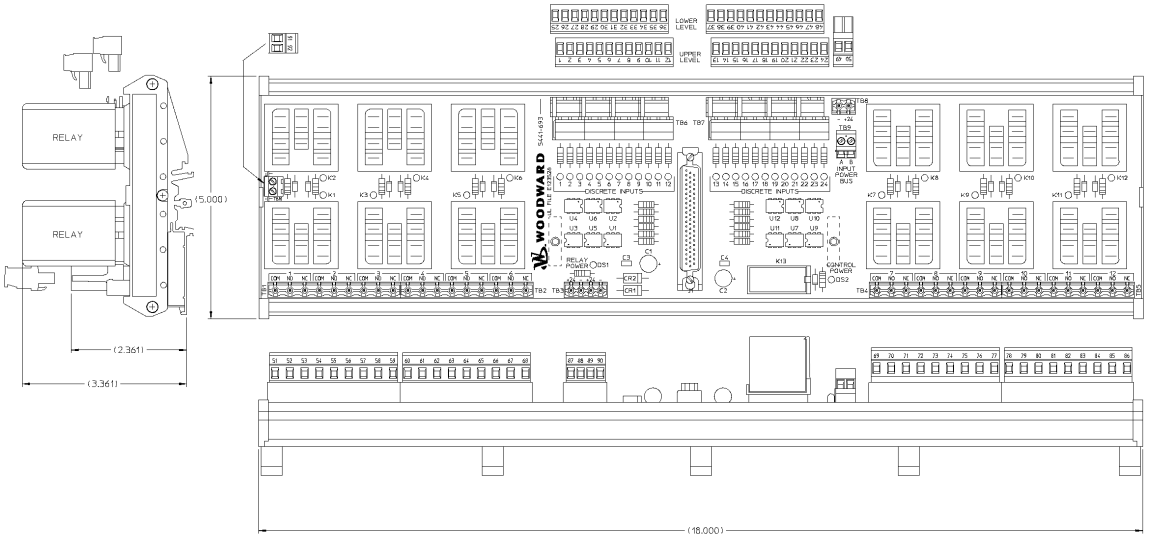


Figure 13-37—24/12 Discrete Module Outline Dimensions

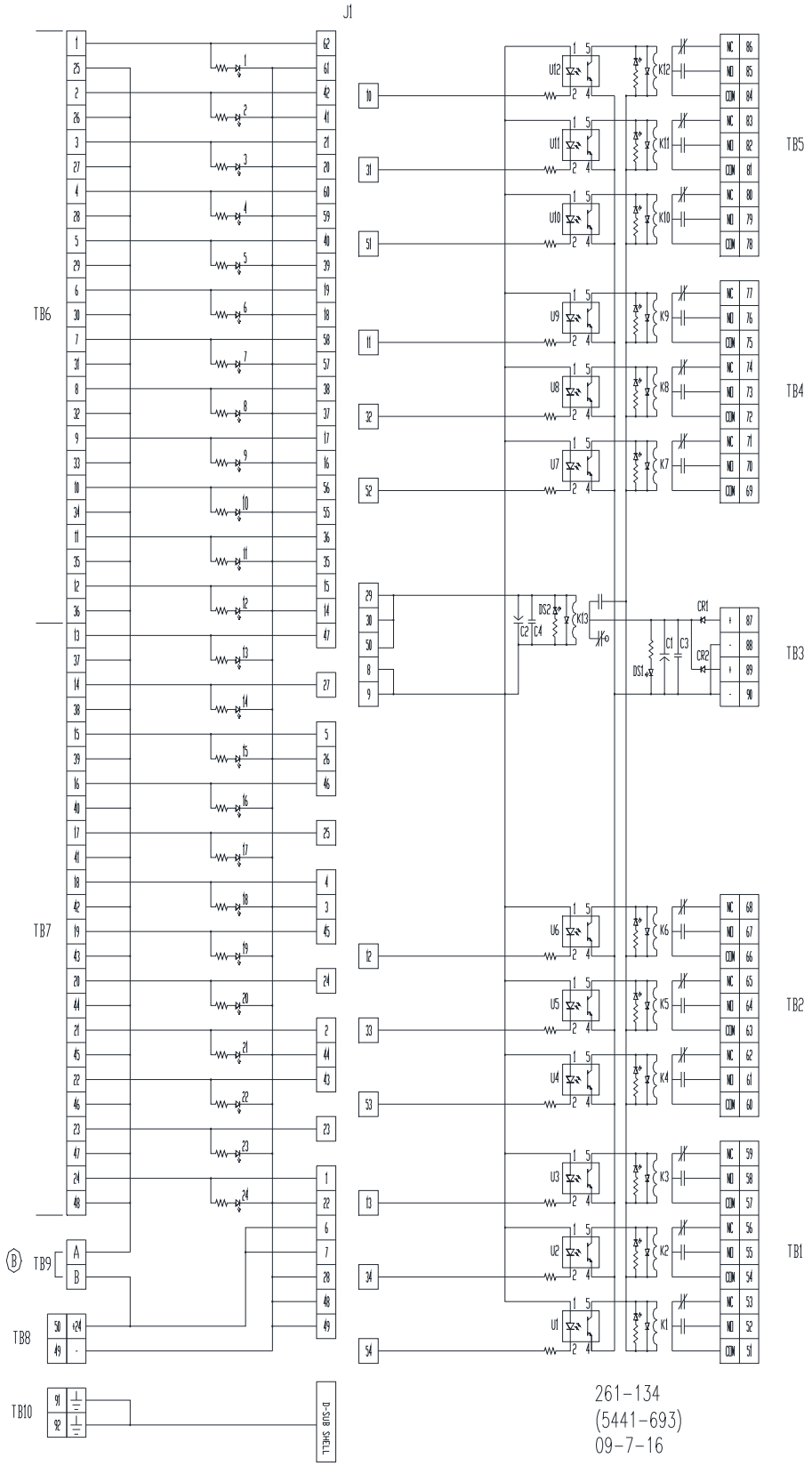


Figure 13-38—24/12 Discrete Module Schematic

13.3.4—24 Vdc 48/24 Discrete FTM

This 24 Vdc 48/24 Discrete FTM is used with the 48/24 Discrete Combo Module and one of three relay boxes (see Chapter 8 for MicroNet module information and Appendix A for FTM part number). Two MicroNet High Density Analog/Discrete cables are used to connect the FTM with the 48/24 Discrete Combo Module (see Appendix A for part numbers). The 48/24 Discrete FTM is then connected to either two 16Ch Relay Modules or one 32Ch Relay Module via a Low Density Discrete Cable(s) (See Appendix A for part numbers).

All discrete Input wiring is through the 48/24 Discrete I/O FTM. Contact wetting voltage may be supplied by the 48/24 Discrete FTM. Optionally, an external 18–32 Vdc power (LV) source can be used to source the circuit wetting voltage. If the 24 Vdc internal power source is used for contact wetting, a jumper is required between FTM terminals 98 and 99.

If an external 24 Vdc power source is used for contact wetting, connect the external 24 Vdc (+) to terminal 98 and external common 24 Vdc (–) to the FTM's discrete input common, terminal 49. Do not install a jumper between terminals 98 and 99.

If an external 24 Vdc is used, the external power supply outputs must be rated to Class II at 30 Vdc or less and outputs must be fused with appropriately sized fuses (a maximum current rating of 100 ÷ V, where V is the supply's rated voltage or 5 A, whichever is less).

The discrete input isolation voltage is 500 Vdc to earth ground and 1000 Vdc to control common.

Figure 13-39—24 Vdc 48/24 Discrete FTM

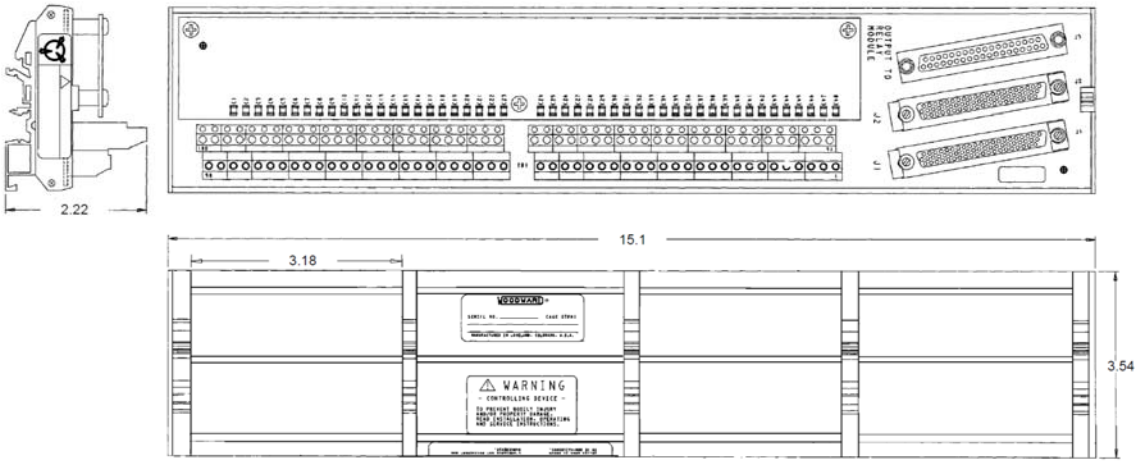


Figure 13-40—24 Vdc 48/24 Discrete FTM Outline Dimensions

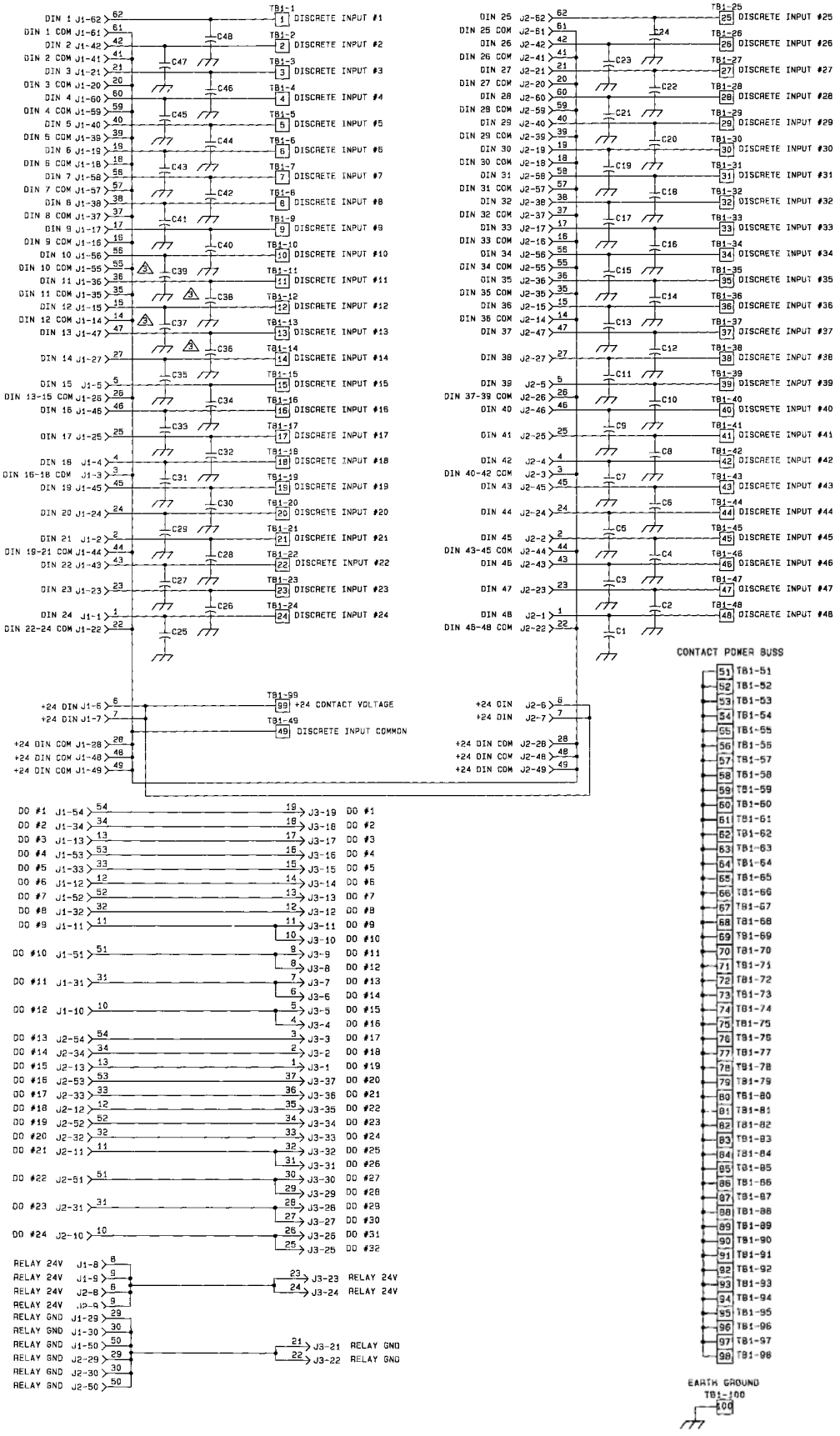


Figure 13-41—24 Vdc 48/24 Discrete FTM Schematic

13.3.5—125 Vdc 48/24 Discrete FTM

WARNING

HIGH VOLTAGE—If the high voltage FTM is being used, and there is 125 Vdc on the FTM terminal blocks, there will be 125 Vdc on the FTM sub D connectors and on the cable when it is connected to the FTM. For this reason, any power should be removed from the FTM terminal blocks before installing the 24/8 Analog I/O module or the FTM.

This 125 Vdc 48/24 Discrete FTM is used with the 48/24 Discrete Combo Module (see Chapter 8 for MicroNet module information and Appendix A for FTM part number). Two MicroNet High Density Analog/Discrete cables are used to connect the FTM with the 48/24 Discrete Combo Module (see Appendix A for part numbers). The 48/24 Discrete FTM is then connected to either two 16Ch Relay Modules or one 32Ch Relay Module via a Low Density Discrete Cable(s) (See Appendix A for part numbers).

All discrete Input wiring is through the 48/24 Discrete FTM. Contact wetting voltage must be supplied by an external 100-150 Vdc power (HV) source. The common for the 125 Vdc must be tied to the discrete input common.

The discrete input isolation voltage is 500 Vdc to earth ground and 1000 Vdc to control common.

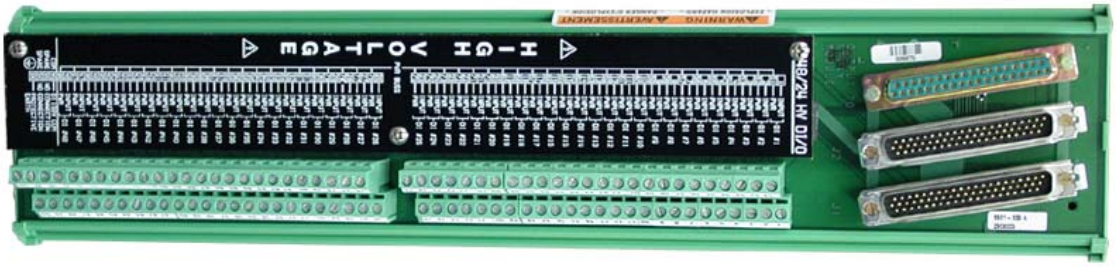


Figure 13-42—125 Vdc 48/24 Discrete FTM Schematic

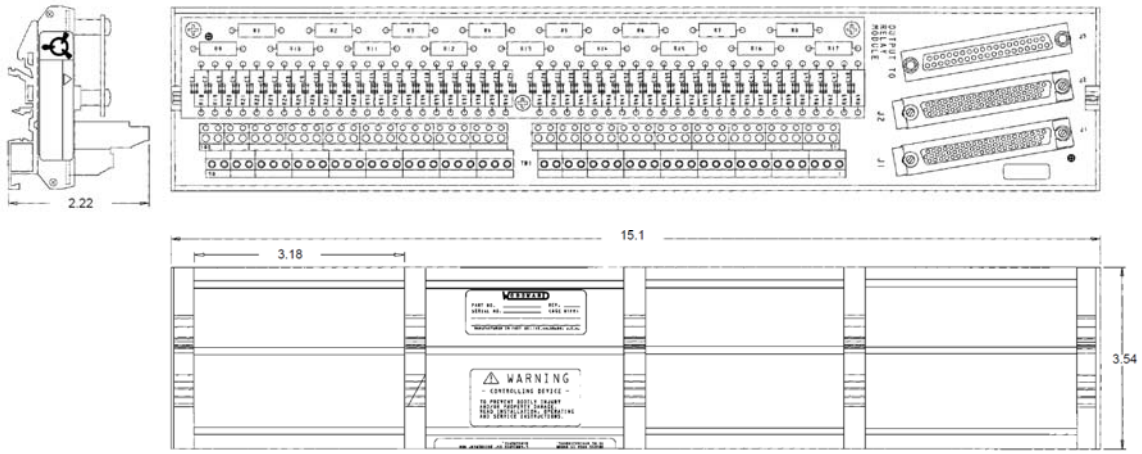


Figure 13-43—125 Vdc 48/24 Discrete FTM Outline Dimensions

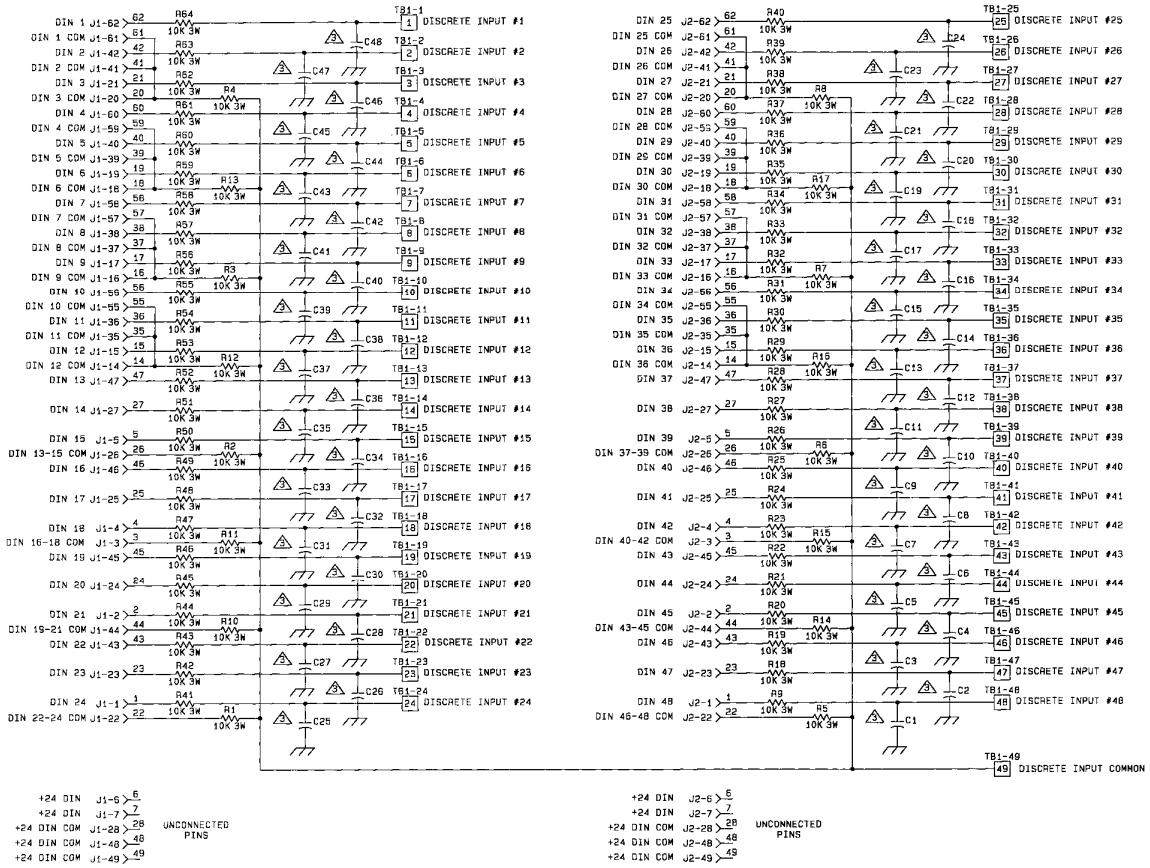


Figure 13-44a—125 Vdc 48/24 Discrete FTM Schematic (part 1)

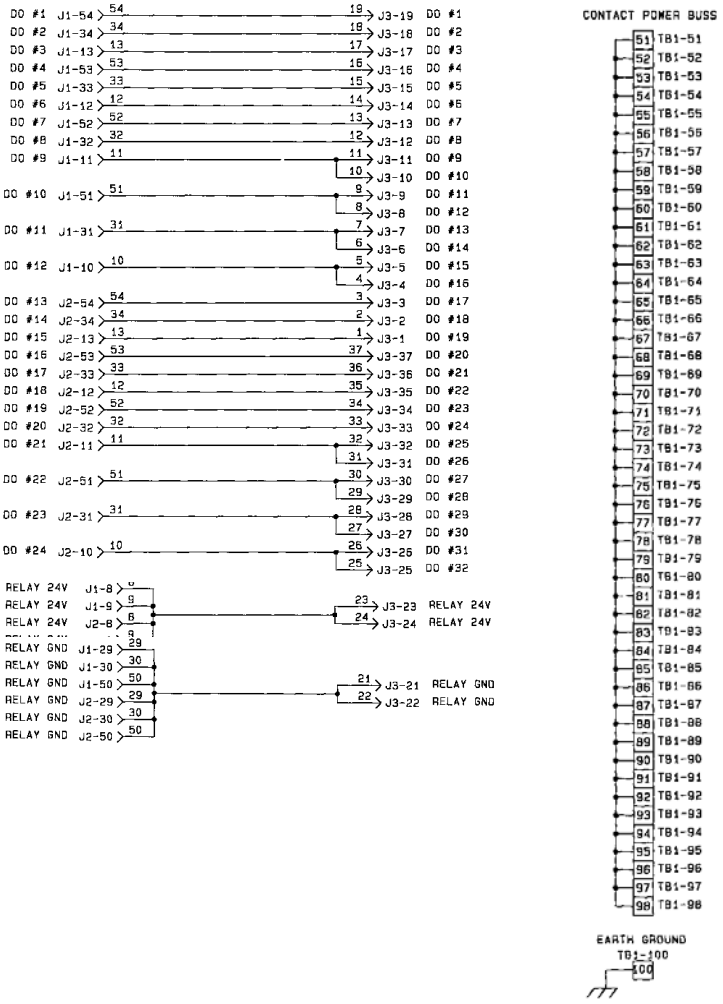


Figure 13-44b—125 Vdc 48/24 Discrete FTM Schematic (part 2)

13.3.6—Discrete Input (with LEDs) FTM

IMPORTANT

Do not use internal 24 Vdc power (TB1-54) to power inputs. Use external 24 Vdc power source as shown in Chapter 8. Internal 24 Vdc doesn't have sufficient current capability to power all LEDs at one time.

This Discrete Input (with LEDs) FTM is used with the 48Ch Discrete Input Module (see Chapter 8 for MicroNet module information and Appendix A for FTM part number). One MicroNet Low Density Discrete cable is use to connect the FTM with the 48Ch Discrete Input Module (see Appendix A for part numbers). Always use an external 24 Vdc power source for energizing the inputs (See Chapter 8 for external power connection). The internal 24 Vdc power is not sufficient to power all LEDs.

Figure 13-45— Discrete Input (with LEDs) FTM

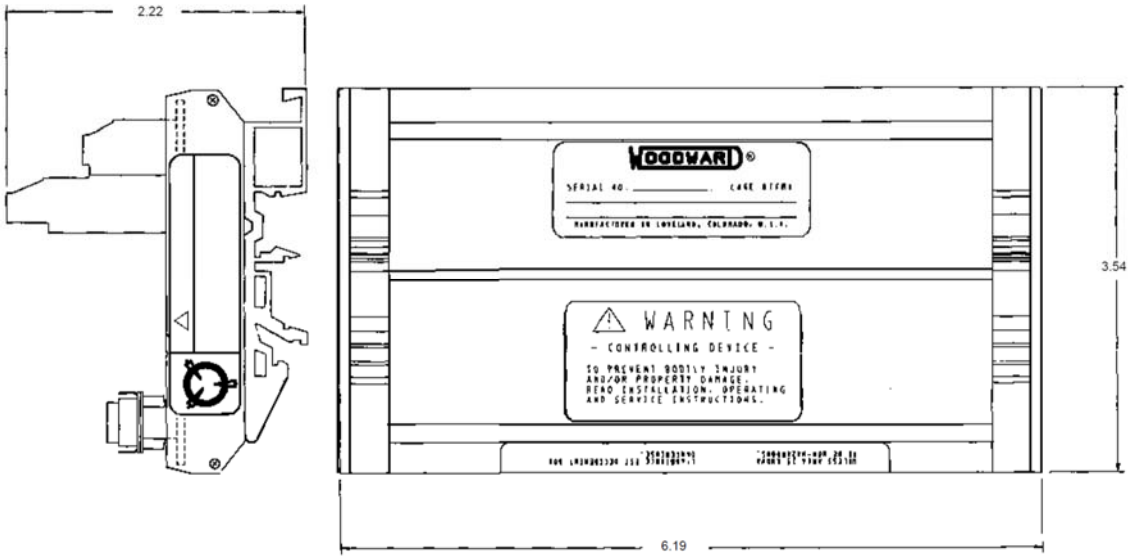


Figure 13-46—Discrete Input (with LEDs) FTM Outline Dimensions

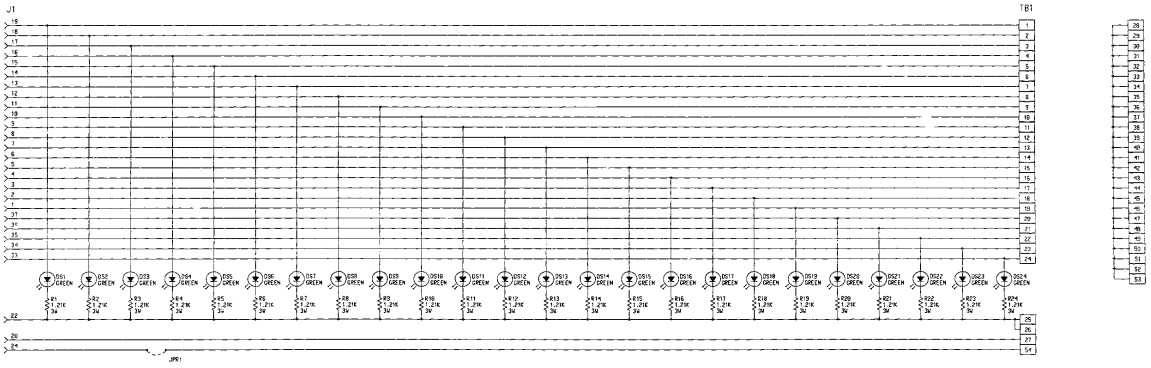


Figure 13-47—Discrete Input (with LEDs) FTM Schematic

13.3.7—24/12 Discrete I/O (with LEDs) FTM

The 24/12 Discrete Module is used with MicroNet Discrete I/O Smart-Plus Module (see Chapter 8 MicroNet module information and Appendix A for FTM part number). The 24/12 Discrete I/O FTM has 24 discrete inputs connections and 2 groups isolated from each other of 6 relay drivers. Two FTMs connect to one MicroNet Discrete I/O Smart-Plus Module. Each FTM uses one MicroNet High Density Analog/Discrete cable to connect it with the MicroNet Discrete I/O Smart-Plus Module (see Appendix A for part numbers). All field connections use removable connectors for ease in replacing module in the field.

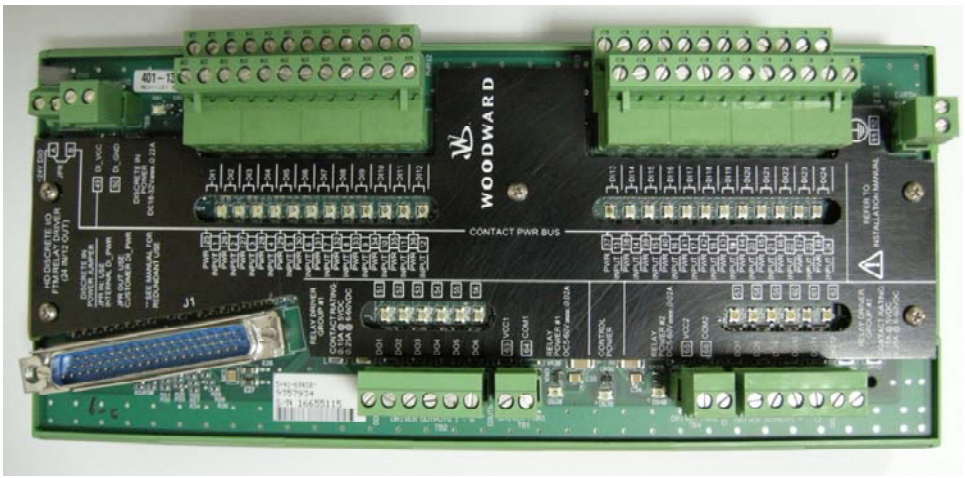


Figure 13-48—24/12 Discrete I/O (with LEDs) FTM

All discrete Input wiring is through the 48/24 Discrete I/O FTM. Contact wetting voltage may be supplied by the 48/24 Discrete FTM. Optionally, an external 18–32 Vdc power (LV) source can be used to source the circuit wetting voltage.

If the 24 Vdc internal power source is used for contact wetting, a jumper is required in terminal block TB9.

If an external power source is used for contact wetting, the external sources common must be connected to the FTM's discrete input common, terminal 49. If the external power supply to be used with voltage < 24 Vdc, jumper from TB9 is required to be removed. If the external power supply voltage >= 24 Vdc jumper from terminal block TB9 may stay – in this case power supply redundancy option can be used.

Each of two groups of relay drivers (Discrete Outputs) require own external power supply. External Power Supply voltage: 5–60 Vdc, the same as for relays driven by the relay driver.

Relay Driver Ratings:
150 mA MAX @ Ext. Power supply voltage: 5 Vdc
250 mA MAX @ Ext. Power supply voltage: 6–60 Vdc

Relay driver power supply input rating:
20 mA MAX @ 60 Vdc

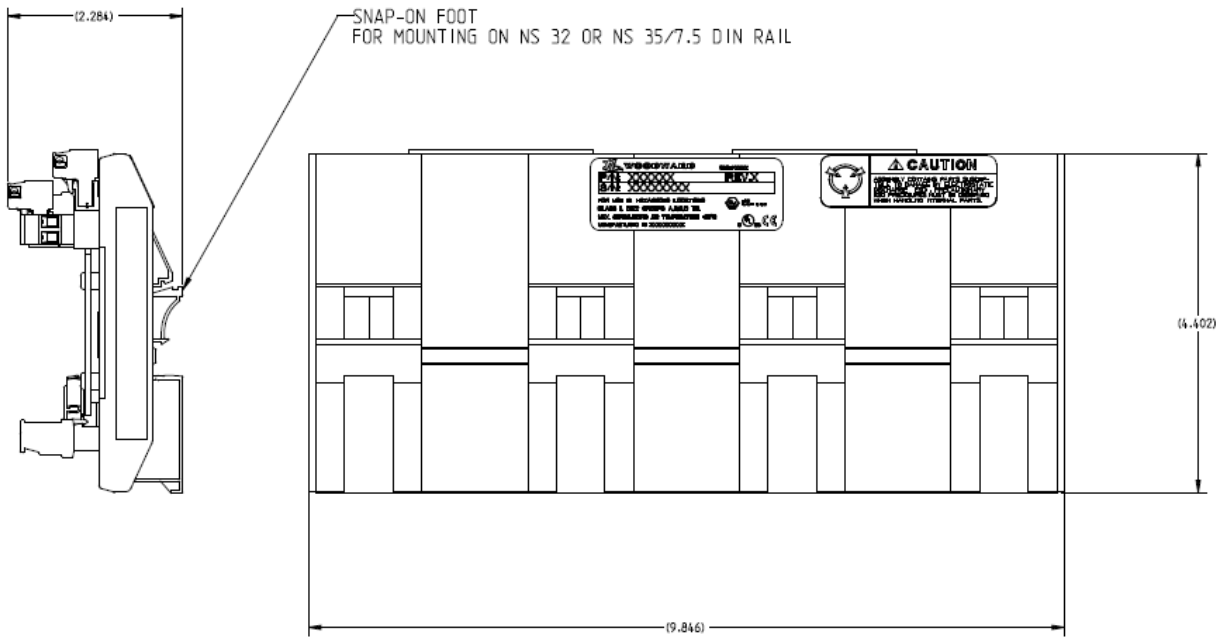


Figure 13-49—Discrete I/O (with LEDs) FTM Outline Drawings

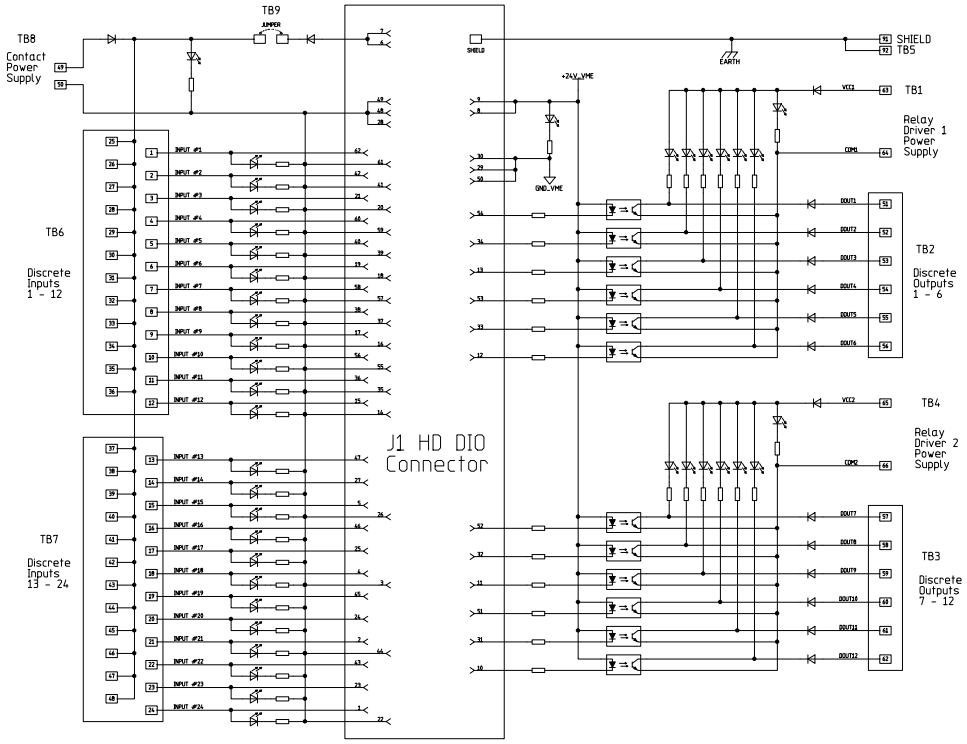


Figure 13-50—Discrete I/O (with LEDs) FTM Block Diagram

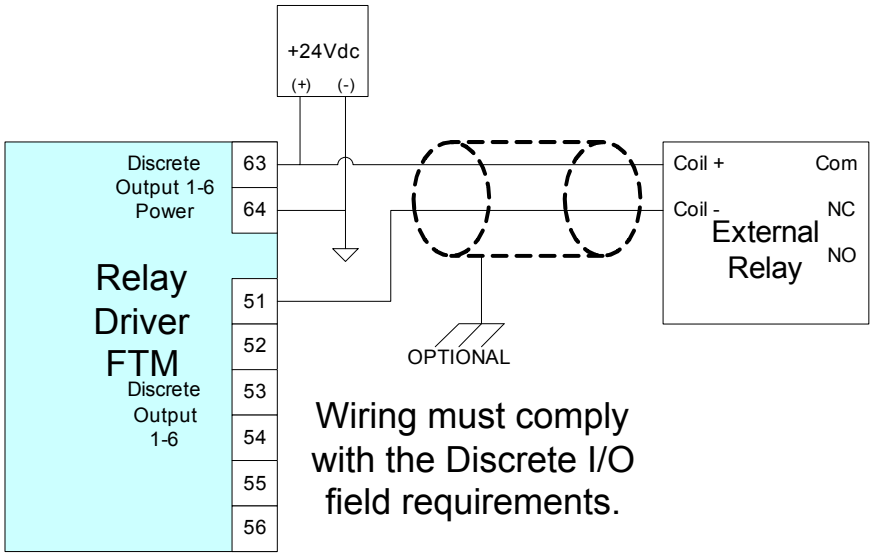


Figure 13-51—Discrete Output Relay Connection Example

IMPORTANT

The Internal or External Discrete Input contact wetting power source is protected via short circuit current limiting on-board the FTM. Because of this protection, the module cannot detect a power fault condition out at the FTM. The module does monitor its power source to the FTM, but the fault coverage only detects internal module faults. If the discrete input power is used for critical I/O, Woodward advises monitoring the voltage with one of the discrete inputs. This is accomplished by dedicating one discrete input for this monitoring purpose. Jumper that input so that it always reads logic high (TRUE). If the dedicated discrete input signal shows a logic level low (FALSE), the GAP application can flag that condition, and take appropriate action, as a power fault on the Discrete I/O FTM.

13.4—Relays

13.4.1—16 Channel Relay Module (Phoenix Contact)

IMPORTANT

This relay module is for use in ordinary or non-hazardous locations only.

This 16 Channel Relay Module (Phoenix Contact) can be used with several different discrete output modules (see Appendix A for the 16 channel Relay Module (Phoenix Contact) part number and applicable discrete output (DO) module part numbers). The 16 Channel Relay Module (Phoenix Contact) is connected to the DO Module via a Low Density Discrete Cable (See Appendix A, Table K for part numbers). It can then be daisy-chained to another relay module using another Low Density Discrete Cable if desired. The J1 connector connects to the DO module and the J2 connector connects to the J1 on the next relay module. This relay module incorporates an I/O lockout relay that will de-energize all of the relays if de-activated by the I/O lock signal from the DO module. All field connections use removable connectors for ease in replacing module in the field. All relays are field replaceable.

Figure 13-52—16 Channel Relay Module (Phoenix Contact)

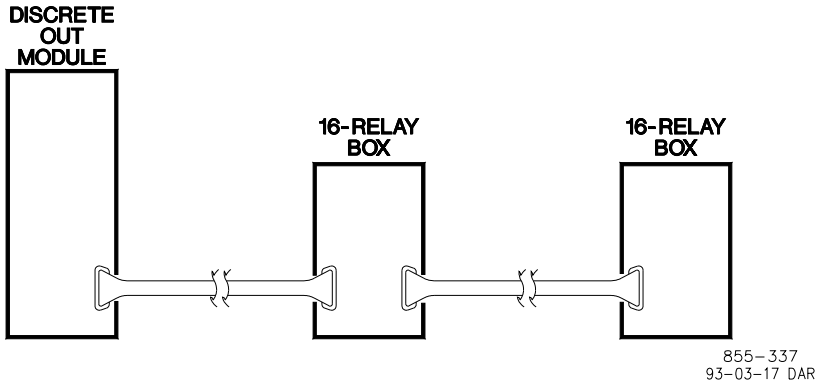


Figure 13-53—16 Channel Relay Module (Phoenix Contact) Configuration

Replacement Relays (see Appendix A)

16 relays, DPDT, and draws 1.5 A @ 24 Vdc from its external power supply (with all 16 relays energized). It also has redundant power input capability.

Relay type:	Dust-tight with magnetic blow-out
Coil rating:	80 mA @ 24 Vdc, suppressor located on circuit board
Isolation:	1000 Vrms
Relay response time:	15 ms (operate and release)
Relay life expectancy:	50 000 operations @ rated load
Replaceability:	Relays are socket mounted and retained by a wire bail
Status indication:	Yellow LED - Relay energized Green LED - Relay power on Green LED - Control power on

The external power source connected to the relay contacts should be limited to 10 A to protect the circuit board.

Contact ratings:
5.0 A @ 240 Vac, 50/60 Hz (resistive) (meets UL ratings only)
3.0 A @ 240 Vac, 50/60 Hz (inductive) (meets UL ratings only)
10.0 A @ 120 Vac, 50/60 Hz (resistive) (meets UL ratings only)
6.0 A @ 120 Vac, 50/60 Hz (inductive) (meets UL ratings only)
600 watt @ 120 Vac, 50/60 Hz (lamp) (meets UL ratings only)
3.0 A @ 150 Vdc (resistive) (meets UL ratings only)
3.0 A @ 150 Vdc (inductive) (meets UL ratings only)
10.0 A @ 28 Vdc (resistive) (meets LVD and UL ratings)
3.0 A @ 28 Vdc (inductive) (meets LVD and UL ratings)

IMPORTANT

Verify that each set of relay contacts meets the power requirements of the circuit with which it is being used. Interposing relays are required when the interfaced circuit demands relay contacts with a higher power rating. If interposing relays or other inductive loads are required, it is recommended that interposing relays with surge (inductive kickback) protection be used. Improper connection could cause serious equipment damage.

Figure 13-54—16 Channel Relay Module (Phoenix Contact) Outline Dimensions

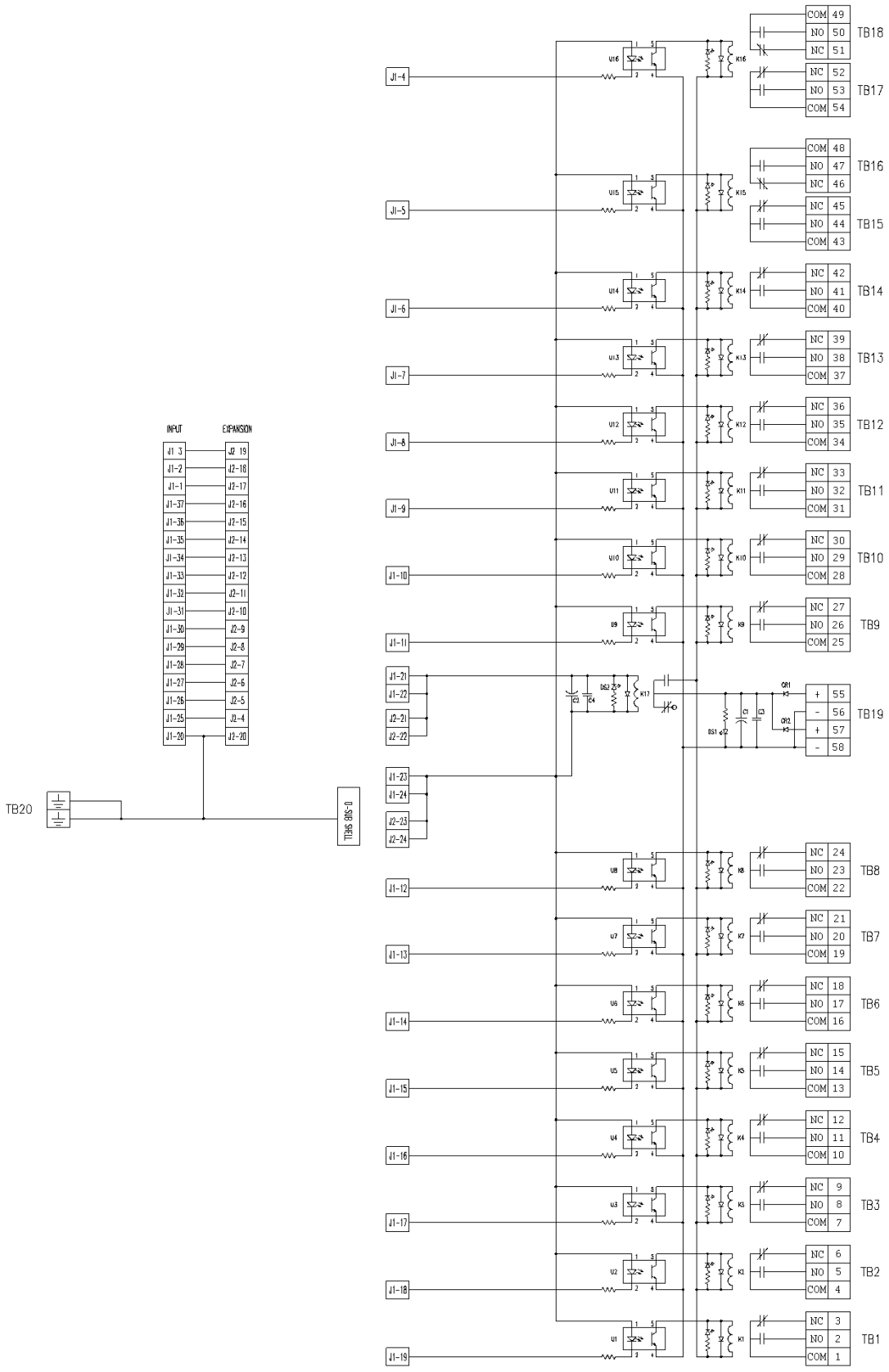


Figure 13-55—16 Channel Relay Module (Phoenix Contact) Schematic

13.4.2—16 Channel Relay Module

IMPORTANT **This relay module is for use in ordinary or non-hazardous locations only.**

This relay module contains 16 field-replaceable relays (16 channels DPDT). It can be used with several different discrete output modules (see Appendix A for the 16 Channel Relay Module part number and applicable discrete output (DO) module part numbers). The 16 Channel Relay Module is connected to the DO Module via a Low Density Discrete Cable (See Appendix A for part numbers). If 32 relays are needed, the module can be daisy-chained to another relay module using another Low Density Discrete Cable. The J1 connector connects to the DO module and the J2 connector connects to the J1 on the next relay module. This relay module incorporates an I/O lockout relay that will de-energize all of the relays if de-activated by the I/O lock signal from the DO module.

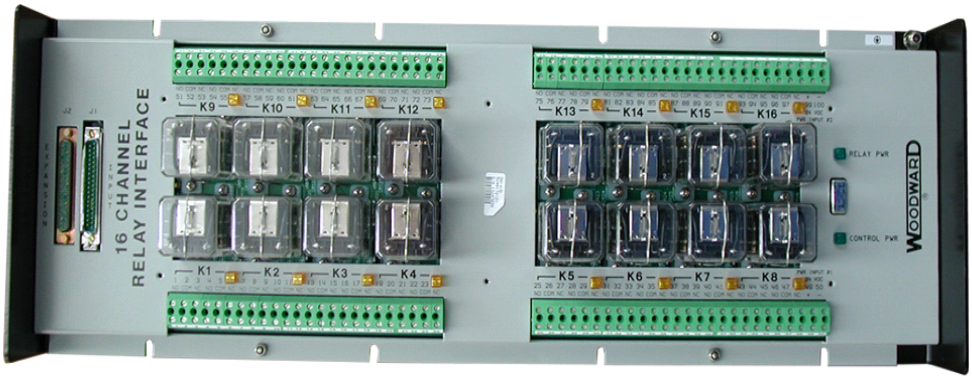


Figure 13-56—16 Channel Relay Module

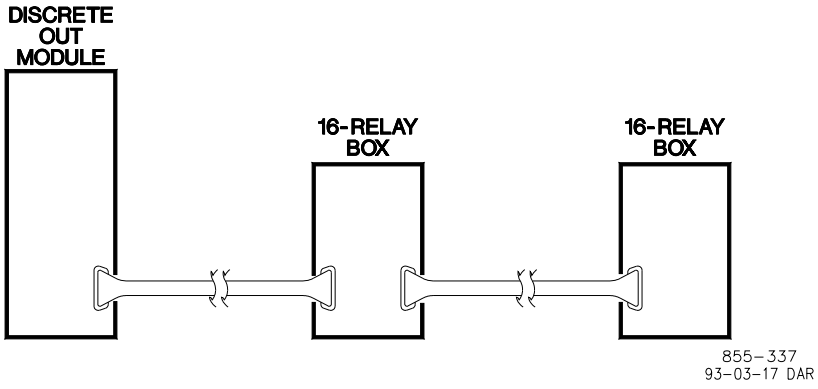


Figure 13-57—16 Channel Relay Module Configuration

Replacement Relays (see Appendix A)

16 relays, DPDT, and draws 1.5 A @ 24 Vdc from its external power supply (with all 16 relays energized). It also has redundant power input capability.

Relay type:	Dust-tight with magnetic blow-out
Coil rating:	80 mA @ 24 Vdc, suppressor located on circuit board
Isolation:	1000 Vrms
Relay response time:	15 ms (operate and release)
Relay life expectancy:	50 000 operations @ rated load
Replaceability:	Relays are socket mounted and retained by a wire bail
Status indication:	Yellow LED - Relay energized Green LED - Relay power on Green LED - Control power on

The external power source connected to the relay contacts should be limited to 10 A to protect the circuit board.

Contact ratings:
5.0 A @ 240 Vac, 50/60 Hz (resistive) (meets UL ratings only)
3.0 A @ 240 Vac, 50/60 Hz (inductive) (meets UL ratings only)
10.0 A @ 120 Vac, 50/60 Hz (resistive) (meets UL ratings only)
6.0 A @ 120 Vac, 50/60 Hz (inductive) (meets UL ratings only)
600 watt @ 120 Vac, 50/60 Hz (lamp) (meets UL ratings only)
3.0 A @ 150 Vdc (resistive) (meets UL ratings only)
3.0 A @ 150 Vdc (inductive) (meets UL ratings only)
10.0 A @ 28 Vdc (resistive) (meets LVD and UL ratings)
3.0 A @ 28 Vdc (inductive) (meets LVD and UL ratings)

IMPORTANT

Verify that each set of relay contacts meets the power requirements of the circuit with which it is being used. Interposing relays are required when the interfaced circuit demands relay contacts with a higher power rating. If interposing relays or other inductive loads are required, it is recommended that interposing relays with surge (inductive kickback) protection be used. Improper connection could cause serious equipment damage.

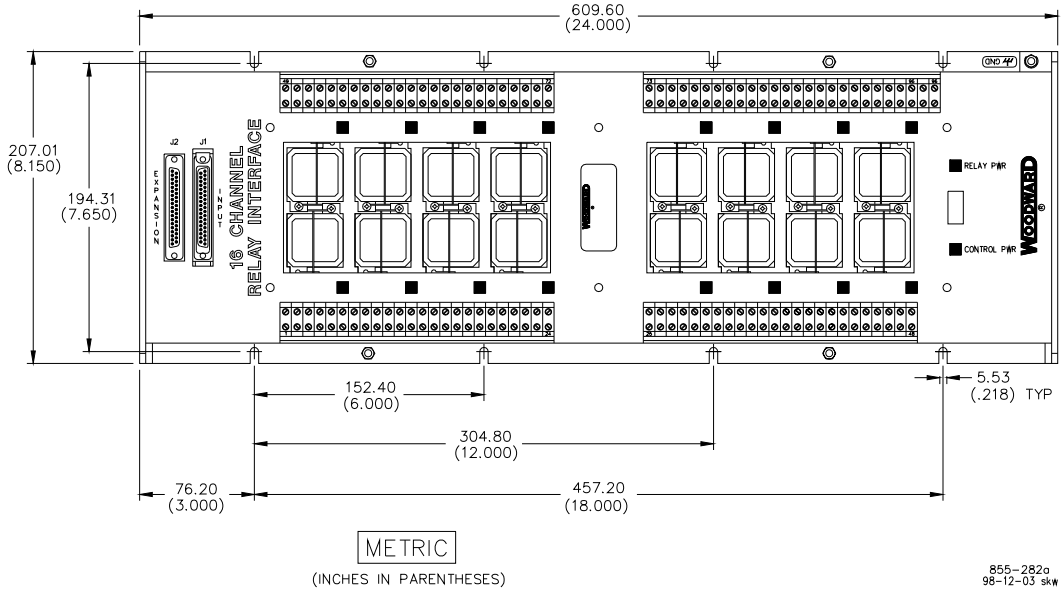


Figure 13-58—16 Channel Relay Module Outline Dimensions

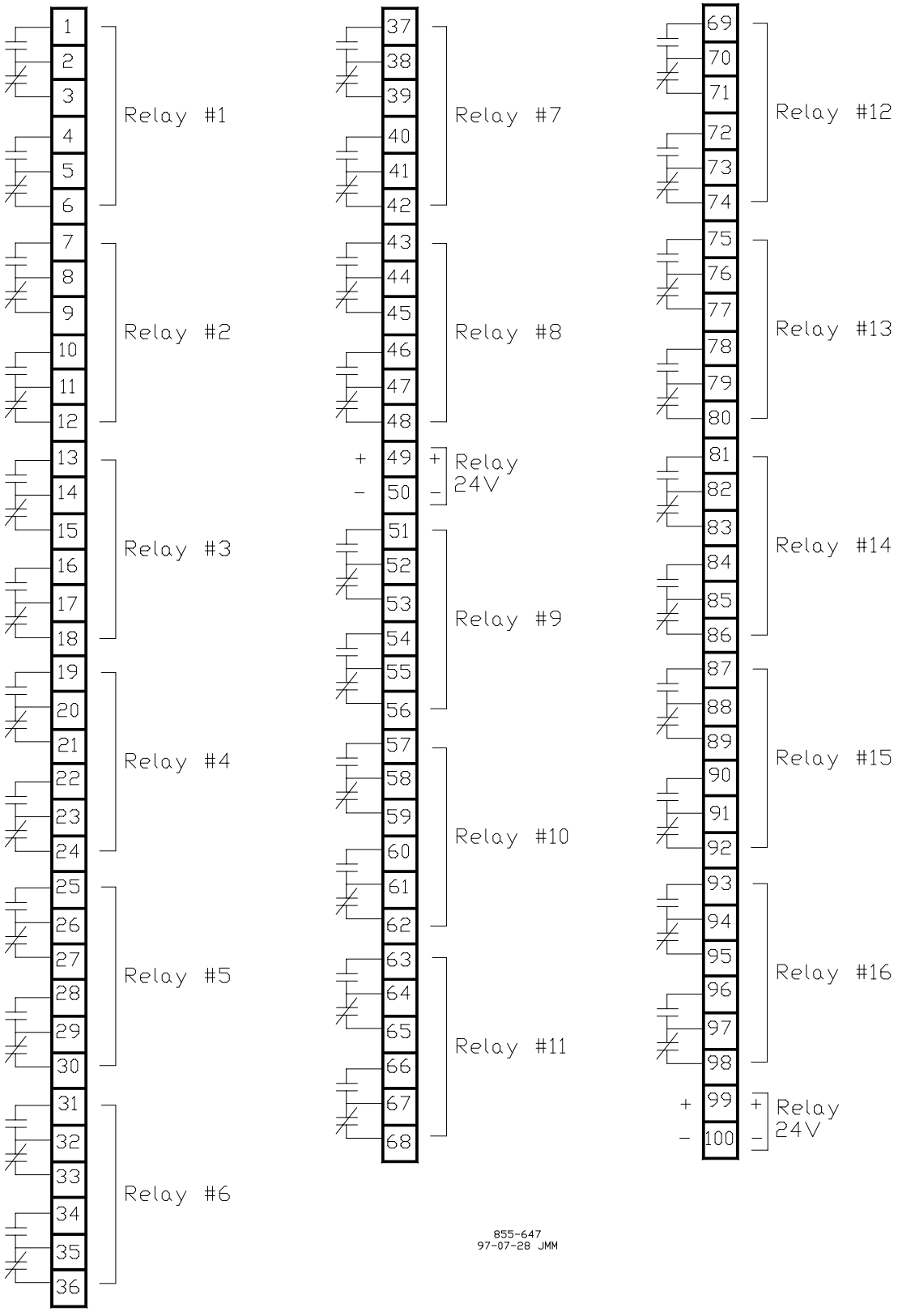


Figure 13-59—Relay Contact Connections for a 16 Channel Relay Box

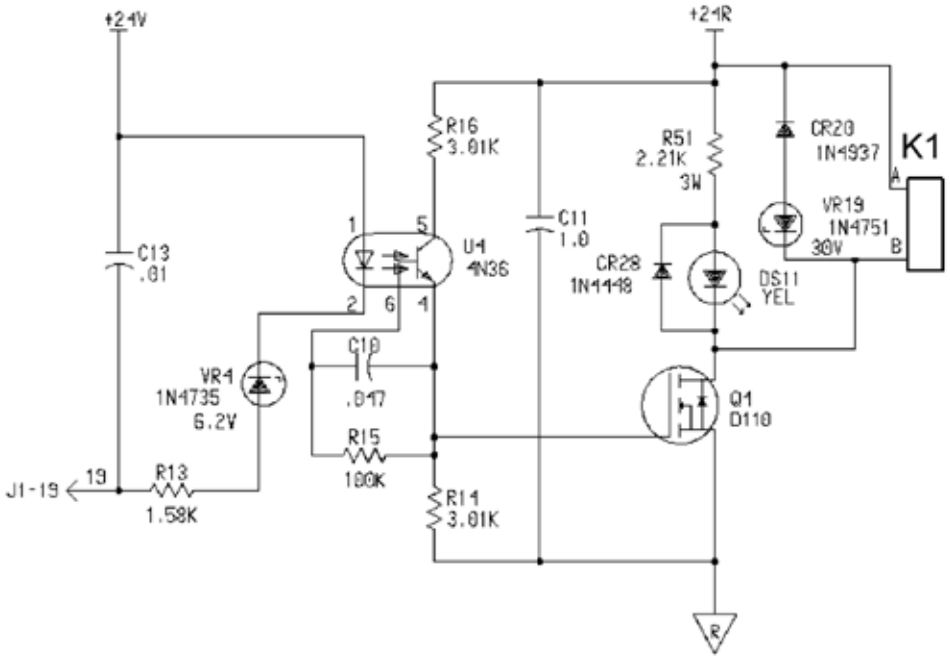


Figure 13-60—Typical 16 Channel Relay Module Relay Driver Circuit (K1)

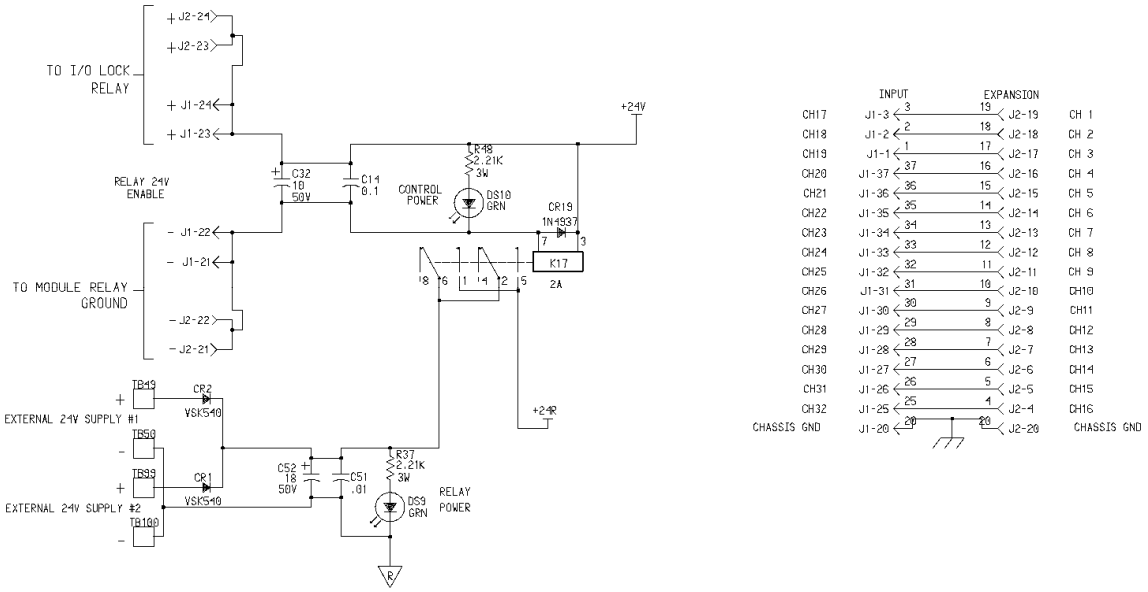


Figure 13-59—16 Channel Relay Module I/O Lock and Second Relay Module Feedthrough Circuits

13.4.3—32 Channel Relay Module (with 2 amp DPDT relays)

IMPORTANT **This 32 Channel Relay Module is approved for use in MicroNet applications for hazardous locations: Class I, Division 2, Groups A, B, C, and D.**

This 32 Channel Relay Module contains 32 relays (32 channels SPDT) that are not field-replaceable. There are two types of relays offered depending on the part number of the module. Consult Woodward for additional information regarding the 2 amp relay version.

This relay module can be used with several different discrete output modules (see Appendix A for the 32 Channel Relay Module part number and applicable discrete output (DO) module part numbers). The 32 Channel Relay Module is connected to the DO Module via a Low Density Discrete Cable (See Appendix A for part numbers). This relay module incorporates an I/O lockout relay that will de-energize all of the relays if de-activated by the I/O lock signal from the DO module.

The 32-relay module draws 3.9 A @ 24 Vdc from its power supply (with all 32 relays energized). De-rating curves must be applied in applications using the 32 Channel Relay Module.

Input Power Rating:	18–32 Vdc, 3.9 A
Relay type:	Hermetically sealed
Coil rating:	80 mA @ 24 Vdc, suppressor located on circuit board
Isolation:	1000 Vrms
Relay response time:	15 ms (operate and release)
Relay life expectancy:	50 000 operations @ rated load
Replaceability:	Individual relays not field replaceable
Status indication:	Yellow LED - Relay energized
	Green LED - Relay power on
	Green LED - Control power on

Contact ratings:
3.0 A @ 120 Vac, 50/60 Hz (resistive) (meets UL ratings only)
2.0 A @ 120 Vac, 50/60 Hz (inductive) (meets UL ratings only)
60 Watt @ 120 Vac, 50/60 Hz (lamp) (meets UL ratings only)
10.0 A @ 28 Vdc (resistive) (meets LVD and UL ratings)
3.0 A @ 28 Vdc (inductive) (meets LVD and UL ratings)

This Equipment is suitable for use in Class I, Division 2, Groups A, B, C, and D or non-hazardous locations only.

The device(s) must be wired in accordance with Class I, Division 2 wiring methods and in accordance with the authority having jurisdiction.

WARNING **EXPLOSION HAZARD—Substitution of components may impair suitability for Class I, Division 2.**

Relay Interface De-rating

The relays must be prevented from exceeding their maximum operating temperature specification of 125 °C that can happen under certain conditions of ambient temperature, coil voltage and contact current. No de-rating is necessary at coil voltages of 24 Vdc and ambient temperatures below 47.5 °C. At higher coil voltages, fewer relays can be energized or contact current must be reduced (or combination thereof). All relays can be energized at 24 Vdc and carry 7 A at ambient temperatures up to 55 °C outside the interface enclosure. The accompanying de-rating curves (Figure 13-45) can be used to help determine if your relay application is within operating limits. The left vertical axis is the ambient temperature. The family of curves is made up of lines of constant coil voltage at various contact currents. The family of diagonal bold lines is for a given numbers of relays energized. The horizontal line marked “55 °C ambient...” is the limit line. Your operating point should be less than 55 °C.

To establish an operating point for your applications, determine the maximum number of relays that will be energized simultaneously for more than a few minutes. Find the diagonal bold lines on the de-rating chart corresponding to number of relays “ON” above and below your number. Interpolate horizontally between lines and sketch in your own line. You may also round up the number to correspond to a line. Next, determine the supply voltage to the relay coils and an average contact current. Find the curves corresponding to your coil voltage and estimate a curve for your average contact current. The intersection of the estimated curve and the diagonal line for the number of energized relays must be less than 55 °C.

If the intersection is above the 55 °C limit the ambient must be de-rated to the indicated temperature.

Example: What would the maximum ambient rating be for the following characteristics? (15) relays “ON”, Average contact current of 5 A, Coil voltage of 32 Vdc.

Answer: Approximately 37 °C. The ambient must be limited to a maximum of 37 °C, or the Relay Interface power must be reduced by decreasing the number of relays “ON”, coil voltage, contact current, or combination of these.

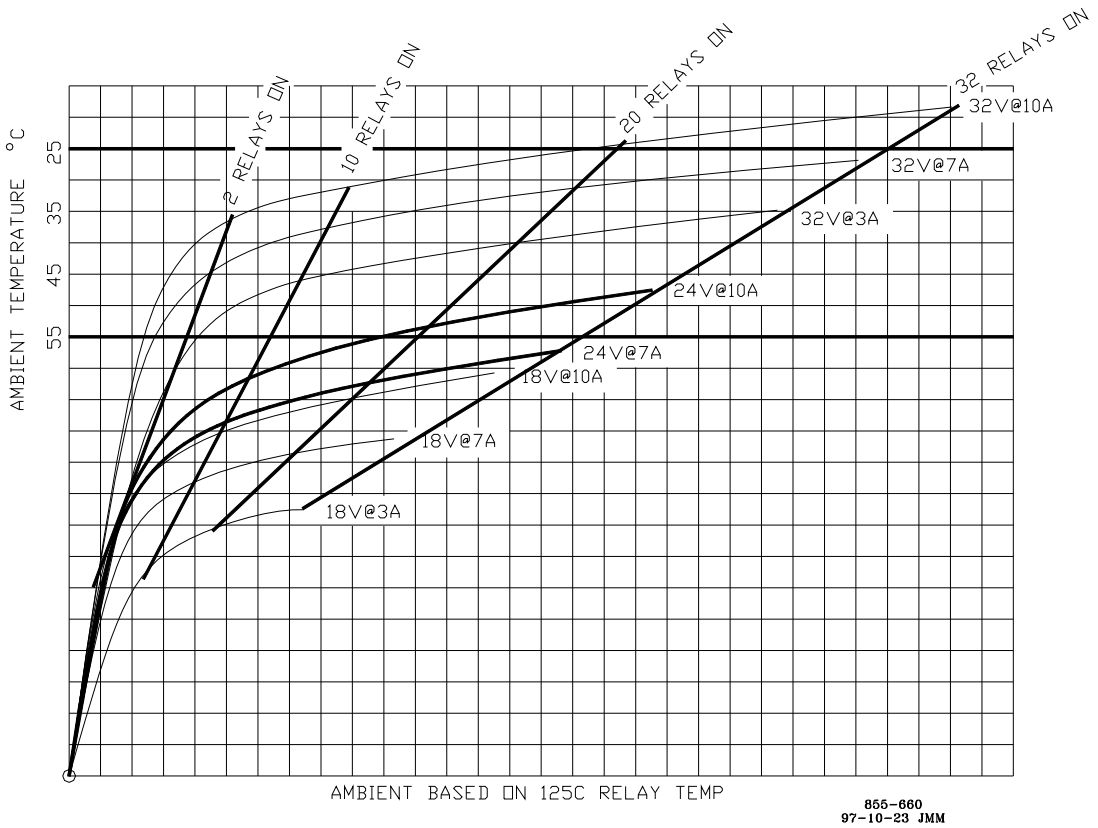


Figure 13-60—32 Channel Relay Module De-rating Curves

Figure 13-61—32 Channel Relay Module

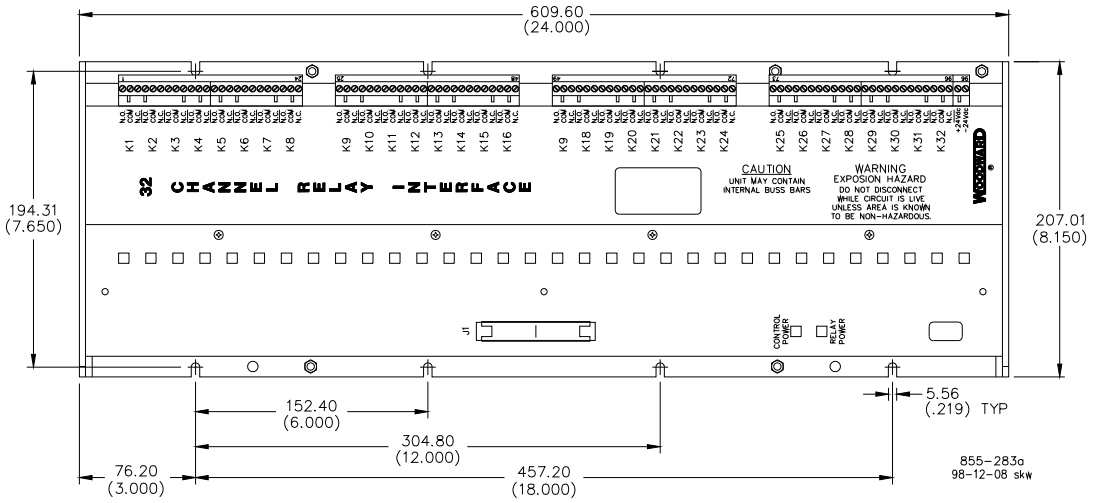


Figure 13-62—32 Channel Relay Module Outline Dimensions

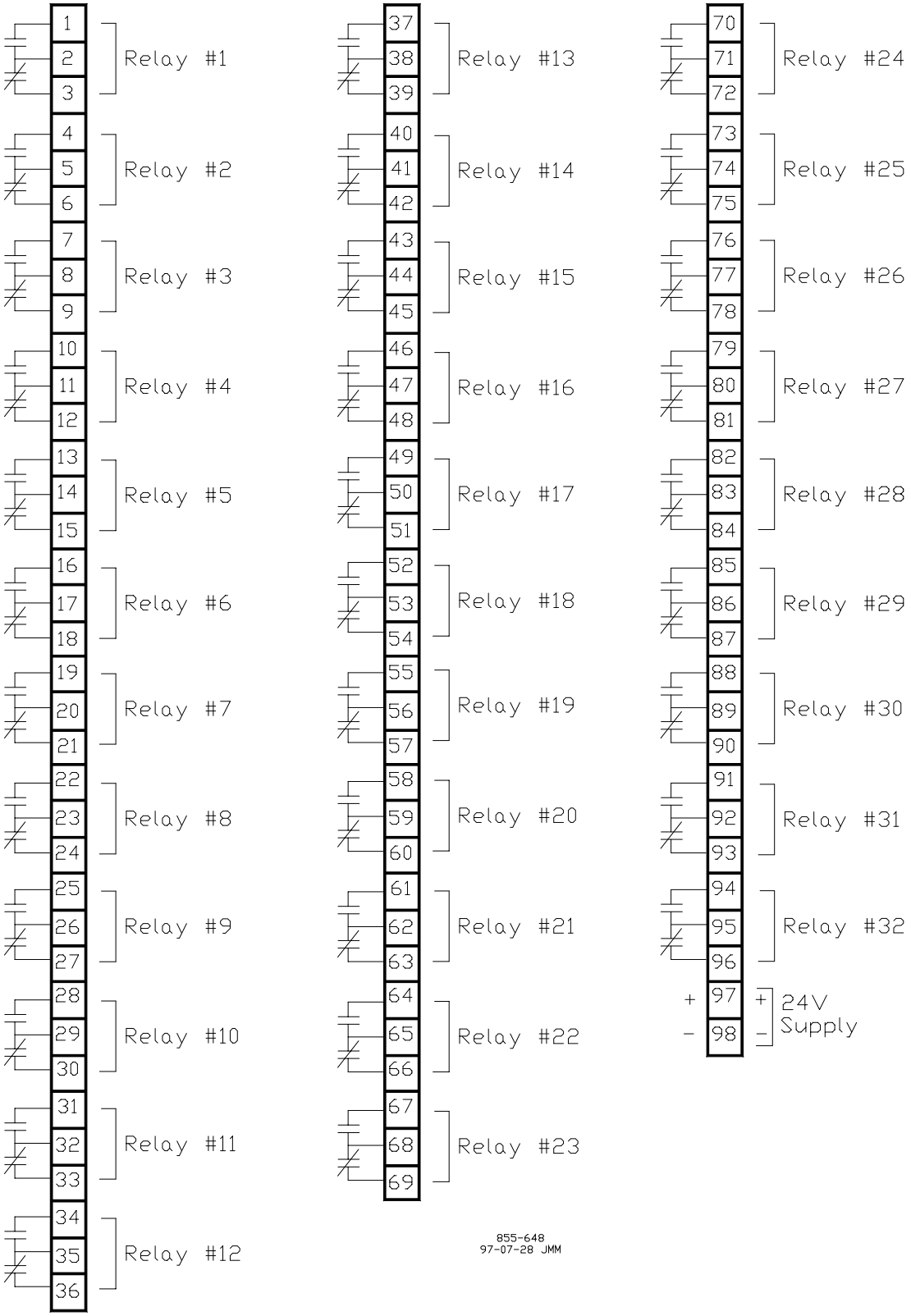


Figure 13-63—Relay Contact Connections for a 32 Channel Relay Module

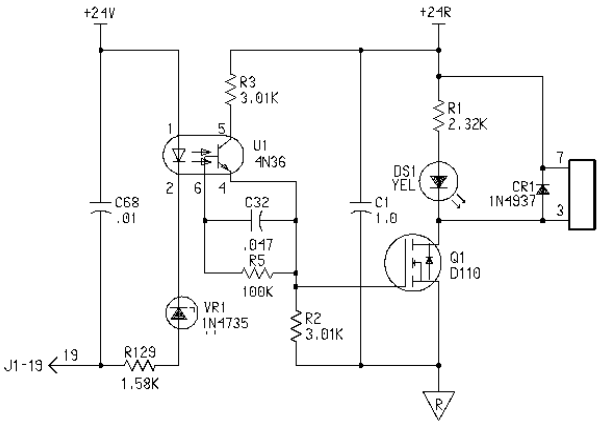


Figure 13-64—Typical 32 Channel Relay Module Driver Circuit (K1).

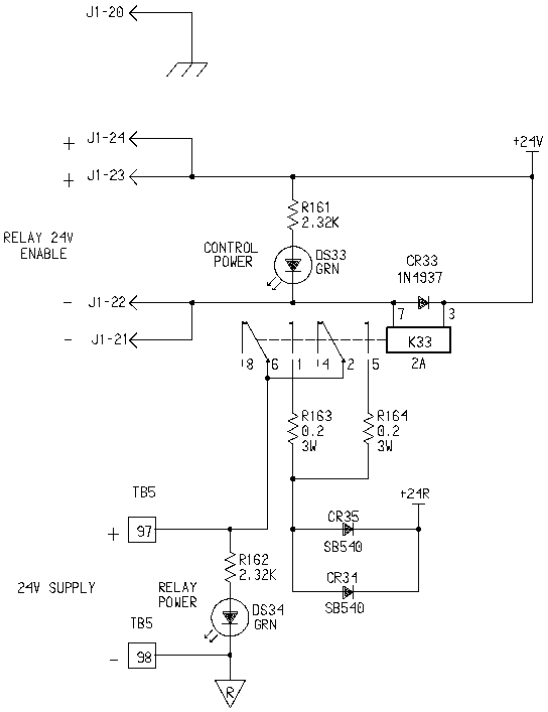


Figure 13-65—32 Channel Relay Module I/O Lock Circuit.

13.5—Service Panel

The Service panel can be used by the system operator to communicate with a 040 CPU Module in a stand-alone MicroNet system (see Chapter 6 for MicroNet CPU module information and Appendix A for applicable module part number). The panel can be used to occasionally check the system, continuously monitor a value, or tune variables, (when applicable), through a 24-key keypad with a split-screen display. An optional mounting panel may be used to install the Service Panel in a 19 inch rack.

IMPORTANT **The Service Panel is used only with the 68040 CPU Module.**

Figure 13-66—68040 CPU Module Service Panel

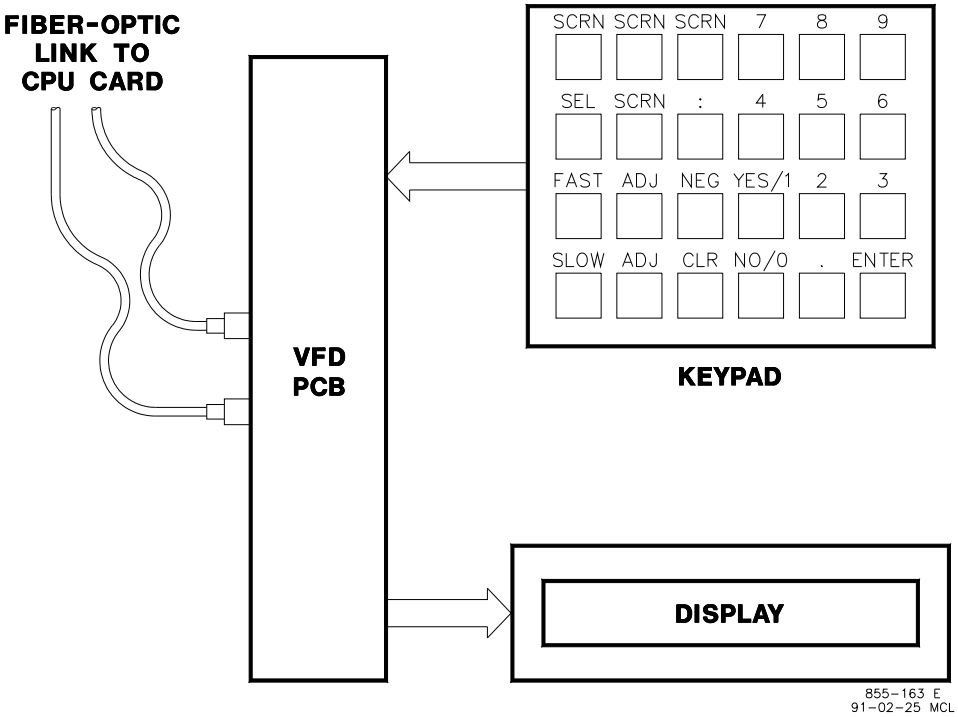


Figure 13-67—Service Panel Block Diagram

The VFD module communicates with the CPU through a twin fiber-optic cable. The fiber optic cables come in several different lengths. See Appendix A for part numbers and lengths.

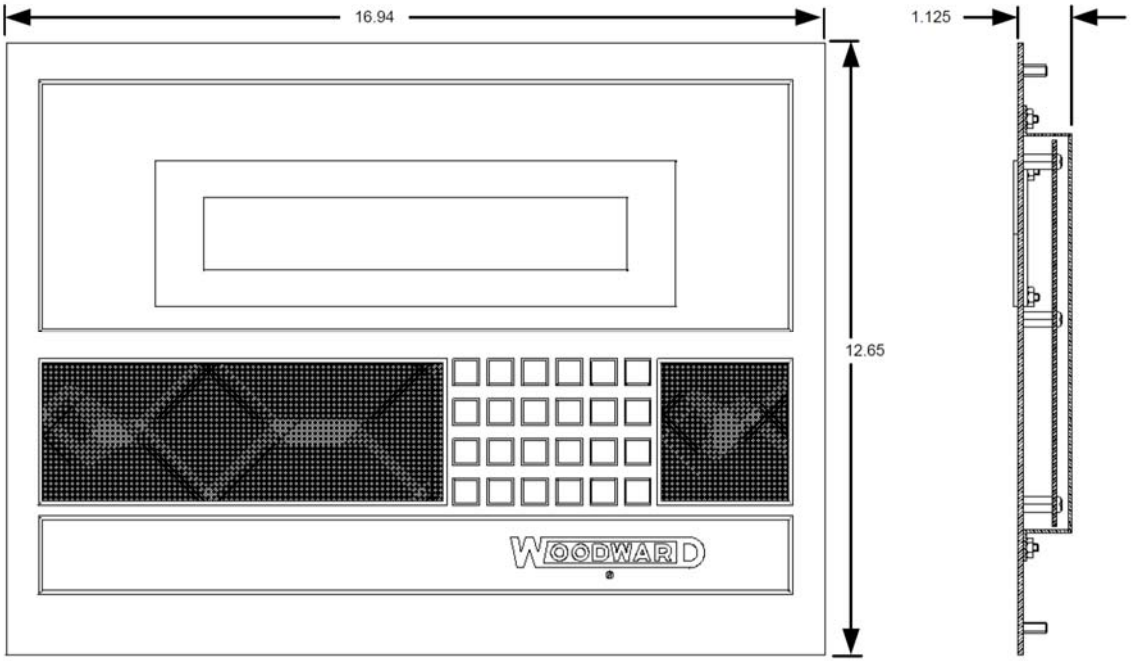


Figure 13-68—Service Panel Outline Dimensions

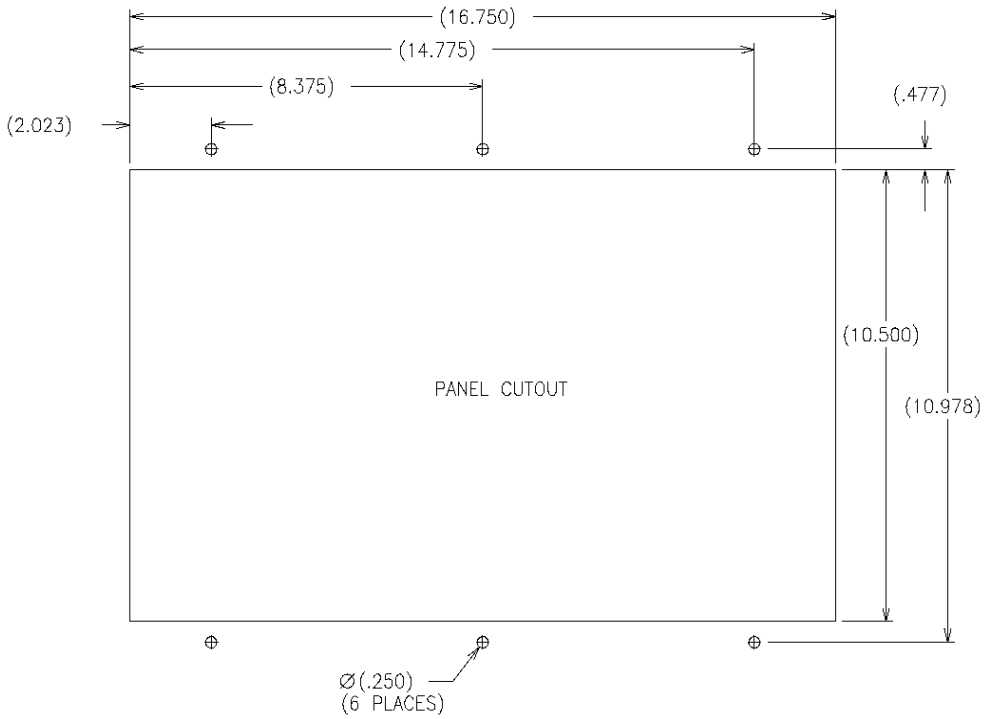


Figure 13-69—Service Panel Cutout Dimensions

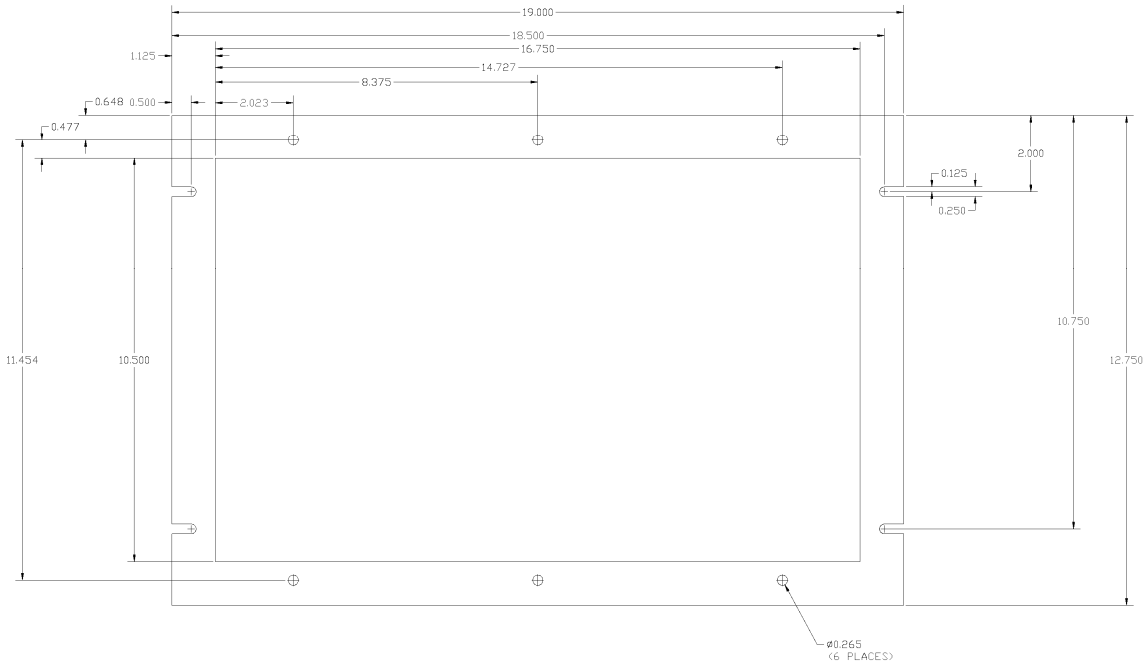


Figure 13-70—Service Panel Optional 19 Inch Mounting Panel

13.6—CPU Interfaces

13.6.1—Ethernet FTM

To ensure signal integrity and robust operation of Ethernet devices when using the Pentium CPU or the Pentium Dual Ethernet CPU modules, an Ethernet FTM (Field Termination Module) is required when interfacing an Ethernet connection (see Appendix A for the Ethernet Isolation FTM part number). Its primary function is to implement EMI shielding and cable shield termination of the Ethernet cable. Along with this FTM, double shielded Ethernet cables (SSTP) are required for customer installations. This FTM should be installed between the CPU Ethernet connection and your field network connection.

Figure 13-71—Ethernet Interface FTM

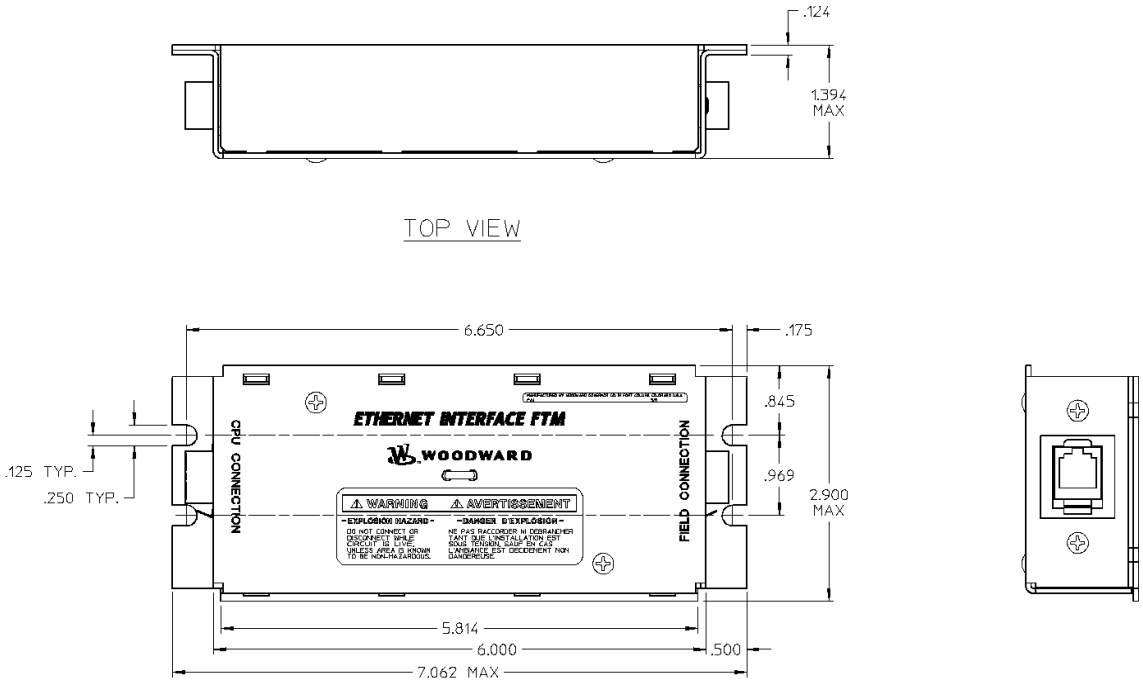


Figure 13-72—Ethernet Interface FTM Outline Drawing

13.6.2—CPU Serial Interface (RS-232–RS-232) FTM

IMPORTANT

A Serial Port Isolator/Converter must be properly installed, grounded, and powered prior to connection with the CPU. Once properly installed, it may be connected to a field device at any time. Alternatively, the isolator may be connected to the field device. However, it must be properly installed, grounded, and powered prior to connection to the CPU.

Additional hardware is required when a RS-232 serial port connection on either the MicroNet CPU (040) or (Pentium) module is needed (see Appendix A for the CPU Serial Interface (RS-232–RS-232) FTM part number). These communication ports are non-isolated. A shielded cable and Serial Port Isolator/Converter are required when using any of these ports to avoid susceptibility to EMI noise and ground loops related to PC connections and typical industrial environments. Depending on the CPU type, the hardware may include the following parts:

1 Ea Filter–RS-232 Db9mf
1 Ea Cable–10 ft. Molded Db9f to Db9f Null Modem w/thumbscrews
1 Ea Converter–Isolated RS-232–RS-232, Phoenix Contact, DIN Rail

Configure the parts for a 040 CPU as shown in Figure 13-55.

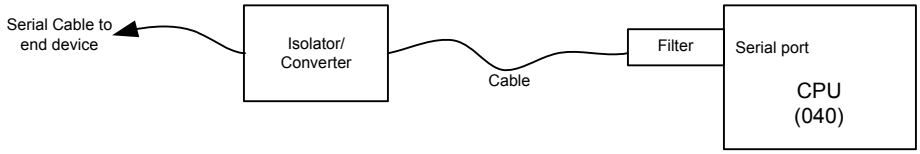


Figure 13-73—Kit Configuration (040 CPU)

The filter is not needed if the Pentium CPU is used. Configure the parts for a Pentium CPU as shown in Figure 13-56.

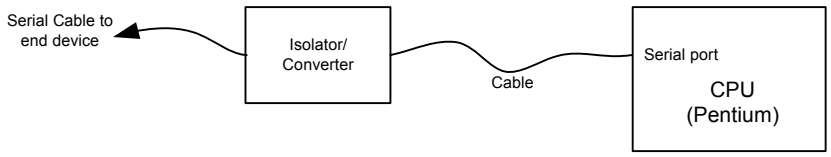


Figure 13-74—Kit Configuration (Pentium CPU)

13.6.3—CPU Serial Interface (RS-232–RS-232) FTM Marine Certified

IMPORTANT

A Serial Port Isolator/Converter must be properly installed, grounded, and powered prior to connection with the CPU. Once properly installed, it may be connected to a field device at any time. Alternatively, the isolator may be connected to the field device. However, it must be properly installed, grounded, and powered prior to connection to the CPU.

Additional hardware is required for Marine Certified applications when a RS-232 serial port connection on either the MicroNet CPU (040) or (Pentium) module is needed (see Appendix A for the CPU Serial Interface (RS-232–RS-232) FTM Marine Certified part number). Depending on the CPU type, the hardware may include the following parts:

1 Ea Filter–RS-232 Db9mf
1 Ea Cable–10 ft. Molded Db9f to Db9f Null Modem w/thumbscrews
1 Ea Converter–Isolated RS-232–RS-232, KD485, DIN Rail

See Figure 13-73 040 CPU and 13-74 for Pentium configurations.

13.6.4—CPU Serial Interface (RS-232–RS-485) FTM

IMPORTANT

A Serial Port Isolator/Converter must be properly installed, grounded, and powered prior to connection with the CPU. Once properly installed, it may be connected to a field device at any time. Alternatively, the isolator may be connected to the field device. However, it must be properly installed, grounded, and powered prior to connection to the CPU.

Additional hardware is required when a RS-485 serial port connection on either the MicroNet CPU (040) or (Pentium) module is needed (see Appendix A for the CPU Serial Interface (RS-232–RS-485) FTM part number). Depending on the CPU type, the hardware may include the following parts:

1 Ea Filter–RS-232 Db9mf
1 Ea Cable–10 ft. Molded Db9f to Db9f Null Modem w/thumbscrews
1 Ea Converter–Interface (RS-232 To RS-485)

See Figure 13-73 for 040 CPU and 13-74 for Pentium configurations.

13.6.5—CPU Serial Interface (RS-232–RS-485) FTM Marine Certified

IMPORTANT

A Serial Port Isolator/Converter must be properly installed, grounded, and powered prior to connection with the CPU. Once properly installed, it may be connected to a field device at any time. Alternatively, the isolator may be connected to the field device. However, it must be properly installed, grounded, and powered prior to connection to the CPU.

Additional hardware is required for Marine Certified applications when a RS-485 serial port connection on either the MicroNet CPU (040) or (Pentium) module is needed (see Appendix A for the CPU Serial Interface (RS-232–RS-485) FTM Marine Certified part number). Depending on the CPU type, the addition hardware may include the following parts:

1 Ea Filter–RS-232 Db9mf
1 Ea Cable–10 ft. Molded Db9f to Db9f Null Modem w/thumbscrews
1 Ea Converter–Isolated RS-232–RS-422/RS-485, KD485, DIN Rail

See Figure 13-73 for 040 CPU and 13-74 for Pentium configurations.

13.7—4-Channel Transformer Isolation Module

The 1751-6058 4-Channel Transformer Isolation Module is used in conjunction with the Analog Input FTM to provide MPU speed input signals to the Digital Speed Sensor Module and provide isolation to the customer overspeed protection devices (see Chapter 9 MicroNet module information and Appendix A for FTM part numbers). Each module contains four 1691-1082 Isolation Transformers.

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

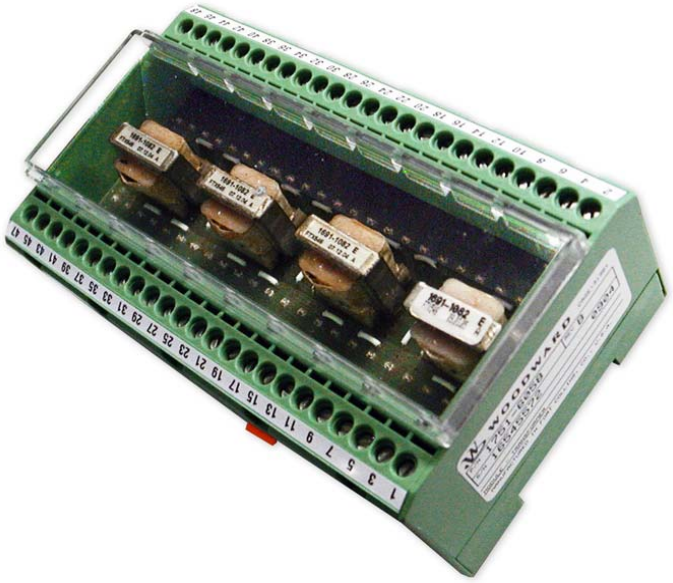


Figure 13-75—4 Channel Isolation Module

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

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

Module Ratings:
Primary Impedance: 10 kΩ at 1 kHz (Ref. only) DC resistance 187 Ω ±20%
Secondary Impedance: 10 kΩ at 1 kHz (Ref. only) DC resistance 250 Ω ±20%
Frequency Response: 50 Hz – 30 kHz ±3 dB
Operating Level: 8 DBM
Maximum Input Rating: 88 Vrms, 10 mA at 30 kHz
Turns ratio: 1:1
Isolation between Primary and Secondary Windings: 600 Vrms

⚠WARNING

The following is required to comply with CSA Hazardous Locations Listings:

1. **All conductors used to wire the Transformer Isolation Module shall not leave one building.**
2. **All inputs to the Transformer Isolation Module shall be supplied by an isolating source with an open circuit potential of less than 88 Vrms. All inputs must be protected by an overcurrent device rated at not more than 1.0 A.**

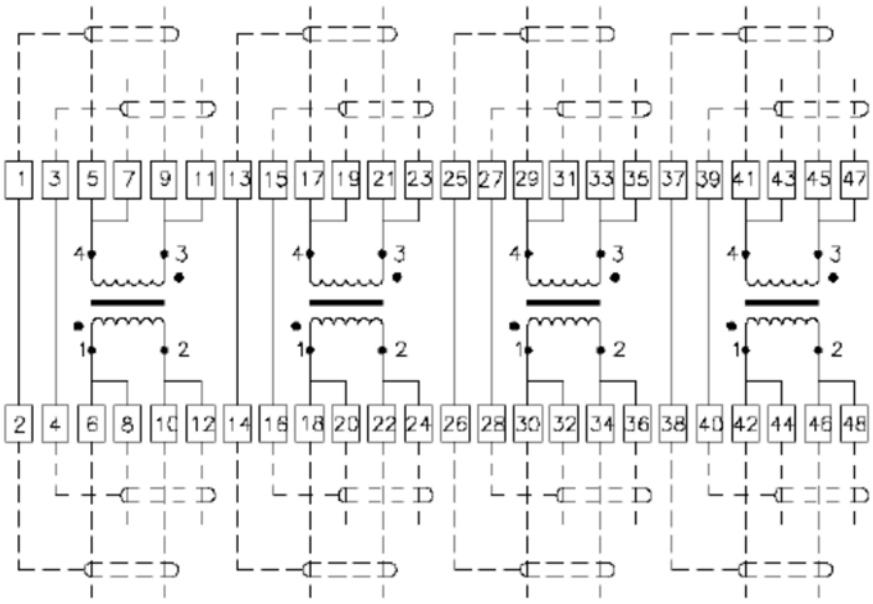


Figure 13-76—Schematic Diagram of the 4-Channel Isolation Module

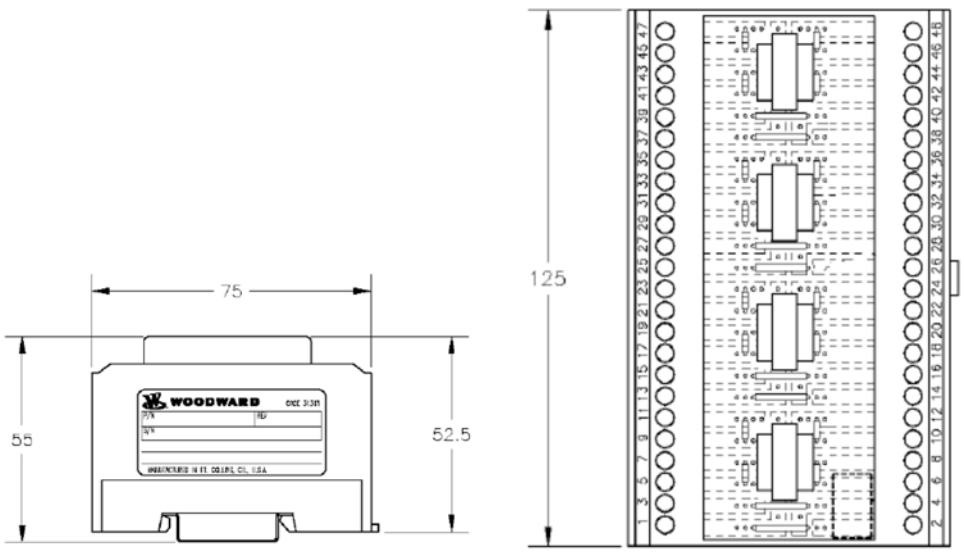


Figure 13-77—4-Channel Isolation Module Outline Dimensions
(Metric; All Dimensions for Ref Only)

Chapter 14.
Distributed I/O Network

See Woodward manual 26640 for detailed information on the RTCnet and LINKnet HT distributed I/O modules.

Chapter 15.
Installation and Replacement Procedures

15.1—Pre-Installation Information

15.1.1—Storage

Store MicroNet controls and associated parts between –20 and +70 °C (–4 and +158 °F) at a maximum relative humidity of 90% non-condensing. If modules (especially power supplies) are to be stored for a long time, apply operating power to them at least once every 18 months. This is done to re-form the aluminum electrolytic capacitors, and will prevent them from overheating upon initial power up after extended storage.

15.1.2—Unpacking

Unpack each part of the system carefully. Check the units for signs of damage, such as bent or dented panels, scratches, or loose or broken parts. If any damage is found, notify the shipper immediately.

15.1.3—Unit Location

Consider the following when selecting a cabinet location for mounting the MicroNet:

- Make sure the MicroNet unit(s) are mounted in a dry location, protected from water and condensation.
- Make sure the ambient temperature of the system location is not lower than 0 °C (32 °F) or higher than 55 °C (131 °F) and that the relative humidity is not over 90%, non-condensing. (**NOTE**—For NTCPU 0–50 °C)
- Provide adequate ventilation for cooling the units. If the units must be mounted near heat-producing devices, shield them from the heat.
- For proper airflow, the installation should allow a 3” (8 cm) air gap above and below the chassis.
- To ensure compliance with the EMC certification, all chassis mounting screws (#8-32 M4) should be installed to properly ground the chassis to the mounting plate.
- Do not install the units or their connecting wires near high-voltage/high-current devices or inductive devices. If this is not possible, shield both the system connecting wires and the interfering devices or wires.
- If the selected location does not already have a conductor to a good earth ground, provide one.
- This equipment is suitable for Class I, Division 2, Groups A, B, C, and D or non-hazardous locations only. The 24/12 and 16 channel relay modules are for use in ordinary or non-hazardous locations only.

15.2—Installation Procedures

WARNING

EXPLOSION HAZARD—Do not remove or install modules while circuit is energized unless area is known to be non-hazardous.

AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas enlever ni installer les cartes pendant que le circuit est sous tension sans s'assurer que la zone est non dangereuse.

15.2.1—Installing a VME I/O Module into an Unpowered Chassis

IMPORTANT

Before installing a module, check for broken connectors and bent pins.

1. Make sure that each module is installed in the correct slot. There are no keys to keep a module from being installed in the wrong slot. To aid in proper module placement, the module slots are labeled with the slot number. Prior to installing, verify that all connector pins are parallel and straight.

2. Align the circuit board edges in the card guides and re-position the two captive-screw fasteners as necessary to prevent interference when the module is inserted. Install the module by aligning the circuit board edges inside the card guides and pushing the module straight in until it is approximately 25 mm (1 inch) from the motherboard. (**Do not make contact with the chassis motherboard mating connectors**.)

3. With even pressure exerted at the top and bottom of the module, in one continuous motion, fully seat the module into the motherboard mating connectors.

IMPORTANT

If resistance is encountered when installing a module, do not force the module. Remove the module and check the connectors for bent contacts or foreign objects. Also check to ensure that the module screws are fully retracted. Forcing a module into place may break the connector or bend the securing screws.

4. Tighten the two screws that secure the module in place (one at the top and one at the bottom).

5. See Section "15.3.2—Replacing a VME I/O Module" below for replacing a module previously installed into functional system.

15.2.2—MicroNet Simplex Installation Notes and Warnings

WARNING

The MicroNet Simplex main power supplies must have the input power removed before installing or removing.

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, and D or non-hazardous locations only.

The 24/12 and 16 channel relay modules are for use in ordinary or non-hazardous locations only.

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

15.2.3—Installing a MicroNet Simplex Power Supply Module

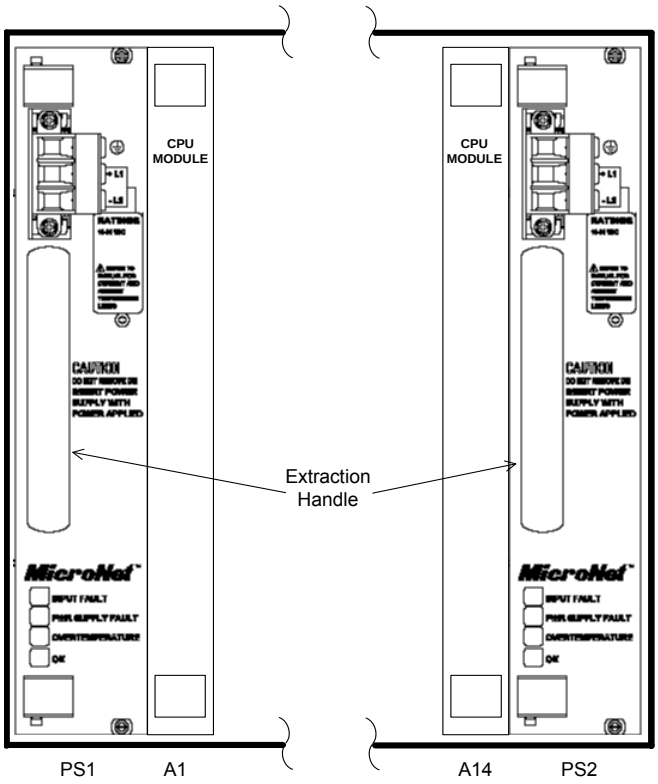


Figure 15-1—MicroNet Power Supply

Installing a Power Supply (PS1, PS2)

1. Be certain power to the supply being installed is disconnected. Verify that all pins in the module connectors are parallel and straight.
2. Install a new power supply by aligning the circuit board edges in the card guides, then pushing the unit into the slots until the connectors on the modules and the connectors on the motherboard make contact.
3. With even pressure exerted at the top and bottom of the supply's front panel, firmly push the unit into place. Alternatively, apply force to the extraction handle.
4. Tighten the screws that secure the module in place.

IMPORTANT

If resistance is encountered when installing a module, do not force the module. Remove the module and check the connectors for bent contacts or foreign objects. Also check to ensure that the module screws are fully retracted. Forcing a module into place may break the connector or bend the securing screws.

15.2.4—Installing the 16/32 Channel Relay Boxes

The system's relay boxes mount on a panel (not provided). Mount the relay boxes within the length of the provided cable from the control's main chassis, leaving adequate service loop.

1. Mark the location of the relay box and the locations of the holes to be drilled to mount it. Figures 15-2 and 15-3 are outline drawings of the relay boxes.
2. Drill and tap holes for appropriately sized hardware.
3. Place the relay box in position. Place the mounting screws into the holes that were drilled and tapped, and tighten them securely.
4. The mounting panel should be well grounded to protective earth via the cabinet structure or ground straps that are low RF impedance. Low RF impedance: length not greater than 4 times the cross-sectional circumference of the ground strap.
5. Additionally, the insulation on the cable between the FTM or relay box and the VME Module may have the insulation removed and a metal "P-clip" used around the cable to ground it within approximately 300 mm (12 inches) of the relay box connector. The requirement for implementing an additional ground is specified in 15.2.6.2 and 15.2.7.2. In all cases the labeled chassis ground connections must also be implemented.
6. If your system includes a second relay box, repeat the above steps for the second relay box.
7. After the FTM, the VME module, and the relay box(es) are installed, the cables that connect them may be installed.

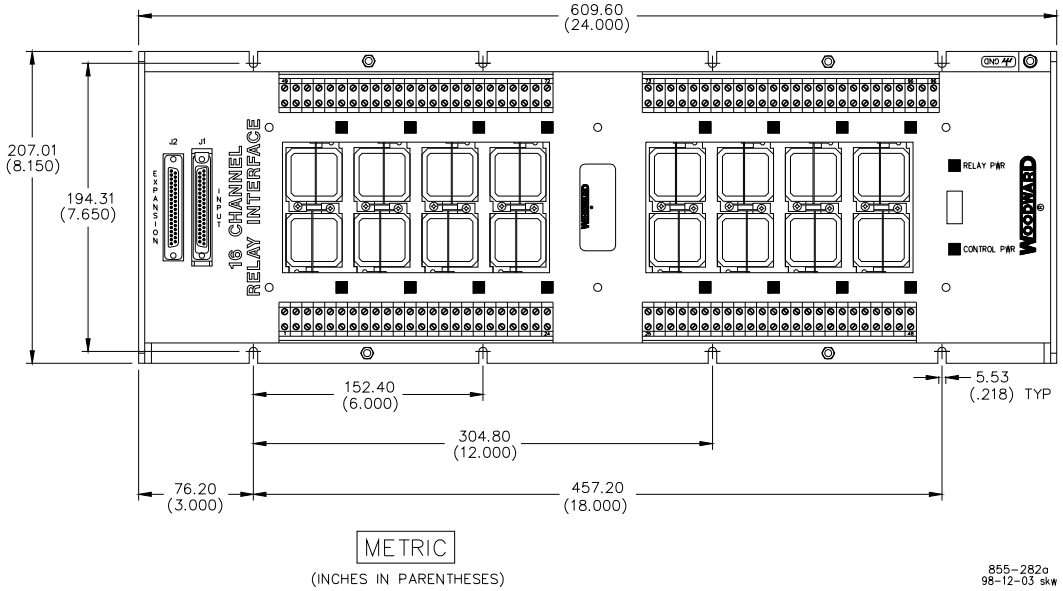


Figure 15-2—16 Channel Relay Box Outline Drawing

Note: For use in ordinary or non-hazardous locations only.

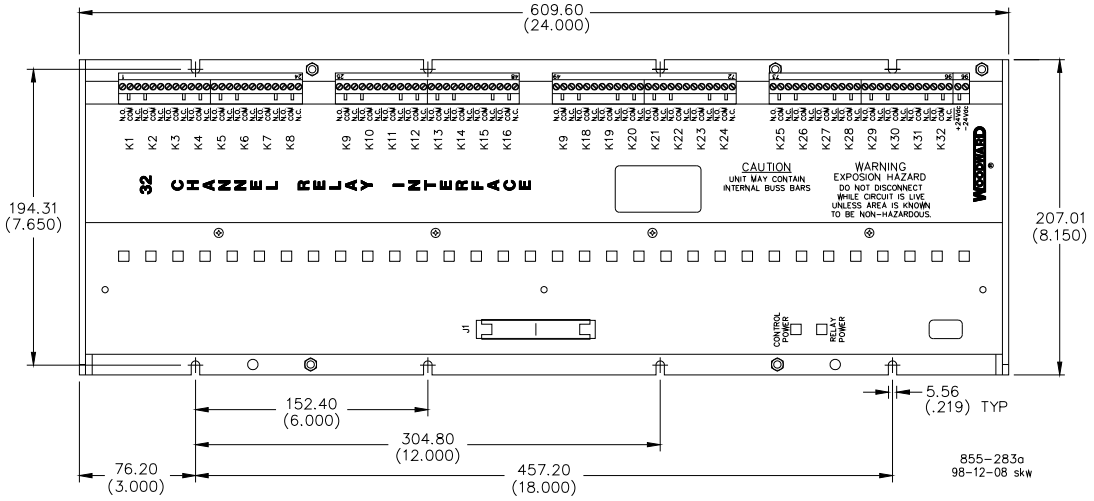


Figure 15-3—32 Channel Relay Box Outline Drawing

Note: Listed for use in hazardous locations (Class I, Division 2, Groups A, B, C, D)

Conditions of UL Acceptability for 32 Channel Relay Box:

1. The devices must be installed in compliance with the enclosure, mounting, spacing, and segregation requirements of the ultimate application.
2. The device(s) must be wired in accordance with Class I, Division 2 wiring methods and in accordance with the authority having jurisdiction.

15.2.5—Installing FTMs

The system's Field Terminal modules (FTMs) mount on a standard DIN (35 x 7.5) rail (not provided). Mount FTMs within the length of the provided cable from the control's main chassis, leaving an adequate service loop.

1. Cut a DIN rail strip to the desired length and mount it to a panel. Leave sufficient space between the DIN rail and other objects for accessibility.
2. Drill and tap at least two holes per 300 mm (12 in) for appropriately sized hardware, and secure the DIN rail using screws and washers.
3. The mounting panel should be well grounded to protective earth via the cabinet structure or ground straps that are low RF impedance. Similarly the DIN rail should be well grounded to the panel. Low RF impedance: length not greater than 4 times the cross-sectional circumference of the ground strap.
4. Verify that the DIN rail is at earth ground potential (connected to a panel that is at earth ground potential). If the DIN rail is not at earth ground potential, connect it to earth ground via a 4 mm² (12 AWG) green/yellow wire or braid, keeping the wire or braid as short as possible.
5. Snap the FTMs onto the DIN rail.
6. Snap ground terminals onto the DIN rail next to the FTMs. See Figure 19-7.
7. Connect a 4 mm² (12 AWG) wire between each ground terminal and the FTM earth ground terminal. Torque to 0.5 to 0.8 N·m (0.37 to 0.59 lb-ft). This wire should be kept short for optimum high frequency grounding. It must be no longer than 150 mm (6 inches) in length.

8. Additionally in some cases, the insulation on the cable between the FTM or relay box and the VME Module may have the insulation removed and a metal “P-clip” used around the cable to ground it within approximately 300 mm (12 inches) of the relay box connector. (This is an additional connection and may not be substituted for the one in note 7.) The requirement for implementing an additional ground is specified in 15.2.6.2 and 15.2.7.2.
9. After both the FTM and the VME module are installed, the cables that connect them may be installed.

Wiring Notes

It is recommended that 0.5 mm² (20 AWG) or larger twisted, shielded wire be used between each external device and FTM.

- Shields inside the cabinet housing the MicroNet should be connected to earth ground at all intermediate terminal blocks, as well as terminated at the control terminal block. The length of exposed wire extending beyond the shield should be limited to 25 mm (1 inch).
- Cable shields must be electrically continuous from the signal source to the point the signal wire enters the FTM.
- FTM terminals accept wires from 0.25–2.5 mm² (24–12 AWG) wire. Two 0.75 mm² (18 AWG) or three 0.5 mm² (20 AWG) wires can be installed in each terminal. Torque 0.5 to 0.8 N·m (0.37 to 0.59 lb-ft).
- Take care to prevent ground loop wiring when interfacing to other devices.
- Shields should be terminated to the cabinet at the entrance/exit point with a grounding bar or similar low impedance ground. The ground bar may be either a direct connection to the cabinet frame protective earth or an AC (capacitor ~0.01 µF) connection where 0.01 µF capacitors are between the bar and cabinet frame/panel every 150–200 mm (6–8 inches) of bar length. Shield termination should be only directly grounded to chassis at one end, preferably the MicroNet Cabinet end.
- Do not place shielded wires in the same conduit as high voltage or large current-carrying cables.

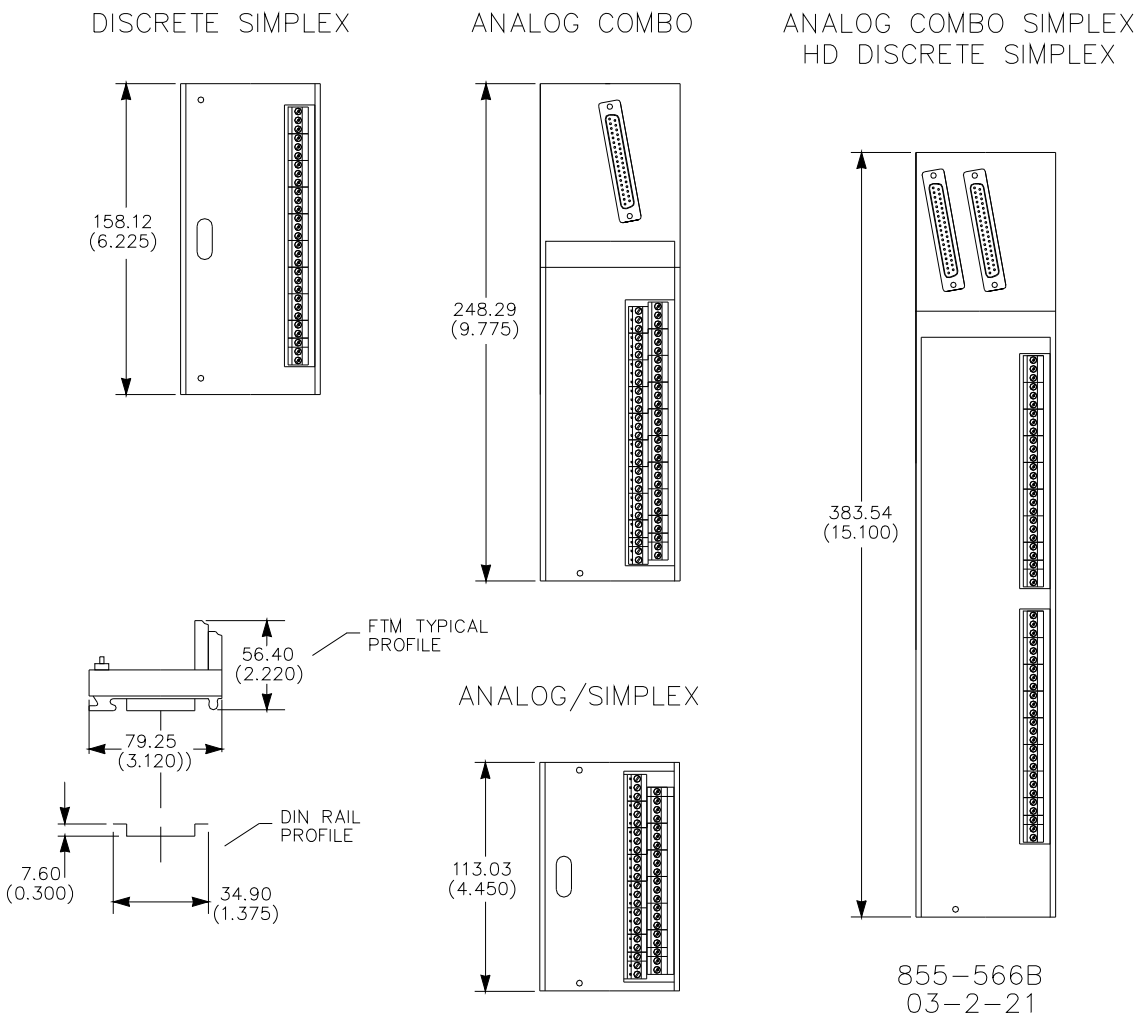


Figure 15-4—FTM Grounding and Outlines

15.2.6—Non-Marine Application Information

15.2.6.1—Shields and Grounding

WARNING

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

An individual shield termination is provided at the FTM terminal block for each of the analog inputs and analog outputs. All of the analog inputs and outputs should be wired using shielded, twisted-pair wiring. The shields should be connected to earth ground at one point only, as well as terminated at the FTM terminal block; which will typically AC couple the shield to earth ground.

Discrete Inputs leaving the cabinet housing the MicroNet should be grouped together based on field signal source location and be shielded as a group. The shield termination should be to the chassis ground on the cabinet housing the MicroNet system; the shield termination should only be to the MicroNet's cabinet. The Discrete Inputs should also have a common wire (Wetting voltage common), grouped with them inside the shield. The field end of the common wire should be un-terminated, unless wetting voltage is provided remotely in the field.

Relay Driver/Discrete Outputs leaving the cabinet housing the MicroNet should also be grouped together based on field relay coil or input location and be shielded as a group. The shield termination should be to the chassis ground on the cabinet housing the MicroNet system; the shield termination should only be to the MicroNet's Cabinet. The Discrete Output wires should also have a common wire (coil voltage common), grouped with them inside the shield. The field end of the common wire should be un-terminated, unless coil voltage is provided remotely in the field.

DI & DO shielding may be electrically continuous metal conduit, cable armor, or completely enclosed metal cable ways, as well as shielded cable, as long as the items listed are grounded only to the cabinet housing the MicroNet system and are electrically continuous between the field termination and cabinet.

Unshielded I/O cables may only be used inside the cabinet that is restricted to very short distances near the cabinet. Also short, on engine, sections of Discrete Input (DI) & Output (DO) cables may be used from the engine junction box were they are restricted to be on the engine/turbine.

See application note 51204 for a more detailed discussion on shield terminations. The length of exposed wire extending beyond the shield should be limited to 25 mm (1 inch).

If the panel that the control chassis and FTMs are mounted on is not at earth ground potential, connect it to earth ground via a 4 mm² (12 AWG) green/yellow wire or braid, keeping the wire or braid as short as possible. The mounting panel should be well grounded to protective earth via the cabinet structure or ground straps that are low RF impedance. Low RF impedance: length not greater than 4 times the cross-sectional circumference of the ground strap.

For compliance with EMC standards, it is required that all analog and discrete input / output wiring be separated from all power wiring. Power wiring leaving the cabinet housing the MicroNet may couple noise if not segregated and routed directly against the grounded metal of the cabinet & mounting plates. If segregation is not possible, a line filter of at least 20 dB attenuation is needed.

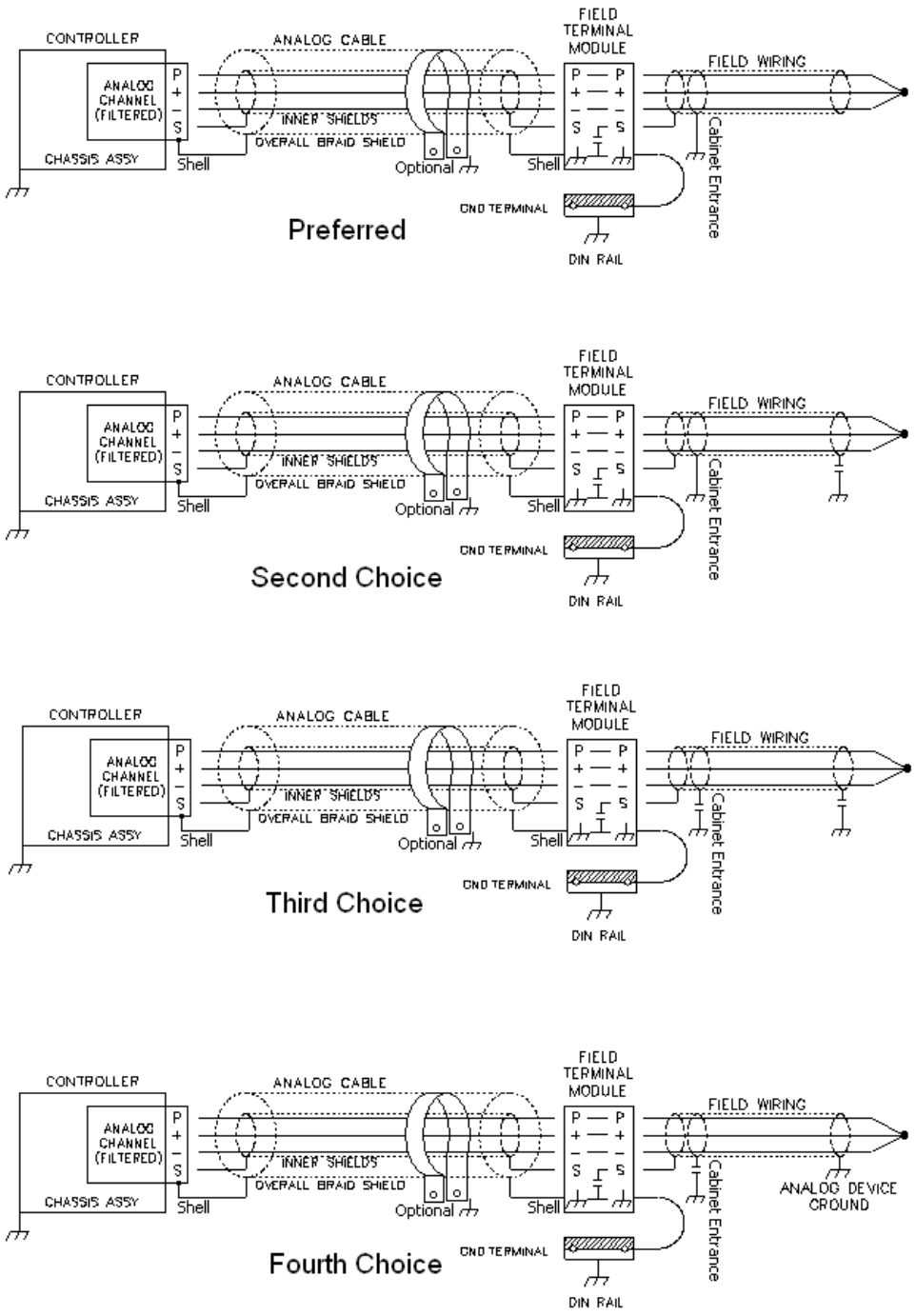


Figure 15-5—Analog Cable Shield Termination Diagram Examples

Signal lines, mainly Analog Outputs and Actuator Outputs, send the system ground (DGND) out of the control as part of the field wiring. Take great care in wiring the field devices with cable runs longer than 30 m (100 feet), so that DGND does not become referenced to Protective Earth.

When there is significant transient ground bounce and the ground potential at the control and field device is significantly different (significant resistance between the two points), referencing DGND to Protective Earth at the field device can cause system disruptions in some VME modules.

A significant potential difference in Protective Earth grounds generally arises when the physical distance between protective earth points is longer than 30 m (100 feet), but may happen any time there is a significant enough inductance and/or resistance.

Transient ground bounce is caused when there is a nearby lightning strike, or nearby switched, high current, heavy inductive loads are switched off.

The control DGND is referenced to Protective Earth internally to the control via capacitance and local shielded cabling capacitance. If the field device's Protective Earth is referenced to DGND, transient ground bounce is placed across the control DGND and field device via the low impedance cabling. The transients can significantly disrupt some modules.

Some ways DGND to Protective Earth referencing happens are as follows:

- Connecting DGND to Protective Earth directly in the field device.
- Connecting multiple cable shields directly to protective earth at the field devices, with cable runs and device to control separation longer than 30 m (100 feet).
- Connecting DGND to Protective Earth indirectly, AC coupling, via intentional filter capacitance.
- Connecting the field device's power or its power reference to Protective Earth with transient limiting devices like a Metal Oxide Varistor or Transient Voltage Suppression Diode.
- Stray Coil capacitance from the actuator coil to the shaft or housing on multiple actuators and grounding the shaft or housing due to the attachment mechanisms.

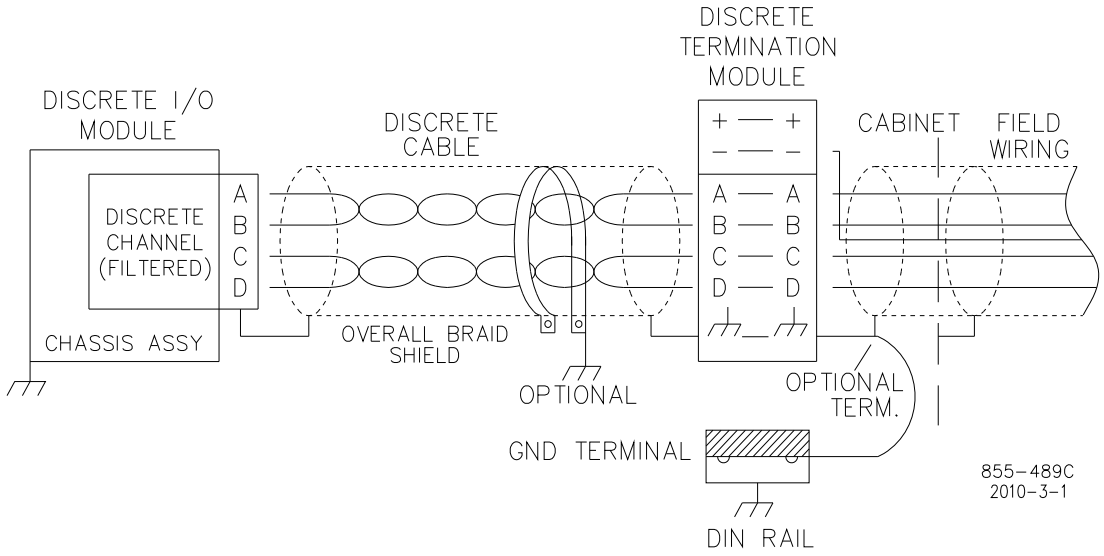


Figure 15-6—Discrete Cable Grounding Diagram Example

15.2.6.2—VME Module Cable Shield Grounding

In all cases, the cable from the VME module (MicroNet I/O Card) to the FTM module or relay box for field wiring may have an additional ground point added. Only commercial Marine applications have strict requirements to add it.

In EMC environments where sensitive equipment coexists or harsh conditions like high current or high voltage noise exist, the additional ground will help with noise suppression and immunity.

The insulation on the cable between the MicroNet and FTM or relay box must be removed to expose the shield, being careful not to cut the shield or nick the inner insulation layers. A metal "P-clip" or similar clamping mechanism is used around the cable shield to ground the shield within 300 mm (12 inches) of the FTM or relay box.

The grounding mechanism should be galvanically compatible with the tin-plated copper shield inside, as well as the grounding point in the cabinet (mounting panel). Typically metal "P-clips", annealed for some spring tension, made of either stainless steel or tin-plated copper are readily available commercially and are acceptably compatible.

15.2.6.3—Cabinet Structural Grounding

- The cabinet needs to be a six-sided metal enclosure.
    - Do not use cabinet doors with unshielded windows—doors should be solid metal as possible.
- If a window in the cabinet door is needed, the window must provide >20 dB of RF attenuation from 10 kHz to 1 GHz.
- The enclosure floor and/or top must provide holes for cable entry, only the floor or top panels may be used.
- Top and bottom cable entry areas must be restricted in size, largest dimension of any aperture (hole) no greater than 152 mm (6 inches). This is particularly important when RF transmitters, like push to talk radios or cell phones, can be located near the cable access areas.
- When RF transmitters (hand-held radios) can be located below the plane of the floor, in the metal cableway area, floor entry areas shall be restricted in size, with largest dimension of any aperture (hole) no greater than 152 mm (6 inches).
- When RF transmitters (hand-held radios) cannot be located below the plane of the floor, in the metal cableway area, no floor entry areas restrictions are required.
- The cabinet frame and mounting areas must be bonded (grounded together).
- All MicroNet chassis mounting screws (#8-32 M4) should be installed to properly ground the chassis to the mounting plate.
- Frame shall be electrically connected at each structural interface (<2.5 mΩ).
- Mounting plates shall be electrically connected to structural frame (<2.5 mΩ).
    - 4 places minimum (4 corners), 6 places preferred — 4 corners + 2 mid-points preferred.
- Cabinet doors must be electrically connected to the main structural frame (<2.5 mΩ).
    - 2 places minimum, 3 places preferred.
    - Use of 25 mm (1 inch) wide bond straps is preferred.
    - Install bond straps at the locations that I/O cables cross the door hinge. If no cables cross the hinge point, locate bond straps to break up the size of gaps/openings in the metal structure to door interface.
- Cover panels shall be electrically connected to structural frame (<10 mΩ).
    - 1 place minimum, 2 places preferred (placed at opposite sides).

- Floor and top must be electrically connected to structural frame (<2.5 mΩ).
  - 2 places minimum, 4 places at the corners preferred.
- DIN rail must be electrically connected to structural frame (<2.5 mΩ).
  - Once every 300 mm (12 inches), use a minimum of 2 screws to bond a DIN rail to cabinet frame.

15.2.6.4—Cable Entry Locations

- The cabinet must provide a shield termination point for cables as they enter the enclosure. Shielded I/O shields must be either AC or DC terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as connected to the FTM shield pins.
- Cable shield termination hardware must be installed at cable entry points.
- Cable shield terminations must be electrically connected to structural frame (<2.5 mΩ), and shall allow direct grounding or AC (capacitive) grounding of cable shields.

15.2.6.5—Equipment Zoning (Segregation)

Separate the equipment inside the cabinet into areas:

- Analog equipment area
- Discrete I/O equipment areas
- Shielded I/O area
- Un-shielded I/O area
- Power area
- Light Industrial compliant equipment area
- Monitor/kybd/pointing device (HMI if applicable)
- Other equipment area

Maintain a minimum of 152 mm (6 inches) of separation between areas.

15.2.6.6—Input Power Routing and Filtering

- Input power must enter the cabinet and be routed separately from all other circuits.
- Route power in middle at back of cabinet. All other I/O and internal cabling must be kept more than 152 mm (6 inches) away.
- Input power must route directly to controls that are Industrial compliant.
- Input power that must route to controls that are Light Industrial compliant must be filtered with a minimum of 20 dB filtering.
- Input power that must be routed near other cabling will be filtered prior to the point they are on a common path and before leaving the cabinet. Filter with a 20 dB filter.

IMPORTANT

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

15.2.6.7—Analog I/O Routing and Shield Termination

I/O Module (FTM & Similar, Analog Driver, etc.) in Cabinet

- Use shielded cable from MicroNet module to I/O module
- Locate I/O module as close to I/O cable entry point as possible
- Locate I/O module away from unshielded discrete areas (> 152 mm / 6 inches)

Field I/O Cable with I/O Module (FTM & Similar, Analog Driver, etc.) in Cabinet

- Route I/O cable against cabinet metal wall from entry point to I/O module.
- Ground I/O cable shield, direct, to cabinet at entry point.
  - If over braid shielded, ground over braid shield to cabinet - connect inner braid shields at I/O module termination point. The inner braid must still be directly grounded to earth at one point.
  - If single shield, ground shield to cabinet.
- If field I/O cable is grounded direct (DC coupled) at remote end of cable, ground the I/O cable shield capacitively at I/O module in cabinet and at the cable entry point into the cabinet.

I/O Module (FTM & Similar, Analog Driver, etc.) not in Cabinet

- Route cable from MicroNet module to I/O module with cable against cabinet metal wall
- DC Ground the cable shield at entry point to the cabinet and at the I/O module.

Field I/O Cable without I/O Module in Cabinet

- Connect all shield braids at I/O module termination point

15.2.6.8—Shielded Discrete I/O Routing and Shield Termination

I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Use shielded cable from MicroNet module to I/O module
- Ground cable shield, direct, at MicroNet module and I/O module
- Locate I/O Module as close to field I/O cable entry point as possible
- Locate I/O module away from analog I/O areas (> 152 mm / 6 inches)
- Locate I/O module away from areas with unshielded discrete I/O (>152 mm / 6 inches)

Field I/O Cable with I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Route I/O cable against cabinet metal wall/structure from cabinet entry point to I/O module;
- If I/O cable is shielded, ground the I/O cable shield, direct, to cabinet at entry point.
  - If over braid shielded, ground over braid shield to cabinet - connect inner braid shields directly to earth ground at one point only
  - If single shield, ground shield to cabinet
  - If field I/O cable shield is grounded direct at remote end of cable, ground the I/O cable shield, capacitively at the entry point to the cabinet
- I/O cable shield ground at the I/O module must be the same type as at cable entry point into cabinet, and it should be direct.

I/O Module (FTM & Similar, Relay Driver, etc.) not in Cabinet

- Route cable from MicroNet module to I/O module with cable against cabinet metal wall
- Ground “MicroNet module to I/O module” cable at entry point to cabinet and at the I/O module

Field I/O Cable without I/O Module in Cabinet

- Ground I/O cable shield, direct, at the I/O module
  - If over braid shielded, ground over braid shields to cabinet - connect inner braid shields at I/O module termination point. The Inner braid must still be directly grounded to earth at one point.
  - If single shield, ground shield to earth at the I/O module

- If field I/O cable is grounded direct (DC coupled) at remote end of cable, ground the I/O cable shield capacitively at the I/O module.
- I/O cable shield ground at the I/O module must be the same type as at cable entry point into cabinet, and it should be direct connected.

15.2.6.9—Unshielded I/O

Unshielded I/O cables may only be used inside the cabinet or for very short distances near the control. Also short on engine sections of discrete inputs & Outputs may be use on the engine/turbine.

Discrete I/O is the only I/O type that may be unshielded, for more details on this requirement please see the Discrete I/O MicroNet Module section.

I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Use Shielded cable from MicroNet module to I/O module.
- Ground cable direct at MicroNet module and I/O module.
- Locate I/O module as close to field I/O cable entry point as possible.
- Locate I/O module away from sensitive analog areas (>152 mm / 6 inches) or other types of unshielded I/O.

I/O Cable with I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

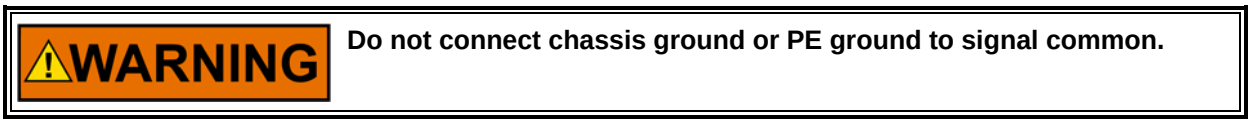
- Route I/O cable against cabinet metal wall from entry point to I/O module;
- Do not let other cable types within 300 mm (12 inches) of unshielded discrete I/O cables if they are parallel for > 61 cm (2 feet)
- Do not let other cable types within 152 mm (6 inches) of unshielded discrete I/O cables if they are parallel for less than 61 cm (2 feet)
- Limit length of unshielded I/O cable inside the cabinet. Any length over 61 cm (2 feet) is too long.
- If lengths greater than 61 cm (2 feet) are required, special considerations should be used to separate this unshielded wiring from other circuits and minimize electromagnetic RF emissions.

I/O Module (FTM & Similar, Relay Driver, etc.) not in Cabinet

- Route cable from MicroNet module to I/O module with cable against cabinet metal wall.
- Ground “MicroNet module to I/O module” cable at entry point of the cabinet and to the I/O module.

15.2.7—Marine Application Information

15.2.7.1—Shields and Grounding



An individual shield termination is provided at the FTM terminal block for each of the analog inputs and analog outputs. All of the analog inputs and outputs should be wired using shielded, twisted-pair wiring. The shields should be connected to earth ground at one point only as well as terminated at the FTM terminal block; which will typically AC couple the shield to earth ground.

Discrete Inputs leaving the cabinet housing the MicroNet should be grouped together based on field signal source location and be shielded as a group. The shield termination should be to the chassis ground on the cabinet housing the MicroNet system; the shield termination should only be to the MicroNet's cabinet. The Discrete Inputs should also have a common wire (Wetting voltage common), grouped with them inside the shield. The field end of the common wire should be un-terminated, unless wetting voltage is provided remotely in the field.

Relay Driver/Discrete Outputs leaving the cabinet housing the MicroNet should also be grouped together based on field relay coil or input location and be shielded as a group. The shield termination should be to the chassis ground on the cabinet housing the MicroNet system; the shield termination should only be to the MicroNet's Cabinet. The Discrete Output wires should also have a common wire (coil voltage common), grouped with them inside the shield. The field end of the common wire should be un-terminated, unless coil voltage is provided remotely in the field.

Unshielded I/O cables may only be used inside the cabinet or for very short distances near the control cabinet. Also short on engine sections of discrete Input & Output cables may be use on the engine/turbine.

See AP Note 51204 for a more detailed discussion on shield terminations. The length of exposed wire extending beyond the shield should be limited to 25 mm (1 inch).

If the panel that the control chassis and FTMs are mounted on is not at earth ground potential, connect it to earth ground via a 4 mm² (12 AWG) green/yellow wire or braid, keeping the wire or braid as short as possible. The mounting panel should be well grounded to protective earth via the cabinet structure or ground straps that are low RF impedance. Low RF impedance: length not greater than 4 times the cross-sectional circumference of the ground strap.

For compliance with EMC standards, it is required that all analog and discrete input / output wiring be separated from all power wiring. Power wiring leaving the cabinet housing the MicroNet may couple noise if not segregated and routed directly against the grounded metal of the cabinet & mounting plates. If segregation is not possible, a line filter of at least 20 dB attenuation is needed.

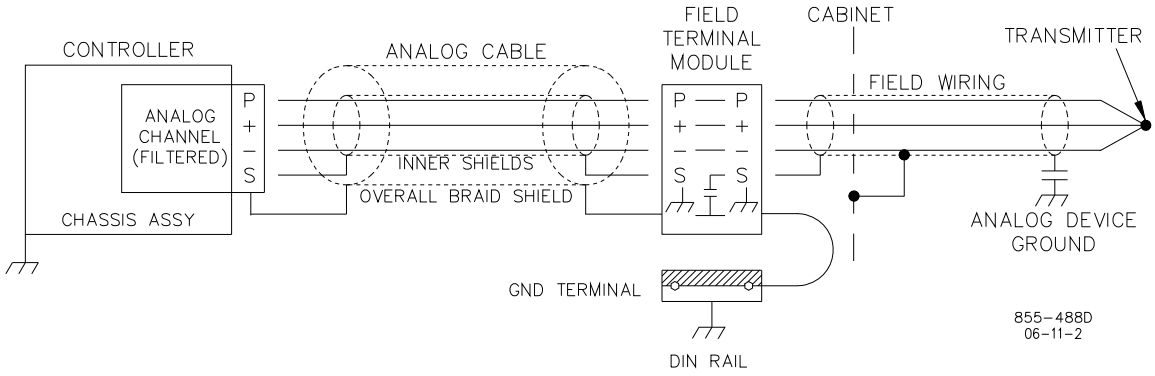


Figure 15-7—Shield Termination Diagram Example

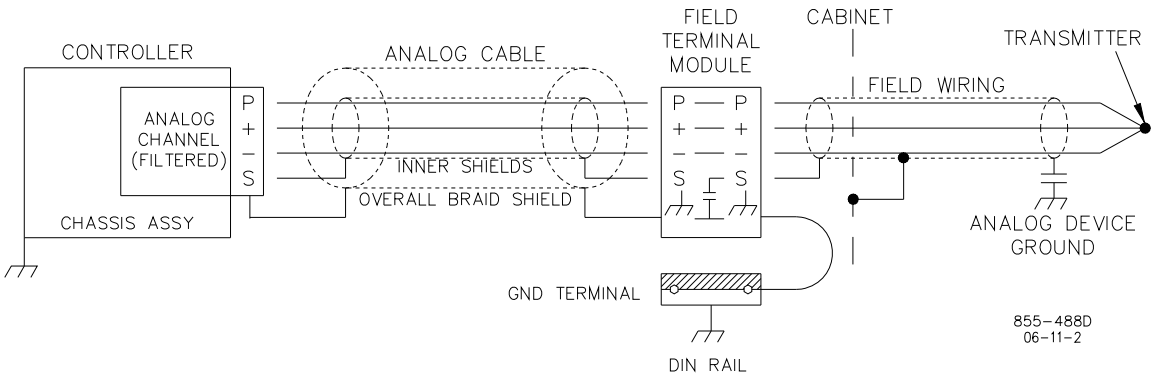


Figure 15-8—Discrete I/O Cable Grounding Diagram Example

Signal lines, mainly Analog Outputs and Actuator Outputs, send the system ground (DGND) out of the control as part of the field wiring. Take great care in wiring the field devices with cable runs longer than 30 m (100 feet), so that DGND does not become referenced to Protective Earth.

When there is significant transient ground bounce and the ground potential at the control and field device is significantly different (significant resistance between the two points), referencing DGND to Protective Earth at the field device can cause system disruptions in some VME modules.

A significant potential difference in Protective Earth grounds generally arises when the physical distance between protective earth points is longer than 30 m (100 feet), but may happen any time there is a significant enough inductance and/or resistance.

Transient ground bounce is caused when there is a nearby lightning strike, or nearby switched, high current, heavy inductive loads are switched off.

The control DGND is referenced to Protective Earth internally to the control via capacitance and local shielded cabling capacitance. If the field device's Protective Earth is referenced to DGND, transient ground bounce is placed across the control DGND and field device via the low impedance cabling. The transients can significantly disrupt some modules.

Some ways DGND to Protective Earth referencing happens are as follows:

- Connecting DGND to Protective Earth directly in the field device.
- Connecting multiple cable shields directly to protective earth at the field devices, with cable runs and device to control separation longer than 30 m (100 feet).
- Connecting DGND to Protective Earth indirectly, AC coupling, via intentional filter capacitance.
- Connecting the field device's power or its power reference to Protective Earth with transient limiting devices like a Metal Oxide Varistor or Transient Voltage Suppression Diode.
- Stray Coil capacitance from the actuator coil to the shaft or housing on multiple actuators and grounding the shaft or housing due to the attachment mechanisms.

15.2.7.2—VME Module Cable Shield Grounding

In all cases, the cable from the VME module (MicroNet I/O Card) to the FTM module or relay box for field wiring may have an additional ground point added. For relay boxes or relay driver FTMs, this is required in marine installations.

In EMC environments where sensitive equipment coexists or harsh conditions like high current or high voltage noise exist, the additional ground will help with noise suppression and immunity.

The insulation on the cable between the MicroNet and FTM or relay box must be removed to expose the shield, being careful not to cut the shield or nick the inner insulation layers. A metal "P-clip" or similar clamping mechanism is used around the cable shield to ground the shield within 300 mm (12 inches) of the FTM or relay box.

The grounding mechanism should be galvanically compatible with the tin-plated copper shield inside, as well as the grounding point in the cabinet (mounting panel). Typically metal "P-clips", annealed for some spring tension, made of either stainless steel or tin-plated copper are readily available commercially and are acceptably compatible.

15.2.7.3—Cabinet Structural Grounding

- The cabinet needs to be a six-sided EMI shielded enclosure. The interior surfaces must be conductive and coated with corrosion protection treatments.
- The enclosure floor and/or top must provide holes for cable entry, only the floor or top panels may be used. Top and bottom cable entry areas must be restricted in size, largest dimension of any aperture (hole) no greater than 152 mm (6 inches). This is particularly important when RF transmitters, like push to talk radios or cell phones, can be located near the cable access areas.
- The cabinet frame and mounting areas must be bonded (grounded together).
- All MicroNet chassis mounting screws (#8-32 M4) should be installed to properly ground the chassis to the mounting plate.
- Frame shall be electrically connected at each structural interface (<2.5 mΩ).
- Mounting plates shall be electrically connected to structural frame (<2.5 mΩ).
  - 6 places minimum — 4 corners + 2 mid-points, 8 places preferred.
- Cabinet Doors must be electrically connected to the main structural frame (<2.5 mΩ) and must be mounted using conductive EMI gaskets along the length of the interface.
- Cover panels shall be electrically connected to structural frame (<10 mΩ) and must be mounted using conductive EMI gaskets along the length of the interface.
- Floor and top must be electrically connected to structural frame (<2.5 mΩ) and must be mounted using conductive EMI gaskets along the length of the interfaces.
- DIN rail must be electrically connected to structural frame (<2.5 mΩ).
  - Once every 300 mm (12 inches), use a minimum of 2 screws to bond a DIN rail to cabinet frame.

15.2.7.4—Cable Entry Locations

- The cabinet must provide a shield termination point for cables as they enter the enclosure. Shielded I/O shields must be either AC or DC terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as connected to the FTM shield pins.
- Cable shield termination hardware must be installed at cable entry points.
- Cable shield terminations must be electrically connected to structural frame (<2.5 mΩ), and shall allow direct grounding or AC (capacitive) grounding of cable shields.

15.2.7.5—Equipment Zoning (Segregation)

Separate the equipment inside the cabinet into areas:

- Analog equipment area
- Discrete I/O equipment areas
- Shielded I/O area
- Un-shielded I/O area
- Power area
- Light Industrial compliant equipment area
- Monitor/kybd/pointing device (HMI if applicable)
- Other equipment area

Maintain a minimum of 152 mm (6 inches) of separation between areas.

15.2.7.6—Input Power Routing and Filtering

- Input power must enter the cabinet and be routed separately from all other circuits.
- Route power in middle at back of cabinet. All other I/O and internal cabling must be kept more than 152 mm (6 inches) away.
- Input power must route directly to controls that are Industrial compliant.
- Input power that must route to controls that are Light Industrial compliant must be filtered with a minimum of 20 dB filtering.
- Input power that must be routed near other cabling will be filtered prior to the point they are on a common path and before leaving the cabinet. Filter with a 20 dB filter.

IMPORTANT

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

15.2.7.7—Analog I/O Routing and Shield Termination

I/O Module in Cabinet

I/O Module (FTM & Similar, Analog Driver, etc.) in Cabinet

- Use shielded cable from MicroNet module to I/O module
- Locate I/O module as close to I/O cable entry point as possible
- Locate I/O module away from unshielded discrete areas (> 152 mm (6 inches))

Field I/O Cable with I/O Module (FTM & Similar, Analog Driver, etc.) in Cabinet

- Route I/O cable against cabinet metal wall from entry point to I/O module.
- Ground I/O cable shield, direct, to cabinet at entry point.
  - If over braid shielded, ground over braid shield to cabinet - connect inner braid shields at I/O module termination point. The inner braid must still be directly grounded to earth at one point.
  - If single shield, ground shield to cabinet.
- If field I/O cable is grounded direct (DC coupled) at remote end of cable, ground the I/O cable shield capacitively at I/O module in cabinet and at the cable entry point into the cabinet.

15.2.7.8—Shielded Discrete I/O Routing and Shield Termination

I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Use shielded cable from MicroNet module to I/O module
- Ground cable shield, direct, at MicroNet module and I/O module. Striping cable installation and adding a P-clamp type termination within 15 cm (6 inches) if the FTM / Relay Box.
- Locate I/O module as close to field I/O cable entry point as possible
- Locate I/O module away from shielded analog I/O areas (> 152 mm / 6 inches)
- Locate I/O module away from areas with unshielded discrete I/O (> 152 mm / 6 inches)

Field I/O Cable with I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Route I/O cable against cabinet metal wall/structure from cabinet entry point to I/O module;
- If I/O cable is shielded, ground the I/O cable shield, direct, to cabinet at entry point.
  - If over braid shielded, ground over braid shield to cabinet - connect inner braid shields directly to earth ground at one point only
  - If single shield, ground shield to cabinet
  - If field I/O cable shield is grounded direct at remote end of cable, ground the I/O cable shield, capacitively at the entry point to the cabinet
- I/O cable shield ground at the I/O module must be the same type as at cable entry point into cabinet, and it should be direct.

15.2.7.9—Unshielded I/O

I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Use Shielded cable from MicroNet module to I/O module (FTM)
- Ground the module to FTM cable shield, within 152 mm (6 inches) of I/O module (see Figure 15-8)
- Locate I/O module as close to field I/O cable entry point as possible
- Locate I/O module away from sensitive analog areas (>152 mm / 6 inches)

I/O Cable with I/O Module (FTM & Similar, Relay Driver, etc.) in Cabinet

- Route I/O cable against cabinet metal wall from entry point to I/O module;
- Do not let other cables within 300 mm (12 inches) of unshielded discrete I/O cables if they are parallel for > 61 cm (2 feet)
- Do not let other cables within 152 mm (6 inches) of unshielded discrete I/O cables if they are parallel for less than > 61 cm (2 feet)
- Limit length of unshielded I/O cable inside the cabinet. Any length over > 61 cm (2 feet) is too long

- If lengths greater than > 61 cm (2 feet) are required, special considerations should be used to separate this unshielded wiring from other circuits and minimize electromagnetic RF emissions.

15.2.8—Third Party Hardware

CE Compliant to Light Industrial Levels

- Locate inside the cabinet, away from all I/O cables that enter or exit the cabinet by > 300 mm (12 inches)
- Locate from all other cables > 152 mm (6 inches) away
- Use only CE compliant devices

CE Complaint to Industrial Levels

- Locate based on Zoning restrictions

15.2.9—Ethernet I/O Connections

- Use Shielded Twisted Pair (STP) category 5 Ethernet cable
- Route Ethernet cable away from all other Internal cabling and external I/O cabling
- Ground internal Ethernet cable at the CPU card and at the entry point to the cabinet
- If external Ethernet cable is grounded direct at remote end of cable, ground the external Ethernet cable shield capacitively. See Ethernet FTM in Chapter 13 Figure 13-54.

15.2.10—CAN I/O Connections

- A shielded CAN cable as defined in section 6.2.10 of volume 1 of this manual.
- Route the CAN cable away from all other Internal cabling and external I/O cabling.
- Ground the internal CAN cable shield at the entry point to the cabinet.
- AC couple the CAN cable shield to earth at each of the CAN devices external to the MicroNet cabinet.
- AC couple the CAN cable shield to earth at each of the CAN devices internal to the MicroNet cabinet.

15.2.11—Connection of Cabinet to Installation Ground

- Ensure the cabinet enclosure is electrically grounded to the plant ground system. Use as large a conductor as is possible. Use plant guidelines.

15.2.12—DIN Rail Grounding

- Provide Chassis ground to FTMs using a DIN rail ground clip.
- Install one each of these clips at the FTM end closest to the Earth ground connection point.
- Use largest gauge wire allowed by Clip and FTM.
- Maximum length of ground wire shall not exceed 5 cm (2 inches)

15.2.13—Equipment Bonding

- DIN rail shall be electrically connected to structural frame (<2.5 mΩ) once every 30 cm (12 inches).
- Use a minimum of 2 screws to bond a DIN rail to cabinet frame.
- Equipment chassis shall be electrically connected to structural frame (<2.5 mΩ).

15.2.14—Safety Ground Wire Installation

- Safety wires shall be routed against the grounded cabinet structure. Locate safety ground wire 15 cm (6 inches) from unshielded cabling, 77 mm (3 inches) from internal shielded cabling, and 15 cm (6 inches) from any I/O cabling exiting the cabinet.
- Safety ground/Protective earth wire should be routed from power input connections to the source of power. These wires should be routed with the power wires. Optimally power wires should be twisted, minimally they should be routed in direct contact with each other & bundled per input group.

15.2.15—Installation of Other Equipment, Fans, Meters, etc.

Shield Termination Schemes

Note: See Application Note B51204 for this information.

15.2.16—Shielded I/O Cable

Note: Copper tape is not reliable for shield termination.

Figure 15-9—Bottom Cable Entry Area

Figure 15-10—Door Bonding

Figure 15-11a—Cable Entry # 1

Figure 15-11b—Cable Entry # 2

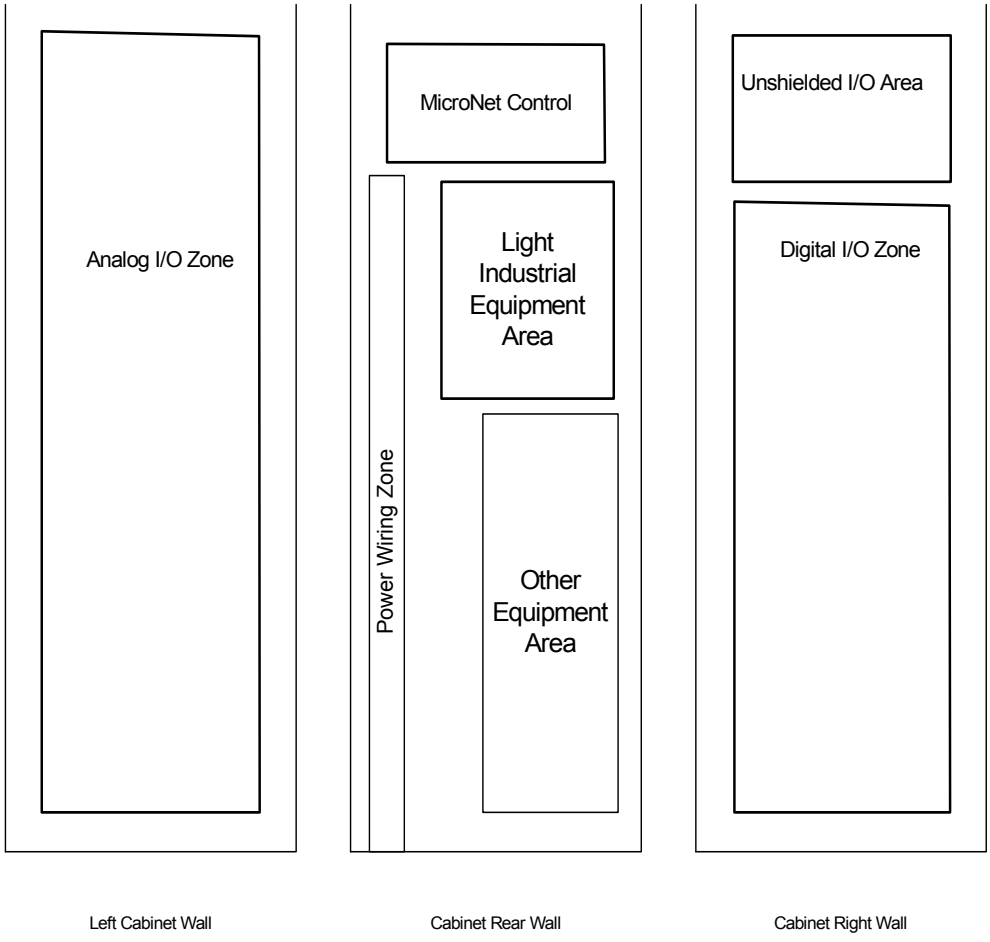


Figure 15-12—Zoning

15.3—Replacement Procedures

15.3.1—Safety Considerations

⚠WARNING

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

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

Do not remove or install power supply while circuit is live unless area is known to be non-hazardous.

Do not remove or install modules while circuit is energized unless area is known to be non-hazardous.

⚠AVERTISSEMENT

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

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

Ne pas enlever ni installer l'alimentation électrique pendant que le circuit est sous tension avant de s'assurer que la zone est non dangereuse.

Ne pas enlever ni installer les cartes pendant que le circuit est sous tension sans s'assurer que la zone non dangereuse.

15.3.2—Replacing a VME I/O Module

Each I/O Module has a red Fault LED controlled by the CPU, which is turned on when the system is reset. During initialization of an I/O module, which occurs after every CPU reset, the CPU turns the Fault LEDs on. The CPU then tests each I/O module using diagnostic routines built into software. If the diagnostic test is not passed, the LED remains on. If the test is successful, the LED goes off. If the Fault LED on a module is illuminated after the diagnostics and initialization have been run, the module may be faulty or in the wrong slot.

LED Diagnostics. If during normal control operation all Kernel I/O modules have their Fault LEDs on, check the Kernel CPU for a failure. If during normal control operation, only one module's Fault LED is turned on or flashing, replace this module. A flashing LED indicates that a certain module failure has occurred, and is used by factory technicians to locate module faults. When a module fault is detected, its outputs are disabled or de-energized.

I/O modules may have a fuse visible at the bottom rear edge of the module. If this fuse is blown, replace it with a fuse of the same type and size.

VME I/O Module Replacement Procedure:

1. **Warnings:** Read all warnings on pages VI and VII of this Volume before replacing any module.
2. If the control is running and on-line, use the Engineering Workstation to verify that any backup CPU is running without faults.
3. **Remove Power:** If possible, remove power from the Chassis and continue at step 5.
4. **Reset CPU:** For simplex CPU systems only: Toggle the CPU switch on a 040 CPU to the reset position. On a MicroNet Plus 5200 CPU or CPU_P1020 system, stop the application using AppManager. (If the CPU reset button is used, be aware that the application will auto-start in approximately 2 minutes.)
5. Remove the cable saddle at the top of the chassis section. The saddle can be lifted off by removing the two screws which hold it in place.
6. **Unseat the module:** Unscrew the module's captive-screw fasteners (one at the top of the module and the other at the bottom), and unseat the module by simultaneously pressing the top module handle (extractor) up and the bottom module handle (extractor) down.
7. **Partially remove the module and disconnect cables:** Pull the module straight out along the card guide slots until it is approximately 25 mm (1 inch) from the motherboard. Disconnect the I/O cables from the module, and secure the ends to avoid damage or shorting of pins. The I/O cables use a slide latch (to disengage, slide the latch towards the top of the module).
8. **Fully remove the module:** Remove the module by pulling it straight out and putting it into a conductive plastic bag. (Woodward P/N 4951-041).
9. **Inspect and partially install module:** Prior to installing a replacement module, verify that all connector pins are parallel and straight. Install the replacement module by aligning the circuit board edges inside the card guides and pushing the module straight in until it is approximately 25 mm (1 inch) from the motherboard. (**Do not make contact with the chassis motherboard mating connectors**.)
10. **Delay time:** If the same module is to be removed and re-installed, wait a minimum of 30 seconds after removal before re-installing the module
11. **Re-connect the cables:** Connect the I/O cables to the module. The I/O cables use a slide latch (to engage, slide the latch towards the bottom of the module). Verify that the I/O cables are connected to the correct cable connector. Re-position the two captive-screw fasteners as necessary to prevent interference when the module is inserted.
12. **Fully insert the I/O module:** With even pressure exerted at the top and the bottom of the module, in one continuous motion, fully seat the module into the motherboard.

IMPORTANT

If resistance is encountered when installing a module, do not force the module. Remove the module and check the connectors for bent contacts or foreign objects. Also check to ensure that the module screws are fully retracted. Forcing a module into place may break the connector or bend the securing screws.

13. Tighten the two captive-screw fasteners (one at the top of the module and the other at the bottom).
14. If power was removed, reapply power.
15. Put a 040 CPU module back in run mode by toggling the CPU switch.

16. On the MicroNet Plus 5200 CPU or CPU_P1020 system, re-start the application as required using AppManager
17. Verify that the replacement MicroNet module is working correctly.
18. Reinstall the cable saddle.

Once the module is properly installed, the module Fault LED will be illuminated until the module is re-initialized by the control. The control performs module diagnostic tests for a few seconds, and if all tests are passed, re-initializes the module (turning off the module Fault LED).

IMPORTANT

If the module's Fault LED does not turn off after the module has been installed for at least one minute, it may be necessary to re-seat the module more firmly. To re-seat a module follow steps #6 and #7 of the above procedure to release the module from the motherboard, then re-install the module by following procedure step #12.

15.3.3—Replacing a Field Termination Module (FTM)

WARNING

It is not possible to replace an FTM without shutting down the entire control system and the prime mover.

WARNING

If power has not been removed from the control system, power will be active at the module and also at the cable connectors. It is recommended that the cables not be removed until after the module has been unseated. If cables are removed with power applied, care must be used to avoid shorting cable connector pins.

WARNING

HIGH VOLTAGE—If the high voltage FTM is being used with the 48/24 Discrete I/O module, and there is 125 Vdc on the FTM terminal blocks, there will be 125 Vdc on the FTM sub D connectors and on the cable when it is connected to the FTM. For this reason, all power should be removed from the FTM terminal blocks before disconnecting any cables.

1. Toggle the CPU switch to the reset position.
2. Carefully—to avoid shorting cable pins—disconnect all I/O cables from the FTM, and secure cable ends to avoid damage or shorting of pins. The I/O cables use a slide latch (to disengage, slide the latch to the release position).
3. Disconnect all field wiring. Care should be taken to avoid shorting the wires.
4. Remove the FTM by inserting a screwdriver into the mounting foot and prying each foot away from the DIN rail. Install the replacement FTM.
5. Reconnect all field wiring. Refer to the Wiring Notes for the appropriate module.
6. Connect all I/O cables to the FTM, being careful to avoid shorting cable pins. Lock the connector in position by sliding the latch to the latched position.
7. If power was removed, reapply power.
8. Put the CPU module back in run mode.
9. Verify that the new FTM is working correctly.

15.3.4—Replacing a Relay Box

WARNING

If power has not been removed from the control system, power will be active at the module and also at the cable connectors. It is recommended that the cables not be removed until after the module has been unseated. If cables are removed with power applied, care must be used to avoid shorting cable connector pins.

WARNING

HIGH VOLTAGE—If there is high voltage on the relay box terminal blocks, there will be high voltage on the relay box connectors. For this reason, all power should be removed from the relay box terminal blocks before disconnecting any cables.

1. Toggle the CPU switch to the reset position.
2. Carefully—to avoid shorting cable pins—disconnect all I/O cables from the relay box, and secure cable ends to avoid damage or shorting of pins. The I/O cables use a slide latch (to disengage, slide the latch to the release position).
3. Disconnect all field wiring. Care should be taken to avoid shorting the wires.
4. Install the replacement relay box.
5. Reconnect all field wiring.
6. Connect all I/O cables to the relay box, being careful to avoid shorting cable pins. Lock the connector in position by sliding the latch to the latched position.
7. If power was removed, reapply power.
8. Put the CPU module back in run mode.
9. Verify that the new relay box is working correctly.

15.3.5—Replacing a Receptacle-mounted Relay

WARNING

HIGH VOLTAGE—When there is high voltage on the relay contacts, there will be high voltage on and around the relay itself. For this reason, all power must be removed from the relay box before replacing the relay.

1. If possible, remove all power from the control system and the Relay module.
2. Identify the faulty relay.
3. Move the relay's hold down spring out of the way, and pull the relay out of its socket.
4. Insert a replacement relay with same manufacturer's part number into the vacated socket, and re-engage the hold down spring.
5. Restore all power if previously removed.
6. Verify that the new relay is functioning correctly.

15.3.6—Replacing an I/O Cable

IMPORTANT **This procedure will shut down the control system.**

⚠WARNING **If power has not been removed from the control system, power will be active at the module and also at the cable connectors. It is recommended that the cables not be removed until after the module has been unseated. If cables are removed with power applied, care must be used to avoid shorting cable connector pins.**

⚠WARNING **HIGH VOLTAGE—If the high voltage FTM is being used with the 48/24 Discrete I/O module, and there is 125 Vdc on the FTM terminal blocks, there will be 125 Vdc on the FTM sub D connectors and on the cable when it is connected to the FTM. For this reason, all power should be removed from the FTM terminal blocks before disconnecting any cables.**

1. Toggle the CPU switch to the reset position.
2. Remove the cable saddle at the top of the chassis section. The saddle can be lifted off by removing the two screws which hold it in place.
3. Unscrew the module's captive-screw fasteners (one at the top of the module and the other at the bottom), and release the module by simultaneously pressing the top module handle up and the bottom module handle down.
4. Unseat the module from the motherboard by pulling the module straight out along the card guide slots until it is approximately 25 mm (1 inch) from the motherboard.
5. Disconnect the I/O cable from the module, and secure the ends to avoid damage or shorting of pins. The I/O cable uses a slide latch (to disengage, slide the latch towards the top of the module).
6. Disconnect the I/O cable from the FTM or Relay/Discrete Input module. This may require removal of the cable shield termination clamp that is next to an FTM in a commercial Marine installation.
7. Install the replacement I/O cable and connect it to the FTM or Relay/Discrete Input module, securing the end to avoid shorting or damage to pins. Remember to install the cable shield termination clamp that is next to an FTM in a commercial Marine installation.
8. Connect the I/O cable to the module. The I/O cable uses a slide latch (to engage, slide the latch towards the bottom of the module). Verify that the I/O cable is connected to the correct cable connector.
9. With even pressure exerted at the top and the bottom of the module, seat the module into the motherboard.
10. Tighten the two captive-screw fasteners (one at the top of the module and the other at the bottom).
11. If power was removed, reapply power.
12. Put the CPU module back in run mode.
13. Verify that the new MicroNet module is working correctly.
14. Reinstall the cable saddle.

15.3.7—Replacing Chassis Fans

1. Installation of MicroNet Plus Fan Item 8926-1001:
2. Use the following procedure to remove a faulty MicroNet Plus Chassis fan from the chassis.
   - Discharge static from your body by touching the main cabinet PE ground.
   - Use a stubby (approximately 3.5 inches long) #2 Phillips screwdriver.
   - Remove the four retaining screws holding the fan assembly to the chassis. Take care not to drop the hardware into the control chassis.
   - Remove power by disconnecting the fan connector from the motherboard mating connector. Remove the fan and guard from the chassis.
   - Discharge static from your body by touching the main cabinet PE ground.
   - Install new fan, fan guard and mounting screws. (Flow arrows should point towards the top of the chassis).
   - Re-connect the fan connector to the mating connector on the motherboard.

1. Installation of MicroNet Fan Item 1886-405:
2. Use the following procedure to remove a faulty MicroNet Chassis fan from the chassis.
   - Discharge static from your body by touching the main cabinet PE ground.
   - Use a stubby (approximately 9 cm/3.5 inches long) #2 Phillips screwdriver.
   - Remove the four retaining screws holding the fan assembly to the chassis.
   - Remove power by disconnecting the wire quick connects.
   - Remove fan and guard from the chassis.
   - Discharge static from your body by touching the main cabinet PE ground.
   - Install new fan, fan guard and mounting screws. (Flow arrows should point towards the top of the chassis).
   - Connect RED wire to the + fan terminal and BLACK wire to - fan terminal.

IMPORTANT **Do not contact quick connect terminals with any metallic surface during reinstallation as they are powered.**

Chapter 16.
Service Options

16.1—Product Service Options

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

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

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

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

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

16.2—Woodward Factory Servicing Options

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

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

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

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

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

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

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

16.3—Returning Equipment for Repair

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

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

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

16.3.1—Packing a Control

Use the following materials when returning a complete control:

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

NOTICE

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

16.4—Replacement Parts

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

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

16.5—Engineering Services

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

- Technical Support
- Product Training
- Field Service

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

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

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

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

16.6—How to Contact Woodward

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

Electrical Power Systems

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

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Stuttgart	+49 (711) 78954-0
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 439500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

16.7—Technical Assistance

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

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam,	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	

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

Appendix A.
Matrix of Modules
with Compliance Information

The "X" indicates approval from the agency shown in the columns.

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
1604-801	A	BLOCK	SECTIONAL TERMINAL (UK 5, PHOENIX, 3004016)						x	x	x
1604-813	A	BLOCK	SECTIONAL EARTH/GRND TERM.				x	x	x	x	x
1606-519	A	CHANNEL	MOUNTING						x	x	x
1606-584	ANP	RAIL	MOUNTING 78 IN.						x	x	x
1611-003	A	CONVERTER	INTERFACE (RS-232 TO RS-422 AND RS-485)				n/a	x		x	
1740-217	A	LIGHT	CABINET, 24VDC 8W FLUORESCENT					x			
1751-6020	A	MODULE	ISOLATED ANALOG VOLTAGE INPUT, 0 TO 10 V INPUT (DATAFORTH)	x		x	n/a	x			
1751-6021	A	MODULE	ISOLATED ANALOG VOLTAGE INPUT, +/- 10V INPUT (DATAFORTH)	x		x	n/a	x			
1751-6034	A	CONVERTER	RTD 100 OHM PT EUROPEAN CURVE (EXT RANGE)	x							
1751-6058	A	MODULE	TRANSFORMER	x		x					
1751-6091	A	RELAY	16 CHANNEL RELAY FTM (PHOENIX CONTACT)		x			x			
1752-357	A	HUB	RAIL RH1-TP (HIRSCHMANN 943 639-002)								
1755-111	A	FILTER	RFI POWER LINE						x	x	x
1784-573	A	CONVERTER	ISOLATED RS232-RS232, KD485, DIN RAIL Only for Marine				n/a	x	x	x	x
1784-575	A	CONVERTER	ISOLATED RS232-RS422/RS485, KD485, DIN RAIL Only for Marine				n/a	x	x	x	x
1784-577	A	CONVERTER	ISOLATED RS232-RS232, PHOENIX, DIN RAIL						x	x	x
1784-635	A	CONVERTER	INTERFACE ISOLATOR (RS-232 TO RS-232)				n/a	x		x	
1784-653	A	CONVERTER	K TYPE THERMOCOUPLE TO 0-5 VOLT, (DATAFORTH)	x		x	n/a	x		x	x
1784-655	A	CONVERTER	100 OHM RTD TO 0-5 VOLT, (DATAFORTH)	x		x	n/a	x		x	x
1784-657	A	CONVERTER	NON-ISOLATED PASS THROUGH, (DATAFORTH)	x		x	n/a	x			
1784-659	A	CONVERTER	NON-ISOLATED PASS THROUGH WITH 200 OHM (DATAFORTH)	x		x	n/a	x		x	x
1784-667	A	CONVERTER	100 OHM RTD, 0-600 DEG C SLOW TO 0-5 VOLT, (DATAFORTH)	x		x	n/a	x			

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
1784-675	A	CONVERTER	200 OHM RTD TO 0-5 VOLT, (DATAFORTH)	x		x	n/a	x			x
1784-695	A	THERMOC	THERMOCOUPLE - J TYPE THERMOCOUPLE 1-5 VOLT (DATFORTH)	x		x	na	x			
1784-1028	A	CONVERTER	ISOLATED LINEARIZED THERMOCOUPLE INPUT (DATAFORTH)	x		x	n/a	x			x
1784-1044	A	CONVERTER	ISOLATED ANALOG VOLTAGE INPUT MODULE (DATAFORTH)	x		x	n/a	x			
1784-1064	A	CONVERTER	E TYPE THERMOCOUPLE (DATAFORTH)	x		x	n/a	x			
1784-1069	A	CONVERTER	5K OHM ISOLATED POTENTIOMENTER INPUT (DATAFORTH)	x		x	n/a	x			
1784-1076	A	CONVERTER	ISOLATED ANALOG VOLTAGE INPUT MODULE (DATAFORTH)	x		x	n/a	x			
1784-1080	A	CONVERTER	10K OHM ISOLATED POTENTIOMENTER INPUT (DATAFORTH)	x		x	n/a	x			
1784-1115	A	CONVERTER	ISOLATED LINEARIZED T-TYPE THERMOCOUPLE INPUT (DATAFORTH)	x		x	n/a	x			
1790-039	A	KEYBOARD	NEMA 12 WITH HULAPOINT				n/a	x	x	x	x
1790-041	A	MONITOR	SCEPTRE LT12G 12.1" SVGA TFT FLAT PANEL				n/a	x	x	x	x
1790-043	A	KEYBOARD	UNICOMP SPACE SAVER W/TRACKPOINT (BLACK)				n/a	x	x	x	x
1790-885	A	MONITOR	T-521 CTC P31-212AR INTERACT 90/120 VAC								
1790-887	A	MONITOR	T-521 CTC P31-212DR INTERACT 20/36 VDC								
1790-889	A	MONITOR	T-521 CTC P2 INTERACT 100-240 VAC								
1790-891	A	MONITOR	T-521 CTC P2 INTERACT 20/36 VDC								
2006-379	A	WIRE	20 GA. 600V CRC WHITE (T-274)						x	x	x
2008-055	A	CABLE	20 GA. 2 COND. SHLD (T-274)						x	x	x
2008-057	A	CABLE	20 GA. 3 COND. SHLD (T-274)						x	x	x
2008-217	A	WIRE	10 GA. 600V CRC GRN/YEL (T-274)						x	x	x
2008-269	A	CABLE	50 OHM COAX						x	x	x
2008-349	A	WIRE	2 CONDUCTOR 22AWG, LOW CAP				n/a	x	x	x	x
2008-535	A	CABLE	TRIAXIAL 50 OHM IMPEDANCE						x	x	x
3799-301	A	PANEL	NETCON IIIB VME BLANK				n/a	x	x	x	x
5009-411	A	MODULE	5009 CPU SIO WITH APPLICATION								
5009-413	A	MODULE	5009 CPU WITH APPLICATION								
5009-415	A	MODULE	5009 CPU WITH APPLICATION								

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5009-418	A	MODULE	5009 CPU SIO WITH APPLICATION								
5009-419	A	MODULE	5009 CPU WITH APPLICATION								
5009-421	A	MODULE	5009 CPU APPLICATION W/ SIO								
5009-423	A	MODULE	5009 CPU APPLICATION W/ SIO								
5009-500	A	MODULE	5009 CPU W/DUAL CPC APPLICATION								
5009-502	A	MODULE	5009 CPU WITH APPLICATION								
5415-962	A	CABLE	NETCON TRANSCEIVER 3FT				n/a	x	x	x	x
5009-419	A	MODULE	5009 CPU WITH APPLICATION								
5009-421	A	MODULE	5009 CPU APPLICATION W/ SIO								
5009-423	A	MODULE	5009 CPU APPLICATION W/ SIO								
5009-500	A	MODULE	5009 CPU W/DUAL CPC APPLICATION								
5009-502	A	MODULE	5009 CPU WITH APPLICATION								
5415-962	A	CABLE	NETCON TRANSCEIVER 3FT				n/a	x	x	x	x
5415-963	A	CABLE	NETCON TRANSCEIVER 10FT				n/a	x	x	x	x
5416-190	A	CABLE	NETCON SERIAL I/O						x	x	x
5416-332	A	CABLE	NETCON 3FT DISCRETE GRA						x	x	x
5416-333	A	CABLE	NETCON 6FT DISCRETE GRA						x	x	x
5416-334	A	CABLE	NETCON 8FT DISCRETE GRA						x	x	x
5416-335	A	CABLE	NETCON 10FT DISCRETE GY						x	x	x
5416-336	A	CABLE	NETCON 12FT DISCRETE GY						x	x	x
5416-337	A	CABLE	NETCON 14FT DISCRETE GY						x	x	x
5416-338	A	CABLE	NETCON 16FT DISCRETE GY						x	x	x
5416-339	A	CABLE	NETCON 18FT DISCRETE GY						x	x	x
5416-340	A	CABLE	NETCON 20FT DISCRETE GY						x	x	x
5416-341	A	CABLE	NETCON 22FT DISCRETE GY						x	x	x
5416-342	A	CABLE	NETCON 24FT DISCRETE GY						x	x	x
5416-350	A	CABLE	NETCON 3B 14FT ANLG BLK						x	x	x
5416-413	A	CABLE	SERIAL I/O RS422						x	x	x
5416-425	A	CABLE	THINNET ETHERNET COAX						x	x	x
5416-519	A	CABLE	MACINTOSH SERIAL I/O						x	x	x
5416-863	A	CABLE	PMU (POWER MONITORING UNIT), VAASA ELECTRONICS VX008-3						x	x	x
5416-966	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 6FT						x	x	x
5416-967	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 8 FT						x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5416-968	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 10FT						x	x	x
5416-969	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 12FT						x	x	x
5416-970	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 14FT						x	x	x
5416-971	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 16FT						x	x	x
5416-972	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 18FT						x	x	x
5416-973	A	CABLE	MICRONET HIGH DENSITY LV DISCRETE GRA 20FT						x	x	x
5416-977	A	CABLE	5009 POWER SUPPLY FLAT RIBBON (6 IN)				n/a	x			
5417-019	A	CABLE	5009 RELAY INTERCONNECT (6 INCH LENGTH)				n/a	x			
5417-026	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 6FT				n/a	x	x	x	x
5417-027	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 8FT				n/a	x	x	x	x
5417-028	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 10FT				n/a	x	x	x	x
5417-029	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 12FT				n/a	x	x	x	x
5417-030	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 14FT				n/a	x	x	x	x
5417-031	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 16FT				n/a	x	x	x	x
5417-032	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 18FT				n/a	x	x	x	x
5417-033	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 20FT				n/a	x	x	x	x
5417-034	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 22FT				n/a	x	x	x	x
5417-035	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 26FT				n/a	x	x	x	x
5417-036	A	CABLE	NETCON LOW DENSITY ANALOG BLACK 40FT				n/a	x	x	x	x
5417-037	A	CABLE	NETCON 3FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-038	A	CABLE	NETCON 6FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-039	A	CABLE	NETCON 8FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-040	A	CABLE	NETCON 10FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-041	A	CABLE	NETCON 12FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5417-042	A	CABLE	NETCON 14FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-043	A	CABLE	NETCON 16FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-044	A	CABLE	NETCON 18FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-045	A	CABLE	NETCON 20FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-046	A	CABLE	NETCON 22FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-047	A	CABLE	NETCON 24FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-048	A	CABLE	NETCON 26FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-049	A	CABLE	NETCON 40FT DISCRETE GRA W/BACKSHELL TAPE				n/a	x	x	x	x
5417-171	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 6FT UL				n/a	x	x	x	x
5417-172	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 8FT UL				n/a	x	x	x	x
5417-173	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 10FT UL				n/a	x	x	x	x
5417-174	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 12FT UL				n/a	x	x	x	x
5417-175	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 14FT UL				n/a	x	x	x	x
5417-176	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 16FT UL				n/a	x	x	x	x
5417-177	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 18FT UL				n/a	x	x	x	x
5417-178	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 20FT UL				n/a	x	x	x	x
5417-179	A	CABLE	NETCON TRANSCEIVER 6FT				n/a	x	x	x	x
5417-180	A	CABLE	MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 40FT UL								
5417-229	A	CABLE	THINNET ETHERNET TRIAX 450 FT						x	x	x
5417-290	A	CABLE	MOLDED DB9F TO DB9F NULL MODEM W/THUMBSCREWS				n/a	x			
5417-293	A	CABLE	TMR CHASSIS/POWER SPLY INTERCONNECT				n/a	x			

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5417-391	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 1.5 FT				n/a	x	x	x	x
5417-392	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 3 FT				n/a	x	x	x	x
5417-393	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 7 FT				n/a	x	x	x	x
5417-394	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 10 FT				n/a	x	x	x	x
5417-395	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 14 FT				n/a	x	x	x	x
5417-396	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 25 FT				n/a	x	x	x	x
5417-397	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 50 FT				n/a	x	x	x	x
5417-398	A	CABLE	DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 100 FT				n/a	x			
5417-399	A	CABLE	SHIELDED PS/2 REPLACEMENT (MALE-MALE) 6 FT				n/a	x	x	x	x
5417-400	A	CABLE	SHIELDED PS/2 REPLACEMENT (MALE-MALE) 10 FT				n/a	x	x	x	x
5417-401	A	CABLE	SHIELDED PS/2 REPLACEMENT (MALE-MALE) 15 FT				n/a	x	x	x	x
5417-402	A	CABLE	SHIELDED PS/2 EXT (MALE-FEMALE) 6 FT				n/a	x	x	x	x
5417-403	A	CABLE	SHIELDED PS/2 EXT (MALE-FEMALE) 10 FT				n/a	x	x	x	x
5417-404	A	CABLE	SHIELDED PS/2 EXT (MALE-FEMALE) 15 FT				n/a	x	x	x	x
5417-405	A	CABLE	TRIPLE SHIELDED VGA VIDEO EXT (HD15M-HD15F) 6 FT				n/a	x	x	x	x
5417-406	A	CABLE	TRIPLE SHIELDED VGA VIDEO EXT (HD15M-HD15F) 10 FT				n/a	x	x	x	x
5417-407	A	CABLE	TRIPLE SHIELDED VGA VIDEO EXT (HD15M-HD15F) 15 FT				n/a	x	x	x	x
5417-408	A	CABLE	TRIPLE SHIELDED VGA VIDEO (HD15M-HD15M) 6 FT				n/a	x	x	x	x
5417-409	A	CABLE	TRIPLE SHIELDED VGA VIDEO (HD15M-HD15M) 10 FT				n/a	x	x	x	x
5417-410	A	CABLE	TRIPLE SHIELDED VGA VIDEO (HD15M-HD15M) 15 FT				n/a	x	x	x	x
5417-411	A	CABLE	SHIELDED RS232 SERIAL EXT (DB9M-DB9F) 6 FT				n/a	x	x	x	x
5417-412	A	CABLE	SHIELDED RS232 SERIAL EXT (DB9M-DB9F) 10 FT				n/a	x	x	x	x
5417-413	A	CABLE	SHIELDED RS232 SERIAL EXT (DB9M-DB9F) 15 FT				n/a	x	x	x	x
5418-1560	A	SOFTWARE	9140RF HMI'S ON HARD DISK								
5437-050	ANP	DOOR	NETCON 3B SIMPLEX MAIN VFD								

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5437-052	ANP	MODULE	NETCON FIELD TERMINAL								
5437-059	A	CHASSIS	I/O XCVR T-MODULE	x			n/a	x	x	x	x
5437-060	ANP	MODULE	NETCON FIELD TERMINAL								
5437-061	ANP	MODULE	NETCON DISCRETE INPUT								
5437-078	ANP	CHASSIS	NETCON 3B SPLX MAIN						x	x	x
5437-079	ANP	MODULE	NETCON FIELD TERMINAL	x							
5437-080	A	MODULE	NETCON FIELD TERMINAL	x			n/a	x	x	x	x
5437-085	ANP	MODULE	NETCON FIELD TERMINAL								
5437-086	ANP	MODULE	NETCON FIELD TERMINAL								
5437-087	ANP	MODULE	NETCON FIELD TERMINAL								
5437-092	A	POWER SUP	EXP CHAS (REDUN)						x	x	x
5437-095	ANP	MODULE	DUPLEX FIELD TERMINAL								
5437-096	ANP	MODULE	DUPLEX FIELD TERMINAL								
5437-173	ANP	MODULE	NETCON FIELD TERMINAL	x							
5437-281	INA	MODULE	ANALOG FIELD TER (STD)	x							
5437-282	INA	MODULE	ANALOG FIELD TERM (TC)	x							
5437-283	INA	MODULE	ANALOG FIELD TER (ACT)	x							
5437-291	ANP	MODULE	NETCON FIELD TERMINAL								
5437-371	ANP	RACK	NETCON 3B REMOTE I/O								
5437-375	ANP	MODULE	FIELD TERMINAL								
5437-403	ANP	MODULE	FIELD TERMINAL STD								
5437-404	ANP	MODULE	FIELD TERMINAL TC								
5437-405	ANP	MODULE	FIELD TERMINAL ACT								
5437-418	ANP	MODULE	NETCON DERIVATIVE ANAL	x			n/a	x	x	x	x
5437-419	A	MODULE	NETCON 24 CHANNEL FTM	x		x	n/a	x	x	x	x
5437-455	A	MODULE	SMART 3000 RESISTOR	x					x	x	x
5437-484	A	MODULE	DUPLEX CURRENT/VOLTAGE FTM				n/a	x	x	x	x
5437-507	A	PANEL	SERVICE NETCON /C						x	x	x
5437-523	A	MODULE	ANALOG FIELD TERM (STD)	x		x	n/a	x	x	x	x
5437-524	A	MODULE	ANALOG FIELD TERM (TC)	x		x	n/a	x	x	x	x
5437-525	A	MODULE	ANALOG FIELD TERM (ACT)						x	x	x
5437-672	A	MODULE	NETCON FIELD TERMINAL	x		x	n/a	x	x	x	x
5437-687	A	MODULE	NETCON 24 CHANNEL FIELD TERMINAL	x		x	n/a	x	x	x	x
5437-727	A	MODULE	FTM ASSEMBLY						x	x	x
5437-730	INA	Control	(SNG) York - Unit #1 NetCon/OCP						x		x
5437-838	A	CHASSIS	5009 POWER SUPPLY	x			x	x	x	x	x
5437-839	A	CHASSIS	5009/MICRONET TMR DIGITAL CONTROL	x			n/a	x	x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5437-843	A	CHASSIS	MICRONET 12 SLOT W/6 SLOT I/O	x			n/a	x	x	x	x
5437-844	A	CHASSIS	MICRONET 18 SLOT W/12 SLOT I/O	x					x	x	x
5437-845	A	BOARD	NOTCH FILTER 3KHZ	x			n/a	x	x	x	x
5437-852	A	CHASSIS	MICRONET TMR						x	x	x
5439-754	ANP	CHASSIS	NETCON 3B SIMPLEX						x	x	x
5439-756	ANP	MODULE	NETCON FIELD TERMINAL								
5439-758	ANP	MODULE	NETCON FIELD TERMINAL								
5439-794	ANP	CHASSIS	NETCON 3B I/O						x	x	x
5441-413	A	RELAY	32 CHAN RELAY INTERFACE	x		x		x	x	x	x
5441-419	A	RELAY	16C INTERFACE **[Ordinary Locations Only]**		x			x	x	x	x
5441-691	INA	MODULE	16 CHANNEL RELAY FTM (PHOENIX CONTACT)				x	x			
5441-693	A	MODULE	HD DISCRETE I/O FTM (24 IN/12 OUT) (PHOENIX CONTACT)		x		x	x	x	x	x
5441-694	A	MODULE	HD DISCRETE I/O FTM RELAY DRIVER (24 IN/12 OUT)	x		x	n/a	x	x	x	x
5441-695	A	MODULE	SIMPLEX FTM, DataForth	x		x	n/a	x	x	x	x
5441-697	A	MODULE	TMR FTM, DataForth	x			n/a	x		x	x
5453-008	A	RACK	FADC LOCOP NETCON CHASSIS, DUAL P. S. CONNECTION								
5453-203	A	PANEL	DISPLAY								
5453-276	A	RELAY	5009 F/T DISCRETE IN [**Ordinary Locations Only]**		x		x	x	x	x	x
5453-277	A	CHASSIS	MICRONET TMR POWER SUPPLY W/REDUNDANT FANS	x							
5453-278	A	CHASSIS	MICRONET 12 SLOT	x			n/a	x	x	x	x
5453-279	A	CHASSIS	MICRONET TMR	x							
5453-750	INA	Box	MicroNet Ethernet Interface FTM				x	x	x		x
5453-751	A	BOX	MICRONET VIDEO INTERFACE FTM	x			n/a	x	x	x	x
5453-754	A	BOX	MICRONET ETHERNET INTERFACE FTM	x			n/a	x		x	
5453-759	A	CHASSIS	MICRONET-PLUS 14 SLOT, REDUND WITH SMART FANS	x		x	x	x	x	x	
5453-829	A	CHASSIS	MICRONET PLUS 8 SLOT, REDUND WITH SMART FANS	x		x	x	x	x	x	
5454-425	A	CHASSIS	5009 TMR POWER SUPPLY W/REDUNDANT FANS	x							
5458-127	A	Board	NetCon 5000B SIO SMT						x		x
5463-783	ANP	MODULE	NETCON DISCRETE INPUT								
5463-784	ANP	MODULE	NETCON DISCRETE OUTPUT								
5463-786	ANP	MODULE	8 CH ANALOG OUT 4-20MA								
5463-787	ANP	MODULE	DIGITAL SPEED SENSOR								
5463-789	ANP	MODULE	ANALOG 8 CHANNEL 0-1MA								

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5463-870	ANP	MODULE	INTEGRATING ACT DRIVER								
5463-872	ANP	MODULE	NON-VOLITAL MEMORY								
5463-877	ANP	MODULE	4 CHANNEL ACUATOR								
5464-015	ANP	MODULE	DIGITAL SPEED SENSOR								
5464-027	ANP	MODULE	4 CH. ACT 4-20MA								
5464-035	ANP	MODULE	4 CHANNEL ACTUATOR								
5464-125	ANP	MODULE	NETCON 5000 MEMORY								
5464-214	ANP	MODULE	NETCON NV MEMORY 1.5M								
5464-215	ANP	MODULE	NETCON NV MEMORY 3M								
5464-310	ANP	MODULE	NETCON 5000 SWITCHED M								
5464-332	A	MODULE	ISO T/C ANALOG IN	x		x	n/a	x	x	x	x
5464-333	A	MODULE	ISO T/C HIGH IN	x		x	n/a	x	x	x	x
5464-334	A	MODULE	ISO 4-20 ANALOG INPUT	x			n/a	x	x	x	x
5464-335	A	MODULE	ISO 0-10V ANALOG	x			n/a	x	x	x	x
5464-336	A	MODULE	SEMI ISO RTD 10	x			n/a	x	x	x	x
5464-337	A	MODULE	SEMI ISO RTD 100	x		x	n/a	x	x	x	x
5464-338	A	MODULE	SEMI ISO RTD 200	x		x	n/a	x	x	x	x
5464-339	A	MODULE	SEMI ISO RTD 500	x		x	n/a	x	x	x	x
5464-340	A	MODULE	SEMI ISO RTD 100 HIGH TEMP	x		x	n/a	x	x	x	x
5464-414	ANP	MODULE	DIGITAL SPEED SENSOR								
5464-444	ANP	MODULE	NETCON 5000 CPU 40MHZ								
5464-449	ANP	MODULE	NETCON 5000 CPU AUX								
5464-458	ANP	MODULE	64 CH DISCRETE OUTPUT								
5464-459	ANP	MODULE	NON-VOL MEMORY 500K								
5464-460	ANP	MODULE	NON-VOL MEMORY 1M								
5464-466	ANP	MODULE	NETCON 5000B CPU 33MHZ								
5464-544	A	MODULE	4 CH ACT 0-200MA	x			n/a	x	x	x	x
5464-545	A	MODULE	4 CH ACT 0-25MA	x			n/a	x	x	x	x
5464-546	ANP	MODULE	1,2 0-200MA 3,4 0-25MA								
5464-553	A	MODULE	INT. ACT DRIVER	x							
5464-554	A	MODULE	INT. ACT DRIVER	x							
5464-555	A	MODULE	INT. ACT DRIVER	x							
5464-556	A	MODULE	INT. ACT DRIVER	x							
5464-575	ANP	MODULE	SPEED SENSOR								
5464-576	ANP	MODULE	SPEED SENSOR								
5464-643	A	MODULE	DISCRETE INPUT	x			n/a	x	x	x	x
5464-644	A	MODULE	INT. ACT DRIVER	x							
5464-645	A	MODULE	INT. ACT DRIVER	x							
5464-648	A	MODULE	ANALOG 8 CH 4-20MA OUT	x					x	x	x
5464-649	A	MODULE	ANALOG 8 CH 0-1MA OUT	x					x	x	x
5464-650	A	MODULE	ANALOG 8 CH 0-5V OUT	x					x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5464-652	A	MODULE	ANALOG 8 CH 0-10V OUT	x					x	x	x
5464-653	A	MODULE	32 CH DISCRETE OUT	x					x	x	x
5464-654	A	MODULE	64 CH DISCRETE OUT	x			n/a	x	x	x	x
5464-655	ANP	MODULE	4 CHANNEL ACTUATOR	x							
5464-656	ANP	MODULE	4 CH. ACT 4-20MA								
5464-657	ANP	MODULE	4 CHANNEL ACTUATOR								
5464-658	A	MODULE	DIGITAL SPEED SENSOR	x		x	n/a	x	x	x	x
5464-659	A	MODULE	DIGITAL SPEED SENSOR	x			n/a	x	x	x	x
5464-660	A	MODULE	ISO 4-20MA DERIVATIVE	x			n/a	x	x	x	x
5464-679	ANP	MODULE	NETCON 5000 CPU 40MHZ								
5464-697	ANP	MODULE	NETCON CPU 40MHZ W/FSH	x							
5464-752	ANP	MODULE	NON VOLATILE MEMORY								
5464-756	ANP	MODULE	NETCON NV MEMORY 4M								
5464-781	ANP	MODULE	NETCON ANALOG OVERSPEED								
5464-782	ANP	MODULE	NETCON ANALOG OVERSPEED								
5464-834	A	MODULE	DIGITAL SPEED SENSOR	x		x	n/a	x	x	x	x
5464-837	A	MODULE	ISO T/C ANALOG IN (HF)	x			n/a	x	x	x	x
5464-839	INA	MODULE	POSITION CONTROLLER TM								
5464-844	ANP	MODULE	DIGITAL SPEED SENSOR								
5464-850	A	MODULE	DIGITAL SPEED SENSOR	x			n/a	x	x	x	x
5464-935	ANP	MODULE	NETCON ANALOG OVERSPEED								
5464-936	ANP	MODULE	NETCON ANALOG OVERSPEED								
5466-001	ANP	MODULE	NETCON DUAL SOLENOID MONITOR								
5466-003	ANP	MODULE	NETCON PRESSURE XDCR OUTPUT								
5466-026	A	MODULE	NETCON DUPLEX CURRENT INPUT	x			n/a	x	x	x	x
5466-030	ANP	MODULE	POSITION CONTROLLER EM	x			n/a	x	x	x	x
5466-031	A	MODULE	NETCON I/O CONTROLLER	x		x	n/a	x	x	x	x
5466-037	ANP	MODULE	NETCON IIIB REAL TIME SIO								
5466-039	INA	MODULE	NetCon Kernal Power Supply						x	x	x
5466-045	INA	MODULE	PRESSURE XDUCER INTERFACE				n/a	x	x	x	x
5466-253	A	MODULE	ANALOG COMBO (TMR)	x			n/a	x	x	x	x
5466-254	ANP	MODULE	ACTUATOR DRIVER CH1,CH2 +/- 200MA WITH WIDE NULL SHIFT								
5466-255	ANP	MODULE	ACTUATOR DRIVER CH1,CH2 +/-200MA WITH WIDER NULL SHIFT								
5466-256	A	MODULE	FT DISCRETE I/O	x			n/a	x	x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5466-257	A	MODULE	HIGH DENSITY ANALOG I/O (TMR)	x					x	x	x
5466-258	A	MODULE	SIMPLEX DISCRETE I/O	x		x	n/a	x	x	x	x
5466-260	ANP	MODULE	NETCON IIIB REAL TIME SIO VER2.06								
5466-272	ANP	MODULE	NETCON DUAL SOLENOID MONITOR								
5466-285	A	MODULE	SOLENOID PROTECTION 4CHANNEL 18-30VDC								
5466-315	A	MODULE	HIGH DENSITY ANALOG I/O	x		x	n/a	x	x	x	x
5466-316	A	MODULE	ANALOG COMBO	x			n/a	x	x	x	x
5466-318	A	MODULE	MICRONET TMR KERNEL P.S.	x			n/a	x			
5466-320	A	MODULE	SOLENOID PROTECTION 4CHANNEL 18-30VDC								
5466-326	A	MODULE	NETCON IIIB PRESSURE INPUT	x		x	n/a	x	x	x	x
5466-328	A	MODULE	NETCON IIIB 3-9 PIN RT SIO	x		x	n/a	x	x	x	x
5466-332	A	MODULE	HIGH DENSITY ANALOG I/O	x		x	n/a	x	x	x	x
5466-344	ANP	MODULE	POSITION CONTROLLER EM DFB	x			n/a	x	x	x	x
5466-345	ANP	MODULE	POSITION CONTROLLER EM SFB	x			n/a	x			
5466-348	A	MODULE	NETCON 5000B SIO	x		x	n/a	x	x	x	x
5466-350	ANP	MODULE	NETCON CPU_060								
5466-351	ANP	MODULE	NETCON CPU_040 WITH LL MEMORY	x							
5466-352	ANP	MODULE	NETCON CPU_040 W/O LL MEMORY	x			n/a	x			
5466-353	A	MODULE	NETCON MAIN CHASSIS TR	x			n/a	x	x	x	x
5466-354	A	MODULE	NETCON REMOTE CHASSIS TRANSCEIVER	x			n/a	x			
5466-355	A	MODULE	NETCON REMOTE CHASSIS TRANSCEIVER	x			n/a	x	x	x	x
5466-400	A	MODULE	ISO 4-20 ANALOG INPUT	x							
5466-404	A	MODULE	DIGITAL SPEED SENSOR	x							
5466-405	ANP	MODULE	DIGITAL SPEED SENSOR								
5466-407	A	MODULE	PENTIUM 233MHZ CPU (W/O OP-SYS)	x			x		x	x	x
5466-409	INA	MODULE	MICRONET PENTIUM CPU,233MHZ,64MB RAM,NT4.0				n/a	x		x	x
5466-411	A	MODULE	MICRONET ETHERNET (RJ45)	x			n/a	x	x		x
5466-416	INA	MODULE	MICRONET PENTIUM WITH DUAL ETHERNET OPTION	x			n/a	x	x	x	x
5466-419	INA	MODULE	NETCON PENTIUM CPU, 233MHZ,128MB RAM,NT4.0,RTX4.3.2.1	x							
5466-425	A	MODULE	HIGH DENSITY ANALOG I/O (TMR)	x		x	n/a	x		x	x
5466-1000	A	MODULE	POWER SUPPLY, 2 SLOT, 24VDC INPUT, MICRONET-PLUS	x		x	x	x	x	x	
5466-1001	A	MODULE	POWER SUPPLY, 2 SLOT, 110VAC/125VDC	x		x	x	x	x	x	

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
			INPUT, MICRONET-PLUS								
5466-1002	A	MODULE	POWER SUPPLY, 2 SLOT, 220VAC INIPUT, MICRONET-PLUS	x		x	x	x	x	x	
5466-1005	A	MODULE	ISO T/C FAIL LOW	x							
5466-1006	A	MODULE	ISO T/C FAIL HIGH	x						x	
5466-1007	A	MODULE	ISO 4-20 ANALOG IN	x							
5466-1008	A	MODULE	ISO 0-10 V ANALOG	x							
5466-1009	A	MODULE	ISO 4-20 ANALOG IN	x							
5466-1010	A	MODULE	ISO 4-20 MA DERIVATIVE	x							
5466-1011	A	MODULE	ISO 4-20/ AD590 ANALOG IN	x							
5466-1012	A	MODULE	ISO T/C ANALOG IN (HF)	x							
5466-1013	A	MODULE	SEMI ISO RTD 100	x						x	
5466-1014	A	MODULE	SEMI ISO RTD 200	x							
5466-1015	A	MODULE	SEMI ISO RTD 500	x							
5466-1016	A	MODULE	SEMI ISO RTD 100 HIGH TEMP	x							
5466-1017	A	MODULE	SEMI ISO RTD 100 (10MS)	x							
5466-1018	A	MODULE	SEMI ISO RTD 200 (10MS)	x							
5466-1019	A	MODULE	SEMI ISO RTD 500 (10MS)	x							
5466-1020	A	MODULE	PENTIUM CPU W/ APPL S/W FOR D-R LM2500+								
5466-1035	A	MODULE	MICRONET CPU5200 (POWERPC MPC5200, 400MHZ, 64MB FLASH, 128MB RAM, DUAL CAN)	x		x	x	x	x	x	
5466-1036	A	MODULE	MICRONET REMOTE RTN (REMOTE REAL TIME NETWORK XCVR)	x		x	x	x	x	x	
5466-1037	A	MODULE	MICRONET CPU5200L (POWERPC MPC5200, SINGLE ETHERNET, SINGLE CAN, NO RTN)	x		x	x	x	x	x	
5466-1045	A	MODULE	MICRONET PLUS CPU5200 (CYBER-SECURITY)	x		x	n/a	x	x	x	x
5466-1046	A	MODULE	MICRONET PLUS RTN (CYBER-SECURITY)	x		x	n/a	x	x	x	x
5466-1047	A	MODULE	MICRONET TMR CPU5200, 400MHz, 64MB FLASH, 128MB RAM, NO-CAN	x		x	x	x			
5466-1049	A	MODULE	MICRONET TMR PLUS KERNEL P.S.	x			n/a	x			
5466-1050	A	MODULE	MICRONET DIO SIMPLEX	x		x	n/a	x	x	x	x
5466-1051	A	MODULE	MICRONET DIO TMR	x		x	n/a	x	x	x	x
5466-1070	A	MODULE	ANALOG COMBO (TMR) 3 MPU/1 PROX				n/a	x	x	x	x
5466-1105	A	MODULE	MICRONET SPEED/ANALOG I/O COMBO - 4X SPEED, 12X I/V SELECTABLE INPUTS, 4X 4-20 MA OUTPUTS	x		x	n/a	x			
5466-1115	A	MODULE	MICRONET HIGH DENSITY COMBO I/O -	x		x	n/a	x			

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
			4 SPEED INPUTS (SELECTABLE MPU/PROX/EDDY), 12 ANALOG INPUTS (SELECTABLE 4-20 MA OR 0-5 V), 4 ANALOG OUTPUTS (4-20 MA 600 OHM)								
5466-1141	NEW	MODULE	MICRONET PLUS CPU5200SA (SECURED APPLICATION)	x		X	n/a	X			
5466-1145	A	MODULE	MICRONET PLUS CPU5200 (CYBER-SECURITY) LICENSED	x		x	n/a	x			
5466-1146	A	MODULE	MICRONET PLUS RTN (CYBER-SECURITY) LICENSED	x		x	n/a	x			
5466-1156	A	MODULE	MICRONET TMR 48/24 HDDIO-2 SMART-PLUS	x		x	n/a	x			
5466-1158	A	MODULE	MICRONET SIMPLEX 48/24 HDDIO-2 SMART-PLUS	x		x	n/a	x			
5466-1245	A	MODULE	MICRONET PLUS CPU5200 (CYBER-READY) EHANCED PERF.	x		x	n/a	x	x	x	x
5466-1246	A	MODULE	MICRONET PLUS RTN (CYBER-READY) EHANCED PERF.	x		x	n/a	x	x	x	x
5466-1510	A	MODULE	MICRONET CPU 1020								
5466-1520	A	MODULE	MICRONET PLUS P1020 CPU (CYBER SECURITY APPLICATION)								
5466-5000	A	MODULE	MODULE - MICRONET SPEED SENSOR, 4 CHANNEL, MPU	X		x	n/a	X			
5466-5001	A	MODULE	MODULE - MICRONET SPEED SENSOR, 4 CHANNEL, EDDY PROBE CH1/MPU	X		x	n/a	x			
5466-5025	A	MODULE	MODULE - MICRONET HIGH DENSITY ANALOG I/O - 24 INPUTS (SELECTABLE 4-20 MA OR 0-5 V), 8 OUTPUTS (4-20 MA 600 OHMS) ISOLATED I/O	X		x	n/a	X			
5466-5026	A	MODULE	MODULE - MICRONET SIMPLEX HIGH DENSITY ANALOG I/O - 24X 4-20 MA INPUTS, 8X 4-20 MA OUTPUTS	x		x	n/a	X			
5466-5027	A	MODULE	MODULE - MICRONET SIMPLEX HIGH DENSITY ANALOG I/O - DATAFORTH 24X 0-5 V INPUTS, 8X 4-20 MA OUTPUTS	x		x	n/a	x			
5500-332	A	MODULE	RELAY								
5501-224	A	BOARD	FAULT TOLERANT RELAY								
5501-325	A	BOARD	MICRONET HV DISC FTM	x					x	x	x
5501-361	A	SENSOR	EMR 1000 Flex Circuit Speed						x		
5501-365	A	BOARD	ANALOG COMBO TMR FTM	x			n/a	x	x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5501-367	A	BOARD	MICRONET SIMPLEX LV DISCRETE FTM	x		x	n/a	x	x	x	x
5501-370	A	BOARD	5009/MICRONET TMR POWER SUPPLY (24V DC)	x			n/a	x	x	x	x
5501-371	A	BOARD	MICRONET SIMPLEX MPU & AIO FTM	x			n/a	x	x	x	x
5501-372	A	BOARD	HIGH DENSITY ANALOG I/O TRIPLEX FTM	x					x	x	x
5501-373	A	BOARD	F/T RELAY - UL APPROVED								
5501-376	A	BOARD	ANALOG HIGH DENSITY MODULE SIMPLEX FTM	x		x	n/a	x	x	x	x
5501-380	A	BOARD	5009/MICRONET TMR POWER SUPPLY (120V AC/DC)	x			x	x	x	x	x
5501-381	A	BOARD	5009/MICRONET TMR POWER SUPPLY (220V AC)	x			x	x	x	x	x
5501-409	A	Board	MicroNet Motherboard (6 Slot)	x					x		x
5501-410	INA	Board	MicroNet Power Supply (24V DC)	x					x		x
5501-411	INA	Board	MicroNet Power Supply (120V AC/DC)	x					x		x
5501-412	INA	Board	MicroNet Power Supply (220V AC)	x					x		x
5501-423	A	Board	MicroNet Motherboard (12 Slot)	x					x		x
5501-428	A	BOARD	NETCON 2CH ACTUATOR CONTROLLER (10MA)	x			n/a	x	x	x	x
5501-429	A	BOARD	NETCON 2CH ACTUATOR CONTROLLER (25MA)	x		x	n/a	x	x	x	x
5501-430	A	BOARD	NETCON 2CH ACTUATOR CONTROLLER (50MA)	x		x	n/a	x	x	x	x
5501-431	A	BOARD	NETCON 2CH ACTUATOR CONTROLLER (100MA)	x		x	n/a	x	x	x	x
5501-432	A	BOARD	NETCON 2CH ACTUATOR CONTROLLER (200MA)	x		x	n/a	x	x	x	x
5501-461	ANP	MODULE	POSITION CONTROLLER TM DFB	x				x	x	x	x
5501-462	ANP	MODULE	POSITION CONTROLLER TM SFB	x				x	x	x	x
5501-465	A	BOARD	MICRONET SIMPLEX POWER SUPPLY (24V DC)	x			x	x	x	x	x
5501-466	A	BOARD	MICRONET SIMPLEX POWER SUPPLY (120V AC/DC)	x			x	x	x	x	x
5501-467	A	BOARD	MICRONET SIMPLEX POWER SUPPLY (220V AC/DC)	x			x	x	x	x	x
5501-468	ANP	MODULE	NETCON CPU_040 W/O LL MEMORY				n/a	x			
5501-469	A	MODULE	NETCON CPU_040 WITH LL MEMORY (EMI FILTER)	x			n/a	x			
5501-470	A	MODULE	NETCON CPU_040 W/O LL MEMORY (EMI FILTER)	x			n/a	x			
5501-471	A	MODULE	NETCON 5000B SIO W/SCREW POSTS	x		x	n/a	x	x	x	x
5501-473	ANP	MODULE	NETCON DUAL OVERSPEED								

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
5501-476	ANP	MODULE	NETCON DUAL OVERSPEED								
5501-477	ANP	MODULE	NETCON DUAL OVERSPEED @ 5478 HZ								
5501-478	ANP	MODULE	NETCON DUAL OVERSPEED @ 5404 HZ								
5501-479	ANP	MODULE	NETCON DUAL OVERSPEED @ 6160 HZ								
5501-502	A	MODULE	TMR SPEED INPUT FTM								
5501-1428	A	MODULE	2CH ACTUATOR CONTROLLER (10MA) W/ FEEDBACK FAULT LATCHING	x		x	n/a	x	x	x	x
5501-1429	A	MODULE	2 CH ACTUATOR CONTROLLER (25MA) W/ FEEDBACK FAULT LATCHING	x		x	n/a	x	x	x	x
5501-1430	A	MODULE	2CH ACTUATOR CONTROLLER (50MA) W/ FEEDBACK FAULT LATCHING	x		x	n/a	x	x	x	X
5501-1431	A	MODULE	2CH ACTUATOR CONTROLLER (100MA) W/ FEEDBACK FAULT LATCHING	x		x	n/a	x	x	x	x
5501-1432	A	MODULE	2CH ACTUATOR CONTROLLER (200MA) W/ FEEDBACK FAULT LATCHING	x		x	n/a	x	x	x	x
5503-267	A	MODULE	NETCON IIIB 3-9 PIN RT SIO W/SCREW POSTS	x			n/a	x		x	
5503-279	A	BOARD	MICRONET HDVIM (AI/RTD/TC) THRU HOLE ASSY	x			x	x	x	x	x
5503-282	A	MODULE	FTM HDVIM (AI/RTD/TC) THRU HOLE ASSY	x			x	x	x	x	x
5503-335	AS	MODULE	MICRONET 5200 CPU, 400MHZ, 64MB FLASH, 128MB RAM	x			x	x		x	
5503-336	AS	MODULE	MICRONET REAL-TIME NETWORK XCVR (REMOTE)	x			x	x		x	
5503-904	A	MODULE	HD ANALOG I/O 12 CH 4-20MA AND 12 CH 0-5V	x							
801-1302	A	PCBA DWG	MICRONET DIO MODULE						x	x	
801-1306	A	PCBA DWG	HD DISCRETE I/O FTM RELAY DRIVER (24IN / 12OUT)						x	x	
8928-096	A	KIT	CPU EMI DB9 RS232 ADAPTOR								
901-1302	A	PCBA Schematic	MICRONET DIO MODULE						x	x	
901-1306	A	PCBA Schematic	HD DISCRETE I/O FTM RELAY DRIVER (24IN / 12OUT)							x	
9905-678	A	MODULE	LINKNET 6 CHANNEL 200 OHM RTD		x	x	n/a	x	x	x	x
9905-760	A	MODULE	ASSY OF LINKNET TERMINATION		x	x	n/a	x	x	x	x
9905-966	A	MODULE	LINKNET TC INPUT FAIL HIGH		x	x	n/a	x	x	x	x
9905-967	A	MODULE	LINKNET TC INPUT FAIL LOW		x	x	n/a	x	x	x	x

Part No	Status	Description	Extended Description	CSA	UL	ATEX	CE (LVD)	CE (EMC)	ABS	DNV	LRS
9905-968	A	MODULE	LINKNET 6 CHANNEL 4-20 MA IN		x	x	n/a	x	x	x	x
9905-969	A	MODULE	LINKNET 6 CHANNEL 4-20 MA IN W/ 24 V		x	x	n/a	x	x	x	x
9905-970	A	MODULE	LINKNET 6 CHANNEL 100 OHM RTD		x	x	n/a	x	x	x	x
9905-971	A	MODULE	LINKNET DISCRETE IN		x	x	n/a	x	x	x	x
9905-972	A	MODULE	LINKNET 6 CHANNEL 4-20 MA OUT		x	x	n/a	x	x	x	x
9905-973	A	MODULE	LINKNET DISCRETE OUT		x	x	n/a	x	x	x	x
9907-072	A	Power Supply	SGL Out 18-32 VDC NetCon	x			x	x	x	x	x
9907-073	A	Power Supply	Multi Out 18-32 VDC NetCon	x			x	x	x	x	x
9907-074	A	Power Supply	SGL Out 42-60 VDC NetCon	x			x	x	x	x	x
9907-075	A	Power Supply	Multi Out 42-60 VDC NetCon	x			x	x	x	x	x
9907-076	A	Power Supply	SGL Out 120 VAC/DC NetCon	x			x	x	x	x	x
9907-077	A	Power Supply	Multi Out 120 VAC/DC NetCon	x			x	x	x	x	x
9907-078	A	Power Supply	SGL Out 220 VAC/DC NetCon	x			x	x	x	x	x
9907-079	A	Power Supply	Multi Out 220 VAC/DC NetCon	x			x	x	x	x	x
9907-205	A	Programmer	Hand Held, CE Compliant, 4 Piece Kit				x	x	x		

Updated Sep 15, 2015 (File 00372-04-07-01.xlsx)

Status	Definition
A	Active
ANP	Active, Non-preferred
AS	Active Service
INA	Inactive

Appendix B. Environmental Specifications

Operating Temperature for the MicroNet Control using the 68040/060 CPU	0 to +55 °C (+32 to +131 °F), using the 68040/060 CPU, still air, no external heat loads Lloyd's: ENV 1
Operating Temperature for the MicroNet Control using the NT CPU	0 to +50 °C (+32 to +122 °F), with moving airflow as provided by MicroNet fans
Operating Temperature for the MicroNet Plus Control using the 5200 CPU	0 to +55 °C (+32 to +131 °F), with moving airflow as provided by MicroNet fans

NOTICE

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

Storage Temperature	–40 to +105 °C (–40 to +221 °F) (except CPU module: –20 to +45 °C (–4 to +113 °F) to maximize real time clock battery life). [NT CPU: –40 to +85 °C (–40 to 185 °F)] Component life is adversely affected by high temperature, high humidity environments. Room temperature storage is recommended for long life. If unit is to be stored for a long period of time, operating power must be applied for a few hours at least once every 18–24 months.
Humidity (MicroNet)	Lloyd's Register Test Specification No. 1, 1996, Humidity Test 2 (2 cycles 20–55 °C at 95% RH non-condensing, over 48 hours, powered on for the purpose of non-condensing) EN 50178 (96 hours @ 93 +2 -3% RH @ 40 °C (104 °F))
Humidity (MicroNet Plus)	Lloyd's Register Test Specification No. 1, 2002, Humidity Test 2 (2 cycles 20–55 °C at 95% RH non-condensing, over 48 hours, powered on for the purpose of non-condensing) EN 50178 (96 hours @ 93 +2 -3% RH @ 40 °C (104 °F))
Vibration (MicroNet)	Lloyd's Register Test Specification No. 1, 1996, Vibration Test 1 (5–13.2 Hz, ±1 mm; 13.2–100 Hz, ±0.7 g) EN 50178 vibration test 1 (10–57 Hz @ 0.075 mm amplitude and 57–150 Hz @ 1 g, 10 sweeps per axis at 1 octave/minute)
Vibration (MicroNet Plus)	Lloyd's Register Test Specification No. 1, 2002, Vibration Test 1 (3–16 Hz, ±1 mm; 16–100 Hz, ±1.0 g) EN 50178 vibration test 1 (10–57 Hz @ 0.075 mm amplitude and 57–150 Hz @ 1 g, 10 sweeps per axis at 1 octave/minute)
Shock	US MIL-STD-810C, Figure 516.2-1 procedure 1b (15 g 11 ms half sine pulse)
Air Quality	Pollution Degree 2
Altitude (max.)	4000 m
Installation Overvoltage Rating	Category II
Ingress Protection	In accordance with the requirements of IP20 as defined in IEC 529, unless mounted in a protective enclosure.
Sound Level	Less than 70 dBA
Weight	MicroNet Simplex and MicroNet Plus I/O Chassis Weight (varies with module set, and may require 2 people to lift safely): 22 kg (48 lb.) MicroNet TMR/5009 Main Power Supply Chassis Weight (varies with module set): 8 kg (17 lb.)
Dielectric Withstand	24 V power supply: 707 Vdc from power input to chassis AC/DC and HVAC version: 2200 Vdc from power input to chassis

⚠WARNING

Ground leakage exceeds 3.5 mA. Protective earth grounding is required.

Appendix C. MicroNet Hardware and Software Compatibility

IMPORTANT

- **Upgrading from one Control Platform to another typically requires hardware or CPU changes and a coder conversion.**
- **During upgrades, it is always recommended to verify that the system is using preferred hardware part numbers and current revisions to take advantage of any robustness improvements that have been made.**
- **When converting from older systems to the newer MicroNet Plus family, Coder 4.00 (or greater) must be used and all hardware modules must be preferred part numbers with current revisions as of OCT-2005.**
- **For specific I/O modules, important update notes are listed in the Module Compatibility list.**

C.1—Coder and CPU Compatibility Matrix

Table C-1. Coder Compatibility with CPU modules on different Control Platforms

						CPU Modules				
						PowerPC 5200 Cyber	PowerPC 5200	Pentium	Motorola x040	Motorola x060
Coder List			**Coder 6.x**			●				
			Coder 5.x				●			
			Coder 4.x				●			
			Coder 3.x					●	●	
			Coder 2.x						●	●
			Coder							
Control Platforms	**6.x**	**5.x**	**4.x**	**3.x**	**2.x**					
MicroNet Plus *	●	●	●			●	●			
MicroNet Simplex 12	●	●	●	●	●	●	●	●	●	●
MicroNet Simplex 6	●	●	●	●	●	●	●	●	●	●
MicroNet TMR		●			●		●		●	●
NetCon Simplex				●	●			●	●	●
NetCon Remote I/O					●				●	●
NetCon F/T					●				●	●

*—**NOTE**–CAN communications and short chassis enabled in Coder 4.02
5200 TMR only compatible with Coder 5.x

C.2—Module Compatibility Matrix

IMPORTANT

- **MicroNet Plus Family refers to using the 14 or 8 slot chassis.**
- **MicroNet Simplex Family refers to using the 12 slot or 6 slot chassis.**

Table C-2. Module Compatibility Matrix

Module Compatibility	MicroNet Family				
	Plus		Simplex		
Power Supplies	**Main**	**Exp**	**Main**	**Exp**	**Notes**
MicroNet Plus, 2-Slot	●	●			
MicroNet Simplex, 3-Slot			●	●	
CPU Modules					
CPU, PowerPC 5200	●		●		Released 2006 for CAN and short chassis. CyberSecure versions available 2012. Enhanced Performance version available 2014.
CPU, Pentium			●		
CPU, Motorola x040			●		
CPU, Motorola x060			●		
Expansion Transceivers					
Remote RTN Transceiver		●		●	Requires use of CPU5200. CyberSecure version available 2012. Enhanced Performance version available 2014.
Main Expansion XCVR (copper)			●	●	Not allowed with CPU5200
Remote Expansion XCVR (copper)			●	●	Not allowed with CPU5200
Fiber Optic Remote XCVR					Not allowed with CPU5200
Communication Modules					
Serial I/O (4 port)	●		●		Use revisions 5466-348A or 5501-471 NEW or greater
RTSIO, Real Time SIO (3ch)	●	●	●	●	
LINKnet LON Network Controller	●	●	●	●	
Ethernet module (1 port, 10Mbps)			●		Not allowed with CPU5200 or Pentium
Combo Modules					
High Density Analog (24/8 HDA)	●	●	●	●	Updated 2001 Rev E
24/8 Analog Smart-Plus Module	●	●	●	●	See section 9.28 for coder compatibility information.
Speed/Analog IO Combo Smart-Plus Module	●	●	●	●	See section 9.29 for coder compatibility information.
Discrete I/O Smart-Plus (48/24 HDDIO)	●	●			Released 2010. Coder 5.03 or greater required. Use 5466-1158 (Simplex) or 5466-1156 (TMR) for backward compatibility with Coder 4.06.
High Density Discrete (48/24 HDD)	●	●	●	●	Updated 2007. rev K or greater required for CPU5200
Analog Input MPU Combo (HDC)	●	●	●	●	Updated 2001 rev E
Analog Input TC/RTD (34ch HDVIM)	●	●	●	●	Available in Coder 3.02 and above Updated 2006 Rev D
Input Modules					
Speed Sensor MPU Input (4ch)	●	●	●	●	For CPU5200 Cyber-Security compatibility, see chart in section 9.26.1
Speed Sensor Smart-Plus Module	●	●	●	●	See section 9.27 for coder compatibility information.
Analog Input 4-20ma (8ch)	●	●	●	●	
Analog Input T/C (8ch)	●	●	●	●	
Analog Input RTD (8ch)	●	●	●	●	
Discrete Input (64ch)	●	●	●	●	
Discrete Input (32ch)	●	●	●	●	

Pressure Input	●	●	●	●	
Voltage Input (8ch)	●	●	●	●	
Output Modules					
Actuator Controller (2ch)	●	●	●	●	Updated 2006 Rev F
Integrating Actuator Driver (2ch)					Available in Coder 3.00 and below
Proportional Actuator Driver (4ch)	●	●	●	●	
Position Control Module (PCM)	●	●	●	●	
Analog Output 4-20ma (8ch)	●	●	●	●	
Voltage Output (8ch)	●	●	●	●	

Appendix D. Declarations

DECLARATION OF CONFORMITY

DoC No.:	00372-04-EU-02-01.DOCX
Manufacturer's Name:	WOODWARD INC
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	MicroNet™ Simplex, MicroNet™ Plus Digital Control Systems when installed in a non-EMI cabinet, 18-36 VDC.
Conformance to Directive(s):	2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments. 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
Marking(s):	Ⓔx Category 3 Group II G, Ex nA [nL] IIC T3 X
Applicable Standards:	EN 61000-6-4 (2011): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2 (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN60079-15; 2005: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection "n" EN 60079-0, 2004: Electrical apparatus for explosive gas atmospheres – Part 0: General Requirements.

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

MANUFACTURER

Signature

Christopher Perkins
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

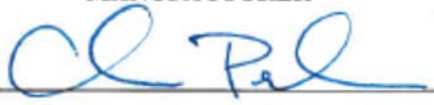
31-Jul-2015
Date

DECLARATION OF CONFORMITY

DoC No.:	00372-04-EU-02-02.DOCX
Manufacturer's Name:	WOODWARD INC
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	MicroNet™ Simplex, MicroNet™ Plus Digital Control Systems, when installed in a non-EMI cabinet, 88-264 VAC, and 100-300VDC.
Conformance to Directive(s):	2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments. Declared to 2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonized laws of Member States relating to electrical equipment designed for use within certain voltage limits.
Markings in addition to CE mark:	94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Ex Category 3 Group II G, Ex nA [nL] IIC T3 X
Applicable Standards:	EN 61000-6-4 (2011): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2 (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN60079-0: (2004) - Explosive Atmospheres - Part 0: Equipment – General requirements EN60079-15: (2005) - Explosive Atmospheres - Part 15: Equipment protection by type of protection "n"

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

MANUFACTURER



Signature

Christopher Perkins

Full Name

Engineering Manager

Position

Woodward, Fort Collins, CO, USA

Place

31-Jul-2015

Date

DECLARATION OF CONFORMITY

DoC No.:	00117-04-EU-02-01.DOCX
Manufacturer's Name:	WOODWARD INC
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	LinkNet Modules; Termination Module, 9905-760; T/C Input, 9905-966; -967; Analog Input, 9905-968; -969; RTD, 9905-970, -678; Discrete In, 9907-971; Analog Output, 9905-972; Discrete Out, 9905-973.
Conformance to Directive(s):	2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments. 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
Marking(s):	Ex Category 3 Group II G, Ex nA [nL] IIC T4 X
Applicable Standards:	EN 61000-6-4 (2011): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2 (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN60079-15; 2005: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection "n"

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

MANUFACTURER

Signature

Christopher Perkins

Full Name

Engineering Manager

Position

Woodward, Fort Collins, CO, USA

Place

10-Nov-2015

Date

Appendix E. Acronyms

A	Ampere
ac	Alternating Current
Act	Actuator
A/D	Analog-to-Digital
AD590	Temperature Measurement Device
AI	Analog Input
AM	Amplitude Modulated
App	Application
AO	Analog Output
ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
Baud	Bits per Second (Data Transmission Rate)
BIOS	Basic I/O Software
BOM	Bill of Materials
CAN	Control Area Network
CAT	Category
COAX	Co-axial
cm	Centimeter
CD-ROM	Computer Disc Read Only Memory
CE	Symbol representing compliance to the EU Directives
Ch	Channel
CJ	Cold Junction
CMRR	Common Mode Rejection Ratio
COM	Communication
Combo	Combination
CPU	Central Processor Unit
CSR	Control Status register
dB	Decibel
dc	Direct Current
DCS	Distributed Control System
DFB	Dual Feedback
DLE	Dry Low Emissions
DI	Discrete Input
DIN	Deutsche Institut für Normung
DIO	Discrete Input/Output
DIP	Dual Inline Package
DO	Discrete Output
DPDT	Double Pole/Double Throw
DRAM	Dynamic Random Access Memory
Drv	Driver
DSP	Digital Signal Processor
DTR	Data Terminal Ready
DUART	Dual Universal Asynchronous Receive/Transmit
EIA	Electronic Industry Alliance
EM	Woodward Actuation Family (Electric Motor)
EM-35	Woodward Actuation Model (Electric Motor)
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	Europäische norm (European Norm)
ESD	Electrostatic Discharge
EU	European Union

FDBK	Feedback
FDOC	Fixed Disk on Chip
FS	Full Scale
FTM	Field Termination Module
FPU	Floating Point Unit
G	Force of Gravity
GAP	Woodward Graphical Application Program(mer)
GND	Ground
GS	Woodward Gas Valve Family
HDVIM	High Density Versatile Input Module
HMI	Human Machine Interface
Hz	Hertz (cycles per second)
HD	High Density
HV	High Voltage
HVAC	High Voltage Alternating Current
IEC	International Electro technical Commission
IEEE	Institute of Electronic & Electrical Engineers
IP	Internet Protocol
I/O	Input/Output
IOLOCK	I/O Control Signal on MicroNet Motherboard
ISO	International Standards Organization
KB	Data Transmission Rate / 1000
KBAUD	Same as KB
LED	Light Emitting Diode
LINKnet	Woodward Local Area Network Product Line
LM	GE Gas Turbine Family
LPT1	Line Printer Terminal #1
LQ	Woodward Liquid Valve Family
LV	Low Voltage
LVD	Low Voltage Directive
LVDT	Linear Variable Differential Transformer
mA	Milliampere
Max	Maximum
Mbps	Million Bits per Second
MFT	Minor Frame Timer
Min	Minimum
MPU	Magnetic Pick-up
ms	Millisecond
mV	Millivolt
MUX	Multiplex(er)
NEC	(US) National Electrical Code
NTCPU	CPU That Runs Microsoft NT Operating System
NT Pentium	Same as NTCPU
NV	Non-volatile
OPC	OLE for Process Control (Communication Protocol)
OPSYS	Operating System
O/S	Overspeed
PC	Personal Computer
PC104	Type of Bus Structure Used in PC Industry
PCB	Printed Circuit Board
PCM	Position Controller Module
PCMCIA	Personal Computer Memory Card International Association
PE	Protective Earth
PPM	Parts Per Million
PROM	Programmable Read Only Memory
PS	Power Supply
PS/2	IBM trademark for keyboard/mouse port

PWM	Pulse Width Modulation
RAM	Random Access Memory
RTD	Resistance Temperature Device
RTN	Real Time Network
RVDT	Rotary Variable Differential Transformer
Rx	Receive
SAE	Society of Automotive Engineers
SFB	Single Feedback
Shld	Shield
Simplex	Control scheme that utilizes one core processor
SIO	Serial Input/Output
SPDT	Single Pole/Double Throw
SSTP	Shielded Shielded Twisted Pair
STP	Shielded Twisted Pair
SYSCON	System Controller
TC	Thermocouple
TCP/IP	Transmission Control Protocol/Internet Protocol
TM	Woodward Actuator Family (Torque Motor)
TM100	Woodward Actuator Model (Torque Motor)
TMR	Triple Modular Redundant
Tx	Transmit
USB	Universal Serial Bus
UART	Universal Asynchronous Receive/Transmit
UL	Underwriters Laboratories
Vac	Volts ac (Alternating Current)
Vdc	Volts dc (Direct Current)
VFD	Vacuum Florescent Display
VME	VERSA Module Eurocard
VRMS	Volts RMS (root mean square)
W	Watt
Xcvr	Transceiver
Xdcr	Transducer
68030	Motorola Microprocessor
68040	Motorola Microprocessor
µA	Microampere

Revision History

Changes in Revision W—
- Updated compliance chart in Appendix A

Changes in Revision V—
- Updated compliance chart in Appendix A

Changes in Revision U—
- Compliance updates to Appendix A

Changes in Revision T—
- Updated some figures and text as marked to improve clarity

Changes in Revision R—
- Updated several drawings as marked
- Updated LINKnet current input module information
- Updated Compatibility chart (Appendix C)

Changes in Revision P—
- Updated compliance and technical information as marked with change bars
- Updated Appendix A

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26166V2.

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