

Product Manual 26166V2 (Revision AE, 8/2024) Original Instructions

MicroNet[™] Simplex Digital Control MicroNet[™] Plus Digital Control

Manual 26166 consists of 3 volumes: (26166V1, 26166V2 & 26166V3)

Installation and Operation Manual



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Contents

| WARNINGS AND NOTICES | 5 |
|---|-----|
| ELECTROSTATIC DISCHARGE AWARENESS | 7 |
| CHAPTER 9. ACTUATOR MODULES | 8 |
| 9.1. Introduction | |
| 9.2. Two Channel Actuator Controller | |
| CHAPTER 10. LINKNET I/O NETWORK | |
| | |
| CHAPTER 11. SPECIALTY FUNCTION MODULES | |
| 11.2. Dual Overspeed Module | |
| 11.3. Dual Solenoid Monitor Module | |
| 11-4. 5466-285 Solenoid Protection 4 Channel Module Operation | |
| CHAPTER 12. FIELD TERMINATION MODULES (FTMs) | 35 |
| 12.1. Introduction | |
| 12.2. Analog I/O FTMs | |
| 12.3. Discrete I/O FTM | |
| 12.4. Relays | |
| 12.5. 4-Channel Transformer Isolation Module | |
| CHAPTER 13. DISTRIBUTED I/O NETWORK | |
| CHAPTER 14. INSTALLATION AND REPLACEMENT PROCEDURES | |
| 14.1. Pre-Installation Information | |
| 14.2. Installation Procedures | |
| · | |
| CHAPTER 15. PRODUCT SUPPORT AND SERVICE OPTIONS | |
| Product Support Options | |
| Returning Equipment for Repair | |
| Replacement Parts | |
| Engineering Services | 115 |
| Contacting Woodward's Support Organization | |
| Technical Assistance | |
| APPENDIX A. MATRIX OF MODULES WITH COMPLIANCE INFORMATION | 117 |
| APPENDIX B. ENVIRONMENTAL SPECIFICATIONS | 127 |
| APPENDIX C. MICRONET HARDWARE AND SOFTWARE COMPATIBILITY | 128 |
| C.1. Coder and CPU Compatibility Matrix | 128 |
| C.2. Control Platforms and CPU Compatibility Matrix | |
| C.3. Module Compatibility Matrix | |
| APPENDIX D. ACRONYMS | |
| REVISION HISTORY | 136 |
| DECLAPATIONS | 138 |

Illustrations and Tables

| Figure 9-1. Two Channel Actuator Controller Module | 9 |
|--|----|
| Figure 9-2. Two Channel Actuator Controller Module, Wiring Example | 11 |
| Figure 9-3. Notch Filter (part number 5437-845) | 12 |
| Figure 9-4. Two Channel Actuator Controller Module Block Diagram | 13 |
| Figure 9-5. Real Time SIO Module | 14 |
| Figure 9-6. Sample System Configuration | 15 |
| Figure 9-7. Wiring Diagram for the Real Time SIO Module | 16 |
| Figure 9-8. Shield Termination Diagram | 17 |
| Figure 11-1. Pressure Transducer Interface Module | 20 |
| Figure 11-2. Module Block Diagram | |
| Figure 11-3. Dual Overspeed Module | 23 |
| Figure 11-4. Dual Solenoid Monitor Module | 29 |
| Figure 11-5. External Solenoid Driver | 33 |
| Figure 11-6. 4 Channel Solenoid Protection Module | |
| Figure 11-7. Solenoid 4CH Protection Functional Diagram | 34 |
| Figure 12-1. 34Ch HDVIM FTM (AI/RTD/TC) | 35 |
| Figure 12-2. 34Ch HDVIM FTM Outline Dimensions | 36 |
| Figure 12-3a. 34Ch HDVIM FTM Schematic (part 1) | 36 |
| Figure 12-3b. 34Ch HDVIM FTM Schematic (part 2) | 37 |
| Figure 12-4. 34Ch HDVIM FTM Cold Junction Sensor Schematic | 38 |
| Figure 12-5. 24/8 Analog FTM | 38 |
| Figure 12-6. 24/8 Analog FTM Outline Dimensions | 38 |
| Figure 12-7. 24/8 Analog FTM Schematic | 40 |
| Figure 12-8. Dataforth FTM | |
| Figure 12-9. Dataforth FTM Outline Dimensions | 41 |
| Figure 12-10. Dataforth FTM Schematic (Inputs) | 42 |
| Figure 12-11. Dataforth FTM Schematic (Outputs) | 43 |
| Figure 12-12. Example of Dataforth SCM7B Modules | 44 |
| Figure 12-13. Four Channel Actuator Driver FTM | 44 |
| Figure 12-14. Four Channel Actuator Driver FTM Outline Dimensions | 45 |
| Figure 12-15. Four Channel Actuator Output FTM Schematic | 45 |
| Figure 12-16. Two Channel Actuator Controller FTM | 46 |
| Figure 12-17. Two Channel Actuator Controller FTM Outline Dimensions | |
| Figure 12-18. 2Ch Actuator Output FTM Schematic | |
| Figure 12-19. Analog Input FTM | 48 |
| Figure 12-20. Analog Input FTM Outline Dimensions | 48 |
| Figure 12-21. Analog Input FTM Schematic | |
| Figure 12-22. TC Input FTM | |
| Figure 12-23. TC Input FTM Outline Dimensions | |
| Figure 12-24. TC Input FTM Schematic | |
| Figure 12-25. Analog Combo FTM | |
| Figure 12-26. Analog Combo FTM Outline Dimensions | |
| Figure 12-27. Analog Combo FTM Schematic | |
| Figure 12-28. Non-Standard Analog Input FTM | |
| Figure 12-29. Non-Standard Analog Input FTM Outline Dimensions | |
| Figure 12-30. Non-Standard Analog Input FTM Schematic | |
| Figure 12-31. 24 Vdc Discrete Input/Output FTM | |
| Figure 12-32. 24 Vdc Discrete Input/Output FTM Outline Dimensions | |
| Figure 12-33. 24 Vdc Discrete Input/Output FTM Schematic | |
| Figure 12-34. Position Controller FTM | |
| Figure 12-35. Position Controller FTM Outline Dimensions | |
| Figure 12-36. Position Controller FTM Schematic | |
| Figure 12-37. 24/12 Discrete Module | |
| Figure 12-38. 24/12 Discrete Module Outline Dimensions | |
| Figure 12-39. 24/12 Discrete Module Schematic | |
| Figure 12-40. 24 Vdc 48/24 Discrete FTM | 62 |

Manual 26166V2

| Figure 12-41. 24 Vdc 48/24 Discrete FTM Outline Dimensions | |
|---|----------|
| Figure 12-42. 24 Vdc 48/24 Discrete FTM Schematic | 63 |
| Figure 12-43. 125 Vdc 48/24 Discrete FTM Schematic | 64 |
| Figure 12-44. 125 Vdc 48/24 Discrete FTM Outline Dimensions | |
| Figure 12-45a. 125 Vdc 48/24 Discrete FTM Schematic (part 1) | |
| Figure 12-45b. 125 Vdc 48/24 Discrete FTM Schematic (part 2) | |
| Figure 12-46. Discrete Input (with LEDs) FTM | |
| Figure 12-47. Discrete Input (with LEDs) FTM Outline Dimensions | |
| Figure 12-48. Discrete Input (with LEDs) FTM Schematic | |
| Figure 12-49. 24/12 Discrete I/O (with LEDs) FTM | |
| Figure 12-50. Discrete I/O (with LEDs) FTM Outline Drawings | |
| Figure 12-51. Discrete I/O (with LEDs) FTM Block Diagram | |
| Figure 12-52. Discrete Output Relay Connection Example | |
| Figure 12-53. 16 Channel Relay Module (Phoenix Contact) | |
| Figure 12-54. 16 Channel Relay Module (Phoenix Contact) Configuration | |
| Figure 12-55. 16 Channel Relay Module (Phoenix Contact) Outline Dimensions | |
| Figure 12-56. 16 Channel Relay Module (Phoenix Contact) Schematic | |
| Figure 12-57. 16 Channel Relay Module | |
| Figure 12-58. 16 Channel Relay Module Configuration | |
| Figure 12-59. 16 Channel Relay Module Outline Dimensions | |
| Figure 12-60. Relay Contact Connections for a 16 Charmer Relay Box | |
| Figure 12-62. 16 Channel Relay Module I/O Lock and Second Relay Module Feedthrough Circuits | |
| Figure 12-63. 32 Channel Relay Module De-rating Curves | |
| Figure 12-63. 32 Channel Relay Module De-rating Curves | |
| Figure 12-65. 32 Channel Relay Module Outline Dimensions | |
| Figure 12-66. Relay Contact Connections for a 32 Channel Relay Module | |
| Figure 12-67. Typical 32 Channel Relay Module Driver Circuit (K1) | |
| Figure 12-68. 32 Channel Relay Module I/O Lock Circuit. | |
| Figure 12-69. 4 Channel Isolation Module | 03 10 |
| Figure 12-70. Schematic Diagram of the 4-Channel Isolation Module | 04 85 |
| Figure 12-71. 4-Channel Isolation Module Outline Dimensions | 05 28 |
| Figure 14-1. MicroNet Power Supply | |
| Figure 14-2. 16 Channel Relay Box Outline Drawing | |
| Figure 14-3. 32 Channel Relay Box Outline Drawing | |
| Figure 14-4. FTM Grounding and Outlines | |
| Figure 14-5. Analog Cable Shield Termination Diagram Examples | |
| Figure 14-6. Discrete Cable Grounding Diagram Example | |
| Figure 14-7. Shield Termination Diagram Example | |
| Figure 14-8. Discrete I/O Cable Grounding Diagram Example | |
| Figure 14-9. Bottom Cable Entry Area | |
| Figure 14-10. Door Bonding | |
| Figure 14-11a. Cable Entry # 1 | |
| Figure 14-11b. Cable Entry # 2 | |
| Figure 14-12. Zoning | |
| · · · · · · · · · = · = · · · · · · · · | |
| Table 9-1. Module Specification | 9 |
| Table 9-2. RS-485 Ports | |
| Table 9-3. Cable Specifications | |
| Table 9-4. Fault LED Definitions | |
| Table 9-5. Real-Time SIO Module Detected I/O Faults | 18 |
| Table 11-1. Pressure Transducer Interface Module Specification | |
| Table 11-2. Fault LED Definitions | |
| Table 11-3. Installation Module Input Signals | |
| Table 11-4. Installation Module Output Signals | |
| Table 11-5. Overspeed Frequency Trip Setpoint Calculation Example | |
| Table 11-6. Overspeed Trip Setpoint Jumper Configuration Options | |
| Table 11-7. Low Frequency Input Setpoint Calculation | |
| Table 11-8. Dual Solenoid Monitor Module Input Signals | |
| . • | |

Released

Manual 26166V2MicroNet Simplex & MicroNet PlusTable 12-1. Dataforth Module Types43Table 12-2. Derating Curves for 32 Channel Relay Module78Table 12-3. Module Ratings85Table C-1. Coder Compatibility with CPU Modules128Table C-2. Control Platforms with CPU Modules129Table C-3. CPU/RTN/RTN Gateway Compatibility Matrix130Table C-4. Module Compatibility Matrix131The following are trademarks of Woodward, Inc.:
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Warnings and Notices

Important Definitions



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

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

MARNING

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 deenergized.
- 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.



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.



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.



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.

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.

- 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.
- 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.



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

Safety Symbols



Direct Current



Alternating Current



Both Alternating and Direct Current



Caution, risk of electrical shock



Caution, refer to accompanying documents



Protective conductor terminal



Frame or chassis terminal

Chapter 9. Actuator Modules



Refer to Manual 26166, Volume 1 for Required Safety Instructions, Special Conditions for Safe Use and Hazardous Location Requirements to ensure the control is used in a safe manner in Ordinary, Marine, Hazardous, and ATEX locations. Volume 1 must be fully understood and complied with for all applications.

9.1. 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.



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.

9.2. Two Channel Actuator Controller

9.2.1. Module Description

Figure 9-3 is a block diagram of the two-channel actuator controller module. Each channel controls an integrating or proportional, hydro mechanical, 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 9-1. Two Channel Actuator Controller Module

Table 9-1. 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 200 kΩ

Circui

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

9.2.3. 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 9-2 shows examples of the field wiring for various transducer types.

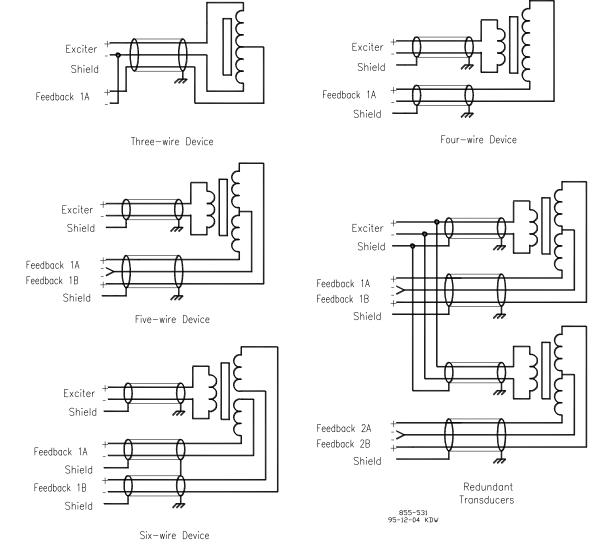


Figure 9-2. Two Channel Actuator Controller Module, Wiring Example

9.2.4. 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.

9.2.5. Woodward Notch Filter

- Reference Part Number: 5437-845
- Reference Drawing Number: 9933-651
- 2 Channel Actuator Controller Modules 5501-428, -429, -430, -431, -432, -1428, -1429, -1430, -1431, -1432

NetCon, MicroNet, and MicroNet Plus control systems with multiple 2 CH Actuator modules (part numbers 5501-428, -429, -430, -431, -432, -1428, -1429, -1430, -1431, -1432), 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 9-3. Notch Filter (part number 5437-845)

9.2.6. 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.

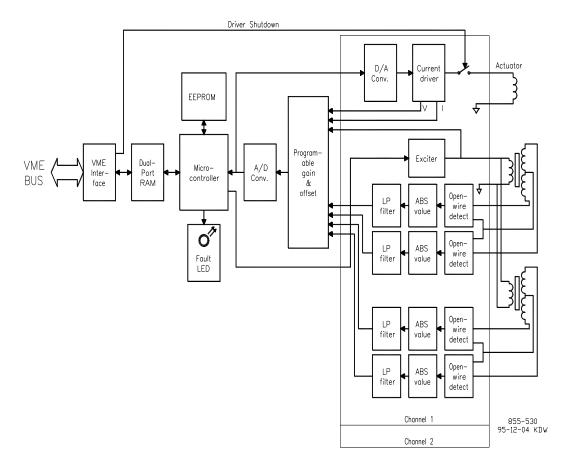


Figure 9-4. Two Channel Actuator Controller Module Block Diagram

9.3. Simplex Real Time SIO

9.3.1. 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

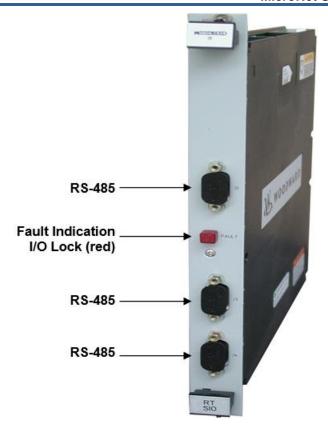


Figure 9-5. Real Time SIO Module

9.3.2. Module Specification

Table 9-2. 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

9.3.3. 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.

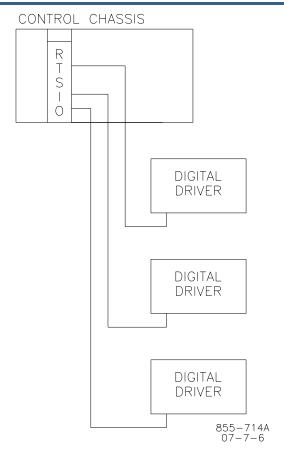


Figure 9-6. Sample System Configuration

9.3.4. 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.

9.3.5. Field Wiring

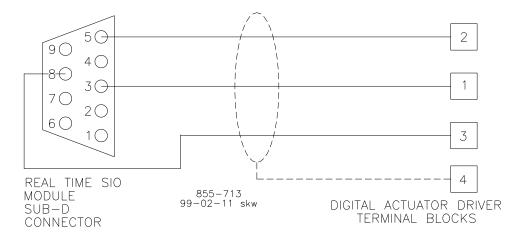


Figure 9-7. Wiring Diagram for the Real Time SIO Module

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 9-3. 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 |



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.

9.3.6. 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.

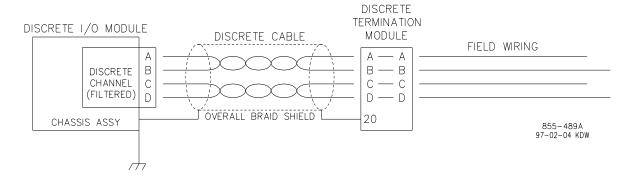


Figure 9-8. Shield Termination Diagram

9.3.7. 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 9-4. Fault LED Definitions

| Number of LED | Failure |
|---------------|--------------------------------------|
| flashes | |
| 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 deenergized.

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

Table 9-5. 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

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.

Chapter 10. LINKnet I/O Network

Note: This chapter has been moved to Volume 3. Please see manual 26166V3 Chapter 10.

Chapter 11. Specialty Function Modules

11.1. Pressure Transducer Interface Module

11.1.1. 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 11-1. Pressure Transducer Interface Module

11.1.2. Module Specification

Table 11-1. 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.



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.

11.1.3. 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).

11.1.4. 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 11-2 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).

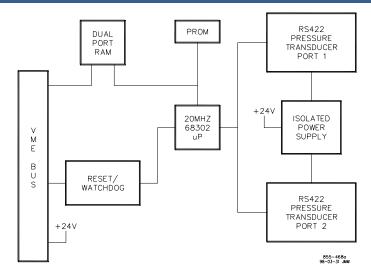


Figure 11-2. Module Block Diagram

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 11-2. 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.

11.2. Dual Overspeed Module

11.2.1. 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 11-3. 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).

11.2.2. Installation

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

Table 11-3. 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 "low" to activate override. | PIN 23 | TB 34 | PIN 23 "high" = OFF state for the input failed override, PIN 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 11-4. Installation Module Output Signals

| Table 11-4. Installation Module Output Olgitals | | | | |
|---|--|--------|--------------|---|
| 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 deenergize 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 deenergize 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. |

| Manual 26166V2 | | | | MicroNet Simplex & MicroNet Plus |
|----------------|--|--------|-------|---|
| | s (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. |

11.2.3. 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.

11.2.4. 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 11-5. Overspeed Frequency Trip Setpoint Calculation Example

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

11.2.5. 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 11-6. Overspeed Trip Setpoint Jumper Configuration Options

| Channel No. 1 | Channel No. 2 | REQUIV | Freq @ RADJ Min | Freq @ RADJ Max |
|---------------|---------------|-------------------------|-----------------|-----------------|
| JR11 | JR26 | $7.50~\mathrm{k}\Omega$ | 7488 Hz | 2828 Hz |
| JR12 | JR24 | 23.2 kΩ | 3265 Hz | 1900 Hz |
| JR13 | JR25 | $9.75~\mathrm{k}\Omega$ | 6313 Hz | 2642 Hz |
| JR11 & JR13 | JR26 & JR 25 | 4.24 kΩ | 10,240 Hz | 3148 Hz |

11.2.6. 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 11-7. Low Frequency Input Setpoint Calculation

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

Channel No. 1 Example with all Q jumpers installed

FFAIL = FOUT / QCNT

- ∴FFAIL = 20 KHz / QJPR1 + QJPR3 + QJPR5 + QJPR7 + QJPR9
- \therefore 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

11.3. 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.

11.3.1. Module Description



Figure 11-4. 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 11-8. 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. |

MicroNet Simplex & MicroNet Plus

| 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. |
| 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. |

MicroNet Simplex & MicroNet Plus

| INPUT | DESCRIPTION | PIN (S) | FTM TB(S) | LOGIC STATE |
|------------------------------------|--|--------------------|----------------|--|
| + 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 11-9. 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. |
| 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. |

| OUTPUT | DESCRIPTION | PIN (S) | FTM TB(S) | LOGIC STATE |
|----------------------------------|---|---------|--------------|---|
| 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 |



See the board layout and schematic listed in Appendix A.

11.3.2. 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) \therefore 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 = 1.0Ω , Vtrip = 2.5 A

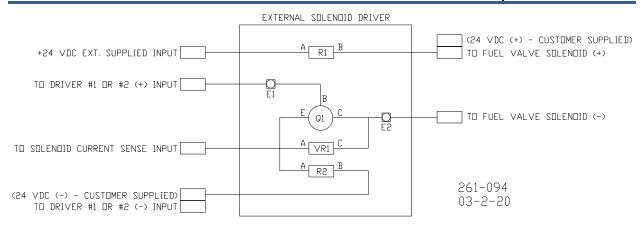


Figure 11-5. External Solenoid Driver

11-4. 5466-285 Solenoid Protection 4 Channel Module Operation

The 5466-285 Solenoid Protection 4 Channel 18-24VDC Module is an independent device used to close a Solenoid Fuel Shutoff Valve in the case of a low current situation such as an open, broken or loose wire or connection. The power is latched away or turned off to the solenoid and will not re-latch to guard against intermittent faults. It utilizes 4 thyristors (SCR), one per solenoid rated at 8 Amps. It is a protection device used on multiple valves including gas and liquid block valves.

- In normal state, there is no voltage passed through the thyristor anode/cathode so there is no current through the solenoid even if commanded from the MicroNet for that particular valve.
- When a command from the MicroNet is issued and at the same time a 'Fuel Initialize' pulse command has to be issued to supply power at the gate of the thyristor to open the valve.
- If no load is sensed (an open), it will not complete the circuit and the valve will not open.
- If the solenoid load is lost during the operation (open, broken or loose wire or connection), the thyristor will not flow current and the valve is closed.
- After closing, when fuel is cutoff to the engine, the supply side to the SCR is then turned off from the MicroNet. The solenoid is isolated on both sides to guard against possible leakage current ground faults.
- If the Solenoid connection is re-made, the thyristor will not flow current without a 'Fuel Initialize' pulse command from the MicroNet and the trip string energized.
- A fuse should be included in the circuit to guard against an over current condition due to a short or other fault.



Figure 11-6. 4 Channel Solenoid Protection Module

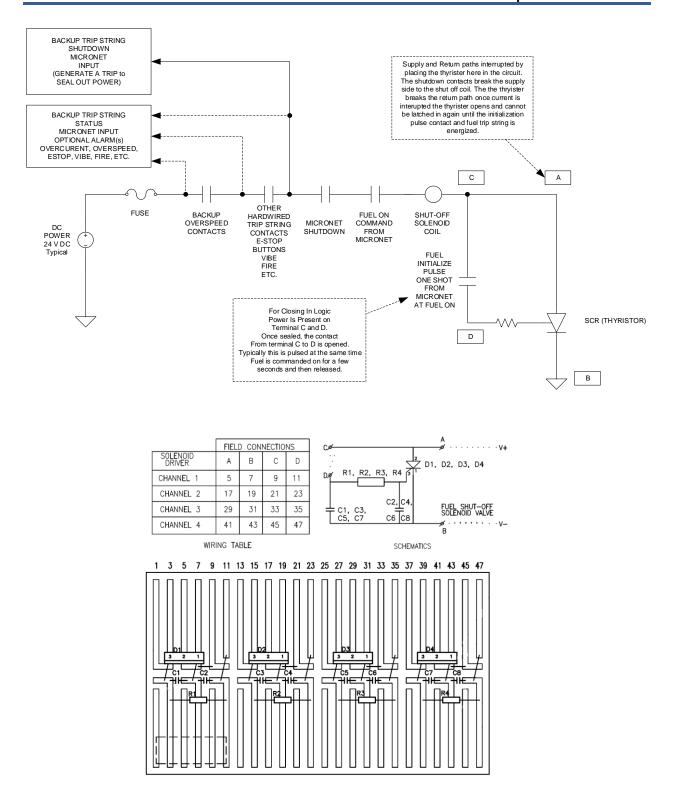


Figure 11-7. Solenoid 4CH Protection Functional Diagram

Chapter 12. Field Termination Modules (FTMs)

12.1. 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.

12.2. Analog I/O FTMs

12.2.1. 34Ch HDVIM FTM (AI/RTD/TC)



Figure 12-1. 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.

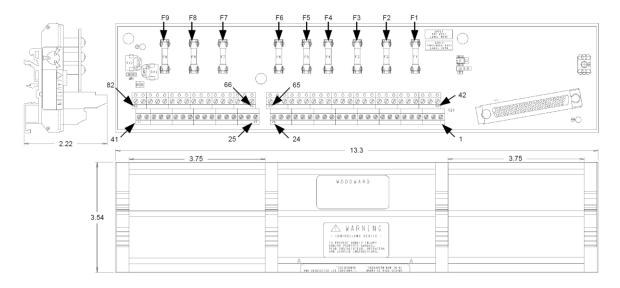


Figure 12-2. 34Ch HDVIM FTM Outline Dimensions

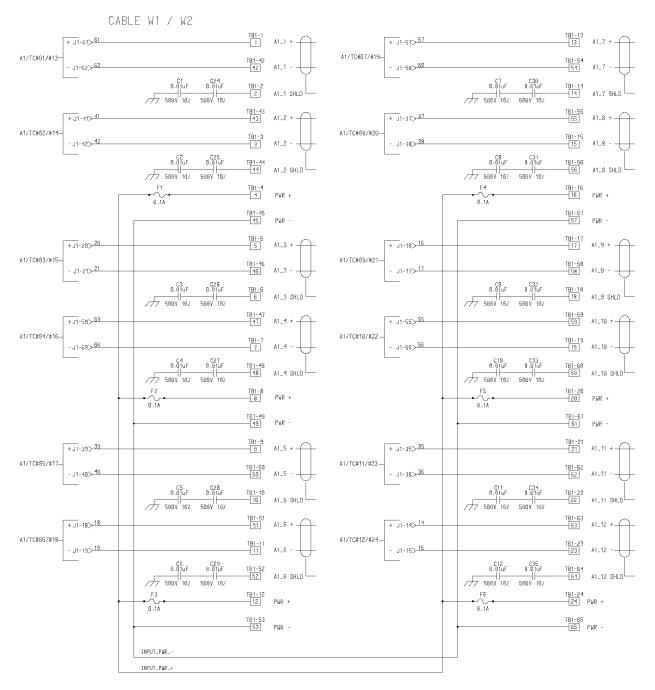


Figure 12-3a. 34Ch HDVIM FTM Schematic (part 1)

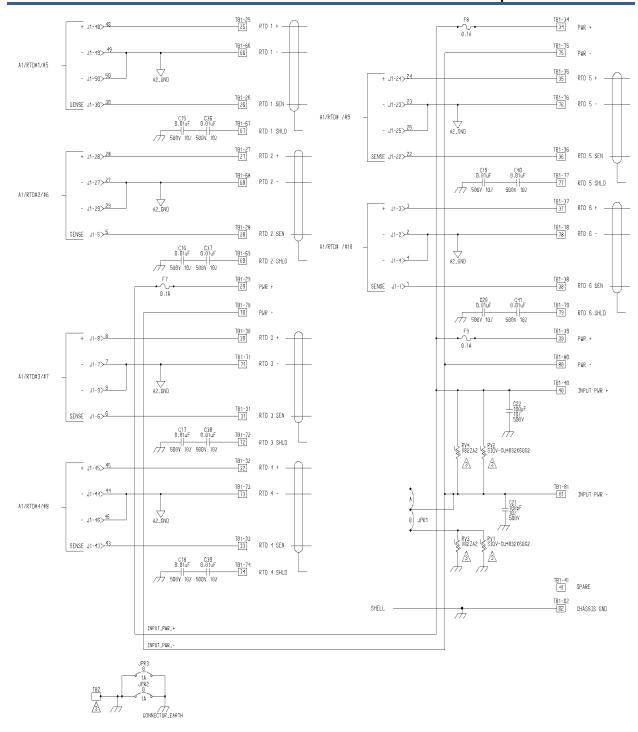


Figure 12-3b. 34Ch HDVIM FTM Schematic (part 2)

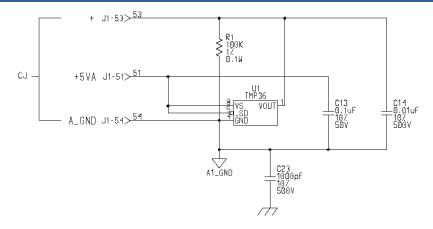


Figure 12-4. 34Ch HDVIM FTM Cold Junction Sensor Schematic

12.2.2. 24/8 Analog FTM



Figure 12-5. 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.

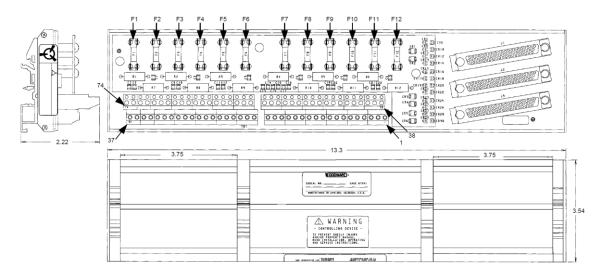


Figure 12-6. 24/8 Analog FTM Outline Dimensions

Replacing a Fuse on the Field Termination Module (FTM)

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



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 12-4 for channel fuse location.
- 4. Replace the FTM cover.

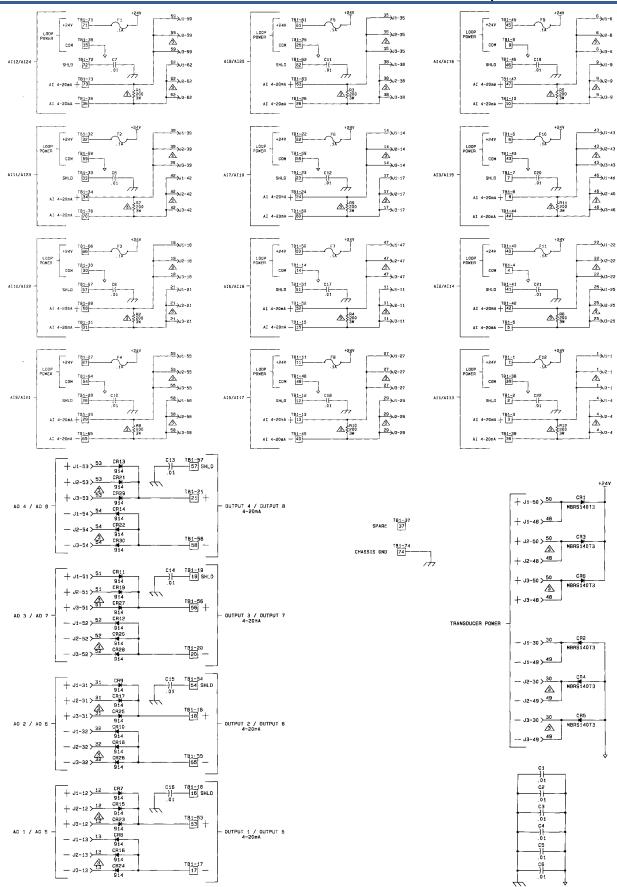


Figure 12-7. 24/8 Analog FTM Schematic

12.2.3. Dataforth FTM

[Shown without I/O modules installed]

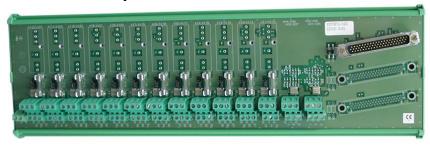


Figure 12-8. Dataforth FTM

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.

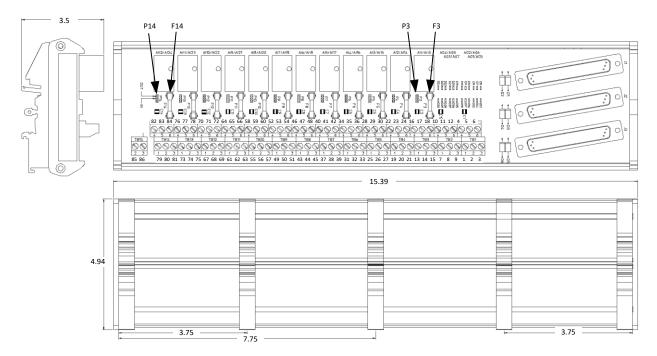


Figure 12-9. Dataforth FTM Outline Dimensions

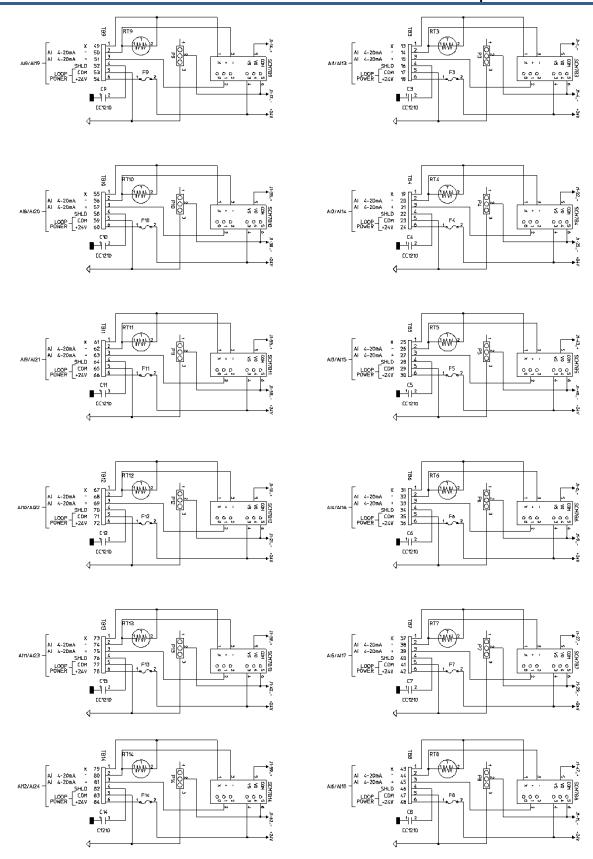


Figure 12-10. Dataforth FTM Schematic (Inputs)

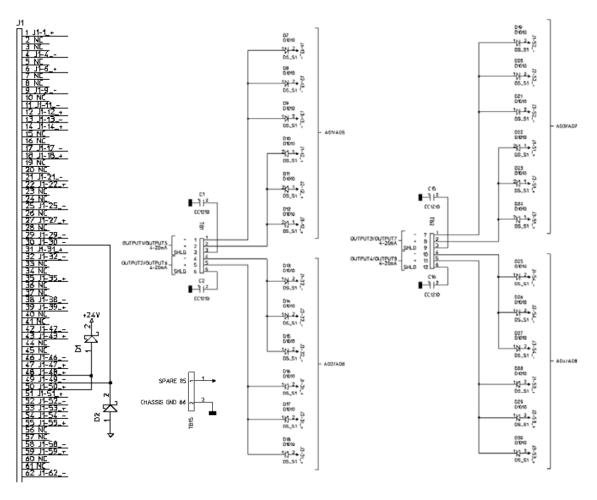


Figure 12-11. Dataforth FTM Schematic (Outputs)

There are currently five SCM7B signal-conditioning modules available for the Dataforth FTM. See Table 12-1 for available signal conditioning modules.

Table 12-1. Dataforth Module Types

| Type Module | Description | Woodward P/N | Dataforth P/N |
|-----------------------|---------------------------|--------------|---------------|
| 4-20 mA Input Module | Pass Through +200Ω Module | 1784-659 | SCM7BPT-1460 |
| 0–5 Vdc Input Module | Pass Through Module | 1784-657 | SCM7BPT |
| 0-10 Vdc Input Module | Isolated Voltage Input | 1751-6020 | SCM7B31-01 |
| RTD (100Ω) Module | European Curve | 1784-655 | SCM7B34-1582 |
| RTD (200Ω) Module | European Curve | 1784-675 | SCM7B34-1583 |
| TC Module | Type K | 1784-1028 | SCM7B47K-1574 |



Figure 12-12. Example of Dataforth SCM7B Modules

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

12.2.4. 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 used to connect the FTM with the 4Ch Actuator module (see Appendix A for part numbers).



Figure 12-13. Four Channel Actuator Driver FTM

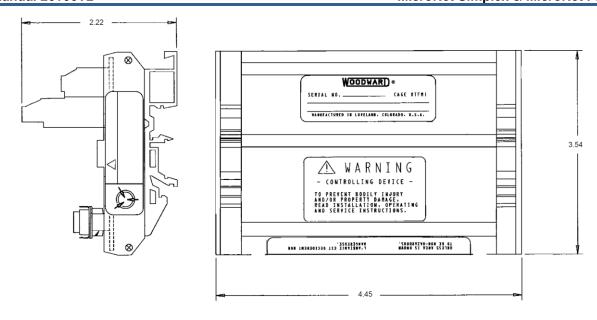


Figure 12-14. Four Channel Actuator Driver FTM Outline Dimensions

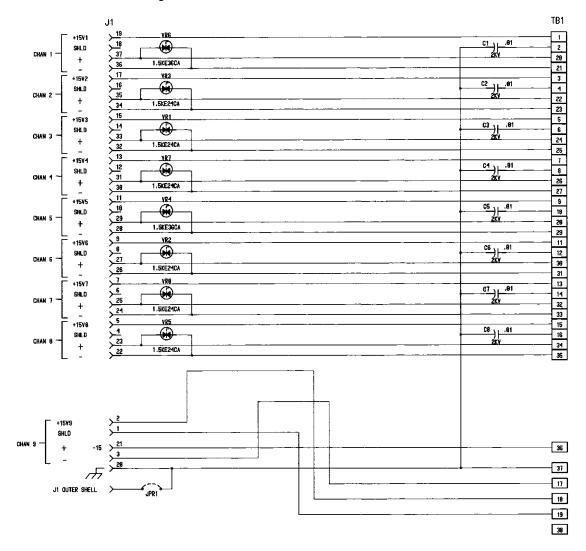


Figure 12-15. Four Channel Actuator Output FTM Schematic

12.2.5. 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 12-16. Two Channel Actuator Controller FTM

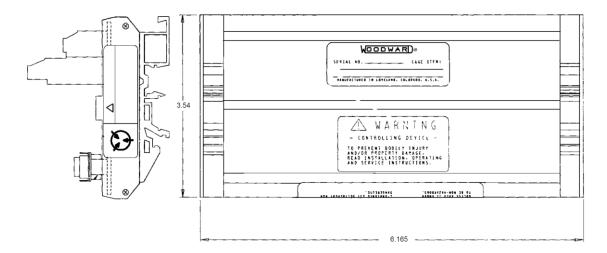


Figure 12-17. Two Channel Actuator Controller FTM Outline Dimensions

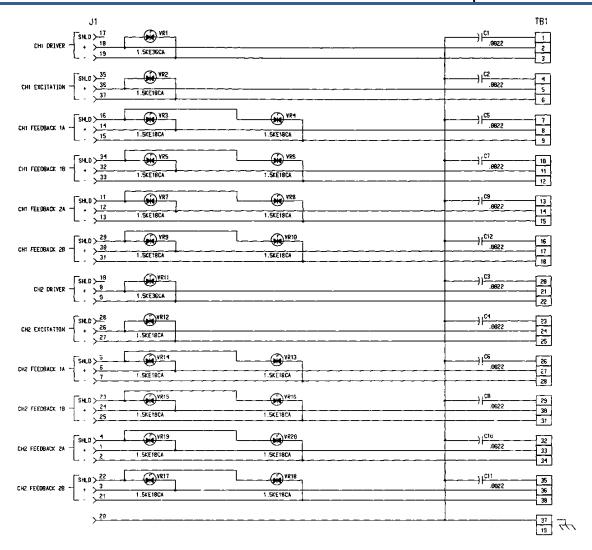


Figure 12-18. 2Ch Actuator Output FTM Schematic

12.2.6. 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 12-19. Analog Input FTM

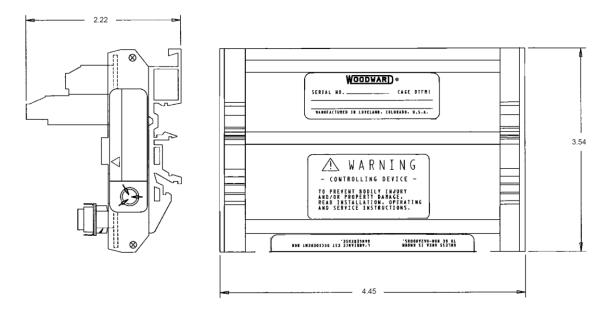


Figure 12-20. Analog Input FTM Outline Dimensions

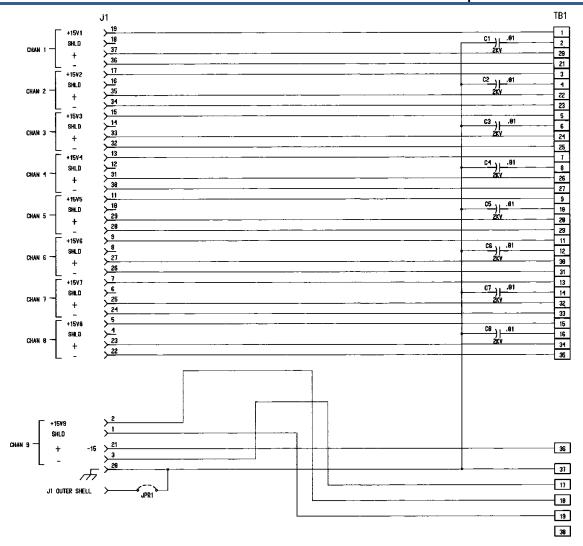


Figure 12-21. Analog Input FTM Schematic

12.2.7. 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 used 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 12-22. TC Input FTM

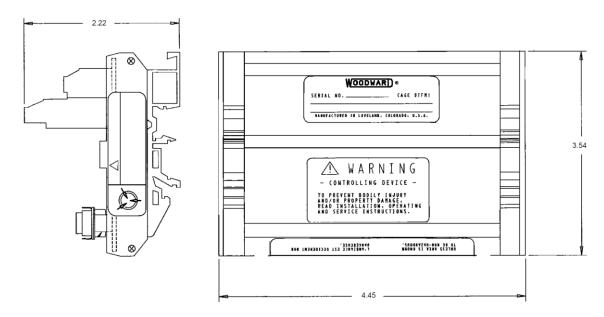


Figure 12-23. TC Input FTM Outline Dimensions

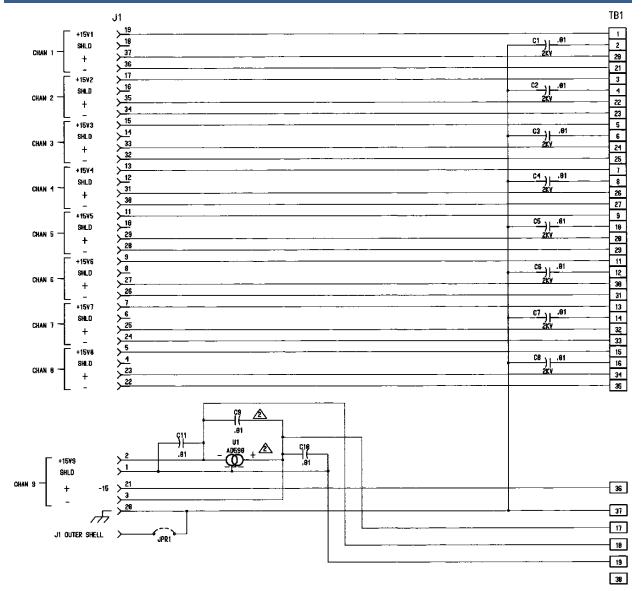


Figure 12-24. TC Input FTM Schematic

12.2.8. 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 12-25. Analog Combo FTM

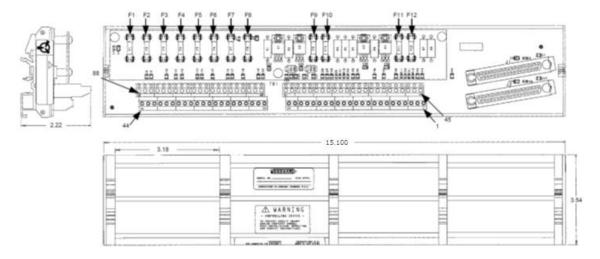


Figure 12-26. Analog Combo FTM Outline Dimensions

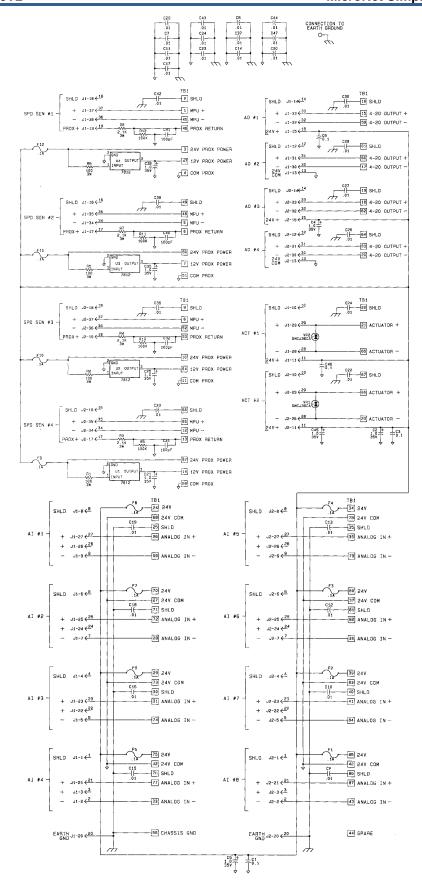


Figure 12-27. Analog Combo FTM Schematic

12.2.9. 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 12-28. Non-Standard Analog Input FTM

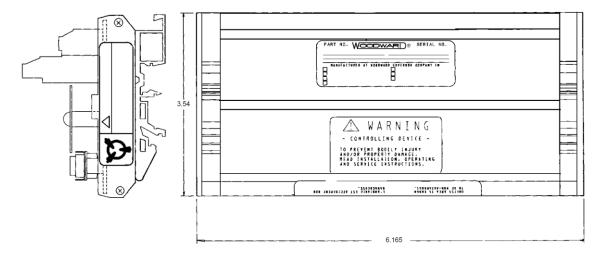


Figure 12-29. Non-Standard Analog Input FTM Outline Dimensions

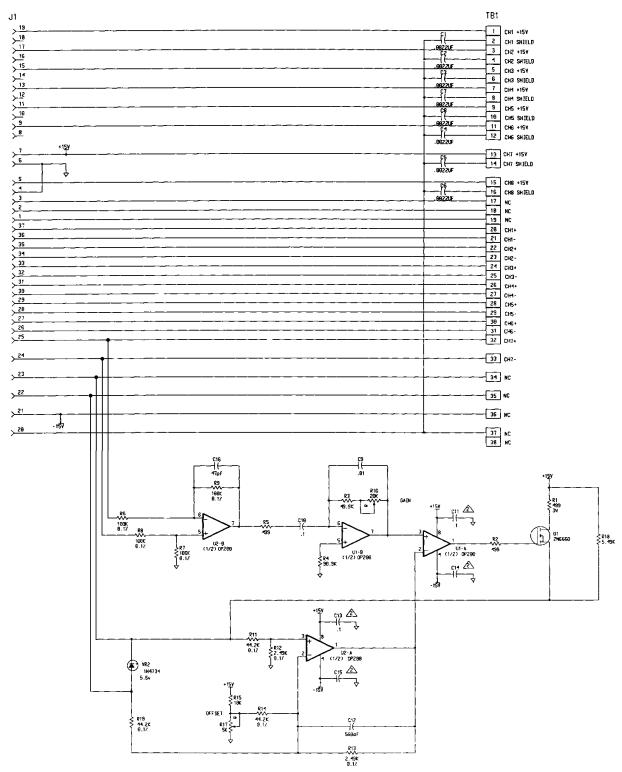


Figure 12-30. Non-Standard Analog Input FTM Schematic

12.3. Discrete I/O FTM

12.3.1. 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 12-31. 24 Vdc Discrete Input/Output FTM

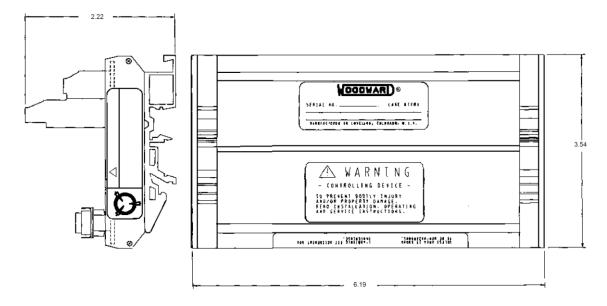


Figure 12-32. 24 Vdc Discrete Input/Output FTM Outline Dimensions

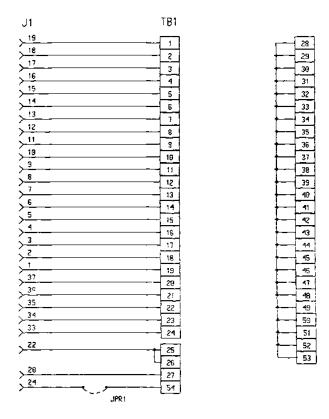


Figure 12-33. 24 Vdc Discrete Input/Output FTM Schematic

12.3.2. 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 12-34. Position Controller FTM

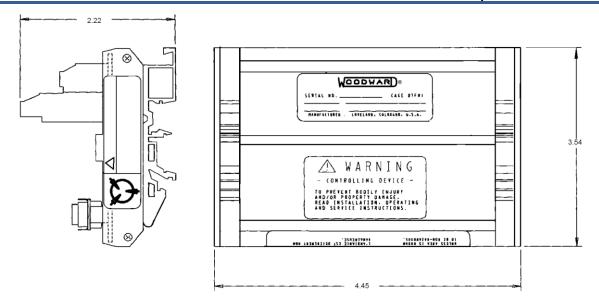


Figure 12-35. Position Controller FTM Outline Dimensions

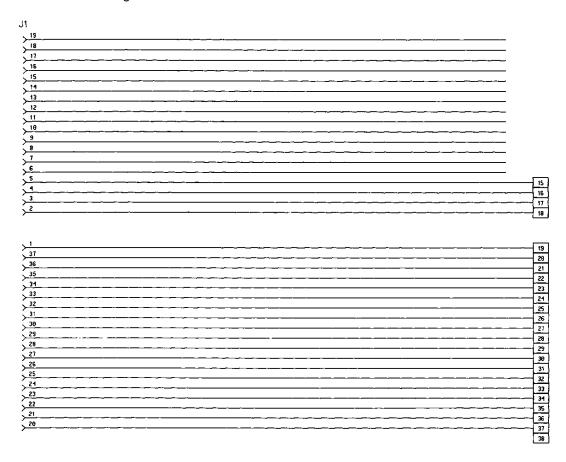


Figure 12-36. Position Controller FTM Schematic

12.3.3. 24/12 Discrete Module (Phoenix Contact)



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 12-37. 24/12 Discrete Module

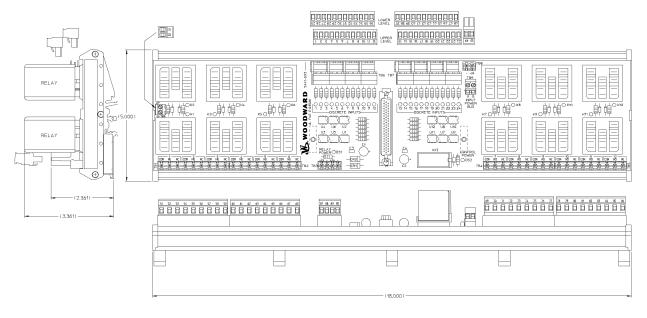


Figure 12-38. 24/12 Discrete Module Outline Dimensions

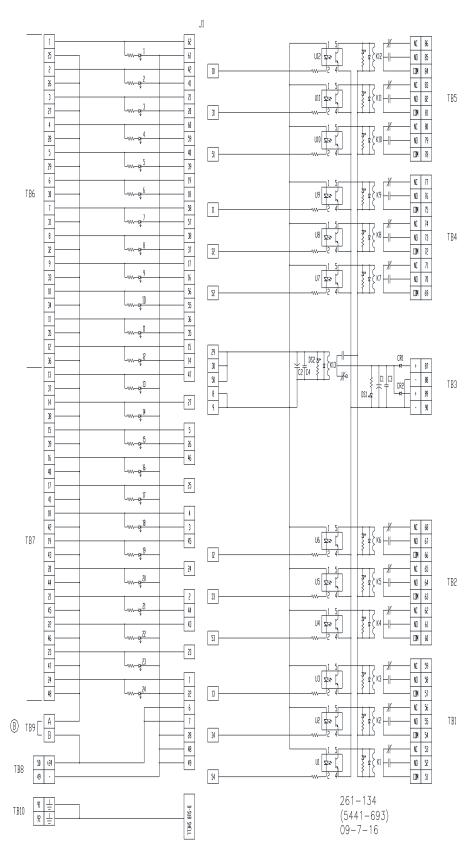


Figure 12-39. 24/12 Discrete Module Schematic

12.3.4. 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. The 48/24 Discrete FTM may supply contact-wetting voltage. 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 $100 \div V$, 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 12-40. 24 Vdc 48/24 Discrete FTM

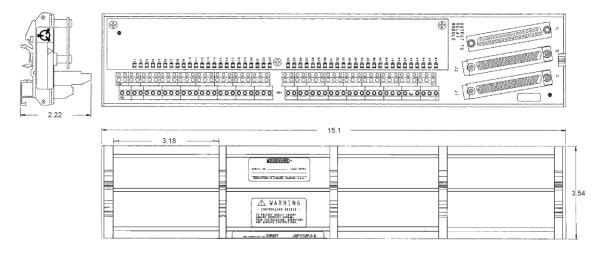


Figure 12-41. 24 Vdc 48/24 Discrete FTM Outline Dimensions

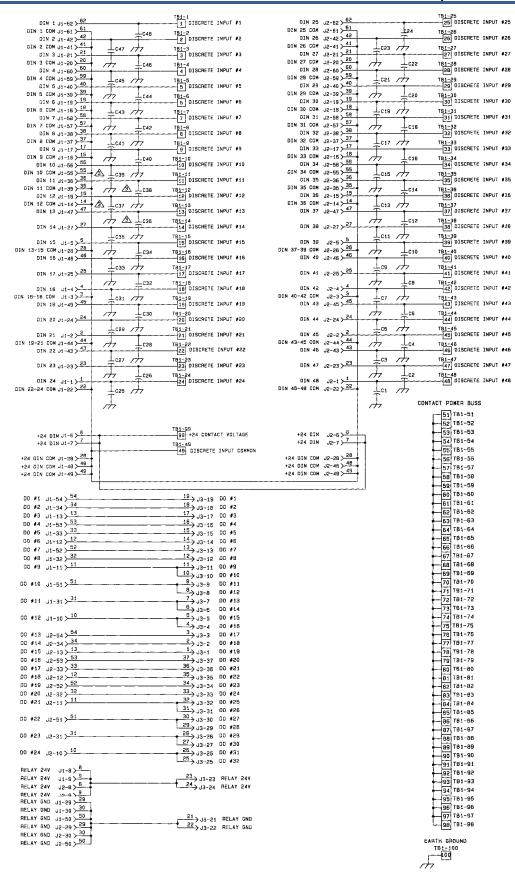


Figure 12-42. 24 Vdc 48/24 Discrete FTM Schematic

12.3.5. 125 Vdc 48/24 Discrete FTM



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.

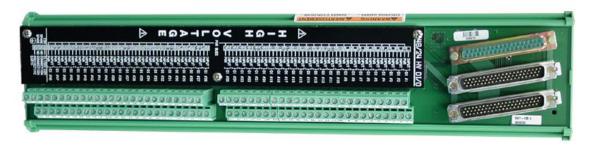


Figure 12-43. 125 Vdc 48/24 Discrete FTM Schematic

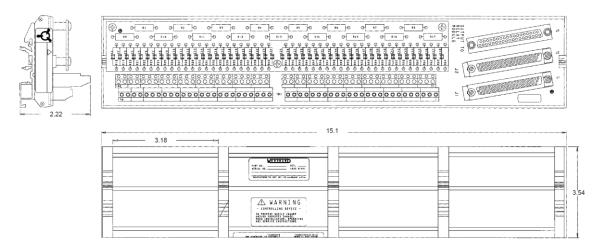


Figure 12-44. 125 Vdc 48/24 Discrete FTM Outline Dimensions

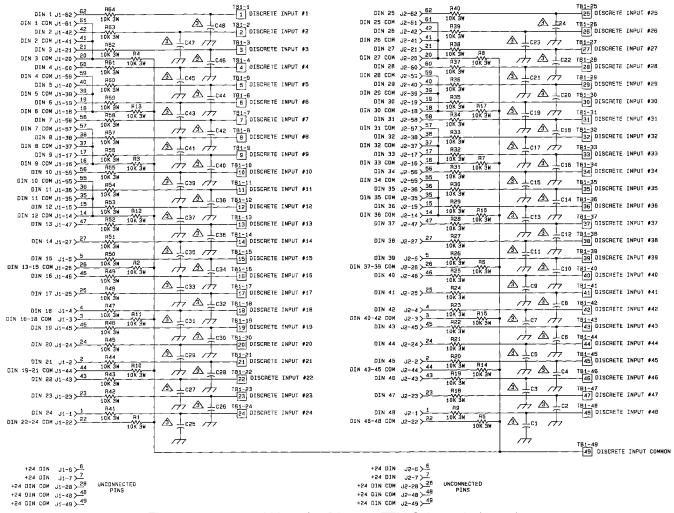


Figure 12-45a. 125 Vdc 48/24 Discrete FTM Schematic (part 1)

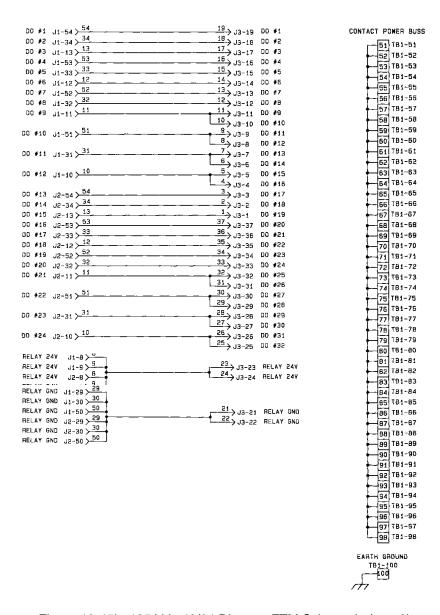


Figure 12-45b. 125 Vdc 48/24 Discrete FTM Schematic (part 2)

12.3.6. Discrete Input (with LEDs) FTM



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 12-46. Discrete Input (with LEDs) FTM

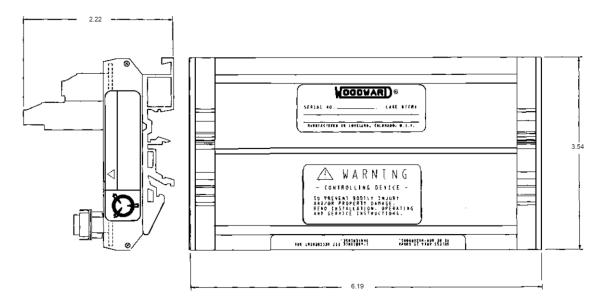


Figure 12-47. Discrete Input (with LEDs) FTM Outline Dimensions

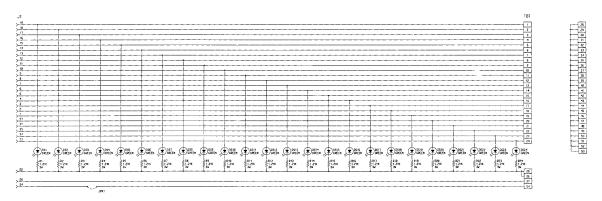


Figure 12-48. Discrete Input (with LEDs) FTM Schematic

12.3.7. 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 12-49. 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

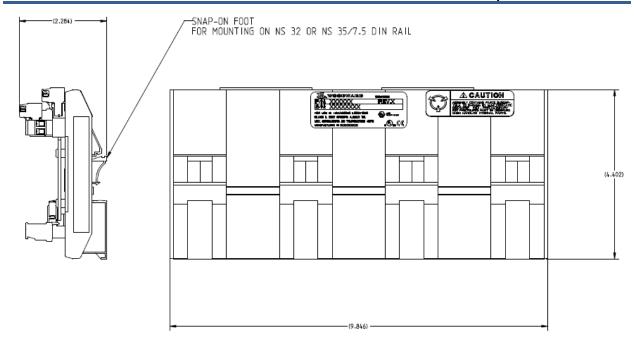


Figure 12-50. Discrete I/O (with LEDs) FTM Outline Drawings

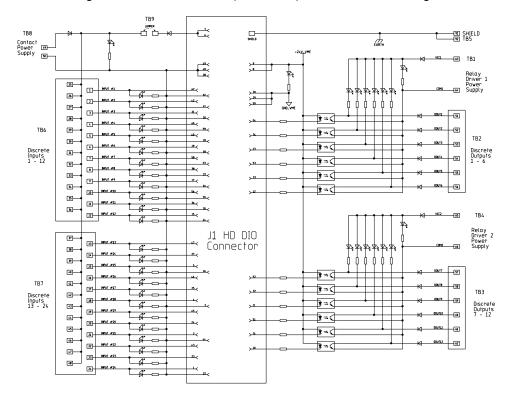


Figure 12-51. Discrete I/O (with LEDs) FTM Block Diagram

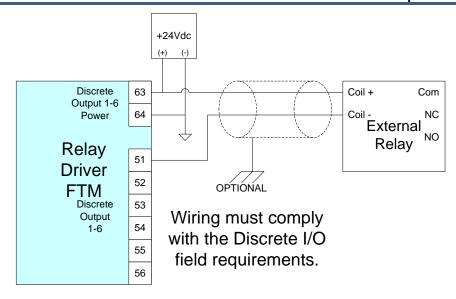


Figure 12-52. Discrete Output Relay Connection Example



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.

12.4. Relays

12.4.1. 16 Channel Relay Module (Phoenix Contact)



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 12-53. 16 Channel Relay Module (Phoenix Contact)

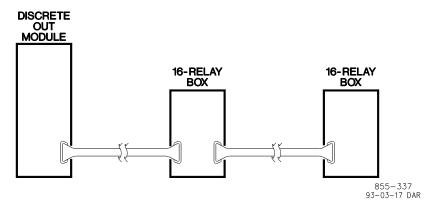


Figure 12-54. 16 Channel Relay Module (Phoenix Contact) Configuration

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)



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.

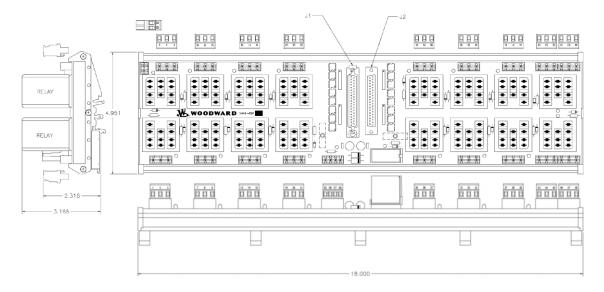


Figure 12-55. 16 Channel Relay Module (Phoenix Contact) Outline Dimensions

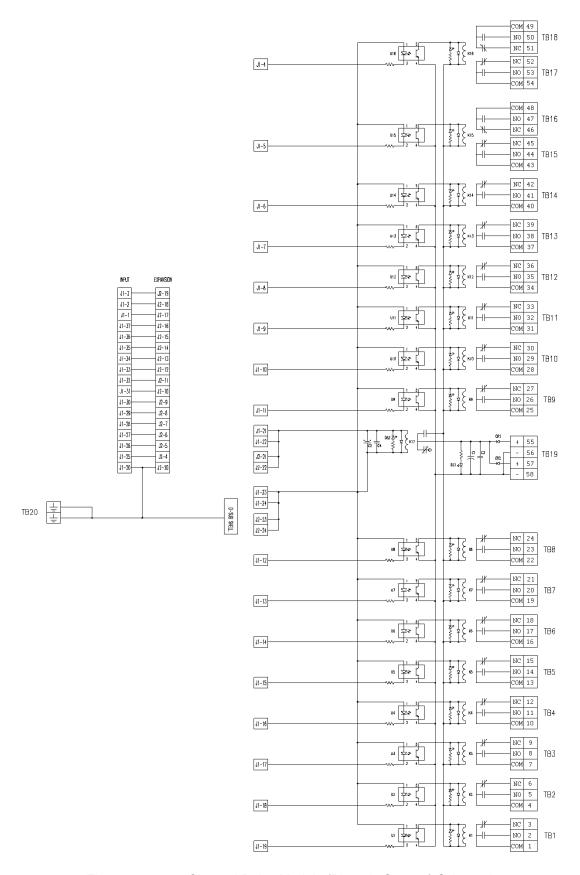


Figure 12-56. 16 Channel Relay Module (Phoenix Contact) Schematic

12.4.2. 16 Channel Relay Module



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 12-57. 16 Channel Relay Module

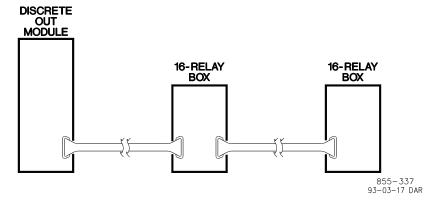


Figure 12-58. 16 Channel Relay Module Configuration

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.

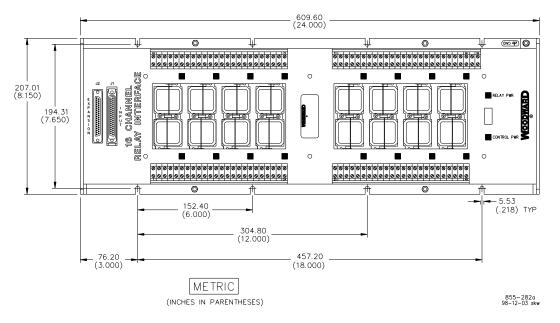


Figure 12-59. 16 Channel Relay Module Outline Dimensions

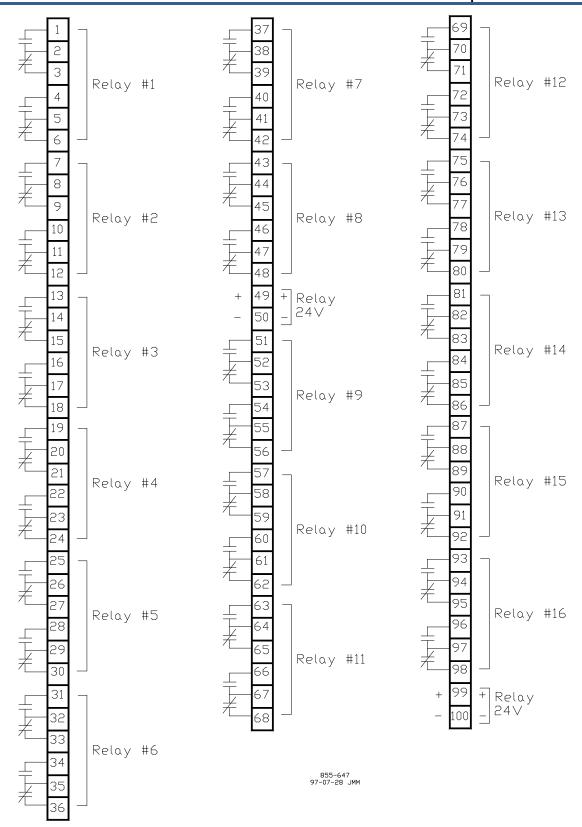


Figure 12-60. Relay Contact Connections for a 16 Channel Relay Box

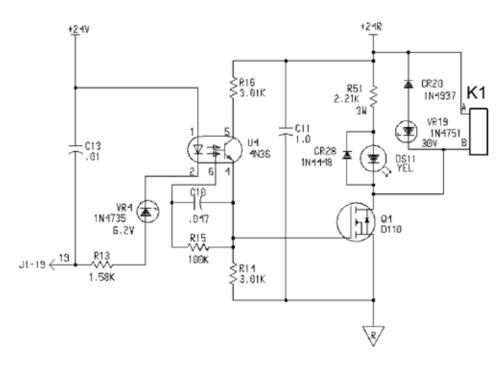


Figure 12-61. Typical 16 Channel Relay Module Relay Driver Circuit (K1)

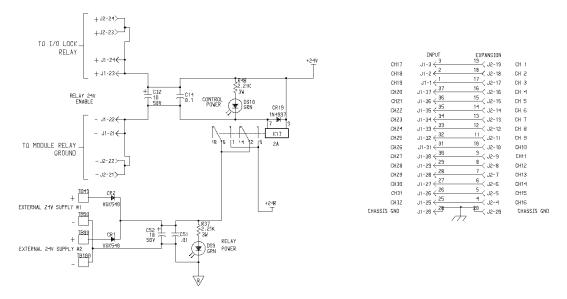


Figure 12-62. 16 Channel Relay Module I/O Lock and Second Relay Module Feedthrough Circuits

12.4.3. 32 Channel Relay Module (with 2 amp DPDT relays)



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). Derating curves must be applied in applications using the 32 Channel Relay Module.

Table 12-2. Derating Curves for 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.



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.



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.

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 12-45) 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.

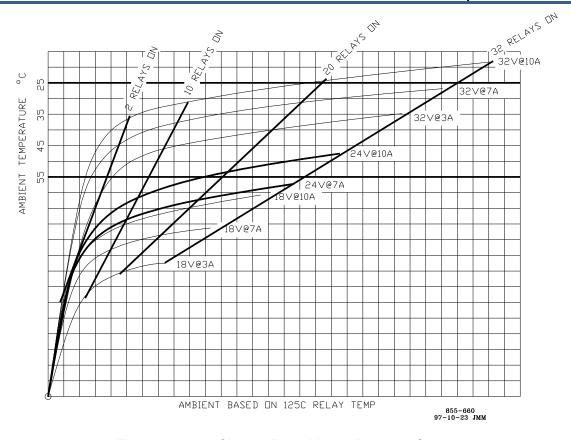


Figure 12-63. 32 Channel Relay Module De-rating Curves

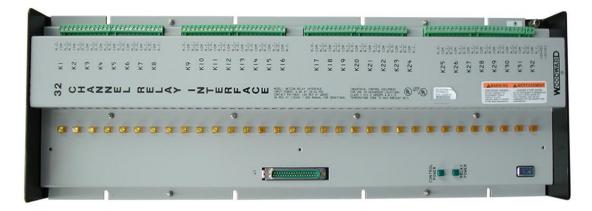


Figure 12-64. 32 Channel Relay Module

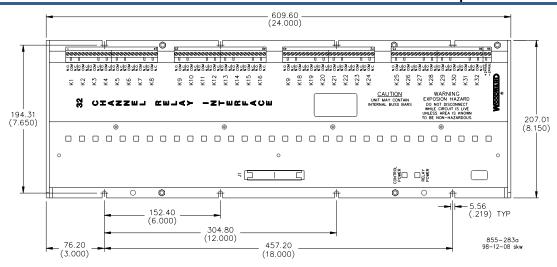


Figure 12-65. 32 Channel Relay Module Outline Dimensions

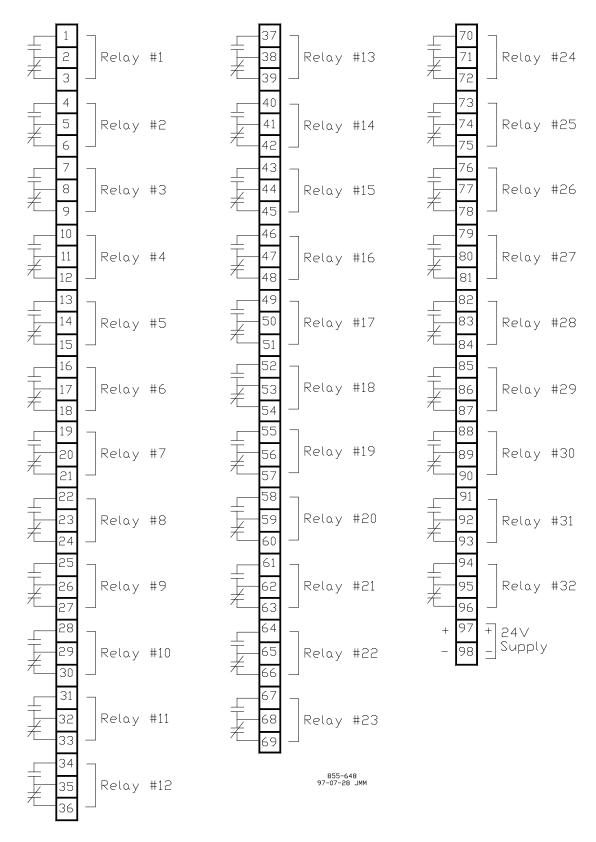


Figure 12-66. Relay Contact Connections for a 32 Channel Relay Module

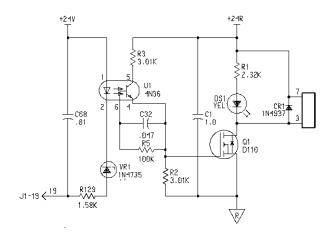


Figure 12-67. Typical 32 Channel Relay Module Driver Circuit (K1).

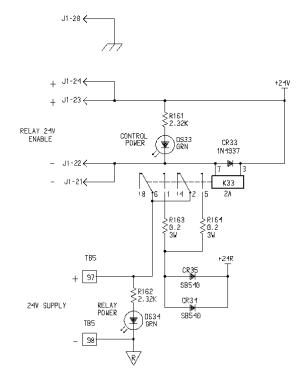


Figure 12-68. 32 Channel Relay Module I/O Lock Circuit.

12.5. 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 12-69. 4 Channel Isolation Module



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.



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.

Table 12-3. Module Ratings

| Primary Impedance: | 10 k Ω at 1 kHz (Ref. only) DC resistance 187 Ω ±20% |
|-------------------------------|--|
| Secondary Impedance: | 10 k Ω 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 | 600 Vrms |
| Secondary Windings: | |

<u>^</u>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.

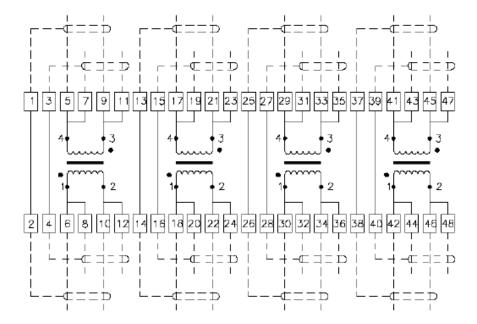


Figure 12-70. Schematic Diagram of the 4-Channel Isolation Module

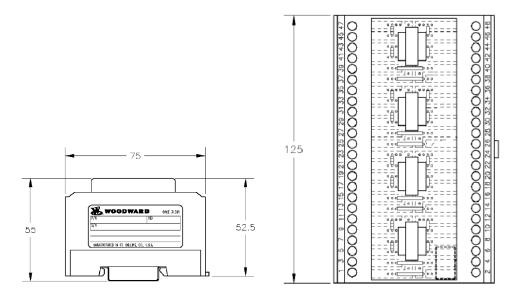


Figure 12-71. 4-Channel Isolation Module Outline Dimensions (Metric; All Dimensions for Ref Only)

Chapter 13. Distributed I/O Network

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

Chapter 14. Installation and Replacement Procedures

14.1. Pre-Installation Information

14.1.1. 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.

14.1.2. 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.

14.1.3. 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.

14.2. Installation Procedures



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



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.

14.2.1. Installing a VME I/O Module into an Unpowered Chassis



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.
- 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 module extraction tabs, in one continuous motion, fully seat the module into the motherboard mating connectors.



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 "14.3.2—Replacing a VME I/O Module" below for replacing a module previously installed into functional system.

14.2.2. MicroNet Simplex Installation Notes and Warnings



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.

14.2.3. Installing a MicroNet Simplex Power Supply Module

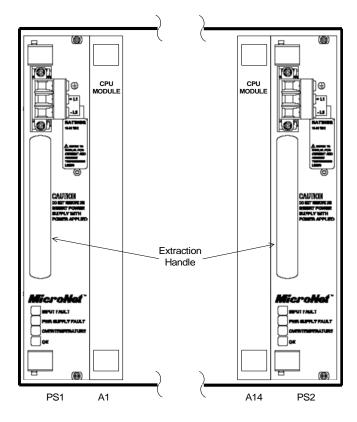


Figure 14-1. MicroNet Power Supply

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.



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.

14.2.4. 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 14-2 and 14-3 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 14.2.6.2 and 14.2.7.2. 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.

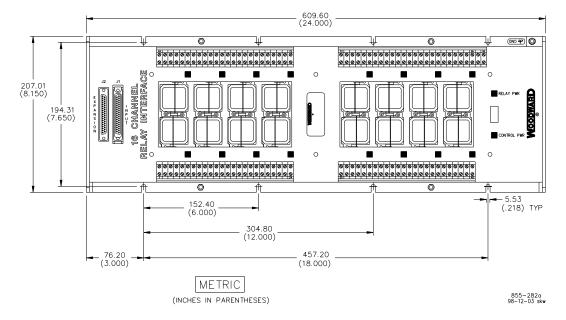


Figure 14-2. 16 Channel Relay Box Outline Drawing

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

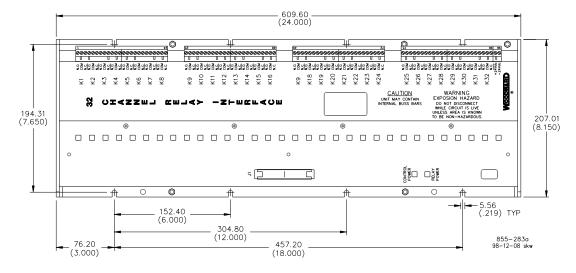


Figure 14-3. 32 Channel Relay Box Outline Drawing

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.

14.2.5. 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, ground the DIN rail to the panel. Low RF impedance: length less 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.
- 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). Keep this wire 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 14.2.6.2 and 14.2.7.2.
- 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.

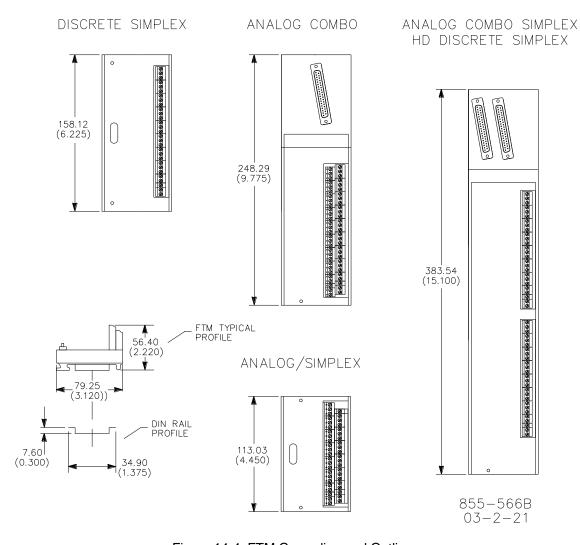


Figure 14-4. FTM Grounding and Outlines

14.2.6. Non-Marine Application Information

14.2.6.1. Shields and Grounding



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.

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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 unterminated, unless coil voltage is provided remotely in the field.

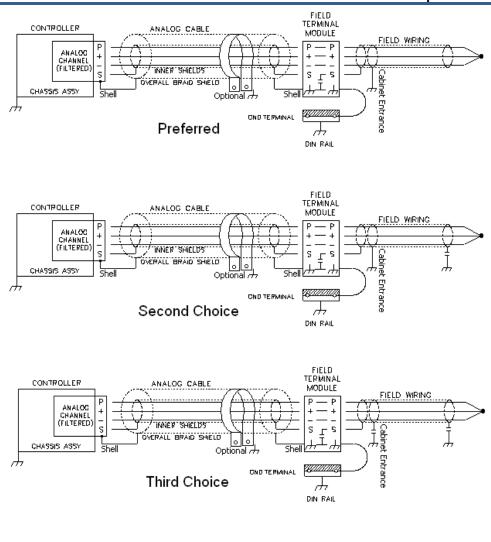
DI & DO shielding may be electrically continuous metal conduit, cable armor, or completely enclosed metal cable ways, as well as shielded cable, as long as the items listed are grounded only to the cabinet housing the MicroNet system and are electrically continuous between the field termination and cabinet.

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.



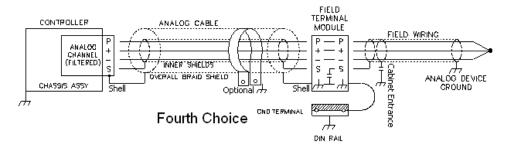


Figure 14-5. Analog Cable Shield Termination Diagram Examples

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

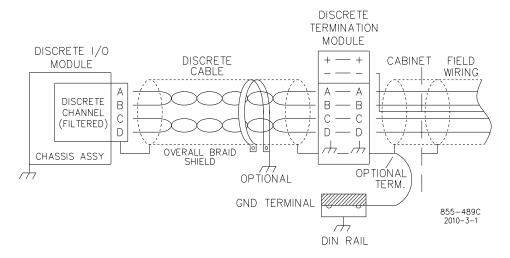


Figure 14-6. Discrete Cable Grounding Diagram Example

14.2.6.2. 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.

Remove the insulation on the cable between the MicroNet and FTM or relay box 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.

14.2.6.3. 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 ($<2.5 \text{ m}\Omega$).
- 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 ($<2.5 \text{ m}\Omega$).
 - o Two places minimum, three 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 m Ω).
 - o One place minimum, two places preferred (placed at opposite sides).
- Floor and top must be electrically connected to structural frame (<2.5 mΩ).
 - o 2 places minimum, 4 places at the corners preferred.
- DIN rail must be electrically connected to structural frame ($<2.5 \text{ m}\Omega$).
- Once every 300 mm (12 inches), use a minimum of 2 screws to bond a DIN rail to cabinet frame.

14.2.6.4. 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 m Ω), and shall allow direct grounding or AC (capacitive) grounding of cable shields.

14.2.6.5. 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.

14.2.6.6. 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.



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.

14.2.6.7. 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

14.2.6.8. 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.
 - o 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.

14.2.6.9. 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.

14.2.7. Marine Application Information

14.2.7.1. Shields and Grounding



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 unterminated, 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.

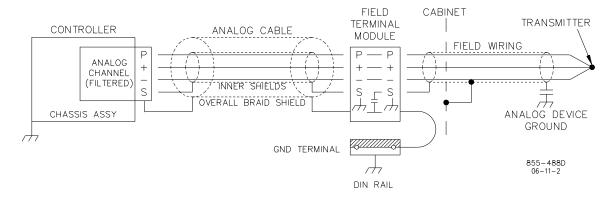


Figure 14-7. Shield Termination Diagram Example

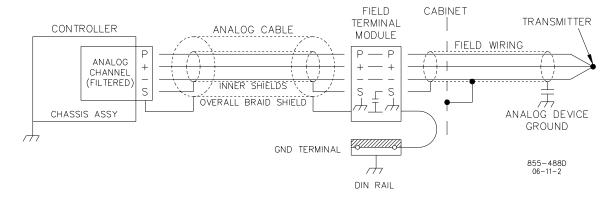


Figure 14-8. Discrete I/O Cable Grounding Diagram Example

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

14.2.7.2. 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.

14.2.7.3. 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.
- Bond the cabinet frame and mounting areas (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 ($<2.5 \text{ m}\Omega$).
- Mounting plates shall be electrically connected to structural frame ($<2.5 \text{ m}\Omega$).
- 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 ($<2.5 \text{ m}\Omega$) and must be mounted using conductive EMI gaskets along the length of the interfaces.
- DIN rail must be electrically connected to structural frame ($<2.5 \text{ m}\Omega$).
 - Once every 300 mm (12 inches), use a minimum of two screws to bond a DIN rail to cabinet frame.

14.2.7.4. 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 m Ω), and shall allow direct grounding or AC (capacitive) grounding of cable shields.

14.2.7.5. 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.

14.2.7.6. 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.



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.

14.2.7.7. 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.

14.2.7.8. 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
 - o 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.

14.2.7.9. 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 14-8)
- 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.

14.2.8. 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

14.2.9. 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.

14.2.10. 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.

14.2.11. 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.

14.2.12. 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)

14.2.13. Equipment Bonding

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

14.2.14. 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.

14.2.15. Installation of Other Equipment, Fans, Meters, etc.

Shield Termination Schemes

Note: See Application Note B51204 for this information.

14.2.16. Shielded I/O Cable

Note: Copper tape is not reliable for shield termination.



Figure 14-9. Bottom Cable Entry Area



Figure 14-10. Door Bonding



Figure 14-11a. Cable Entry # 1

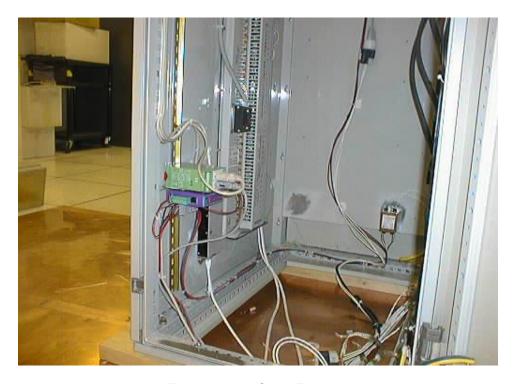


Figure 14-11b. Cable Entry # 2

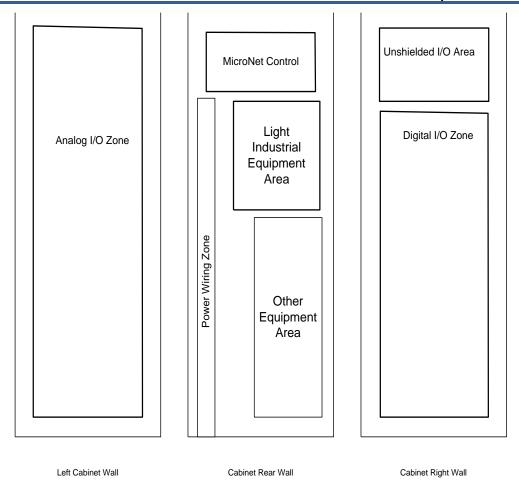


Figure 14-12. Zoning

14.3. Replacement Procedures

14.3.1. Safety Considerations



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.



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.

14.3.2. Replacing a VME 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 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.) When used in a redundant configuration, live removal and insertion of the CPU module is allowed in a MicroNet Plus chassis. The CPU should be reset immediately before removing it from the chassis. This notifies the module that it will be removed and provides a graceful failover to another healthy CPU module if available.
- 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 module extraction tabs, in one continuous motion, fully seat the module into the motherboard.



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.

Note: Ensure that the module is fully inserted by verifying that the faceplate is flush with the other modules. For a new CPU module, a large amount of force can be required to properly seat the module.

- 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 reinitialized 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).



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.

14.3.3. Replacing a Field Termination Module (FTM)



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



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.



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).
- 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.

14.3.4. Replacing a Relay Box



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.



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.

14.3.5. Replacing a Receptacle-mounted Relay



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 reengage the hold down spring.
- 5. Restore all power if previously removed.
- 6. Verify that the new relay is functioning correctly.

14.3.6. Replacing an I/O Cable



This procedure will shut down the control system.



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.



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.

14.3.7. Replacing Chassis Fans

- Installation of MicroNet Plus Fan Item 8926-1001:
- 2. Use the following procedure to remove a faulty MicroNet Plus Chassis fan from the chassis.
 - a. Discharge static from your body by touching the main cabinet PE ground.
 - b. Use a stubby (approximately 3.5 inches long) #2 Phillips screwdriver.
 - c. Remove the four retaining screws holding the fan assembly to the chassis. Take care not to drop the hardware into the control chassis.
 - d. Remove power by disconnecting the fan connector from the motherboard mating connector. Remove the fan and guard from the chassis.
 - e. Discharge static from your body by touching the main cabinet PE ground.
 - f. Install new fan, fan guard and mounting screws. (Flow arrows should point towards the top of the chassis).
 - g. 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.
 - a. Discharge static from your body by touching the main cabinet PE ground.
 - b. Use a stubby (approximately 9 cm/3.5 inches long) #2 Phillips screwdriver.
 - c. Remove the four retaining screws holding the fan assembly to the chassis.
 - d. Remove power by disconnecting the wire guick connects.
 - e. Remove fan and guard from the chassis.
 - f. Discharge static from your body by touching the main cabinet PE ground.
 - g. Install new fan, fan guard and mounting screws. (Flow arrows should point towards the top of the chassis).
 - h. Connect RED wire to the + fan terminal and BLACK wire to fan terminal.



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

Chapter 15. Product Support and Service Options

Product Support Options

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

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

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

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

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

A current list of Woodward Business Partners is available at: https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner

Product Service Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (Woodward North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690).

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 North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690). This option is applicable to mechanical products only.

Returning Equipment for Repair

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

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

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

Packing a Control

Use the following materials when returning a complete control:

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



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

Replacement Parts

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

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

Engineering Services

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

- Technical Support
- Product Training
- Field Service

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

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

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

For information on these services, please contact one of the Full-Service Distributors listed at https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner

Contacting Woodward's Support Organization

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

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

Products Used in

| Engine Systems |
|---------------------------------|
| Facility Phone Number |
| Brazil+55 (19) 3708 4800 |
| China+86 (512) 8818 5515 |
| Germany +49 (711) 78954-510 |
| India+91 (124) 4399500 |
| Japan+81 (43) 213-2191 |
| Korea+ 82 (32) 422-5551 |
| The Netherlands+31 (23) 5661111 |
| United States+1 (970) 482-5811 |

Products Used in

| Turbomachi | ed in Industrial nery Systems |
|------------------|----------------------------------|
| Facility | Phone Number |
| Brazil+ | 55 (19) 3708 4800 |
| China+8 | 6 (512) 8818 5515 |
| India | +91 (124) 4399500 |
| Japan | +81 (43) 213-2191 |
| Korea | + 82 (32) 422-5551 |
| The Netherlands- | -+31 (23) 5661111 |
| Poland | +48 (12) 295 13 00 |
| United States | +1 (970) 482-5811 |

Technical Assistance

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

| General | |
|--|--|
| Your Name | |
| Site Location | |
| Phone Number | |
| Fax Number | |
| Prime Mover Information | |
| Manufacturer | |
| Turbine Model Number | |
| Type of Fuel (gas, steam, etc.) | |
| Power Output Rating | |
| Application (power generation, marine, etc.) | |
| Control/Governor Information | |
| Control/Governor #1 | |
| Woodward Part Number & Rev. Letter | |
| Control Description or Governor Type | |
| Serial Number | |
| Control/Governor #2 | |
| Woodward Part Number & Rev. Letter | |
| Control Description or Governor Type | |
| Serial Number | |
| Control/Governor #3 | |
| Woodward Part Number & Rev. Letter | |
| Control Description or Governor Type | |
| Serial Number | |
| Symptoms | |
| Description | |
| | |

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

Appendix A. Matrix of Modules with Compliance Information

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

This chart is for reference only. Woodward must be consulted for the latest compliance information.

Note: MicroNet TMR Controls do not have ATEX or Marine Type Approvals.

| Part No | Status | Description | Extended Description | CS A | UL | ATE X | CE (LVD) | CE (EMC) | AB S | DN V | LRS |
|-----------|--------|-------------|---|---------|----|----------|-------------|-------------|---------|---------|-----|
| 1604-801 | А | BLOCK | SECTIONAL TERMINAL (UK 5, PHOENIX, 3004016) | | | | | | Х | х | х |
| 1604-813 | Α | BLOCK | SECTIONAL EARTH/GRND TERM. | | | | Х | Х | Х | Х | Х |
| 1606-519 | Α | CHANNEL | MOUNTING | | | | | | Х | Х | Х |
| 1606-584 | ANP | RAIL | MOUNTING 78 IN. | | | | | | Х | Х | Х |
| 1611-003 | Α | CONVERTER | INTERFACE (RS-232 TO RS-422 AND RS-485) | | | | n/a | х | | Х | |
| 1711-1349 | INA | SWITCH | ETHERNET MODULE HIRSCHMANN SWITCH 7TX/2FX | | Х | | | | | х | |
| 1711-1350 | Α | SWITCH | ETHERNET MODULE PHOENIX CONTACT FL SWITCH SFNT 8TX | | Х | | n/a | х | Х | Х | х |
| 1711-1351 | INA | SWITCH | ETHERNET MODULE PHOENIX CONTACT FL SWITCH SFNT 7TX/FX | | Х | | n/a | х | Х | Х | х |
| 1711-1410 | Α | SWITCH | ETHERNET MODULE PHOENIX CONTACT FL SWITCH 2206- 7TX/2FX SM | | | | | | | | |
| 1711-1424 | Α | SWITCH | ETHERNET MODULE RED LION SWITCH SLX 4TX/2FX | | Х | | | | Х | | |
| 1740-217 | А | LIGHT | CABINET, 24VDC 8W FLUORESCENT | | | | | Х | | | |
| 1751-147 | А | MODULE | 4 CH. MPU WITH 1:3 TRANSFORMER | Х | | х | | | | | |
| 1751-6020 | Α | MODULE | ISOLATED ANALOG VOLTAGE INPUT, 0 TO 10 V INPUT (DATAFORTH) | Х | | Х | n/a | х | | | |
| 1751-6021 | Α | MODULE | ISOLATED ANALOG VOLTAGE INPUT, +/-10V INPUT (DATAFORTH) | Х | | х | n/a | х | | | |
| 1751-6034 | Α | CONVERTER | RTD 100 OHM PT EUROPEAN CURVE (EXT RANGE) | Х | | | | | | | |
| 1751-6058 | Α | MODULE | TRANSFORMER | Х | | Х | | | | | |
| 1751-6091 | Α | RELAY | 16 CHANNEL RELAY FTM (PHOENIX CONTACT) [Ordinary Location Only] | | х | | | х | | | |
| 1752-357 | А | HUB | RAIL RH1-TP (HIRSCHMANN 943 639-002) | | | | | | | | |
| 1755-111 | Α | FILTER | RFI POWER LINE | | | | | | Х | Х | Х |
| 1784-573 | А | CONVERTER | ISOLATED RS232-RS232, KD485, DIN RAIL Only for Marine | | | | n/a | х | Х | х | х |
| 1784-575 | А | CONVERTER | ISOLATED RS232-RS422/RS485, KD485, DIN RAIL Only for Marine | | | | n/a | х | Х | х | х |
| 1784-577 | А | CONVERTER | ISOLATED RS232-RS232, PHOENIX, DIN RAIL | | | | | | Х | х | Х |
| 1784-635 | Α | CONVERTER | INTERFACE ISOLATOR (RS-232 TO RS-232) | | | | n/a | х | | х | |
| 1784-653 | Α | CONVERTER | K TYPE THERMOCOUPLE TO 0-5 VOLT, (DATAFORTH) | х | | х | n/a | х | | х | х |
| 1784-655 | Α | CONVERTER | 100 OHM RTD TO 0-5 VOLT, (DATAFORTH) | Х | | х | n/a | х | | х | х |
| 1784-657 | А | CONVERTER | NON-ISOLATED PASS THROUGH, (DATAFORTH) | Х | | х | n/a | х | | | |
| 1784-659 | Α | CONVERTER | NON-ISOLATED PASS THROUGH WITH 200 OHM (DATAFORTH) | Х | | х | n/a | х | | Х | Х |
| 1784-667 | Α | CONVERTER | 100 OHM RTD, 0-600 DEG C SLOW TO 0-5 VOLT, (DATAFORTH) | Х | | х | n/a | х | | | |
| 1784-675 | Α | CONVERTER | 200 OHM RTD TO 0-5 VOLT, (DATAFORTH) | х | | х | n/a | х | | | х |
| 1784-695 | A | THERMOC | THERMOCOUPLE - J TYPE THERMOCOUPLE 1-5 VOLT (DATFORTH) | Х | | х | n/a | х | | | |

| 1784-1028 | A | CONVERTER | ISOLATED LINEARIZED THERMOCOUPLE INPUT (DATAFORTH) | х | | Х | n/a | Х | | | х |
|----------------------|-----|-------------|---|---|---|---|-----|---|---|---|----------|
| 1784-1044 | А | CONVERTER | ISOLATED ANALOG VOLTAGE INPUT MODULE (DATAFORTH) | Х | | Х | n/a | Х | | | |
| 1784-1064 | А | CONVERTER | E TYPE THERMOCOUPLE (DATAFORTH) | х | | Х | n/a | Х | | | |
| 1784-1069 | А | CONVERTER | 5K OHM ISOLATED POTENTIOMENTER INPUT (DATAFORTH) | х | | х | n/a | Х | | | |
| 1784-1076 | А | CONVERTER | ISOLATED ANALOG VOLTAGE INPUT MODULE (DATAFORTH) | Х | | Х | n/a | х | | | |
| 1784-1080 | А | CONVERTER | 10K OHM ISOLATED POTENTIOMENTER INPUT (DATAFORTH) | Х | | Х | n/a | х | | | |
| 1784-1115 | А | CONVERTER | ISOLATED LINEARIZED T-TYPE THERMOCOUPLE INPUT (DATAFORTH) | х | | х | n/a | х | | | |
| 1790-039 | Α | KEYBOARD | NEMA 12 WITH HULAPOINT | | | | n/a | Х | Х | Х | Х |
| 1790-041 | А | MONITOR | SCEPTRE LT12G 12.1" SVGA TFT FLAT PANEL | | | | n/a | х | х | х | х |
| 1790-043 | А | KEYBOARD | UNICOMP SPACE SAVER W/TRACKPOINT (BLACK) | | | | n/a | х | х | х | х |
| 1790-885 | А | MONITOR | T-521 CTC P31-212AR INTERACT 90/120 VAC | | | | | | | | |
| 1790-887 | Α | MONITOR | T-521 CTC P31-212DR INTERACT 20/36 VDC | | | | | | | | |
| 1790-889 | А | MONITOR | T-521 CTC P2 INTERACT 100-240 VAC | | | | | | | | |
| 1790-891 | Α | MONITOR | T-521 CTC P2 INTERACT 20/36 VDC | | | | | | | | |
| 2006-379 | Α | WIRE | 20 GA. 600V CRC WHITE (T-274) | | | | | | Х | Х | Х |
| 2008-055 | Α | CABLE | 20 GA. 2 COND. SHLD (T-274) | | | | | | Х | Х | Х |
| 2008-057 | Α | CABLE | 20 GA. 3 COND. SHLD (T-274) | | | | | | Х | Х | Х |
| 2008-217 | Α | WIRE | 10 GA. 600V CRC GRN/YEL (T-274) | | | | | | Х | Х | Х |
| 2008-269 | Α | CABLE | 50 OHM COAX | | | | | | Х | Х | Х |
| 2008-349 | Α | WIRE | 2 CONDUCTOR 22AWG, LOW CAP | | | | n/a | Х | Х | Х | Х |
| 2008-535 | Α | CABLE | TRIAXIAL 50 OHM IMPEDANCE | | | | | | Х | Х | Х |
| 3799-301 | Α | PANEL | NETCON IIIB VME BLANK | | | | n/a | Х | Х | Х | Х |
| 5009-411 | INA | MODULE | 5009 CPU SIO WITH APPLICATION | | Х | | | | | | |
| 5009-413 | INA | MODULE | 5009 CPU WITH APPLICATION | | Х | | | | | | |
| 5009-415 | INA | MODULE | 5009 CPU WITH APPLICATION | | Х | | | | | | |
| 5009-418 | INA | MODULE | 5009 CPU SIO WITH APPLICATION | | Х | | | | | | |
| 5009-419 | INA | MODULE | 5009 CPU WITH APPLICATION | | Х | | | | | | |
| 5009-421 | INA | MODULE | 5009 CPU APPLICATION W/ SIO | | Х | | | | | | |
| 5009-423 | INA | MODULE | 5009 CPU APPLICATION W/ SIO | | Х | | | | | | |
| 5009-500 | INA | MODULE | 5009 CPU W/DUAL CPC APPLICATION | | Х | | | | | | |
| 5009-502 | INA | MODULE | 5009 CPU WITH APPLICATION | | Х | | | | | | |
| 5415-962 | Α | CABLE | NETCON TRANSCEIVER 3FT | | | | n/a | Х | Х | Х | Х |
| 5415-963 | Α | CABLE | NETCON TRANSCEIVER 10FT | | | | n/a | Х | Х | Х | Х |
| 5416-190 | Α | CABLE | NETCON SERIAL I/O | | | | | | Х | Х | Х |
| 5416-332 | Α | CABLE | NETCON 3FT DISCRETE GRA | | | | | | Х | Х | Х |
| 5416-333 | Α | CABLE | NETCON 6FT DISCRETE GRA | | | | | | Х | Х | Х |
| 5416-334 | Α | CABLE | NETCON 8FT DISCRETE GRA | | | | | | Х | Х | Х |
| 5416-335 | Α | CABLE | NETCON 10FT DISCRETE GY | | | | | | Х | Х | Х |
| 5416-336 | A | CABLE | NETCON 12FT DISCRETE GY | | | | | | Х | Х | Х |
| 5416-337 | A | CABLE | NETCON 14FT DISCRETE GY | | | | | | X | X | X |
| 5416-338 | A | CABLE | NETCON 16FT DISCRETE GY | | | | | | Х | Х | Х |
| 5416-339 | Α | CABLE | NETCON 18FT DISCRETE GY | | | | | | X | X | X |
| 5416-340 | A | CABLE | NETCON 20FT DISCRETE GY | | | | | | X | X | X |
| 5416-341 | A | CABLE | NETCON 24FT 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 5416-863 | A | CABLE CABLE | MACINTOSH SERIAL I/O PMU (POWER MONITORING UNIT), | | | | | | X | X | X |
| 5416-966 | Α | CABLE | VAASA ELECTRONICS VX008-3 MICRONET HIGH DENSITY LV | | | | | | х | Х | Х |
| | 1 | | DISCRETE GRA 6FT | | | | | | | | <u> </u> |

| 5416-967 | Α | CABLE | MICRONET HIGH DENSITY LV | | | Х | Х | Х |
|----------|---|-------|---|-----|---|---|---|---|
| 5416-968 | Α | CABLE | DISCRETE GRA 8 FT MICRONET HIGH DENSITY LV DISCRETE GRA 10FT | | | х | х | х |
| 5416-969 | А | CABLE | MICRONET HIGH DENSITY LV DISCRETE GRA 12FT | | | Х | Х | Х |
| 5416-970 | Α | CABLE | MICRONET HIGH DENSITY LV DISCRETE GRA 14FT | | | х | х | х |
| 5416-971 | Α | CABLE | MICRONET HIGH DENSITY LV DISCRETE GRA 16FT | | | х | х | х |
| 5416-972 | А | CABLE | MICRONET HIGH DENSITY LV DISCRETE GRA 18FT | | | Х | Х | х |
| 5416-973 | Α | CABLE | MICRONET HIGH DENSITY LV DISCRETE GRA 20FT | | | х | х | х |
| 5416-977 | А | CABLE | 5009 POWER SUPPLY FLAT RIBBON (6 IN) | n/a | Х | | | |
| 5417-019 | А | CABLE | 5009 RELAY INTERCONNECT (6 INCH LENGTH) | n/a | х | | | |
| 5417-026 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 6FT | n/a | х | Х | Х | х |
| 5417-027 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 8FT | n/a | Х | Х | Х | х |
| 5417-028 | Α | CABLE | NETCON LOW DENSITY ANALOG BLACK 10FT | n/a | Х | х | х | х |
| 5417-029 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 12FT | n/a | Х | Х | Х | х |
| 5417-030 | Α | CABLE | NETCON LOW DENSITY ANALOG BLACK 14FT | n/a | Х | х | х | х |
| 5417-031 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 16FT | n/a | х | Х | Х | х |
| 5417-032 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 18FT | n/a | х | Х | Х | х |
| 5417-033 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 20FT | n/a | х | Х | х | х |
| 5417-034 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 22FT | n/a | х | Х | Х | х |
| 5417-035 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 26FT | n/a | Х | Х | Х | х |
| 5417-036 | А | CABLE | NETCON LOW DENSITY ANALOG BLACK 40FT | n/a | Х | Х | Х | х |
| 5417-037 | А | CABLE | NETCON 3FT DISCRETE GRA W/BACKSHELL TAPE | n/a | Х | Х | Х | х |
| 5417-038 | А | CABLE | NETCON 6FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-039 | А | CABLE | NETCON 8FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-040 | А | CABLE | NETCON 10FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-041 | А | CABLE | NETCON 12FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-042 | А | CABLE | NETCON 14FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-043 | А | CABLE | NETCON 16FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-044 | А | CABLE | NETCON 18FT DISCRETE GRA W/BACKSHELL TAPE | n/a | х | Х | Х | х |
| 5417-045 | А | CABLE | NETCON 20FT DISCRETE GRA W/BACKSHELL TAPE | n/a | Х | Х | Х | х |
| 5417-046 | А | CABLE | NETCON 22FT DISCRETE GRA W/BACKSHELL TAPE | n/a | Х | Х | Х | х |
| 5417-047 | А | CABLE | NETCON 24FT DISCRETE GRA W/BACKSHELL TAPE | n/a | Х | Х | Х | х |
| 5417-048 | А | CABLE | NETCON 26FT DISCRETE GRA W/BACKSHELL TAPE | n/a | Х | Х | Х | х |
| 5417-049 | А | CABLE | NETCON 40FT DISCRETE GRA W/BACKSHELL TAPE | n/a | Х | х | Х | х |
| 5417-171 | А | CABLE | MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 6FT UL | n/a | Х | х | Х | х |
| 5417-172 | А | CABLE | MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 8FT UL | n/a | Х | х | Х | х |
| 5417-173 | Α | CABLE | MICRONET HIGH DENSITY | n/a | Х | х | х | х |

| 5417-174 | Α | CABLE | MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 12FT UL | | n/a | Х | х | Х | Х |
|-----------|-----|----------|---|----|-----|---|--|---|----------|
| 5417-175 | Α | CABLE | MICRONET HIGH DENSITY | | n/a | х | х | х | х |
| 5417-176 | Α | CABLE | ANALOG/DISCRETE GRA 14FT UL MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 16FT UL | | n/a | Х | х | х | х |
| 5417-177 | Α | CABLE | MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 18FT UL | | n/a | х | х | х | х |
| 5417-178 | Α | CABLE | MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 20FT UL | | n/a | Х | х | х | х |
| 5417-179 | Α | CABLE | NETCON TRANSCEIVER 6FT | | n/a | Х | Х | Х | х |
| 5417-180 | Α | CABLE | MICRONET HIGH DENSITY ANALOG/DISCRETE GRA 40FT UL | | | | | | |
| 5417-229 | Α | CABLE | THINNET ETHERNET TRIAX 450 FT | | | | Х | Х | Х |
| 5417-290 | Α | CABLE | MOLDED DB9F TO DB9F NULL MODEM W/THUMBSCREWS | | n/a | Х | | | |
| 5417-293 | Α | CABLE | TMR CHASSIS/POWER SPLY INTERCONNECT | | n/a | х | | | |
| 5417-391 | Α | CABLE | DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 1.5 FT | | n/a | Х | х | х | х |
| 5417-392 | Α | CABLE | DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 3 FT | | n/a | х | х | Х | х |
| 5417-393 | Α | CABLE | DOUBLE SHIELDED CAT-5 | | n/a | Х | х | Х | х |
| 5417-394 | Α | CABLE | ETHERNET (SSTP), 7 FT DOUBLE SHIELDED CAT-5 ETHERNET (SSTP), 40 FT | | n/a | Х | х | Х | х |
| 5417-395 | Α | CABLE | DOUBLE SHIELDED CAT-5 | | n/a | Х | Х | Х | х |
| 5417-396 | Α | CABLE | ETHERNET (SSTP), 14 FT DOUBLE SHIELDED CAT-5 | | n/a | х | х | Х | х |
| 5417-397 | Α | CABLE | ETHERNET (SSTP), 25 FT DOUBLE SHIELDED CAT-5 | | n/a | Х | х | Х | х |
| 5417-398 | Α | CABLE | ETHERNET (SSTP), 50 FT DOUBLE SHIELDED CAT-5 | | n/a | Х | | | |
| 5417-399 | Α | CABLE | ETHERNET (SSTP), 100 FT SHIELDED PS/2 REPLACEMENT | | n/a | х | х | х | х |
| 5417-400 | Α | CABLE | (MALE-MALE) 6 FT SHIELDED PS/2 REPLACEMENT | | n/a | Х | x | х | х |
| 5417-401 | Α | CABLE | (MALE-MALE) 10 FT SHIELDED PS/2 REPLACEMENT | | n/a | X | х | Х | x |
| 5417-402 | A | CABLE | (MALE-MALE) 15 FT SHIELDED PS/2 EXT (MALE- | | n/a | x | X | x | x |
| 5417-403 | A | CABLE | FEMALE) 6 FT SHIELDED PS/2 EXT (MALE- | | n/a | | | | |
| | | | FEMALE) 10 FT | | | Х | Х | Х | Х |
| 5417-404 | A | CABLE | SHIELDED PS/2 EXT (MALE- FEMALE) 15 FT | | n/a | Х | Х | Х | х |
| 5417-405 | Α | CABLE | TRIPLE SHIELDED VGA VIDEO EXT (HD15M-HD15F) 6 FT | | n/a | Х | х | х | х |
| 5417-406 | Α | CABLE | TRIPLE SHIELDED VGA VIDEO EXT (HD15M-HD15F) 10 FT | | n/a | Х | Х | Х | Х |
| 5417-407 | Α | CABLE | TRIPLE SHIELDED VGA VIDEO EXT (HD15M-HD15F) 15 FT | | n/a | Х | Х | Х | Х |
| 5417-408 | Α | CABLE | TRIPLE SHIELDED VGA VIDEO (HD15M-HD15M) 6 FT | | n/a | Х | х | Х | х |
| 5417-409 | Α | CABLE | TRIPLE SHIELDED VGA VIDEO (HD15M-HD15M) 10 FT | | n/a | Х | х | Х | х |
| 5417-410 | Α | CABLE | TRIPLE SHIELDED VGA VIDEO (HD15M-HD15M) 15 FT | | n/a | Х | х | Х | х |
| 5417-411 | Α | CABLE | SHIELDED RS232 SERIAL EXT (DB9M-DB9F) 6 FT | | n/a | Х | Х | Х | х |
| 5417-412 | Α | CABLE | SHIELDED RS232 SERIAL EXT (DB9M-DB9F) 10 FT | | n/a | Х | х | х | х |
| 5417-413 | Α | CABLE | SHIELDED RS232 SERIAL EXT (DB9M-DB9F) 15 FT | | n/a | Х | х | Х | х |
| 5418-1560 | Α | SOFTWARE | 9140RF HMI'S ON HARD DISK | | | | | | — |
| 5437-050 | INA | DOOR | NETCON 3B SIMPLEX MAIN VFD | | | | | | |
| 5437-052 | INA | MODULE | NETCON FIELD TERMINAL | | | | | | |
| 5437-059 | INA | CHASSIS | I/O XCVR T-MODULE | Х | n/a | Х | Х | Х | х |
| 5437-060 | ANP | MODULE | NETCON FIELD TERMINAL | | | | | | ļ |
| 5437-061 | INA | MODULE | NETCON DISCRETE INPUT | | | | | | <u> </u> |
| 5437-078 | INA | CHASSIS | NETCON SIELD TERMINAL | ., | | | Х | Х | Х |
| 5437-079 | INA | MODULE | NETCON FIELD TERMINAL | Χ | | | 1 | l | |

| 5437-080 | Α | MODULE | NETCON FIELD TERMINAL | Х | | | n/a | Х | Х | Х | Х |
|----------------------|------------|-----------------|---|----|----|----|------------|--|--|--------|-----|
| 5437-085 | ANP | MODULE | NETCON FIELD TERMINAL | | | | | | | | |
| 5437-086 | INA | MODULE | NETCON FIELD TERMINAL | | | | | | | | |
| 5437-087 | INA | MODULE | NETCON FIELD TERMINAL | | | | | | | | |
| 5437-092 | INA | POWER SUP | EXP CHAS (REDUN) | | | | | | Х | Х | Х |
| 5437-095 | ANP | MODULE | DUPLEX FIELD TERMINAL | | | | | | | | |
| 5437-096 | ANP | MODULE | DUPLEX FIELD TERMINAL | | | | | | | | |
| 5437-173 | INA | MODULE | NETCON FIELD TERMINAL | Х | | | | | | | |
| 5437-281 | INA | MODULE | ANALOG FIELD TER (STD) | Х | | | | | | | |
| 5437-282 | INA | MODULE | ANALOG FIELD TERM (TC) | Х | | | | | | | |
| 5437-283 | INA | MODULE | ANALOG FIELD TER (ACT) | Х | | | | | | | |
| 5437-291 | INA | MODULE | NETCON FIELD TERMINAL | | | | | | | | |
| 5437-371 | ANP | RACK | NETCON 3B REMOTE I/O | | | | | | | | |
| 5437-375 | INA | MODULE | FIELD TERMINAL | | | | | | | | |
| 5437-403 | ANP | MODULE | FIELD TERMINAL STD | | | | | | | | |
| 5437-404 | ANP | MODULE | FIELD TERMINAL TC | | | | | | | | |
| 5437-405 | INA ANP | MODULE | FIELD TERMINAL ACT | | | | / | . | | | |
| 5437-418 | | MODULE | NETCON DERIVATIVE ANAL | X | | ., | n/a | X | X | X | X |
| 5437-419 | A | MODULE | NETCON 24 CHANNEL FTM | X | | Х | n/a | Х | X | X | X |
| 5437-455 | INA | MODULE | SMART 3000 RESISTOR | Х | | | / | . | X | X | X |
| 5437-484 | INA | MODULE | DUPLEX CURRENT/VOLTAGE FTM | | | | n/a | Х | X | X | X |
| 5437-507 5437-523 | A | PANEL MODULE | SERVICE NETCON /C ANALOG FIELD TERM (STD) | Х | | ~ | n/a | | X | X | X |
| 5437-523 | A | MODULE | ANALOG FIELD TERM (STD) ANALOG FIELD TERM (TC) | | | X | n/a n/a | X | X | X | X |
| 5437-524 | INA | MODULE | ANALOG FIELD TERM (TC) ANALOG FIELD TERM (ACT) | Х | | Х | II/d | Х | X | X | X |
| 5437-525 | A | MODULE | NETCON FIELD TERMINAL | v | | ~ | n/a | | X | X | X |
| 5437-672 | A | MODULE | NETCON FIELD TERMINAL NETCON 24 CHANNEL FIELD | X | | X | n/a n/a | X | X | X X | X |
| 3437-007 | ^ | INIODOLE | TERMINAL | Х | | Х | 11/d | Х | Х | ^ | Х |
| 5437-727 | INA | MODULE | FTM ASSEMBLY | | | | | | Х | Х | Х |
| 5437-730 | INA | Control | (SNG) York - Unit #1 NetCon/OCP | | | | | | X | _^ | X |
| 5437-838 | A | CHASSIS | 5009 POWER SUPPLY | Х | | | Х | Х | X | Х | X |
| 5437-839 | A | CHASSIS | 5009/MICRONET TMR DIGITAL | X | | | n/a | X | X | X | X |
| 0407 000 | ^ | 011/10010 | CONTROL | ^ | | | 11/4 | ^ | ^ | _ ^ | ^ |
| 5437-843 | Α | CHASSIS | MICRONET 12 SLOT W/6 SLOT I/O | х | | | n/a | Х | х | х | х |
| 5437-844 | INA | CHASSIS | MICRONET 18 SLOT W/12 SLOT I/O | Х | | | ., | | Х | Х | Х |
| 5437-845 | Α | BOARD | NOTCH FILTER 3KHZ | Х | | | n/a | Х | Х | Х | Х |
| 5437-852 | Α | CHASSIS | MICRONET TMR | | | | | | Х | Х | Х |
| 5439-754 | INA | CHASSIS | NETCON 3B SIMPLEX | | | | | | Х | Х | Х |
| 5439-756 | ANP | MODULE | NETCON FIELD TERMINAL | | | | | | | | |
| 5439-758 | ANP | MODULE | NETCON FIELD TERMINAL | | | | | | | | |
| 5439-794 | ANP | CHASSIS | NETCON 3B I/O | | | | | | Х | Х | Х |
| 5441-413 | Α | RELAY | 32 CHAN RELAY INTERFACE | Х | | Х | | Х | Х | Х | Х |
| 5441-419 | Α | RELAY | 16C INTERFACE (Ordinary Location) | | Х | | | Х | Х | Х | Х |
| 5441-691 | INA | MODULE | 16 CHANNEL RELAY FTM (PHOENIX | | | | Х | Х | | | |
| | | | CONTACT) [Ordinary Locations Only] | | | | | | | | |
| 5441-693 | Α | MODULE | HD DISCRETE I/O FTM (24 IN/12 | | х | | Х | Х | х | х | Х |
| | | | OUT) [Ordinary Locations Only] | | | | | | | | |
| 5441-694 | Α | MODULE | HD DISCRETE I/O FTM RELAY | Х | | х | n/a | Х | х | х | х |
| 5444 SSS | | MODULE | DRIVER (24 IN/12 OUT) | | | | , | ļ | | | 1 |
| 5441-695 | A | MODULE | SIMPLEX FTM, DataForth | Х | | Χ | n/a | X | Х | X | X |
| 5441-697 | A | MODULE | TMR FTM, DataForth | Х | | | n/a | Х | | Х | Х |
| 5453-008 | INA | RACK | FADC LOCOP NETCON CHASSIS, | | | | | | | | |
| E4E2 202 | INIA | DANEL | DUAL P. S. CONNECTION | | | | | | | | 1 |
| 5453-203 | INA | PANEL | DISPLAY | | ., | | ., | . , | ., | | ., |
| 5453-276 | Α | RELAY | 5009 F/T DISCRETE IN (Ordinary | | Х | | Х | Х | х | Х | х |
| E4E2 277 | ٨ | CHACCIC | Location) MICRONET TMR POWER SUPPLY | ., | | | | - | | | - |
| 5453-277 | Α | CHASSIS | MICRONET TMR POWER SUPPLY W/REDUNDANT FANS | Х | | | | | | | |
| 5453-278 | Α | CHASSIS | MICRONET 12 SLOT | Х | | | n/a | | v | v | V |
| 5453-278 | A | CHASSIS | MICRONET 12 SLOT | | | | 11/d | Х | Х | Х | Х |
| 5453-279 | INA | Box | MicroNet Ethernet Interface FTM | Х | | | v | х | Х | | х |
| 5453-751 | INA | BOX | MICRONET VIDEO INTERFACE FTM | Х | | | x n/a | X | X | Х | X |
| 5453-751 | A | BOX | MICRONET ETHERNET INTERFACE | X | | | n/a | X | | X | |
| J4JJ-1J4 | | DOX | FTM | ^ | | | 11/4 | _ ^ | | ^ | |
| 5453-759 | Α | CHASSIS | MICRONET-PLUS 14 SLOT, | Х | | Х | Х | х | Х | Х | Х |
| 0.00700 | '` | 000.0 | REDUND WITH SMART FANS | ^ | | ^ | ^ | _ ^ | ^ | ^ | _ ^ |
| 5453-829 | Α | CHASSIS | MICRONET PLUS 8 SLOT, REDUND | Х | | х | Х | Х | х | х | х |
| 2.30 320 | 1 | | WITH SMART FANS | | | ^ | | ^ | ^ |] ^ | ^ |
| 5454-425 | Α | CHASSIS | 5009 TMR POWER SUPPLY | Х | | | | | | | |
| | | | W/REDUNDANT FANS | | | | | | | | |
| 5458-127 | Α | Board | NetCon 5000B SIO SMT | | | | | | х | | Х |
| | • | • | | | | | | • | • | • | |

| 5463-783 | INA | MODULE | NETCON DISCRETE INPUT | | | | | | | |
|----------------------|------------|------------------|--|-----|---|------|----|----------|----|--|
| 5463-784 | INA | MODULE | NETCON DISCRETE OUTPUT | | | | | | | |
| 5463-786 | INA | MODULE | 8 CH ANALOG OUT 4-20MA | | | | | | | |
| 5463-787 | INA | MODULE | DIGITAL SPEED SENSOR | | | | | | | |
| 5463-789 | INA | MODULE | ANALOG 8 CHANNEL 0-1MA | | | | | | | |
| 5463-870 | INA | MODULE | INTEGRATING ACT DRIVER | | | | | | | |
| 5463-872 | INA | MODULE | NON-VOLITAL MEMORY | | | | | | | |
| 5463-877 | INA | MODULE | 4 CHANNEL ACUATOR | | | | | | | |
| 5464-015 | INA | MODULE | DIGITAL SPEED SENSOR | | | | | | | |
| 5464-027 | INA | MODULE | 4 CH. ACT 4-20MA | | | | | | | |
| 5464-035 | INA | MODULE | 4 CHANNEL ACTUATOR | | | | | | | |
| 5464-125 | INA | MODULE | NETCON 5000 MEMORY | | | | | | | |
| 5464-214 | ANP | MODULE | NETCON NV MEMORY 1.5M | | | | | | | |
| 5464-215 | ANP | MODULE | NETCON NV MEMORY 3M | | | | | | | |
| 5464-310 | INA | MODULE | NETCON 5000 SWITCHED M | | | | | | | |
| 5464-332 | INA | MODULE | ISO T/C ANALOG IN | Х | Х | n/a | Х | Х | Х | Х |
| 5464-333 | INA | MODULE | ISO T/C HIGH IN | Х | Х | n/a | Х | Х | Х | Х |
| 5464-334 | INA | MODULE | ISO 4-20 ANALOG INPUT | Х | | n/a | Х | Х | Х | Х |
| 5464-335 | INA | MODULE | ISO 0-10V ANALOG | Х | | n/a | Х | Х | Х | Х |
| 5464-336 | INA | MODULE | SEMI ISO RTD 10 | Х | | n/a | Х | Х | Х | Х |
| 5464-337 | INA | MODULE | SEMI ISO RTD 100 | Х | х | n/a | Х | Х | Х | Х |
| 5464-338 | INA | MODULE | SEMI ISO RTD 200 | Х | х | n/a | Х | Х | Х | Х |
| 5464-339 | INA | MODULE | SEMI ISO RTD 500 | Х | Х | n/a | Х | Х | Х | Х |
| 5464-340 | INA | MODULE | SEMI ISO RTD 100 HIGH TEMP | Х | Х | n/a | Х | Х | Х | Х |
| 5464-414 | INA | MODULE | DIGITAL SPEED SENSOR | | | | | | | |
| 5464-444 | INA | MODULE | NETCON 5000 CPU 40MHZ | | | | | | | |
| 5464-449 | INA | MODULE | NETCON 5000 CPU AUX | | | | | | | |
| 5464-458 | INA | MODULE | 64 CH DISCRETE OUTPUT | | | | | | | |
| 5464-459 | ANP | MODULE | NON-VOL MEMORY 500K | | | | | | | |
| 5464-460 | ANP | MODULE | NON-VOL MEMORY 1M | | | | | | | |
| 5464-466 | INA | MODULE | NETCON 5000B CPU 33MHZ | | | | | | | |
| 5464-544 | INA | MODULE | 4 CH ACT 0-200MA | Х | | n/a | Х | Х | Х | Х |
| 5464-545 | INA | MODULE | 4 CH ACT 0-25MA | Х | | n/a | Х | Х | Х | Х |
| 5464-546 | INA | MODULE | 1,2 0-200MA 3,4 0-25MA | | | | | | | |
| 5464-553 | INA | MODULE | INT. ACT DRIVER | Х | | | | | | |
| 5464-554 | INA | MODULE | INT. ACT DRIVER | Х | | | | | | |
| 5464-555 | INA | MODULE | INT. ACT DRIVER | Х | | | | | | |
| 5464-556 | INA | MODULE | INT. ACT DRIVER | Х | | | | | | |
| 5464-575 | INA | MODULE | SPEED SENSOR | | | | | | | |
| 5464-576 | INA | MODULE | SPEED SENSOR | | | | | | | |
| 5464-643 | A | MODULE | DISCRETE INPUT | Х | | n/a | Х | Х | Х | Х |
| 5464-644 | INA | MODULE | INT. ACT DRIVER | Х | | | | | | |
| 5464-645 | INA | MODULE | INT. ACT DRIVER | Х | | | | | | |
| 5464-648 | INA | MODULE | ANALOG 8 CH 4-20MA OUT | Х | | | | Х | Х | Х |
| 5464-649 | INA | MODULE | ANALOG 8 CH 0-1MA OUT | X | | | | X | X | X |
| 5464-650 5464-652 | INA | MODULE MODULE | ANALOG 8 CH 0 10V OUT | X | | | | X | X | X |
| | INA INA | | ANALOG 8 CH 0-10V OUT | X | | | | X | X | X |
| 5464-653 5464-654 | A | MODULE MODULE | 32 CH DISCRETE OUT 64 CH DISCRETE OUT | X | | n/c | v | X | X | X |
| 5464-655 | INA | MODULE | 4 CHANNEL ACTUATOR | X | | n/a | Х | Х | Х | Х |
| 5464-656 | INA | MODULE | 4 CHANNEL ACTUATOR 4 CH. ACT 4-20MA | X | | | | | | |
| 5464-657 | INA | MODULE | 4 CHANNEL ACTUATOR | + | | | | | | |
| 5464-658 | INA | MODULE | DIGITAL SPEED SENSOR | х | х | n/a | х | Х | Х | Х |
| 5464-659 | INA | MODULE | DIGITAL SPEED SENSOR | X | ^ | n/a | X | X | X | X |
| 5464-660 | INA | MODULE | ISO 4-20MA DERIVATIVE | X | | n/a | X | X | X | X |
| 5464-679 | INA | MODULE | NETCON 5000 CPU 40MHZ | ^ | | 11/4 | _^ | | _^ | - |
| 5464-697 | INA | MODULE | NETCON CPU 40MHZ W/FSH | х | | | | | | |
| 5464-752 | ANP | MODULE | NON VOLATILE MEMORY | ^ | | | | | | |
| 5464-756 | ANP | MODULE | NETCON NV MEMORY 4M | + + | | | | | | |
| 5464-781 | INA | MODULE | NETCON ANALOG OVERSPEED | + + | | | | | | |
| 5464-782 | INA | MODULE | NETCON ANALOG OVERSPEED | + + | | | | | | |
| 5464-834 | INA | MODULE | DIGITAL SPEED SENSOR | х | Х | n/a | Х | Х | Х | Х |
| 5464-837 | INA | MODULE | ISO T/C ANALOG IN (HF) | X | | n/a | X | X | X | X |
| 5464-839 | INA | MODULE | POSITION CONTROLLER TM | | | | | | | |
| 5464-844 | INA | MODULE | DIGITAL SPEED SENSOR | | | | | | | |
| 5464-850 | INA | MODULE | DIGITAL SPEED SENSOR | Х | | n/a | Х | х | Х | х |
| 5464-935 | ANP | MODULE | NETCON ANALOG OVERSPEED | | | ** | | | | |
| 5464-936 | ANP | MODULE | NETCON ANALOG OVERSPEED | | | | | | | |
| 5466-001 | INA | MODULE | NETCON DUAL SOLENOID | | | | | | | |
| | | | MONITOR | | | | | <u> </u> | | <u> </u> |
| - | | • | | | - | | | | | |

| 5466-003 | INA | MODULE | NETCON PRESSURE XDCR OUTPUT | | | | | | | |
|-----------|-----|----------|--|---|-----|------|---|--|---|-----|
| 5466-026 | INA | MODULE | NETCON DUPLEX CURRENT INPUT | Х | | n/a | Х | Х | Х | Х |
| 5466-030 | INA | MODULE | POSITION CONTROLLER EM | Х | | n/a | Х | Х | X | Х |
| 5466-031 | INA | MODULE | NETCON I/O CONTROLLER | X | х | n/a | X | X | X | X |
| 5466-037 | INA | MODULE | NETCON IIIB REAL TIME SIO | | ^ | 11/4 | | | | |
| 5466-039 | INA | Module | NetCon Kernal Power Supply | | | | | х | Х | Х |
| 5466-045 | INA | MODULE | PRESSURE XDUCER INTERFACE | | + | n/o | | | | |
| | | | | | | n/a | Х | Х | Х | Х |
| 5466-253 | A | MODULE | ANALOG COMBO (TMR) | Х | | n/a | Х | Х | Х | Х |
| 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 | INA | MODULE | FT DISCRETE I/O | Х | | n/a | Х | Х | Х | Х |
| 5466-257 | Α | MODULE | HIGH DENSITY ANALOG I/O (TMR) | Х | | Х | Х | Х | Х | Х |
| 5466-258 | INA | MODULE | SIMPLEX DISCRETE I/O | Х | х | n/a | Х | Х | Х | Х |
| 5466-260 | INA | MODULE | NETCON IIIB REAL TIME SIO | | | | | | | |
| 0.00 200 | | | VER2.06 | | | | | | | |
| 5466-272 | ANP | MODULE | NETCON DUAL SOLENOID | | | | | | | |
| 5466-285 | Α | MODULE | MONITOR SOLENOID PROTECTION | | | | | | | |
| 3400-263 | ^ | INIODULE | 4CHANNEL 18-30VDC | | | | | | | |
| 5466-315 | INA | MODULE | HIGH DENSITY ANALOG I/O | х | х | n/a | х | х | Х | Х |
| 5466-316 | A | MODULE | ANALOG COMBO | | ^ | n/a | | X | X | |
| | INA | MODULE | MICRONET TMR KERNEL P.S. | X | | | X | _ x | X | Х |
| 5466-318 | | | | Х | | n/a | Х | | | |
| 5466-320 | INA | MODULE | SOLENOID PROTECTION 4CHANNEL 18-30VDC | | | | | | | |
| 5466-326 | Α | MODULE | NETCON IIIB PRESSURE INPUT | Х | Х | n/a | Х | Х | Х | Х |
| 5466-328 | Α | MODULE | NETCON IIIB 3-9 PIN RT SIO | Х | х | n/a | Х | Х | Х | Х |
| 5466-332 | INA | MODULE | HIGH DENSITY ANALOG I/O | х | х | n/a | Х | Х | Х | х |
| 5466-344 | INA | MODULE | POSITION CONTROLLER EM DFB | X | | n/a | X | X | X | X |
| 5466-345 | INA | MODULE | POSITION CONTROLLER EM SFB | X | | n/a | X | _^ | | |
| 5466-348 | ANP | MODULE | NETCON 5000B SIO | X | | n/a | X | V | | · · |
| | INA | | NETCON 9000B SIO | X | Х | II/a | X | Х | Х | Х |
| 5466-350 | | MODULE | | | | | | | | |
| 5466-351 | INA | MODULE | NETCON CPU_040 WITH LL MEMORY | Х | | | | | | |
| 5466-352 | INA | MODULE | NETCON CPU_040 W/O LL MEMORY | Х | | n/a | Х | | | |
| 5466-353 | INA | MODULE | NETCON MAIN CHASSIS TR | Х | | n/a | Х | Х | Х | Х |
| 5466-354 | INA | MODULE | NETCON REMOTE CHASSIS TRANSCEIVER | х | | n/a | Х | | | |
| 5466-355 | INA | MODULE | NETCON REMOTE CHASSIS | х | | n/a | Х | х | х | х |
| | | | TRANSCEIVER | | | | | | | |
| 5466-400 | INA | MODULE | ISO 4-20 ANALOG INPUT | Х | | | | | | |
| 5466-404 | INA | MODULE | DIGITAL SPEED SENSOR | Х | | | | | | |
| 5466-405 | INA | MODULE | DIGITAL SPEED SENSOR | | | | | | | |
| 5466-407 | Α | MODULE | PENTIUM 233MHZ CPU (W/O OP- SYS) | Х | | Х | | х | Х | Х |
| 5466-409 | INA | MODULE | MICRONET PENTIUM CPU,233MHZ,64MB RAM,NT4.0 | | | n/a | х | | х | х |
| 5466-411 | INA | MODULE | MICRONET ETHERNET (RJ45) | х | + | n/a | Х | Х | | Х |
| 5466-416 | INA | MODULE | MICRONET PENTIUM WITH DUAL | X | + | n/a | X | X | Х | X |
| | | | ETHERNET OPTION | | | ıı/d | ^ | _ ^ | ^ | ^ |
| 5466-419 | INA | MODULE | NETCON PENTIUM CPU, 233MHZ,128MB | Х | | | | | | |
| | | | RAM,NT4.0,RTX4.3.2.1 | | | | | | | |
| 5466-425 | INA | MODULE | HIGH DENSITY ANALOG I/O (TMR) | Х | | n/a | Х | | Х | Х |
| 5466-1000 | Α | MODULE | POWER SUPPLY, 2 SLOT, 24VDC INPUT, MICRONET-PLUS | Х | х | Х | Х | х | Х | Х |
| 5466-1001 | А | MODULE | POWER SUPPLY, 2 SLOT, 110VAC/125VDC INPUT, MICRONET-PLUS | х | х | Х | х | х | Х | Х |
| 5466-1002 | Α | MODULE | POWER SUPPLY, 2 SLOT, 220VAC INIPUT, MICRONET-PLUS | х | х | Х | х | х | Х | Х |
| 5466-1005 | INA | MODULE | ISO T/C FAIL LOW | х | + | | | | | |
| 5466-1006 | INA | MODULE | ISO T/C FAIL HIGH | X | + | | | - | Х | |
| 5466-1007 | INA | MODULE | ISO 4-20 ANALOG IN | X | + + | | | | ^ | |
| | INA | MODULE | ISO 0-10 V ANALOG IN | | + | | | 1 | | - |
| 5466-1008 | | | | X | | | | - | | |
| 5466-1009 | INA | MODULE | ISO 4-20 ANALOG IN | X | | | | | | |
| 5466-1010 | INA | MODULE | ISO 4-20 MA DERIVATIVE | X | | | | 1 | | |
| 5466-1011 | INA | MODULE | ISO 4-20/ AD590 ANALOG IN | Х | | | | | | L |

| 5466-1012 | INA | MODULE | ISO T/C ANALOG IN (HF) | Х | | | | | | | |
|------------|-------------|-----------|--|-----|--|----|------|---------|---|-----|-----|
| 5466-1013 | INA | MODULE | SEMI ISO RTD 100 | х | | | | | | х | |
| 5466-1014 | INA | MODULE | SEMI ISO RTD 200 | Х | | | | | | | |
| 5466-1015 | INA | MODULE | SEMI ISO RTD 500 | Х | | | | | | | |
| 5466-1016 | INA | MODULE | SEMI ISO RTD 100 HIGH TEMP | Х | | | | | | | |
| 5466-1017 | INA | MODULE | SEMI ISO RTD 100 (10MS) | Х | | | | | | | |
| 5466-1018 | INA | MODULE | SEMI ISO RTD 200 (10MS) | Х | | | | | | | |
| 5466-1019 | INA | MODULE | SEMI ISO RTD 500 (10MS) | Х | | | | | | | |
| 5466-1020 | INA | MODULE | PENTIUM CPU W/ APPL S/W FOR D- | | | | | | | | |
| 5400 4005 | ^ | MODILLE | R LM2500+ | | | | | | | | |
| 5466-1035 | Α | MODULE | MICRONET CPU5200 (POWERPC MPC5200, 400MHZ, 64MB FLASH, | Х | | Х | Х | Х | Х | Х | |
| | | | 128MB RAM, DUAL CAN) | | | | | | | | |
| 5466-1036 | Α | MODULE | MICRONET REMOTE RTN (REMOTE | Х | | Х | Х | Х | Х | Х | |
| 0 100 1000 | '` | III OBOLL | REAL TIME NETWORK XCVR) | _ ^ | | ^ | Α | Α | , | _ ^ | |
| 5466-1037 | INA | MODULE | MICRONET CPU5200L (POWÉRPC | Х | | Х | Х | Х | Х | х | |
| | | | MPC5200, SINGLE ETHERNET, | | | | | | | | |
| | | | SINGLE CAN, NO RTN) | | | | | | | | |
| 5466-1045 | Α | MODULE | MICRONET PLUS CPU5200 | Х | | х | n/a | Х | Х | Х | Х |
| 7100 1010 | | | (CYBER-SECURITY) | | | | , | | | | |
| 5466-1046 | Α | MODULE | MICRONET PLUS RTN (CYBER- | х | | Х | n/a | Х | Х | х | Х |
| 5466-1047 | Α | MODULE | SECURITY) MICRONET TMR CPU5200, 400MHz, | Х | | | Х | Х | | | |
| 3400-1047 | ^ | WIODULL | 64MB FLASH, 128MB RAM, NO-CAN | ^ | | | ^ | | | | |
| 5466-1049 | Α | MODULE | MICRONET TMR PLUS KERNEL P.S. | Х | | | n/a | Х | | | |
| 5466-1050 | Α | MODULE | MICRONET DIO SIMPLEX | X | | Х | n/a | X | Х | х | х |
| 5466-1051 | Α | MODULE | MICRONET DIO TMR | Х | | | n/a | X | Х | Х | Х |
| 5466-1070 | INA | MODULE | ANALOG COMBO (TMR) 3 MPU/1 | | | | n/a | Х | Х | х | Х |
| | | | PROX | | | | | | | | |
| 5466-1105 | Α | MODULE | MICRONET SPEED/ANALOG I/O | Х | | Х | n/a | Х | Х | Х | Х |
| | | | COMBO - 4X SPEED, 12X I/V | | | | | | | | |
| | | | SELECTABLE INPUTS, 4X 4-20 MA | | | | | | | | |
| E400 444E | ^ | MODULE | OUTPUTS | | | | - /- | | | | |
| 5466-1115 | Α | MODULE | MICRONET HIGH DENSITY COMBO I/O - 4 SPEED INPUTS | Х | | Х | n/a | Х | Х | Х | х |
| | | | (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 | Α | MODULE | MICRONET PLUS CPU5200SA | х | | Х | n/a | Х | Х | х | Х |
| | | | (SECURED APPLICATION) | | | | , | | | | |
| 5466-1145 | Α | MODULE | MICRONET PLUS CPU5200 | х | | Х | n/a | Х | Х | Х | Х |
| 5466-1146 | Α | MODULE | (CYBER-SECURITY) LICENSED MICRONET PLUS RTN (CYBER- | | | Х | n/a | Х | | · · | · · |
| 3400-1140 | A | WIODULE | SECURITY) LICENSED | Х | | Χ. | II/a | X | Х | Х | Х |
| 5466-1156 | Α | MODULE | MICRONET TMR 48/24 HDDIO-2 | Х | | | n/a | Х | | | |
| 0400 1100 | / \ | WODOLL | SMART-PLUS | ^ | | | 11/4 | ^ | | | |
| 5466-1158 | Α | MODULE | MICRONET SIMPLEX 48/24 HDDIO-2 | х | | Х | n/a | Х | Х | х | х |
| | | | SMART-PLUS | | | | | <u></u> | | | L |
| 5466-1245 | Α | MODULE | MICRONET PLUS CPU5200 | Х | | Х | n/a | Х | Х | Х | Х |
| | | | (CYBER-READY) EHANCED PERF. | | | | | | | | |
| 5466-1246 | Α | MODULE | MICRONET PLUS RTN (CYBER- | Х | | Х | n/a | Х | Х | Х | х |
| F400 4047 | _ | MODILLE | READY) EHANCED PERF. | | | | /- | | | | - |
| 5466-1247 | Α | MODULE | MICRONET TMR CPU5200, SHARED | Х | | | n/a | Х | | | |
| 5466-1250 | Α | MODULE | RTN MICRONET TMR CPU5200, DIRECT | Х | | | n/a | Х | | | 1 |
| 3400-1250 | ^ | INIODOLE | EXPANSION | ^ | | | 11/d | X | | | |
| 5466-1347 | Α | MODULE | SHARED RTN W/CANOPEN | Х | | | | | | | 1 |
| 5466-1510 | ANP | MODULE | MICRONET PLUS P1020 CPU | X | | Х | n/a | Х | Х | Х | х |
| 5466-1511 | A | MODULE | MICRONET PLUS P1020 CPU | X | | Х | n/a | X | X | X | X |
| 5466-1520 | ANP | MODULE | MICRONET PLUS P1020 CPU | х | | Х | n/a | X | Х | X | Х |
| | | | (CYBER SECURITY APPLICATION) | | | | - | | | | |
| 5466-1521 | Α | MODULE | MICRONET PLUS P1020 CPU | х | | Х | n/a | Х | Х | х | х |
| <u> </u> | | | (CYBER SECURITY APPLICATION) | | | | | | | | ļ |
| 5466-5000 | Α | MODULE | MODULE - MICRONET SPEED | х | | Х | n/a | Х | Х | х | х |
| F400 F004 | ^ | MODULE | SENSOR, 4 CHANNEL, MPU | | | | 1- | | | | |
| 5466-5001 | Α | MODULE | MODULE - MICRONET SPEED | Х | | Х | n/a | Х | Х | Х | Х |
| | | | SENSOR, 4 CHANNEL, EDDY PROBE CH1/MPU | | | | | | | | |
| 5466-5002 | Α | MODULE | MICRONET SPEED SENSOR, 4 | Х | | Х | n/a | х | Х | Х | Х |
| 0-100-0002 | , `` | MODULE | CHANNEL, 2 MPU/2 PROX | ^ | | ^ | 11/4 | ^ | ^ | ^ | ^ |
| | | | , | • | | | | | | | |

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|-----------|-----|--------|--|---|---|-----|---|---|----------|---|
| 5466-5003 | Α | MODULE | MICRONET SPEED SENSOR, 4 CHANNEL, 3 MPU/1 PROX | Х | х | n/a | Х | х | х | х |
| 5466-5006 | Α | MODULE | MODULE - SIO MODULE, W/SCREW POSTS, SMART-PLUS | х | х | n/a | Х | | | |
| 5466-5007 | Α | MODULE | MODULE - SIO MODULE, W/SLIDE LOCK, SMART-PLUS | х | х | n/a | х | | | |
| 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 | х | х | n/a | х | х | х | х |
| 5466-5026 | A | MODULE | MODULE - MICRONET SIMPLEX HIGH DENSITY ANALOG I/O - 24X 4- 20 MA INPUTS, 8X 4-20 MA OUTPUTS | х | х | n/a | х | х | х | х |
| 5466-5027 | A | MODULE | MODULE - MICRONET SIMPLEX HIGH DENSITY ANALOG I/O - DATAFORTH 24X 0-5 V INPUTS, 8X 4-20 MA OUTPUTS | х | х | n/a | х | х | х | х |
| 5500-332 | Α | MODULE | RELAY | | | | | | | |
| 5501-224 | INA | BOARD | FAULT TOLERANT RELAY [Ordinary Locations Only] | | | | | | | |
| 5501-325 | Α | BOARD | MICRONET HV DISC FTM | Х | | | | х | х | Х |
| 5501-361 | Α | SENSOR | EMR 1000 Flex Circuit Speed | | | | | X | <u> </u> | |
| 5501-365 | A | BOARD | ANALOG COMBO TMR FTM | х | | n/a | х | X | Х | Х |
| 5501-367 | A | BOARD | MICRONET SIMPLEX LV DISCRETE FTM | X | x | n/a | X | X | X | Х |
| 5501-370 | Α | BOARD | 5009/MICRONET TMR POWER SUPPLY (24V DC) | х | | n/a | Х | Х | Х | Х |
| 5501-371 | Α | BOARD | MICRONET SIMPLEX MPU & AIO FTM | х | | n/a | Х | Х | Х | Х |
| 5501-372 | Α | BOARD | HIGH DENSITY ANALOG I/O TRIPLEX FTM | х | | | | Х | Х | Х |
| 5501-373 | INA | BOARD | F/T RELAY - UL APPROVED[Ordinary Locations Only] | | | | | | | |
| 5501-376 | Α | BOARD | ANALOG HIGH DENSITY MODULE SIMPLEX FTM | Х | х | n/a | Х | Х | Х | Х |
| 5501-380 | Α | BOARD | 5009/MICRONET TMR POWER SUPPLY (120V AC/DC) | Х | | Х | Х | Х | Х | Х |
| 5501-381 | Α | BOARD | 5009/MICRONET TMR POWER SUPPLY (220V AC) | х | | Х | Х | Х | Х | Х |
| 5501-409 | Α | Board | MicroNet Motherboard (6 Slot) | Х | | | | Х | | Х |
| 5501-410 | INA | Board | MicroNet Power Supply (24V DC) | Х | | | | Х | | Х |
| 5501-411 | INA | Board | MicroNet Power Supply (120V AC/DC) | Х | | | | Х | | Х |
| 5501-412 | INA | Board | MicroNet Power Supply (220V AC) | Х | | | | Х | | Х |
| 5501-423 | Α | Board | MicroNet Motherboard (12 Slot) | Х | | | | Х | | Х |
| 5501-428 | ANP | BOARD | NETCON 2CH ACTUATOR CONTROLLER (10MA) | х | | n/a | Х | Х | Х | Х |
| 5501-429 | ANP | BOARD | NETCON 2CH ACTUATOR CONTROLLER (25MA) | х | х | n/a | Х | Х | Х | Х |
| 5501-430 | ANP | BOARD | NETCON 2CH ACTUATOR CONTROLLER (50MA) | х | х | n/a | Х | Х | Х | Х |
| 5501-431 | ANP | BOARD | NETCON 2CH ACTUATOR CONTROLLER (100MA) | х | х | n/a | Х | Х | Х | Х |
| 5501-432 | ANP | BOARD | NETCON 2CH ACTUATOR CONTROLLER (200MA) | х | х | n/a | Х | Х | Х | Х |
| 5501-461 | INA | MODULE | POSITION CONTROLLER TM DFB | Х | | | Х | Х | Х | Х |
| 5501-462 | INA | MODULE | POSITION CONTROLLER TM SFB | Х | | | Х | Х | Х | Х |
| 5501-465 | A | BOARD | MICRONET SIMPLEX POWER SUPPLY (24V DC) | х | | Х | Х | Х | Х | Х |
| 5501-466 | Α | BOARD | MICRONET SIMPLEX POWER SUPPLY (120V AC/DC) | Х | | Х | Х | Х | Х | Х |
| 5501-467 | A | BOARD | MICRONET SIMPLEX POWER SUPPLY (220V AC/DC) | х | | X | х | Х | Х | Х |
| 5501-468 | INA | MODULE | NETCON CPU_040 W/O LL MEMORY | | | n/a | Х | | | |
| 5501-469 | INA | MODULE | NETCON CPU_040 WITH LL MEMORY (EMI FILTER) | х | | n/a | Х | | | |
| 5501-470 | INA | MODULE | NETCON CPU_040 W/O LL MEMORY (EMI FILTER) | х | | n/a | Х | | | |
| 5501-471 | ANP | MODULE | NETCON 5000B SIO W/SCREW POSTS | Х | Х | n/a | X | Х | Х | Х |

Manual 26166V2

MicroNet Simplex & MicroNet Plus

| 5501-473 | ANP | MODULE | NETCON DUAL OVERSPEED | 1 | | | | | 1 | | |
|-----------|--------|---------------------------|--------------------------------------|---|---|---|-----|---|---|---|---|
| | | | | | | | | | | | |
| 5501-476 | INA | MODULE | NETCON DUAL OVERSPEED | | | | | | | | |
| 5501-477 | INA | MODULE | NETCON DUAL OVERSPEED @ | | | | | | | | |
| 5504 470 | 15.1.0 | MODULE | 5478 HZ | | | | | | | | |
| 5501-478 | INA | MODULE | NETCON DUAL OVERSPEED @ | | | | | | | | |
| | | | 5404 HZ | | | | | | | | |
| 5501-479 | INA | MODULE | NETCON DUAL OVERSPEED @ | | | | | | | | |
| | | | 6160 HZ | | | | | | | | |
| 5501-502 | Α | MODULE | TMR SPEED INPUT FTM | | | | | | | | |
| 5501-1428 | Α | MODULE | 2CH ACTUATOR CONTROLLER | Х | | Х | n/a | Х | Х | Х | Х |
| | | | (10MA) W/ FEEDBACK FAULT | | | | | | | | |
| | | | LATCHING | | | | | | | | |
| 5501-1429 | Α | MODULE | 2 CH ACTUATOR CONTROLLER | Х | | Х | n/a | Х | Х | Х | Х |
| | | | (25MA) W/ FEEDBACK FAULT | | | | | | | | |
| | _ | | LATCHING | | | | | | | | |
| 5501-1430 | Α | MODULE | 2CH ACTUATOR CONTROLLER | Х | | Х | n/a | Х | Х | Х | Х |
| | | | (50MA) W/ FEEDBACK FAULT | | | | | | | | |
| | | | LATCHING | | | | | | | | |
| 5501-1431 | Α | MODULE | 2CH ACTUATOR CONTROLLER | Х | | Х | n/a | Х | Х | Х | Х |
| | | | (100MA) W/ FEEDBACK FAULT | | | | | | | | |
| | | | LATCHING | | | | | | | | |
| 5501-1432 | Α | MODULE | 2CH ACTUATOR CONTROLLER | х | | Х | n/a | Х | х | Х | Х |
| | | | (200MA) W/ FEEDBACK FAULT | | | | | | | | |
| | | | LATCHING | | | | | | | | |
| 5503-267 | Α | MODULE | NETCON IIIB 3-9 PIN RT SIO | Х | | | n/a | Х | | Х | |
| | | | W/SCREW POSTS | | | | | | | | |
| 5503-279 | INA | BOARD | MICRONET HDVIM (AI/RTD/TC) | х | | | Х | Х | х | Х | х |
| | | | THRU HOLE ASSY | | | | | | | | |
| 5503-282 | INA | MODULE | FTM HDVIM (AI/RTD/TC) THRU | х | | | Х | Х | х | Х | Х |
| | | | HOLE ASSY | | | | | | | | |
| 5503-335 | INA | MODULE | MICRONET 5200 CPU, 400MHZ, | х | | | Х | Х | | Х | |
| | | | 64MB FLASH, 128MB RAM | | | | | | | | |
| 5503-336 | INA | MODULE | MICRONET REAL-TIME NETWORK | х | | | Х | Х | | Х | |
| | | | XCVR (REMOTE) | | | | | | | | |
| 5503-904 | INA | MODULE | HD ANALOG I/O 12 CH 4-20MA AND | Х | | | | | | | |
| | | | 12 CH 0-5V | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 8928-096 | INA | KIT | CPU EMI DB9 RS232 ADAPTOR | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 9905-678 | INA | MODULE | LINKNET 6 CHANNEL 200 OHM RTD | | Х | Х | n/a | Х | Х | Х | Х |
| 9905-760 | INA | MODULE | ASSY OF LINKNET TERMINATION | | Х | Х | n/a | Х | Х | Х | Х |
| 9905-966 | INA | MODULE | LINKNET TC INPUT FAIL HIGH | | Х | Х | n/a | Х | Х | Х | Х |
| 9905-967 | INA | MODULE | LINKNET TC INPUT FAIL LOW | | Х | X | n/a | X | X | X | X |
| 9905-968 | INA | MODULE | LINKNET 6 CHANNEL 4-20 MA IN | | Х | X | n/a | X | X | X | X |
| 9905-969 | INA | MODULE | LINKNET 6 CHANNEL 4-20 MA IN W/ | | X | X | n/a | X | X | X | X |
| | | | 24 V | | | | , 🔾 | | ^ | | ^ |
| 9905-970 | INA | MODULE | LINKNET 6 CHANNEL 100 OHM RTD | | Х | Х | n/a | Х | Х | Х | х |
| 9905-971 | INA | MODULE | LINKNET DISCRETE IN | | X | X | n/a | X | X | X | X |
| 9905-972 | INA | MODULE | LINKNET 6 CHANNEL 4-20 MA OUT | | X | X | n/a | X | X | X | X |
| 9905-973 | INA | MODULE | LINKNET DISCRETE OUT | | X | X | n/a | X | X | X | X |
| 9907-072 | INA | Power Supply | SGL Out 18-32 VDC NetCon | Х | ^ | | X | X | X | X | X |
| 9907-072 | INA | Power Supply Power Supply | Multi Out 18-32 VDC NetCon | X | | | X | X | X | X | X |
| 9907-073 | INA | Power Supply Power Supply | SGL Out 42-60 VDC NetCon | | | | | | | | |
| 9907-074 | INA | | Multi Out 42-60 VDC NetCon | X | | | X | X | X | X | X |
| | | Power Supply | | X | | | X | X | X | X | X |
| 9907-076 | INA | Power Supply | SGL Out 120 VAC/DC NetCon | X | | | X | X | X | X | X |
| 9907-077 | INA | Power Supply | Multi Out 120 VAC/DC NetCon | X | | | X | X | X | X | X |
| 9907-078 | INA | Power Supply | SGL Out 220 VAC/DC NetCon | Х | | | Х | X | Х | Х | Х |
| 9907-079 | INA | Power Supply | Multi Out 220 VAC/DC NetCon | Х | | | Х | Х | Х | Х | Х |
| 9907-205 | Α | Programmer | Hand Held, CE Compliant, 4 Piece Kit | | | | X | X | Х | | |

Updated: August 2024

Status Definition

Active

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

Appendix B. **Environmental Specifications**

Operating Temperature for the MicroNet Control

using the 68040/060 CPU

Operating Temperature for the MicroNet Control

using the NT CPU

Operating Temperature for the MicroNet Plus Control using the P 1020 CPU

Operating Temperature for the MicroNet Plus Control using the 5200 CPU 0 to +55 °C (+32 to +131 °F), using the 68040/060 CPU, still air, no external heat loads Lloyd's: ENV 1

0 to +50 °C (+32 to +122 °F), with moving airflow as provided by

MicroNet fans 0 to +55 °C (+32 to +131 °F), with moving airflow as provided by

MicroNet fans

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.

-40 to +105 °C (-40 to +221 °F) (except CPU module: -20 to +45 °C (-4 to +113 °F) Storage Temperature:

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))

Lloyd's Register Test Specification No. 1, 1996, Vibration Test 1 Vibration (MicroNet):

(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

Note: For Extended Atmospheric Environment Requirements please reference

Application Note 51530.

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

| | | | | dules | | | | |
|-------|--------------|--------------|-----------------------|-------------|--------------------|---------|------------------|------------------|
| | | CPU P1020 | CPU 5200 Cyber/ | CPU 5200 | CPU 5200 TMR | Pentium | Motorola x040 | Motorola x060 |
| | | | Enhanced | | | | | |
| | Micronet 1.0 | • | • | | | | | |
| | Coder 6.x | | • | | | | | |
| Coder | Coder 5.x | | | • | • | | | |
| List | Coder 4.x | | | • | | | | |
| List | Coder 3.x | | | | | • | • | |
| | Coder 2.x | | | | | | • | • |
| | TMR 1.0 | | | | • | | | |

C.2. Control Platforms and CPU Compatibility Matrix

Table C-2. Control Platforms with CPU Modules.

| | | | | (| CPU Modu | ıles | | |
|-------------------|---------------------------------|--------------|--------------------------------|-------------|--------------------|---------|------------------|------------------|
| | | CPU P1020 | CPU 5200 Cyber/ Enhanced | CPU 5200 | CPU 5200 TMR | Pentium | Motorola x040 | Motorola x060 |
| | MicroNet Plus 1 | • | • | • | | | | |
| | MicroNet Simplex 12 | | • | • | | • | • | • |
| | MicroNet Simplex 6 | | • | • | | • | • | • |
| Control Platforms | MicroNet TMR ^{2, 3} | | | | • | | • | • |
| | | | | | | | _ | |
| | NetCon Simplex | | | | | • | • | • |
| | NetCon Remote I/O | | | | | | • | • |
| | NetCon F/T | | | | | | • | • |

NOTES:

- (1) CAN communications and short chassis enabled in Coder 4.02
- (2) If used with an expansion chassis, a Plus Expansion Chassis is required.
- (3) 040 TMR only compatible with Coder 2.x

Table C-3. CPU/RTN/RTN Gateway Compatibility Matrix

| CPU | RTN | RTN Gateway | Name | FTP | SFTP | Original non- Secure Servlink | SSH Servlink | Acct Mgr | Encrypted Apps | Supported Coders |
|---------------|----------------|------------------------------|---|-----|------|--|-----------------|-------------|-------------------|--|
| 5466- 1035 | 5466- 1036 | N/A | 5200 CPU | Х | | Х | | | | 4.0x-504-1 |
| 5466- 1045 | 5466- 1046 | 8200- 1250/8200- 1253# | 5200 CPU Cyber Ready | | Х | | Х | | | 5.03-0 to 5.04-0, 6.00-0 + |
| 5466- 1145 | 5466- 1146 | 8200- 1250/8200- 1253# | 5200 CPU Cyber Licensed | | Х | | Х | Х | | 6.00-4+, Micronet 1.00-0+ (5466-1145 Rev "D" and greater) |
| 5466- 1245 | 5466- 1246 | 8200-1252 | 5200 CPU Enhanced Performance CPU | Х | | Х | | Х | | 6.00-4 +, Micronet 1.00-0+ |
| 5466- 1141 | 5466- 1246 | 8200-1252 | 5200 CPU Secure Application (GEJV) | Х | | Х | | Х | Х | 6.00-4 +, Micronet 1.00-0+ |
| 5466- 1510 | 5466- 1146* | 8200- 1253# | P1020 CPU (NON- SECURED APPLICATION) | | Х | | Х | Х | | Micronet 1.00-0+ |
| 5466- 1520 | 5466- 1146* | 8200- 1253# | P1020 CPU (SECURED APPLICATION) | | Х | | Х | Х | Х | Micronet 1.00-0+ |
| 5466- 1511 | 5466- 1146* | 8200- 1253# | P1020 CPU (NON- SECURED APPLICATION) | | Х | | Х | Х | | Micronet 1.02-0+ |
| 5466- 1521 | 5466- 1146* | 8200- 1253# | P1020 CPU (SECURED APPLICATION) | | Х | | Х | Х | Х | Micronet 1.02-0+ |
| | | le; The non-pr | eferred 5466- | | | | | | | |
| | ill also fu | | referred 8200- | | | | | | | |
| | ill also fu | | reierreu ozuu- | | | | | | | |

C.3. Module Compatibility Matrix



- 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-4. Module Compatibility Matrix

| Module Compatibility | M | licroNe | et Famil | у | | | |
|--|----------|---------|----------|------|---|--|--|
| Module Companionity | Plus Sin | | | olex | | | |
| Power Supplies | Main | Ехр | Main | Exp | Notes | | |
| MicroNet Plus, 2-Slot | • | • | | | | | |
| MicroNet Simplex, 3-Slot | | | • | • | | | |
| CPU Modules | | | | | | | |
| CPU, P 1020 | • | | | | | | |
| CPU, PowerPC 5200 | • | | • | | | | |
| 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 5466-5006 or 5466-5007 modules | | |
| 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. | | |

Manual 26166V2

MicroNet Simplex & MicroNet Plus

| 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. Acronyms

A Ampere

ac Alternating Current

Act Actuator

A/D Analog-to-Digital

AD590 Temperature Measurement Device

Al 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

Manual 26166V2

| FDBK | Feedback |
|-------------|---|
| FDOC | Fixed Disk on Chip |
| FS | |
| 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 | |
| HD | High Density |
| HV | High Voltage |
| HVAC | High Voltage Alternating Current |
| IEC IEEE | International Electro technical Commission 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 | |
| LED | |
| LINKnet | |
| 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 | |
| MPU | Magnetic Pick-up Millisecond |
| ms m\/ | Millivolt |
| m∨ 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 PS/2 | Power Supply IPM trademark for keyboard/mayon port |
| PS/2 | IBM trademark for keyboard/mouse port |

Manual 26166V2

| 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 AE—

- Moved Chapter 10 content to Volume 3 of this manual
- Updated Table 12-1 DataForth Module Types
- Updated Appendix A—Matrix of Modules and Compliance Information
- Update Table C-3 CPU/RTN/RTN Gateway Compatibility Matrix in Appendix C

Changes in Revision AD-

- Added Section 11.4, including Figures 11-6 and 11-7 to Chapter 11
- Removed CPU P1020 references from MicroNet Simplex 12 and MicroNet Simplex 6 in Table C-2

Changes in Revision AC-

- Added Woodward P/N and corrected DataForth P/N in Table 12-1
- Changed status of part numbers 5466-348 and 5501-471 to AMP in Appendix A
- Added part numbers 5466-5006 and 5466-5007 to Appendix A
- Changed note on Serial I/O (4 port) in Appendix C.3

Changes in Revision AB-

- Added part numbers to section 10.2.5
- Changes to section 11.1 Regulatory Compliance.
- Changed dimension to Figure 13-25
- Changed IMPORTANT boxes to WARNING boxes in Sections 13.3.3, 13.4.1, and 13.4.2
- Expanded explosion hazard warning text and added French Warning box to 13.4.3
- Updated content in Appendix A table
- Replaced Table C-1, created new table C-2, and replaced old table C-2 renaming it C-3.
- Renamed old Table C-3 to Table C-4.

Changes in Revision AA-

- Added Phoenix RTN switches to list on V1 pg. 85
- Added notes and Important Boxes regarding GAP to Chapter 8
- Added note to Air Quality in Appendix B
- Added switches 1711-1350 and 1711-1351 to the Compliance Matrix

Changes in Revision Y-

- Updated compliance chart in Appendix A
- Moved information from Sections 10.3, 10.5, 13.5, and 13.6 into Volume 3
- Added Table C-2 to Appendix C

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

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.: 00372-04-EU-02-01

Manufacturer's Name: WOODWARD INC.

Manufacturer straine. WOOD

Manufacturer's Contact Address:

1041 Woodward Way Fort Collins, CO 80524 USA

Fort Collins, CO 60324 OSA

Model Name(s)/Number(s): MicroNet[™] Simplex, MicroNet[™] Plus Digital Control Systems when

installed in a non-EMI cabinet, 18-36 VDC.

The object of the declaration described above is in conformity with the following relevant

Union harmonization legislation:

Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in

potentially explosive atmospheres

Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States

relating to electromagnetic compatibility (EMC)

Markings in addition to CE marking:

(a) Category 3 Group II G, Ex nA [nL] IIC T3 X

Applicable Standards:

EN 61000-6-4, 2007/A1:2011: 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.

Conformity Assessment:

ATEX Annex IV - Production Quality Assessment, 01 220 113542

TUV Rheinland Industrie Service GmbH (0035)

Am Grauen Stein, D51105 Cologne

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

06-MAY-2016

Date

5-09-1183 Rev 26

EU DECLARATION OF CONFORMITY

EU DoC No.:

00372-04-EU-02-02

Manufacturer's Name:

WOODWARD INC.

Manufacturer's Contact Address:

1041 Woodward Way Fort Collins, CO 80524 USA

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.

The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:

Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in

potentially explosive atmospheres

Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States

relating to electromagnetic compatibility (EMC)

Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to the making available on the market of electrical

equipment designed for use within certain voltage limits

Markings in addition to CE marking:

Category 3 Group II G, Ex nA [nL] IIC T3 X

Applicable Standards:

EN 61000-6-4, 2007/A1:2011: 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"

Last two digits of the year in which the CE marking was affixed for the first time:

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

06-MAY -2016

Date

5-09-1183 Rev 26

EU DECLARATION OF CONFORMITY

EU DoC No.: 00117-04-EU-02-01

Manufacturer's Name: WOODWARD INC.

Manufacturer's Contact Address: 1041 Woodward Way Fort Collins, CO 80524 USA

Model Name(s)/Number(s): 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.

The object of the declaration described above is in conformity with the following relevant

Union harmonization legislation:

Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in

potentially explosive atmospheres

Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States

relating to electromagnetic compatibility (EMC)

Markings in addition to CE marking:

Category 3 Group II G, Ex nA [nL] IIC T4 X

Applicable Standards:

EN 61000-6-4, 2007/A1:2011: 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: 2009 Explosive atmospheres - Part 0 - General

Requirements

Conformity Assessment: A

ATEX Annex IV - Production Quality Assessment, 01 220 113542

TUV Rheinland Industrie Service GmbH (0035)

Am Grauen Stein, D51105 Cologne

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

06- MAY- 2016

Date

5-09-1183 Rev 26

Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 26166V2.





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