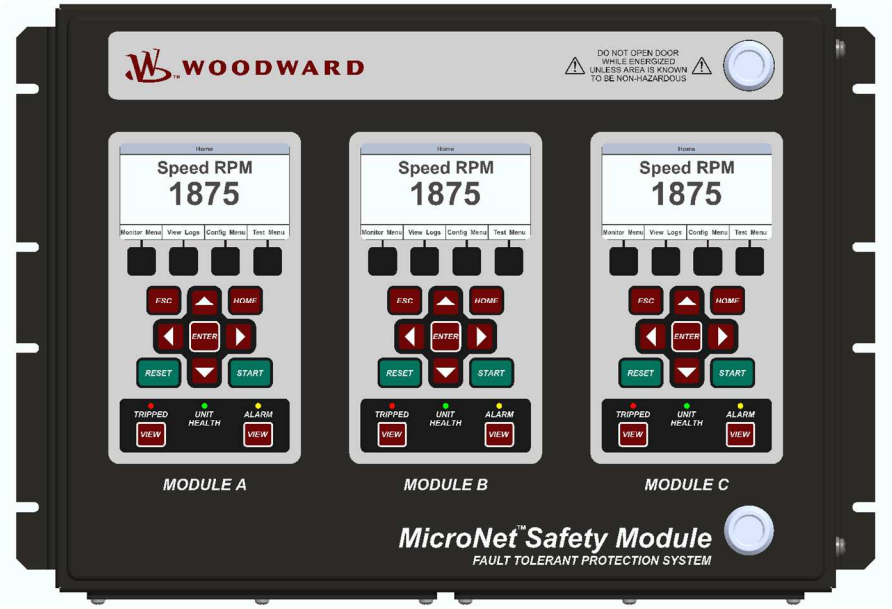
WOODWARD

# Product Manual 26547V1
# (Revision G, 1/2021)
**Original Instructions**




# MicroNet™ Safety Module
# Fault Tolerant Protection System

**Manual 26547 consists of 2 volumes (26547V1 & 26547V2)**

## Volume 1 - Installation and Operation

**General Precautions**

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

**Practice all plant and safety instructions and precautions.**

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

**Revisions**

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**The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.**

**Proper Use**

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

**Translated Publications**

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



**Manual 26547V1**

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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.

**⚠WARNING**

**Overspeed / Overtemperature / Overpressure**

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

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

**⚠WARNING**

**Personal Protective Equipment**

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

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

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

**⚠WARNING**

**Start-up**

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

***NOTICE***

**Battery Charging Device**

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

# Electrostatic Discharge Awareness

**NOTICE**

**Electrostatic Precautions**

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

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

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

Follow these precautions when working with or near the control.

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

# Regulatory Compliance

## European Compliance for CE Marking

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

**Low Voltage Directive:** 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

**ATEX – Potentially Explosive Atmospheres Directive:** 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
II 3 G, Ex nA IIC T4

## Other European Compliance

Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking:

**RoHS Directive:** Restriction of Hazardous Substances 2011/65/EU:
Woodward Turbomachinery Systems products are intended exclusively for sale and use only as a part of Large Scale Fixed Installations per the meaning of Art.2.4(e) of directive 2011/65/EU. This fulfills the requirements stated in Art.2.4(c) and as such the product is excluded from the scope of RoHS2.

## North American Compliance

**CSA:** Certified for Class I, Division 2, Groups A, B, C, and D, T4 at 60 °C Ambient for use in the United States and Canada.
Certificate 160584-2217246

## Other International Compliance

**Australia (& New Zealand) RCM**: Compliance is limited to application for those units bearing the Regulatory Compliance Mark (RCM). Only EMC is applicable in virtually all Woodward intended applications. RCM on WWD products is very limited due to allowed exemptions from applying the RCM or having a DoC
**EMC:** Electromagnetic Compatibility (EMC) Declaration of Conformity (DoC) RCM requirements for the Australian (& New Zealand) Radiocommunications Act is a separate document only created for products applying the RCM to the label.
Products with a RCM on the label have an EMC Declaration of Conformity available: Woodward products typically comply with at least CISPR11 Group1, Class A emissions limits, Electromagnetic Interference (EMI) testing, even if not marked with the RCM: as long as the “CE mark” is on the label.

**TÜV:** TÜV certified for SIL-3 per IEC 61508 Parts 1-7, Functional Safety of Electrical / Electronic / Programmable Electronic Safety Related Systems

## Other Compliance

**Gas Corrosion:** IEC60068-2-60:1995 Part 2.60 Methods 1 and 4 (conformal coating)

**Machinery Protection:** API670, API612, & API-611 compliant

## Special Conditions for Safe Use

This Equipment is Suitable for use in Class I, Division 2, Groups A, B, C, D or Non-Hazardous Locations Only.

This equipment is suitable for use in European Zone 2, Group IIC environments or Non-Hazardous Locations Only.

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

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

Protective Earth Grounding is required by the input PE terminal.

Field wiring must be rated at least 85 °C for operating ambient temperatures expected to exceed 50 °C.

For European ATEX compliance on panel mount models, this equipment must be installed in an area providing adequate protection against the entry of dust or water. A minimum ingress protection rating of IP54 is required for the enclosure.

Personnel must discharge their electrostatic build up to the cabinet ground point or use an ESD strap prior to touching the ProTech® interior surfaces if the engine/turbine is operational. The unit is designed to have one of three modules be removed during operation; however ESD to the remaining operational modules may cause signal deviations. Signal deviations due to direct ESD may be large enough to result in the operational module to trip, shutting down the engine since two modules are in a tripped mode. Signal deviations were noted when ESD testing was done to the Speed pins, the IRIG-B pins, Service Port pins, and RS-232/RS-485 Modbus communications port pins.

**⚠WARNING**

**Do not remove module unless module is de-energized and all wire connections have been disconnected**

The Service Port (RS-232 communication) is not designed to remain connected during operation except at servicing & programming intervals. It should not have a cable connected to it other than during programming & servicing.

This device contains a single cell primary battery. This battery is not to be charged and is not customer replaceable.

Control is suitable for installation in pollution degree 2 environments.

**⚠WARNING**

**Measurement inputs are classified as permanently connected IEC measurement Category I and are designed to safely withstand occasional transient overvoltages up to 1260 V (pk). To avoid the danger of electric shock, do not use these inputs to make measurements within measurement categories II, III, or IV.**

**⚠WARNING**

**Explosion Hazard—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.**

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

**AVERTISSEMENT**

**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 ou Zone 2.**

## Safety Symbols


Both direct and alternating current


Alternating current


Direct current


Caution, risk of electrical shock


Caution, refer to accompanying documents


Protective conductor terminal


Frame or chassis terminal

# Acronyms and Definitions

| | |
|---|---|
| **2oo3** | 2-out-of-3 |
| **Block Identifier** | The identifier used for each logic block for configuration purposes (Chapter 9) |
| **CAN** | Controller Area Network |
| **DC** | Diagnostic Coverage |
| **DCS** | Distributed Control System |
| **Module** | Functionality contained within one of the three identical sections |
| **MPU** | Magnetic Pick-up |
| **PC** | Personal Computer or laptop with Windows operating system |
| **PCT** | Programming and Configuration Tool |
| **PFD** | Probability of Failure on Demand |
| **PFH** | Probability of dangerous Failure per Hour |
| **PLC** | Programmable Logic Controller |
| **PROX** | Proximity Probe |
| **RTU** | Remote Terminal Unit |
| **Settings-File** | A file that contains the configuration settings loaded with the ProTech Service Tool (.wset). |
| **MSM** | MicroNet™ Safety Module |

# Chapter 1.
# General Information

## Description

The MicroNet™ Safety Module is a safety system that provides specialized overspeed protection functions plus additional programmable logic and configurable inputs and outputs to address other safety critical functions.

The MicroNet Safety Module consists of three independent modules whose trip outputs are either independent or voted in a 2-out-of-3 configuration.

The MicroNet Safety Module includes Alarm, Event, Trip and Sequence of Event log functions with time-stamping. Indication that a test was active at the time of the event is provided on all logs and first-out indications are provided for Event and Trip logs. Trip response time monitoring and logging is also built into the MicroNet Safety Module.

The MicroNet Safety Module provides various pre-defined and user-definable test features including automated periodic tests.

There are several ways to interface with the MicroNet Safety Module. The front panel of allows the user to view current values, and perform certain configuration and test functions. All of the features and most of the information available from the front panel is also accessible via the Modbus® * interface. Finally, the Programming and Configuration Tool (PCT) is software that is run on a PC to define configurable inputs and programmable logic, download log files, and manage settings files.

*—Modbus is a trademark of Schneider Automation Inc.

This product is designed for critical applications and when installed correctly meets API-670, API-612, API-611, and IEC61508 (SIL-3) standards.

The following Table shows the various hardware configurations (mounting options, power supplies, and trip relay options) available:

Table 1-1 Available MicroNet Safety Module Models

| Part Number | Description |
|---|---|
| 8237-1252 | MicroNet Safety Module – Bulkhead Mount, HV/LV, Ind relay |
| 8237-1253 | MicroNet Safety Module – Bulkhead Mount, HV/HV, Ind relay |
| 8237-1254 | MicroNet Safety Module – Bulkhead Mount, HV/LV, voted relays |
| 8237-1255 | MicroNet Safety Module – Bulkhead Mount, HV/HV, voted relays |
| 8237-1375 | MicroNet Safety Module – Panel Mount, HV/LV, Ind relay |
| 8237-1376 | MicroNet Safety Module – Panel Mount, HV/HV, Ind relay |
| 8237-1377 | MicroNet Safety Module – Panel Mount, HV/LV, voted relays |
| 8237-1378 | MicroNet Safety Module – Panel Mount, HV/HV, voted relays |
| 5437-1104 | Spare Module for MSM models 8237-1254, -1377 |
| 5437-1105 | Spare Module for MSM models 8237-1255, -1378 |
| 5437-1106 | Spare Module for MSM models 8237-1252, -1375 |
| 5437-1107 | Spare Module for MSM models 8237-1253, -1376 |

# Applications

The MicroNet Safety Module is designed to be applied as a safety system for any size steam, gas, or hydro turbine, reciprocating engine, or plant process equipment. This safety PLC's fast (12 millisecond) response time, 0.5 to 32 000 rpm speed range, and integrated overspeed and acceleration detection/protection functionality, make it ideal for application on critical low-speed or high-speed rotating motors, compressor, turbines or engines. This standalone safety device accepts 10 discrete or analog inputs per module (30 total) and one speed (MPU or PROX) input (3 total). Each individual module (kernel) of the MicroNet Safety Module provides 3 programmable relay outputs (9 total) and an analog speed output (3 total) in addition to the trip relay outputs. Configurable logic allows the customization required to meet specific application requirements to ensure plant protection.

The MicroNet Safety Module utilizes a triple modular redundant architecture and 2-out-of-3 voting logic to accurately determine unsafe conditions and ensure that no single-point failure will affect system reliability or availability. With this design, system failures (switches, transducers, modules) are detected, annunciated, and allowed to be repaired or replaced while the monitored system continues to operate on-line.

Alternatively, this standalone safety device can be configured to protect any plant system or device, and report the system's device's status to the plant DCS. The MicroNet Safety Module control's versatile inputs, outputs, programming environment, and communications make it ideal as a safety protection device for use in small applications that could possibly reach an unsafe state or condition and that must communicate directly to the plant DCS. The MicroNet Safety Module is designed for critical applications where both personnel safety and unit availability (operation run time) is a concern or necessity.

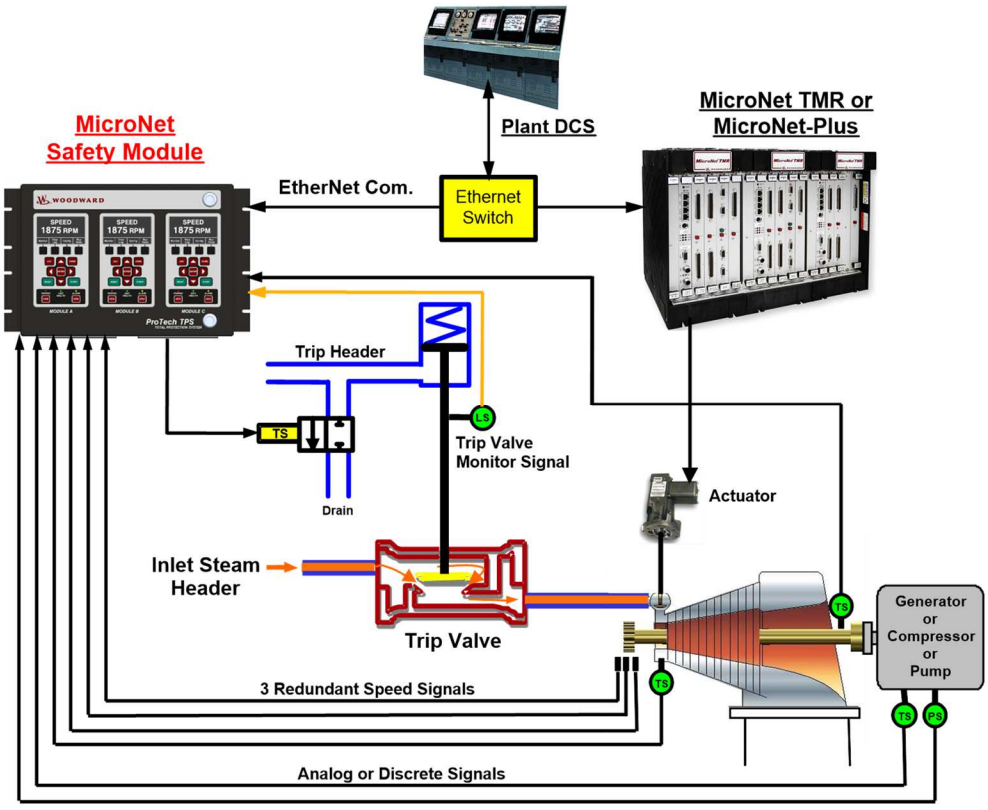



Figure 1-1. Typical MicroNet Safety Module Application (Voted Trip Relay Models)

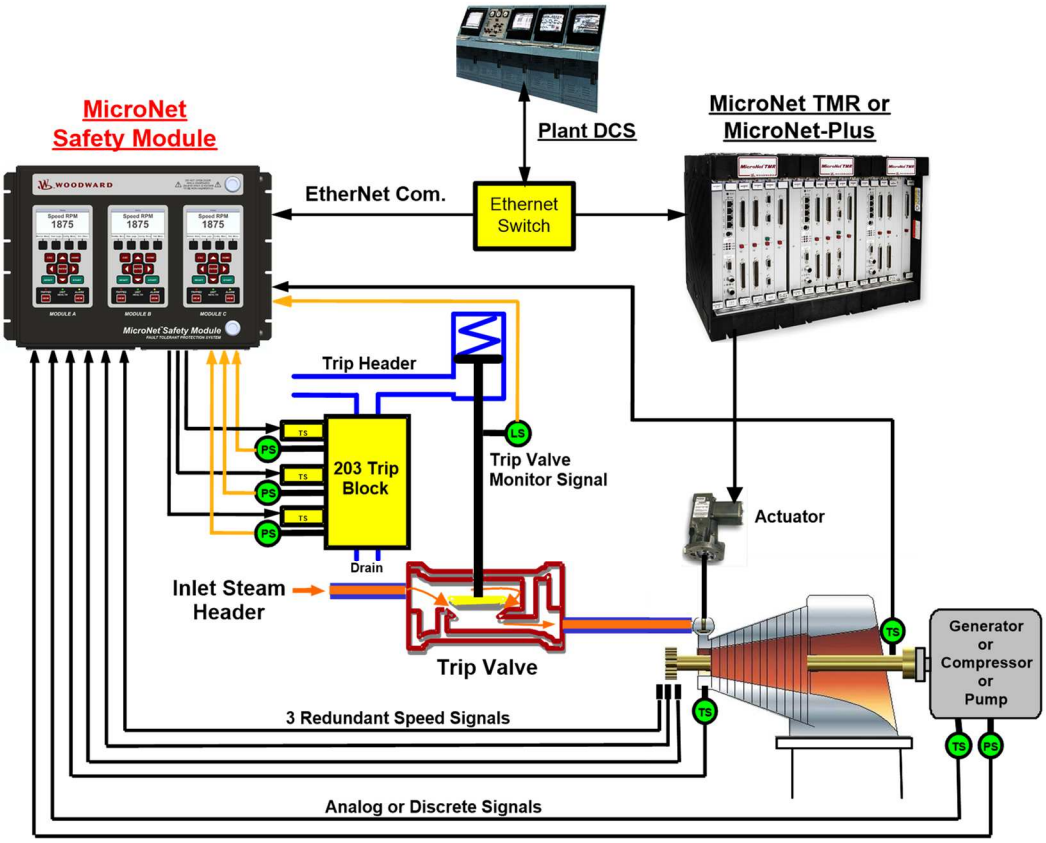



Figure 1-2. Typical MicroNet Safety Module Application (Independent Trip Relay Models)

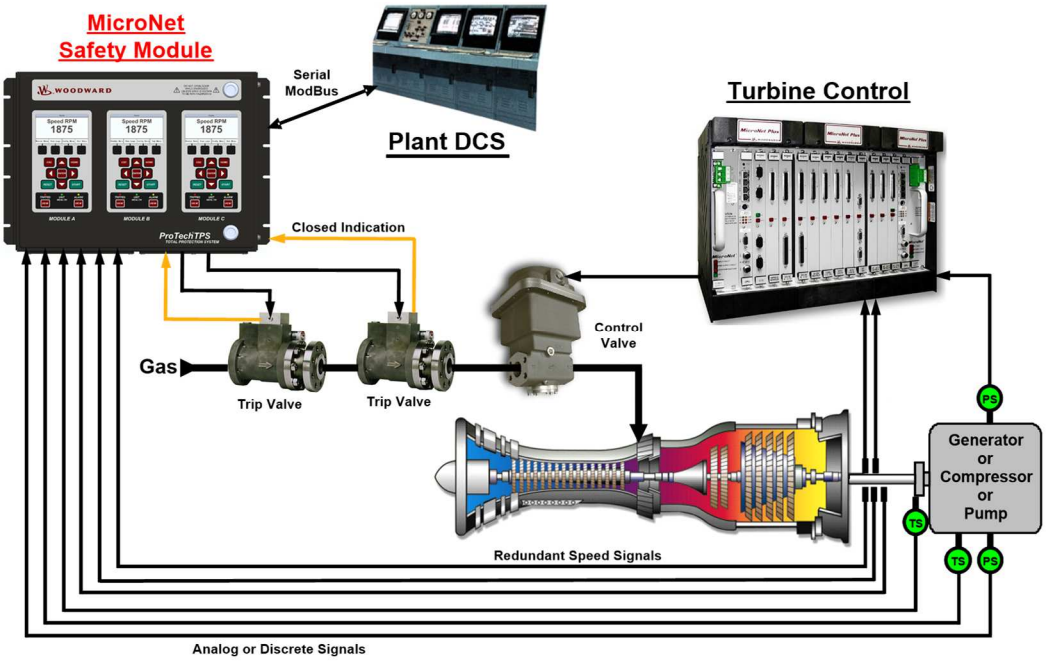



Figure 1-3. Typical Gas Turbine Application (Voted Trip Relay Models)

The MicroNet Safety Module is certified as an IEC61508 SIL-3 (Safety Integrity Level 3) safety device and can be applied as a stand-alone IEC61508-based device or within an IEC61511-based plant safety system.

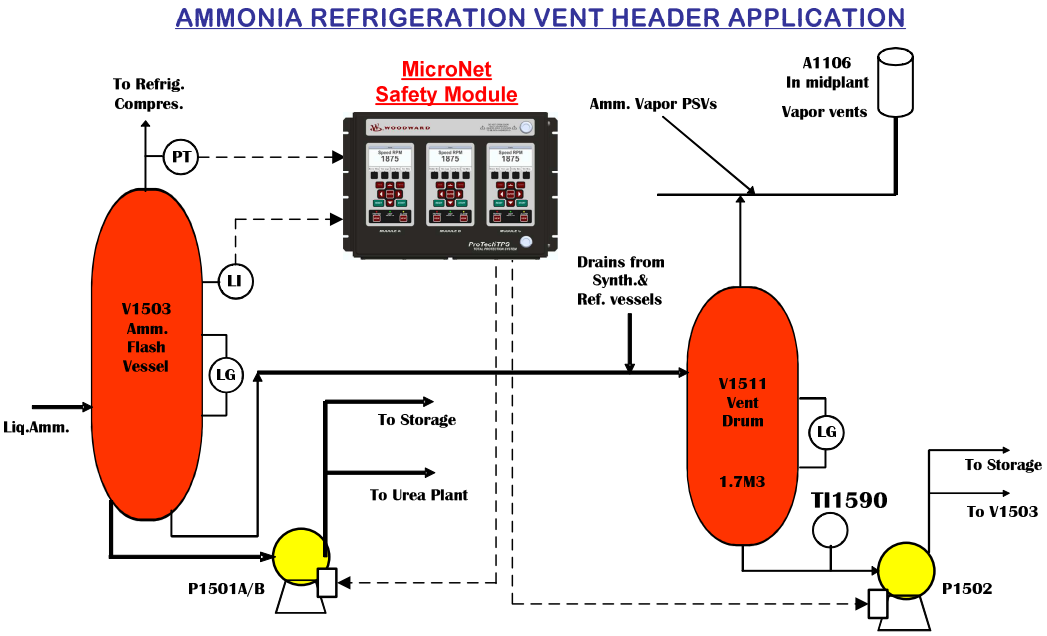



Figure 1-4. Typical Safety PLC Application (Voted Trip Relay Models)

# Chapter 2. Installation

## Introduction

This chapter provides instructions on how to mount and connect the MicroNet™ Safety Module into a system. Hardware dimensions, ratings, and jumper configurations are given to allow a customer to mount, wire, and configure the MicroNet Safety Module package to a specific application.

Electrical ratings, wiring requirements, and options are provided to allow a customer to fully install the MicroNet Safety Module into a new or existing application.

## Unpacking

Before opening the shipping packaging, inspect the shipping container for damage and document any damage.

Be careful when opening & removing the shipping container. You may retain the original shipping container for unit storage or return shipping for suggested refurbishment. (See Asset Management chapter for storage details.)

Be careful when unpacking the MicroNet Safety Module system from the shipping container. The precautions called out in the Electrostatic Discharge Awareness section should be followed during unpacking, handling, installation and operation during maintenance.

Once removed from the shipping packaging, check the device for signs of damage such as a bent or dented case and loose or broken parts. If damage is found, notify the shipper immediately.

## System Installation Procedure

1. Review system manual to gain a complete understanding of the MicroNet Safety Module system.
2. Create a site specific wiring diagram by referencing included wiring diagrams & constraints then perform mechanical and electrical installation following this chapter's instructions.
3. Visual inspection
   a. Verify that all mounting hardware is tightened and that no wires are pinched.
   b. Verify that no wiring insulation is nicked or abraded.
   c. Verify that all terminal blocks are installed and terminal screws are tight. (Follow control wiring instructions for all terminal blocks.)
   d. If used, verify that speed sensors have been correctly installed, and have the correct clearance from the speed gear (adjust if necessary). See manual 82510, Magnetic Pickups and Proximity Switches for Electronic Governors.
4. Apply power to each module (one at a time), and verify that each module boots up and its front panel screen displays turbine speed
5. If no special programming logic is used skip to step 11
6. If special programming logic is required install MicroNet Safety Module programming and configuration tool (PCT) from provided PCT Installation CD on to the desired computer and create system application program
7. Once the system application program is complete connect an extension (i.e. straight-through, not null-modem) RS-232 serial cable from the respective computer to any module's (A, B, C) service port, and download the program into the module
8. From the respective module's front panel copy downloaded program to other unit modules
9. From each module's front panel verify that the correct program has been installed in each module by comparing unit CRC codes.
10. From each module's front panel, enter the configuration mode and verify that each of the overspeed and over-acceleration settings are correct.
11. Enter the configuration mode and configure all settings to the specific application's requirements

12. Perform a full system checkout by verifying all system trips, alarms, and test routines function correctly before starting the machinery/system.
13. When ready, start the turbine/machinery following the equipment manufacturer's recommended starting procedure

## Enclosures

**NOTICE**

**Module identification is always from left to right, with module A on the left, module B in the center, and module C on the right. This applies to either the bulkhead-mount versions with the front cover open, or the panel-mount versions with the back cover removed.**

Depending on the model purchased, the MicroNet Safety Module has either a bulkhead-mounted or a panel-mounted enclosure package.

The bulkhead-mounted enclosure models are designed to be mounted on a wall or skid next to the turbine and are rated for IP56-based environments. With these models, field wiring access is through gland plates located on the bottom of the enclosure. Figures 2-1, 2-2, and 2-3 display the bulkhead mounted MicroNet Safety Module model's physical layout and mounting pattern.

The MicroNet Safety Module panel-mounted enclosure models are designed for installation within a control room panel or cabinet, and by itself, it cannot be bulkhead mounted. Once installed within an IP56 rated panel or cabinet, the MicroNet Safety Module panel-mounted models are rated for IP56-based environments. A gasket is attached to the rear side of the package's bezel to properly seal the MicroNet Safety Module control's face-plate & around the mounting studs to a panel. With these models, field wiring access is located on the MicroNet Safety Module control's back side, and a back cover is included to protect wiring terminals after installation. Figures 2-4 and 2-5 display the Panel-Mount MicroNet Safety Module model's layout and mounting pattern.


Figure 2-1. Typical MicroNet Safety Module Bulkhead Package—Front View

Figure 2-2. Typical MicroNet Safety Module Bulkhead Package—Front Door Open

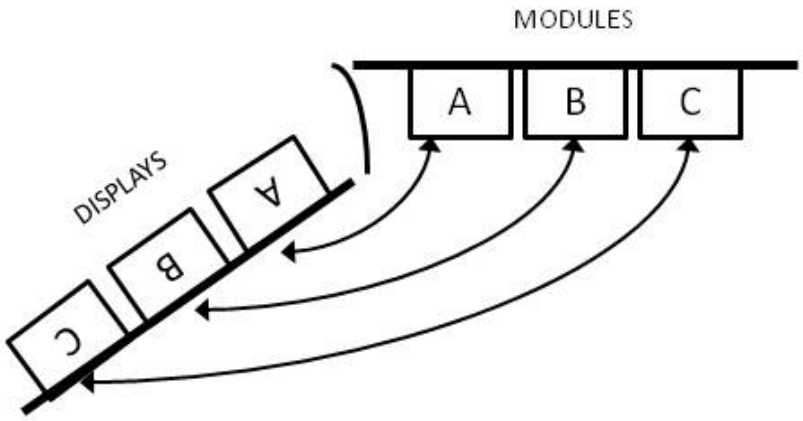



Figure 2-2a. Bulkhead Schematic Showing Front Panel A Connection to Module A and Front Panel C Connection to Module C—Top View

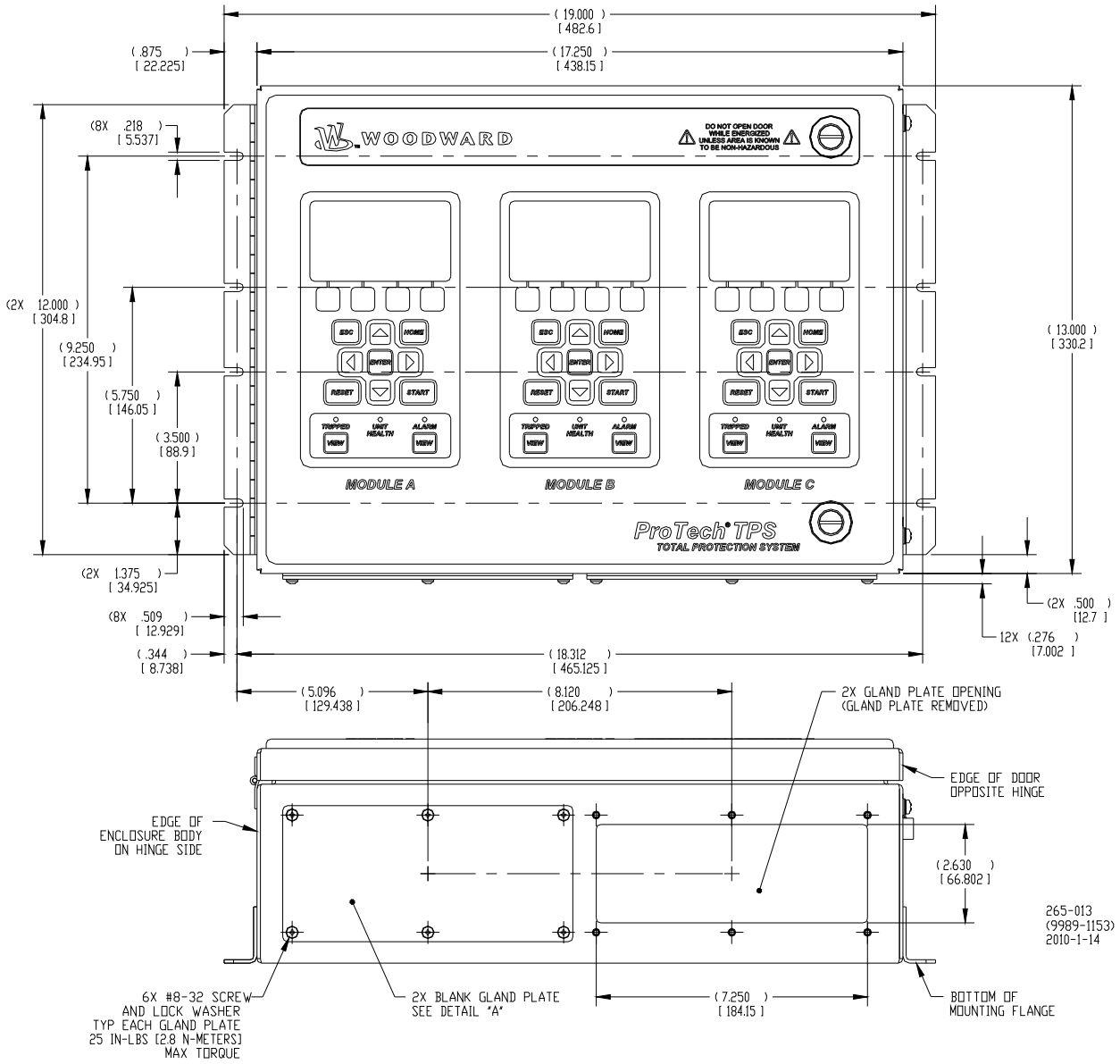


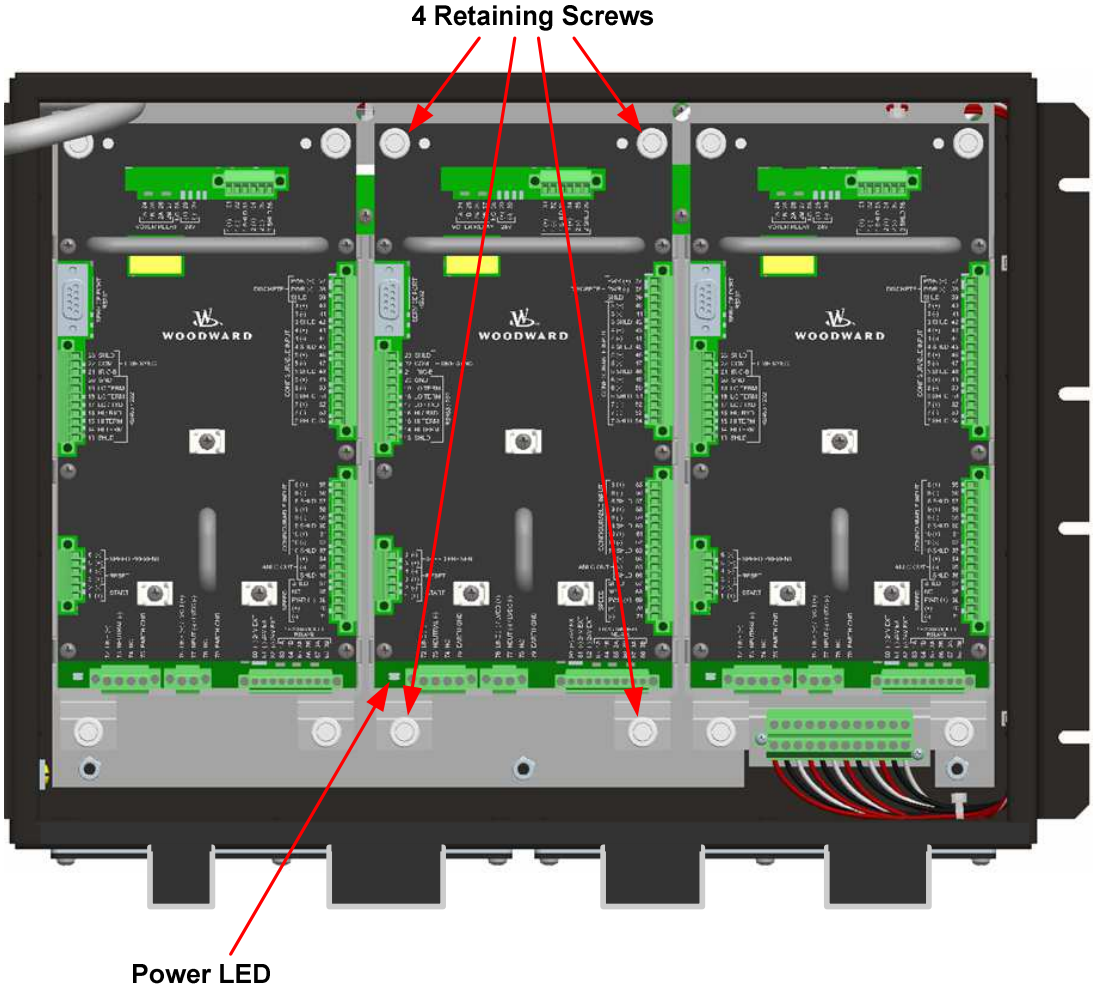

Figure 2-3. Mounting Outline Diagram for Bulkhead-Mounted Models

# Module Removal and Installation – Bulkhead Mount Package

Follow this procedure for module removal and installation:

**Removal:**

1. Disconnect power from the module to be removed
2. Verify power removed by observing power LED is OFF
3. Remove terminal blocks from module terminals
4. Loosen 4 module retention screws
5. Remove module by pulling the two handles simultaneously




**Installation:**

1. Insert module into slot by pressing firmly on handles. The module has guides to assist in location.
2. Tighten 4 module retention screws
3. Install terminal blocks
4. Apply power and observe that the power LED is ON


Figure 2-4a. Typical MicroNet Safety Module Panel Mount Package—Front View

Figure 2-4b. Typical MicroNet Safety Module Panel Mount Package—Rear View with Cover

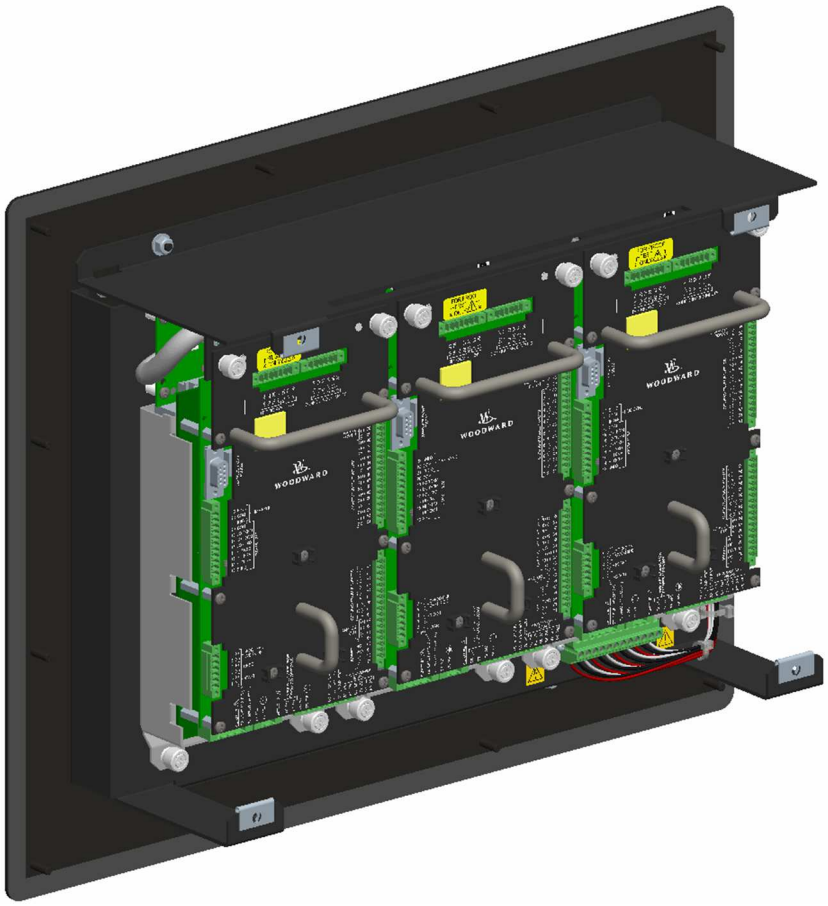


Figure 2-4c. Typical MicroNet Safety Module Panel Mount Package—Rear View without Cover

**NOTICE**

**Module identification is always from left to right, with module A on the left, module B in the center, and module C on the right. This applies to either the bulkhead-mount versions with the front cover open, or the panel-mount versions with the back cover removed.**

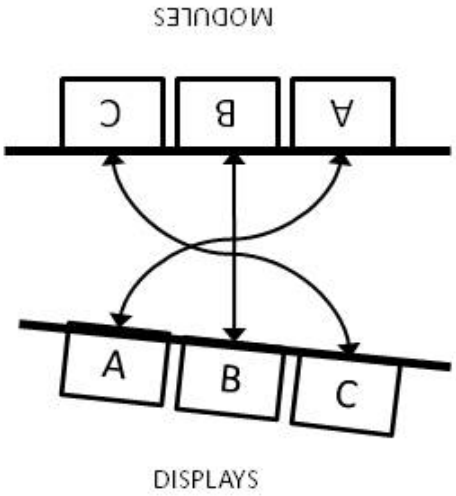



Figure 2-4d. Panel Mount Schematic Showing Front Panel A Connection to Module A and Front Panel C Connection to Module C—Top View

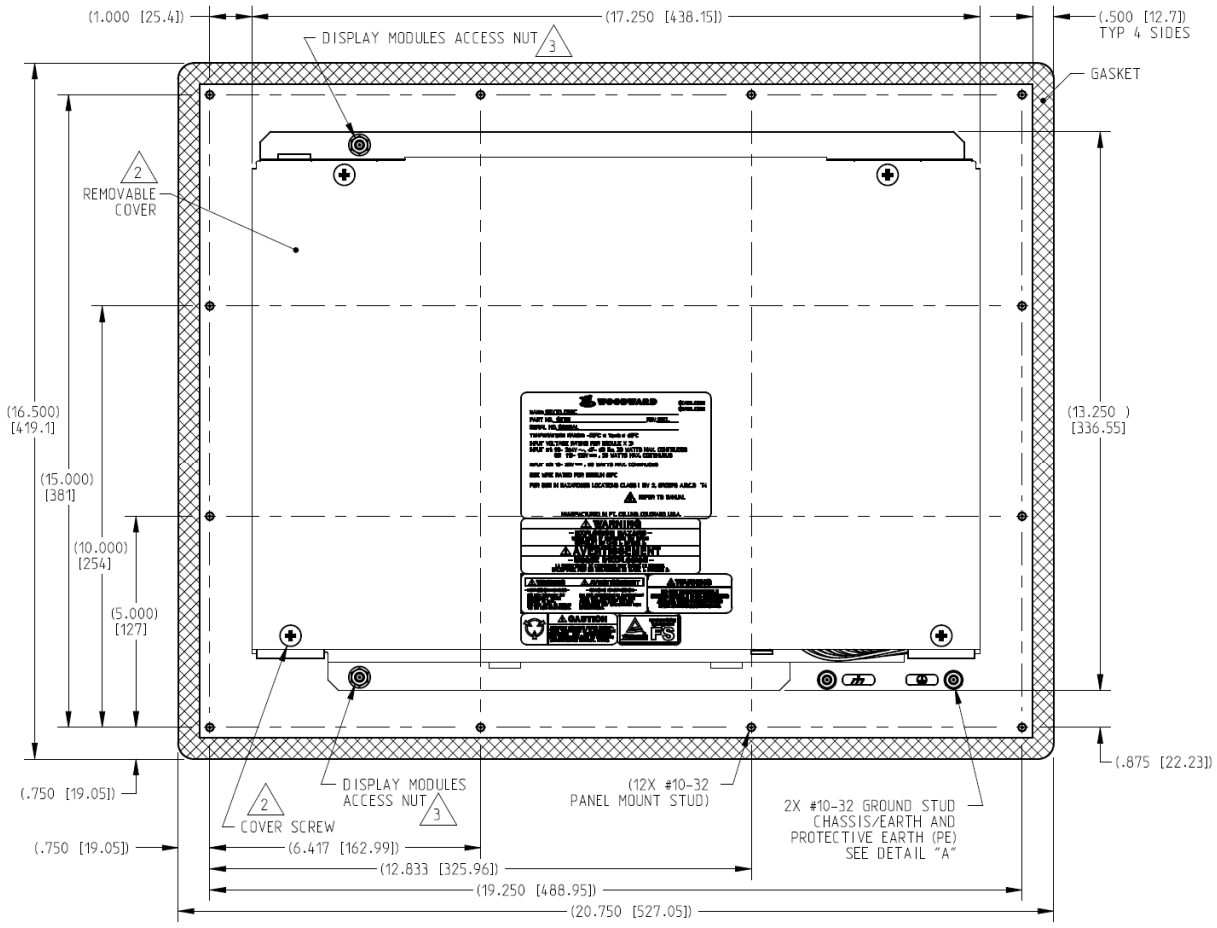



Figure 2-5a. Mounting Outline Diagram for Panel-Mount Models

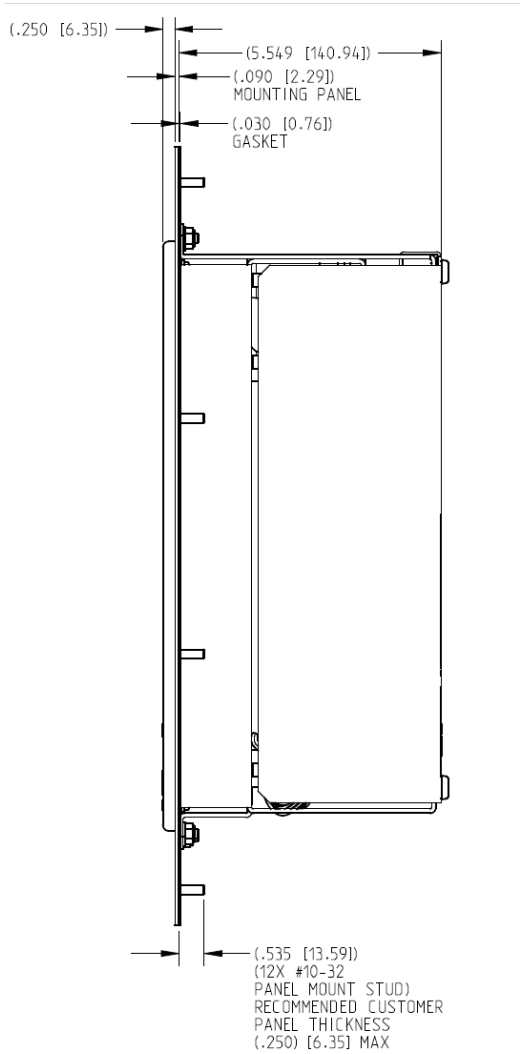



Figure 2-5b. Mounting Outline Diagram for Panel-Mount Models

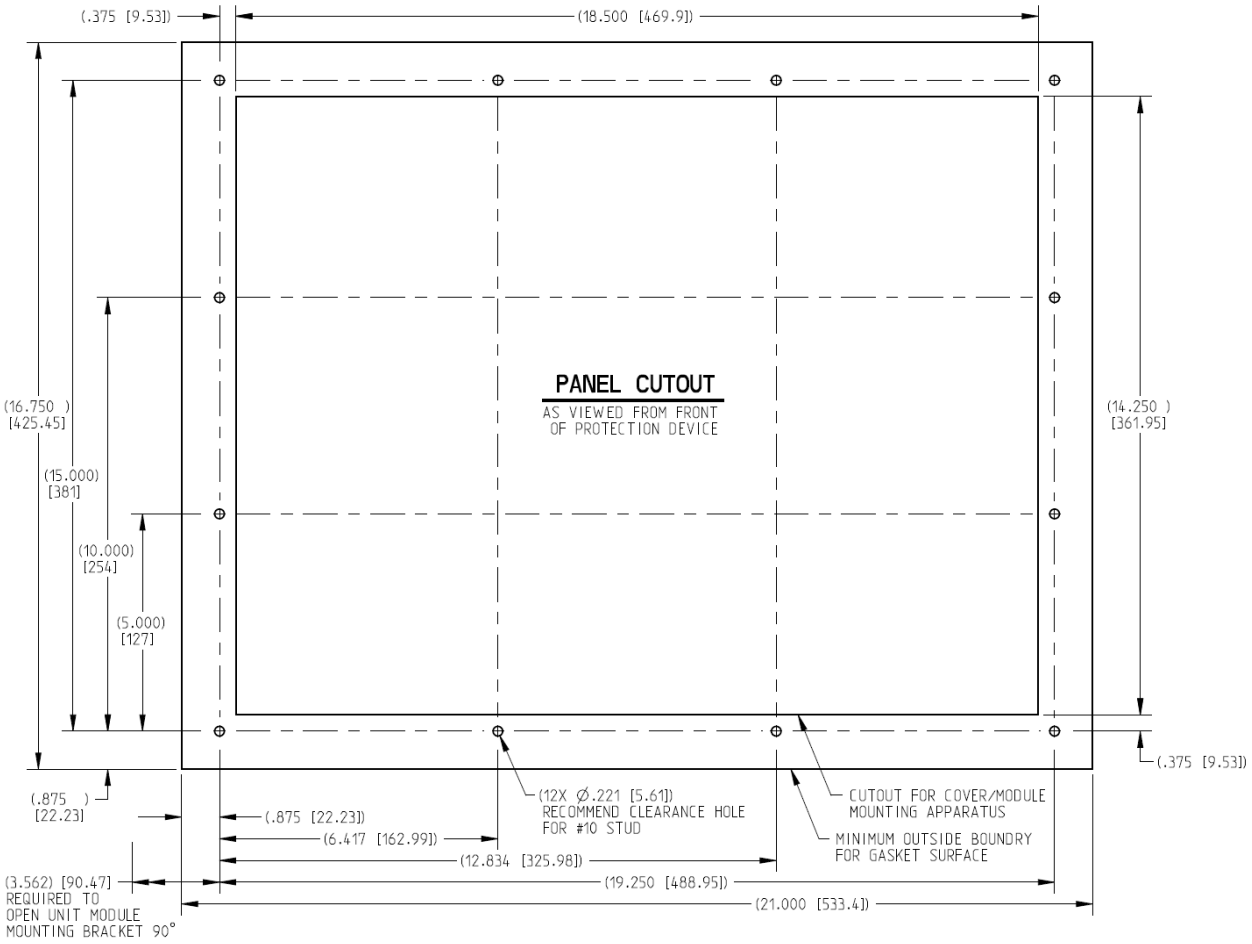


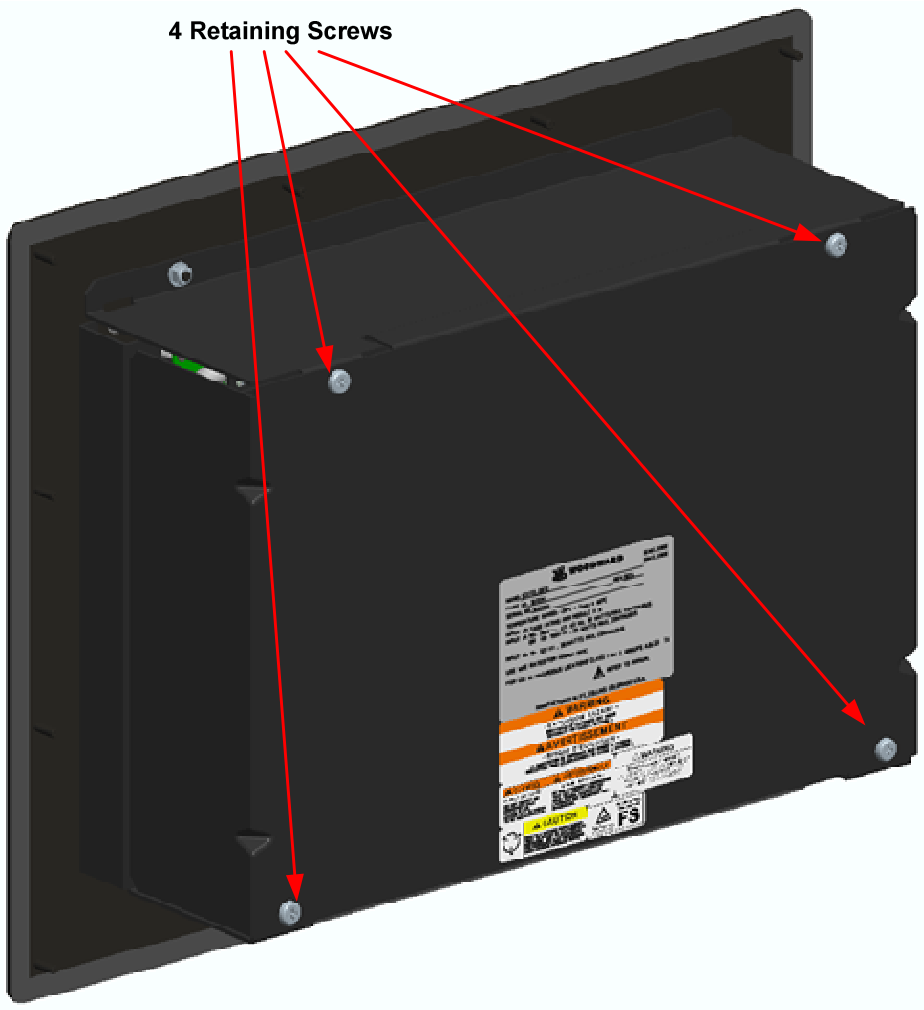

Figure 2-5c. Panel Cutout Diagram for Panel-Mount Models

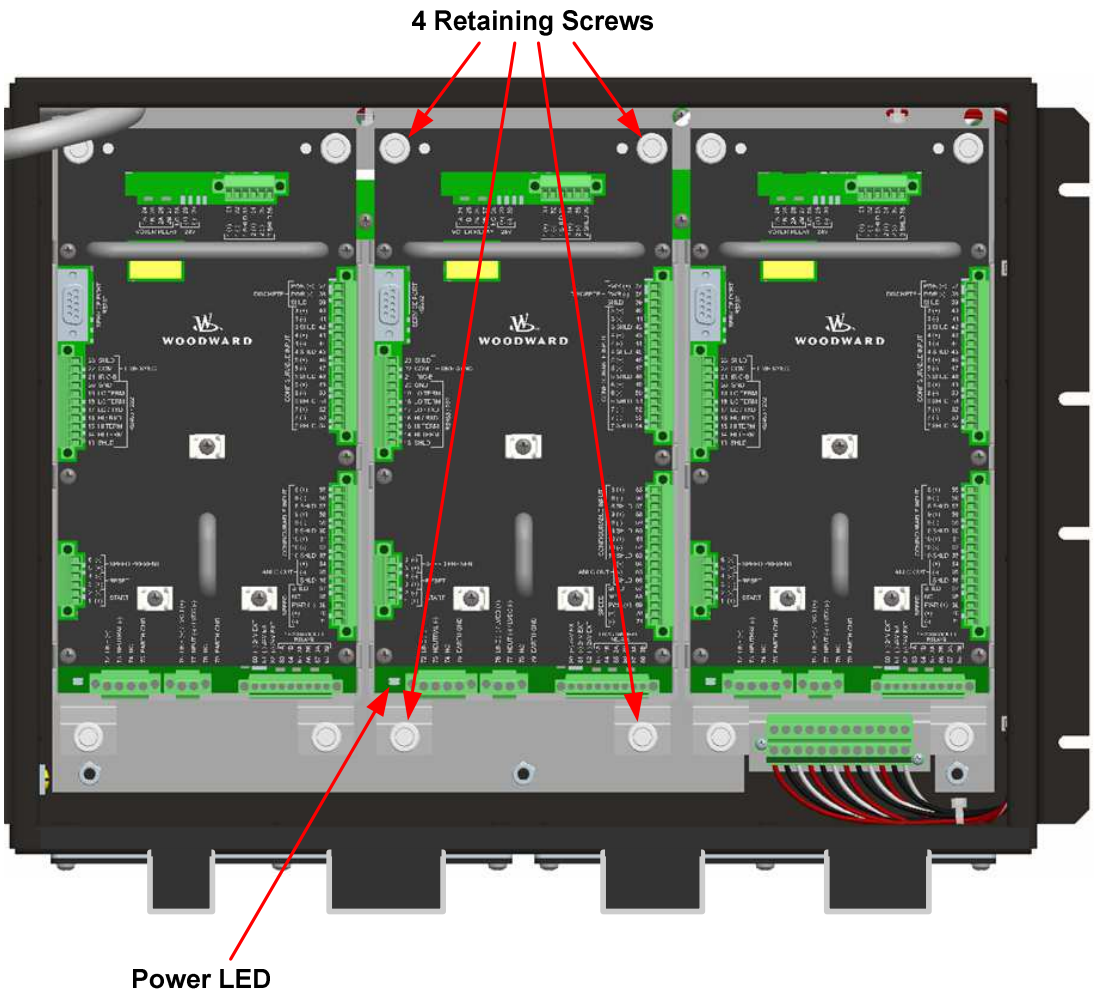
## Module Removal and Installation – Panel Mount Package

Follow this procedure for module removal and installation:

**Removal:**

1. Disconnect power from the module to be removed
2. Remove 4 back panel retaining screws
3. Remove back panel
4. Verify power removed by observing power LED is OFF
5. Remove terminal blocks from module terminals
6. Loosen 4 module retaining screws
7. Remove module by pulling the two handles simultaneously






**Installation:**

1. Insert module into slot by pressing firmly on handles. The module has guides to assist in location.
2. Tighten 4 module retaining screws
3. Install back panel
4. Install 4 retaining screws
5. Install terminal blocks
6. Apply power and observe that the power LED is ON

## Mounting Location Considerations

Consider the following general requirements when selecting the mounting location:

- Adequate ventilation for cooling
- A location that will provide an operating temperature range of (–20 to +60) °C / (–4 to +140) °F
- The MicroNet Safety Module weighs approximately 12 kg (26.5 lb)
- Space for opening & servicing
- Space for installing & removing panel mount covers
- Space for installing cable strain relief as needed
- Vertical orientation of the unit
- Protection from direct exposure to sunlight, water, or to a condensation-prone environments
- Protection from high-voltage or high-current devices which produce electromagnetic interference
- Avoidance of vibration
- A location that has $H_2S$ and $SO_2$ gases at or below the levels classified in international standard IEC 721-3-3 1994 – environment Class 3C2
- Maximum purge pressure: 4 psi

## Environmental Specifications

| | |
|---|---|
| Operating Temperature: | (–20 to +60) °C / (–4 to +140) °F |
| Storage Temperature (non operational): | (–20 to +65) °C / (–4 to +158) °F |
| Relative Humidity: | Up to 95 % (non-condensing) |
| Vibration: | 0.04 $G^2$/Hz, 1.04 Grms, 10 to 500 Hz |
| Shock: | 30 G, 11 ms half-sine pulse |
| Altitude: | Up to 3000 meters above sea level |
| Enclosure (Bulkhead Mount Version): | IP56 (per IEC 60529) |
| Enclosure (Panel Mount Version): | IP56, installed in IP56 enclosure/cabinet |
| Weight (Bulkhead Mount Version): | Approximately 12 kg (26 lb) |
| Weight (Panel Mount Version): | Approximately 10 kg (22 lb) |
| Pollution Degree | 2 (per IEC 60664-1) |
| Overvoltage Category | II (per IEC 60664-1) |

## Power Supply Requirements

Each MicroNet Safety Module system consists of three separate internal modules (A, B, C), and each of these three modules accept two input power sources. Depending on the MicroNet Safety Module model purchased, the internal modules will accept either two high voltage (HV) input power sources or one HV input power source and one low voltage (LV) input power source.

HV / HV Models accept:

- Input #1: High Voltage Power Source: (88 to 264) V (ac)/(47 to 63) Hz; (100 to 150) V (dc) @ 90 W (30 W per module)
  - Nominally AC: 115 V (ac) / 240 V (ac)
  - Nominally 125 V (dc)
- Input #2: High Voltage Power Source: (88 to 264) V (ac)/(47 to 63) Hz; (100 to 150) V (dc) @ 90 W (30 W per module)
  - Nominally 115 V (ac) / 240 V (ac)
  - Nominally 125 V (dc)

HV / LV Models accept:

- Input #1: High Voltage Power Source: (88 to 264) V (ac)/(47 to 63) Hz; (100 to 150) V (dc) @ 90 W (30 W per module)
  - Nominally 115 V (ac) / 240 V (ac)
  - Nominally 125 V (dc)
- Input #2: Low Voltage Power Supply: (18 to 32) V (dc) @ 90 W (30 W per module)
  - Nominally 24 V (dc)

Each MicroNet Safety Module will function normally with power sourced to both or either power supply input independently, however Woodward recommends that both input power sources be used to improve system availability. Please refer to Table 1-1 for available MicroNet Safety Module models.

**IMPORTANT**

**Since the MicroNet Safety Module is designed to detect a failure of either power supply input, a continuous "Power Supply Fault Alarm" will be issued if power-sources are not connect for both power supply inputs.**

Each MicroNet Safety Module requires a power source capable of a certain output voltage and current. In most cases, this power rating is stated in Volt-Amps (VA). The maximum VA of a source can be calculated by taking the rated output voltage times the maximum output current at that voltage. This value should be greater than or equal to the VA requirement listed.

**⚠WARNING**

**Each power source must be provided with an external disconnecting means that is identifiable to the specific power supply (A, B, or C).**

**NOTICE**

**A PE (Protective Earth) ground wire for each of the high voltage power supplies must be connected to PE ground. The PE ground connection wire must originate and be connected to PE at the power source. The PE ground wire must follow the power wires to the applicable power input connector PE Ground pin, so that each HV input has a PE ground. The PE ground wire gauge must be capable of handling the same current as the individual power wiring.**

**NOTICE**

**A PE (Protective Earth) ground wire for the enclosure must be provided and connected to PE Ground. At least one of the enclosure's PE labeled connection points must have a wire going from the enclosure to a building PE ground point. This wire must be of sufficient gauge to handle the rated current of all the interposing relay wires or 1.5 mm² (16 AWG), whichever is larger.**

## Shielded Wiring

All shielded cable must be twisted conductor pairs with either a foil or a braided shield. A braided shield is preferred and highly recommended. All analog and communication signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields as shown in the control wiring diagram (Figure 2-7). Wire exposed beyond the shield must not exceed 50 mm (2 inches). The shield termination should be done with the shield by opening the braid and pulling the wires through, not with an added wire. If a wire is used it must be the largest gauge accepted by the shield lug terminal. The other end of the shield must be left open or grounded through a capacitor and insulated from any other conductor. Do not run shielded signal wires with other wires carrying large currents or high voltages. See Woodward manual 50532, *EMI Control in Electronic Governing Systems*, for more information.

Installations with severe electromagnetic interference (EMI) may require relay and discrete input wiring to be shielded, conduits and/or double shielded wire may be needed, or other precautions may have to be taken. These additional precautions may be implemented in any installation. Contact Woodward for more information.

## Control Wiring Guidelines

### Electrical Connections

**⚠WARNING**

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

Figures 2-8 and 2-9 show the control wiring diagrams for the MicroNet Safety Module system. Refer to Figure 2-10 for proper routing and stress relief of field wiring entering the MicroNet Safety Module system. Wire tie-wrap fasteners are provided on each module to assist with I/O wire routing and installation.

Plug-in screw-type terminal blocks are used to connect field wiring to each MicroNet Safety Module & to the trip (interposing) relay contacts.

The size of the field wiring to the MicroNet Safety Module system should be between 1.5 mm² and 6 mm² (16 AWG and 10 AWG) for power supply wiring and between 0.3 mm² and 4 mm² (22 AWG and 12 AWG) for all other I/O wiring. Wires for the all the pluggable I/O terminal blocks should be stripped at 8 mm (0.3 inch). Torque and screwdriver requirements are listed below.

**IMPORTANT**

**The screw lug terminal blocks are designed to flatten stranded wire. Do not tin (solder) the wire's strands that terminate at the MicroNet Safety Module Terminal Blocks. If the wire strands are soldered together, the solder will cold flow and shrink over time causing the connection to become intermittent or disconnected.**

**Woodward recommends the following for MicroNet Safety Module:**

- **Stranded bare copper wire (unless gaseous Sulfur compounds are present) at the wire ends**
- **Stranded copper wire with individually tin plated strands at the wire ends**
- **Hollow ferrules at the wire ends**
- **Use single wire per terminal. There are enough terminals provided for all I/O wiring**

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

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

Figure 2-6. Screw Connection Terminal Block

The MicroNet Safety Module system's terminal blocks are designed to be removed by hand.

With circuit power & trip (interposing) relay controlled power disconnected, all terminal blocks can be removed, one at a time by unscrewing their terminal-locking screws and pulling them out of their sockets by hand.

**NOTICE**

**When removing a terminal block, never pull on the wires connected to the terminal block.**

Field wiring access for bulkhead mounted models is through gland plates located on the bottom of the enclosure. These gland plates allow users to bore multiple and different sized access holes for conduit entry, as required. Refer to Figure
2-3 for gland plate location and size. For EMI (electromagnetic interference) reasons, Woodward recommends that all low-voltage field wiring be separated from all high-voltage field wiring by using separate conduit and conduit entries into the MicroNet Safety Module enclosure. Woodward also recommends that power wiring be segregated in the same manner, however LV & HV input power may be routed together.

Field wiring access for panel-mounted models is located on the back of the MicroNet Safety Module enclosure. To allow proper installation of the unit's back cover plate, Woodward recommends that all field wiring be routed from the bottom of the package. The units back cover must be installed. Refer to Figure 2-5 for field wiring access information. For EMI (electromagnetic interference) reasons, Woodward recommends that all low-voltage field wiring be separated from all high-voltage field wiring where possible. Woodward also recommends that power wiring be segregated in the same manner, however LV & HV input power may be routed together.

**⚠WARNING**

**HIGH VOLTAGE—When wiring to interposing relays, be sure to wire both contacts with the same polarity. Failure to do so will create a potential shock hazard, which could cause injury or death.**

***IMPORTANT***

**All input and output wiring must be in accordance with Class I Division 2 wiring methods, and in accordance with the authority having jurisdiction.**

**All peripheral equipment must be suitable for the location in which it is being used.**

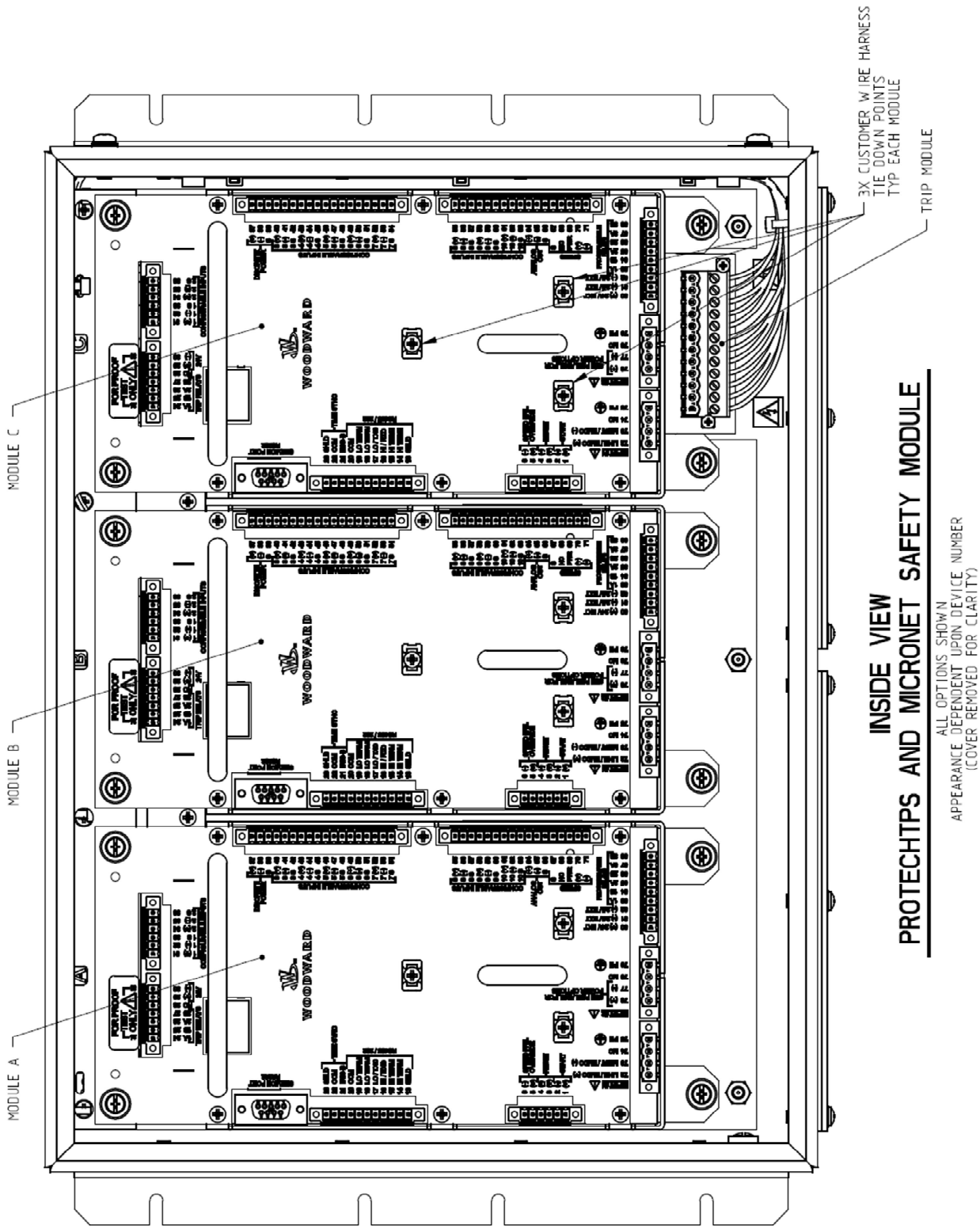



Figure 2-7. Inside View of MicroNet Safety Module

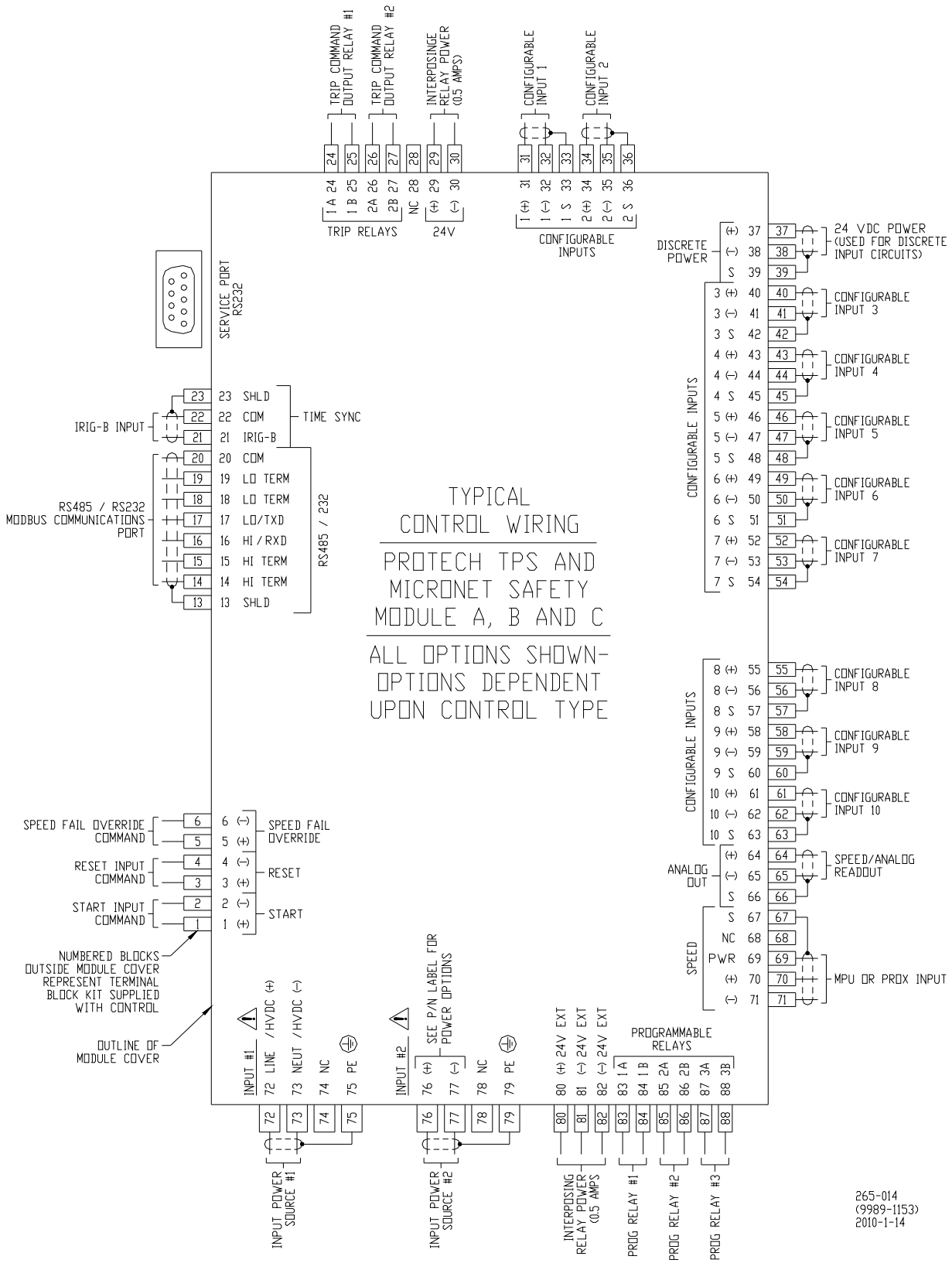



Figure 2-8. MicroNet Safety Module Control Wiring Diagram

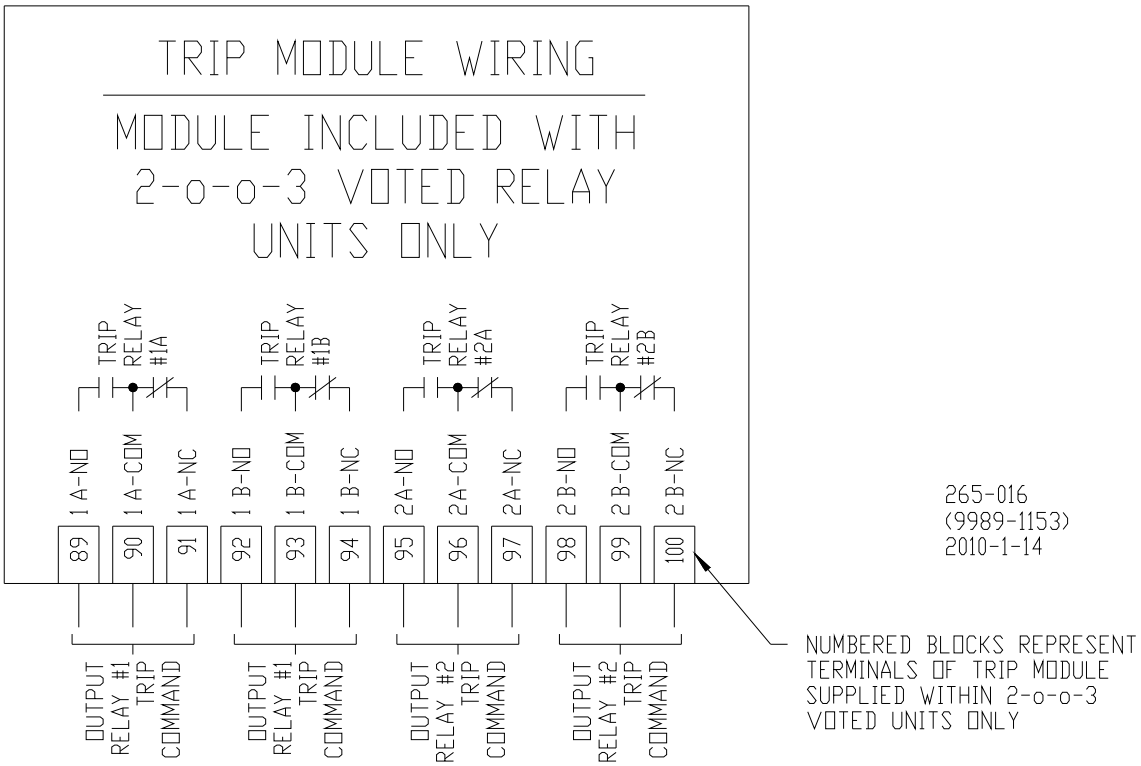



Figure 2-9. Trip Module – Included within Voted Trip Relay Units Only

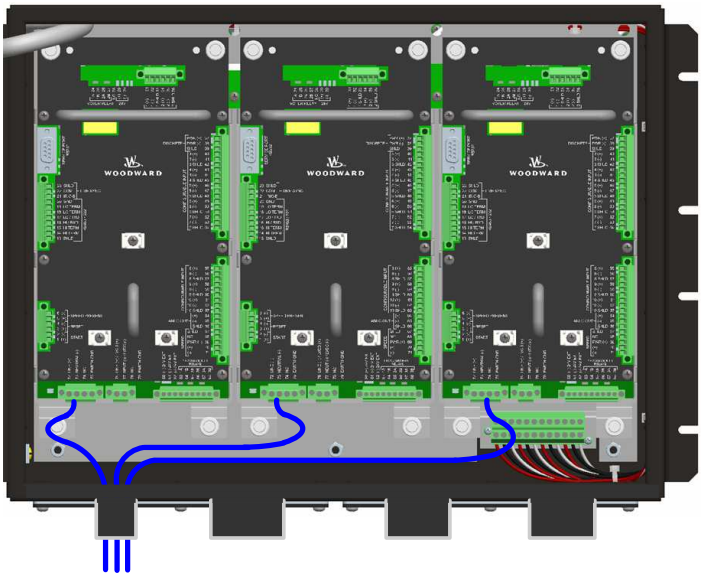


Figure 2-10a. Power Supply Field Wiring Routing & Stress Relief Diagram

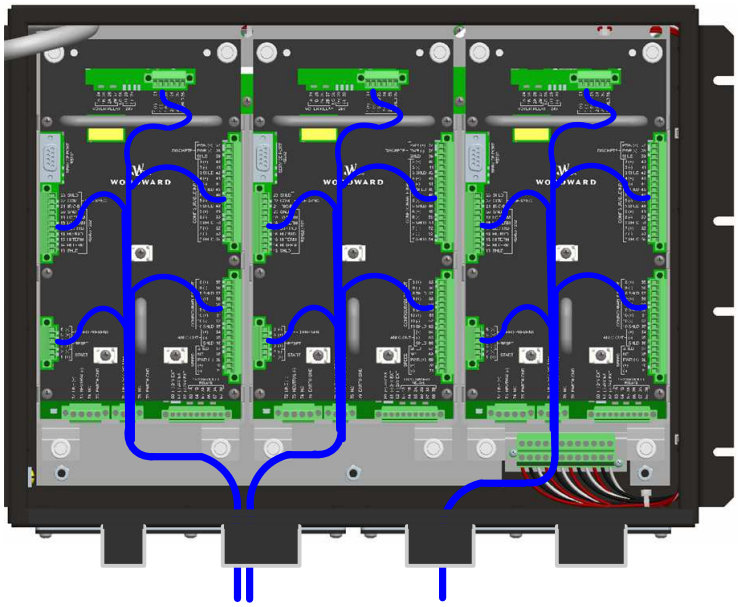


Figure 2-10b. Configurable I/O Wiring Routing & Stress Relief Diagram

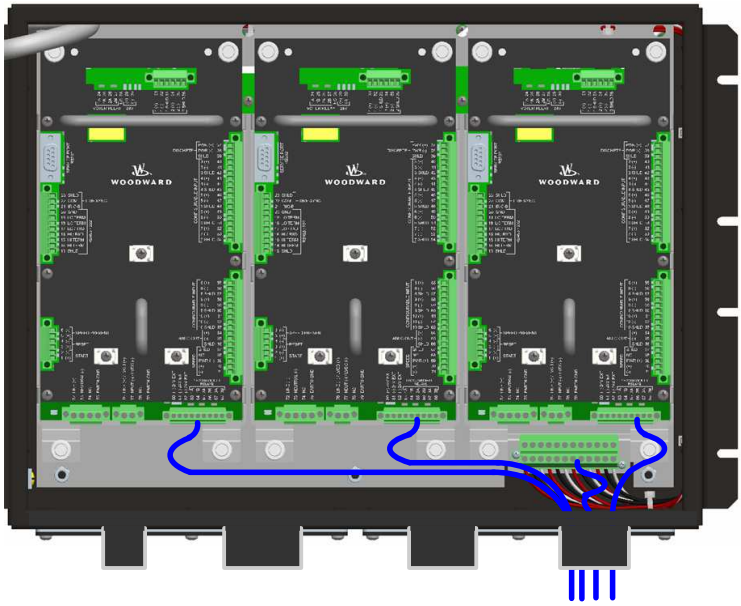


Figure 2-10c. Relay Output Field Wiring Routing & Stress Relief Diagram

## Speed Sensor Inputs

To sense speed, each MicroNet Safety Module's module (A, B, C) accepts a signal from a speed sensor mounted reading off of a gear connected or coupled to the turbine's rotor or engine's crank shaft. Speed sensors may be any of the following:

- Passive magnetic pickup unit (MPU)
- Active proximity probe
- Eddy current probe

A passive MPU provides a frequency output signal corresponding to turbine speed by sensing the movement of a gear's teeth past the MPU's pole piece. The closer the MPU's pole piece is to a gear's teeth and the faster the gear turns the higher a passive MPU's output amplitude will be. (Speed signal amplitude increase with both speed increase and distance decrease.) The MicroNet Safety Module must sense an MPU voltage of 1 to 35 V (rms) for proper operation. With proper MPU, gear size, and MPU-to-gear clearance, speed measurement can range from 100 to 32 000 Hz. Standard MPU clearance is recommended to be 0.25 mm to 1.02 mm (0.010 inch to 0.040 inch) from tooth face to pole piece. For information on selecting the correct MPU or gear size please refer to Woodward manual 82510. Refer to Figure 2-11a for wiring information.

Proximity and eddy-current probes may be used to sense very low speeds to high speeds (0.5 to 25 000 Hz). The speed probe input voltage must be between 16 V (dc) and 28 V (dc) and output signal be between 16 and 28 V peak-to-peak for proper speed detection. The voltage for the speed probes must be from the provided voltage port or have its common referenced (connected) to the provided common pin for proper operation. See Figures 2-11b thru 2-11c for proximity and eddy-current probe wiring schematics.

An application may use the same or different types of speed probes (MPU, proximity, eddy-current), between the three different inputs depending on the specific application's requirements.

The MicroNet Safety Module is capable of detecting a sudden loss of the speed signal and either issue an Alarm or a Trip per user-configuration. The sudden loss of speed diagnostic occurs when a loss of speed is detected, i.e. speed < 0.5 Hz, and the last measured speed was greater than 100 Hz. The diagnostic routine is updated every 4 ms.

**IMPORTANT**

**Woodward does *NOT* recommend that gears mounted on an auxiliary shaft that is coupled to the turbine rotor be used to sense turbine speed. Auxiliary shafts tend to turn slower than the turbine rotor (reducing speed-sensing resolution) and have coupling gear back-lash, resulting in less than optimal speed sensing. For safety purposes, Woodward also does *NOT* recommend that the speed sensing device sense speed from a gear coupled to a generator or the mechanical drive side of a system's rotor coupling.**

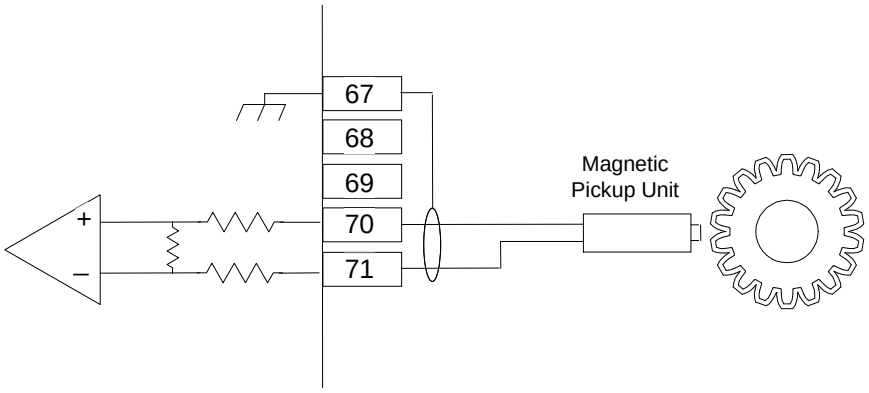



Figure 2-11a. Example MPU (Passive Magnetic Pickup Unit) Wiring

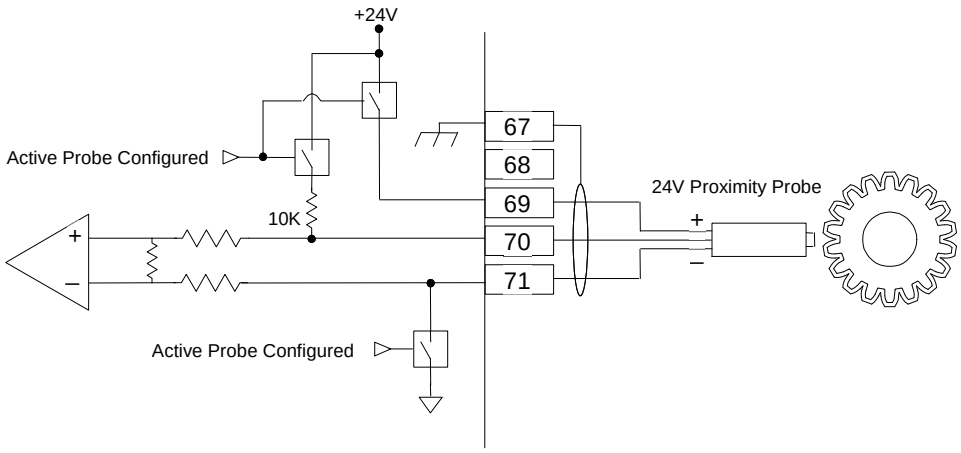



Figure 2-11b. Example Proximity Probe (Active Magnetic Pickup Unit) Wiring (Internal Power)

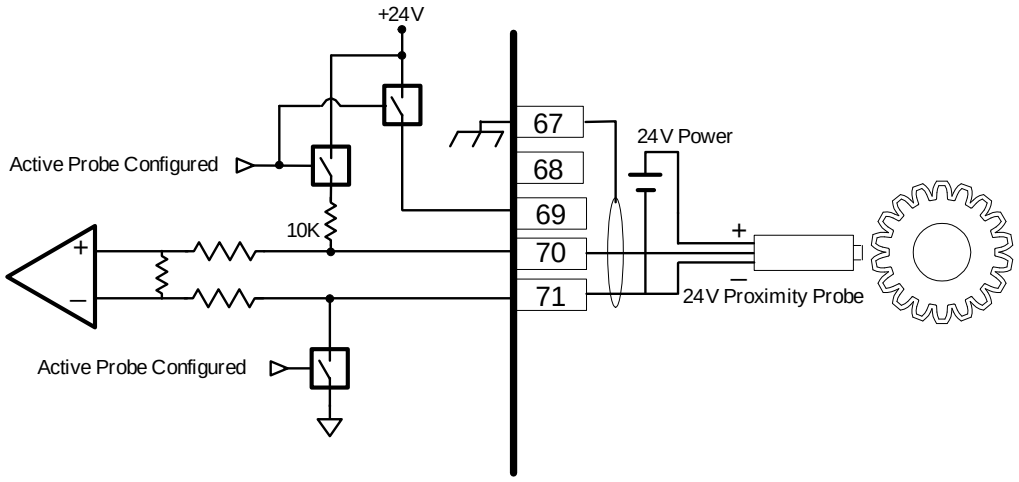



Figure 2-11c. Example Proximity Probe (Active Magnetic Pickup Unit) Wiring (External Power, Non-preferred)

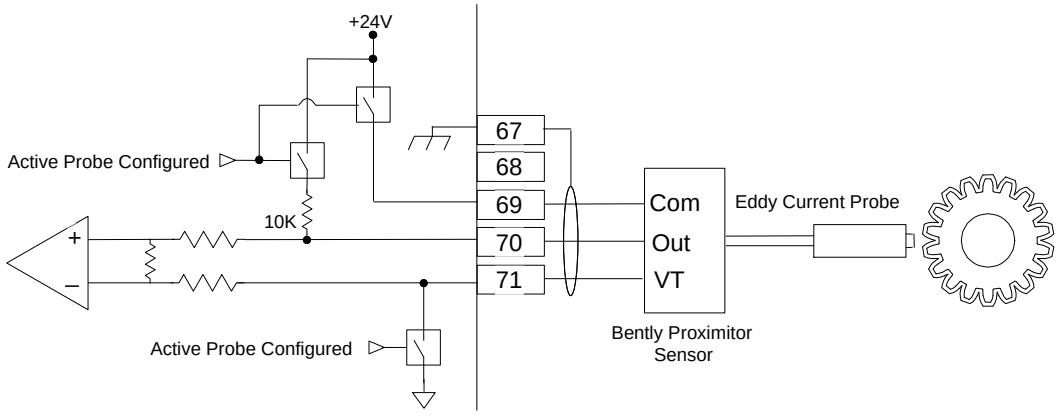



Figure 2-11d. Example Eddy Current Probe (Active Magnetic Pickup Unit) Wiring

## Dedicated Discrete Inputs

Each MicroNet Safety Module's module (A, B, C) accepts three dedicated discrete inputs. All discrete inputs accept dry contacts. Contact wetting voltage is available through terminals 1, 3, and 5 but an external +24 V (dc) source can be used. Refer to Figure 2-12 for wiring information. In general, an input contact signal must change state for a minimum of 10 milliseconds for a MicroNet Safety Module's module to sense and register a change in state. The Dedicated Discrete Inputs are Start, Reset and Speed-Fail-Override. Refer to Chapter 3 (Functionality) of this manual for information on each discrete input's functionality.

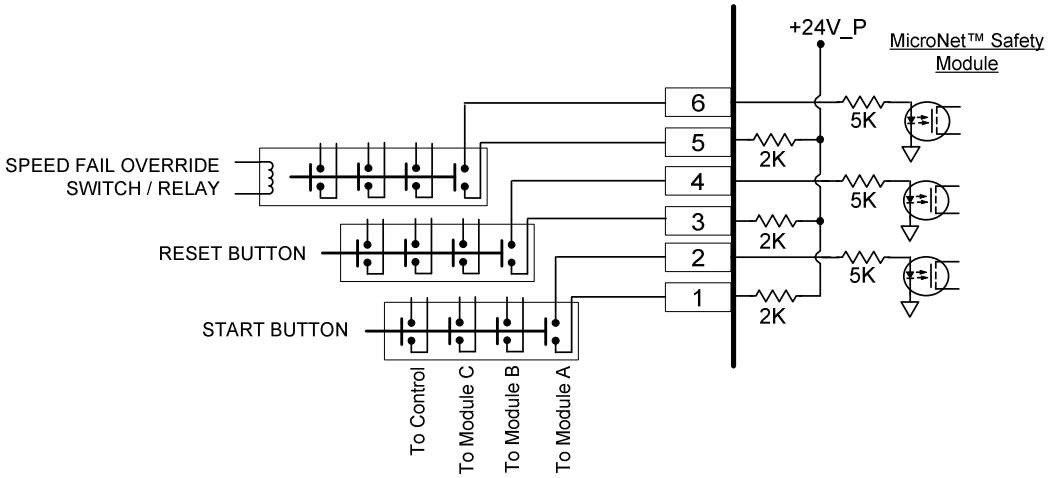



Figure 2-12a. Example Standard Discrete Input Wiring (Internal Power Option)

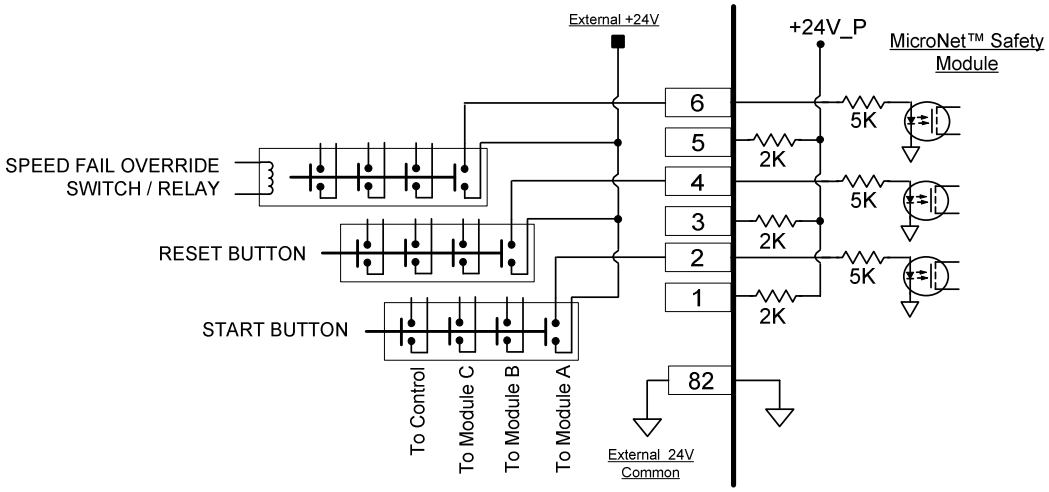



Figure 2-12b. Example Standard Discrete Input Wiring (External Power Option)

## Configurable Discrete and Analog Inputs

Ten configurable inputs per module (A, B, C) are available to sense discrete contact input signals or 4–20 mA analog input signals. Depending on the application's needs, each input can be configured within the MicroNet Safety Module Programming and Configuration Tool (PCT) to function as discrete or analog input.

## Configurable Discrete and Analog Inputs—Discrete Input Wiring

When an input is configured to function as a discrete input, it must be wired as shown in Figures 2-13a or 2-13b to function properly. Contact wetting voltage is available through terminal 37. Discrete input wires do not need to be shielded, but may be shielded. If shielding is used, terminate shield as indicated on AI mode. If a shield is used, a common wire must be run with the signal wire for field powered DI's, and both power & common must run with the signal wire for MicroNet Safety Module powered DI's. Shielded DI's may be grouped with multiple signals & one common/power wire in a single shield. In general, an input contact signal must change state for a minimum of 4 milliseconds for a MicroNet Safety Module's module to sense and register a change in state. Refer to Chapter 3 (Functionality) of this manual for information on how to program and use each discrete input in an application.

**NOTICE**

**If total current draw through terminal 37 exceeds 50 mA, the power supply's internal breaker will open. Upon such a condition, all load must be removed from the specified terminals to allow this breaker to reset. The internal 24 V provides enough power to operate all 10 inputs in discrete mode.**

**NOTICE**

**For reliability reasons, Woodward recommends that input circuitry for each module (A, B, C) be fully isolated from the input circuitry of the other two modules. For example, the power source and wiring for module A should not be shared or connected in any way to modules B or C.**

**If desired, an external (18 to 26) V (dc) power source can be used for the circuit-wetting voltage. In this case, terminal 38 (contact input common) must be connected to the external power source's common to establish a common reference point. Each contact input pulls 4.8 mA at 24 V when closed and requires at least 2.5 mA and 14 V to recognize a closure command. Refer to Figure 2-13b for wiring information.**

**IMPORTANT**

**Woodward recommends that separate input transducers be utilized for each MicroNet Safety Module's module (A, B, C) to reduce nuisance trips, increase system availability, and simplify unit replacement.**

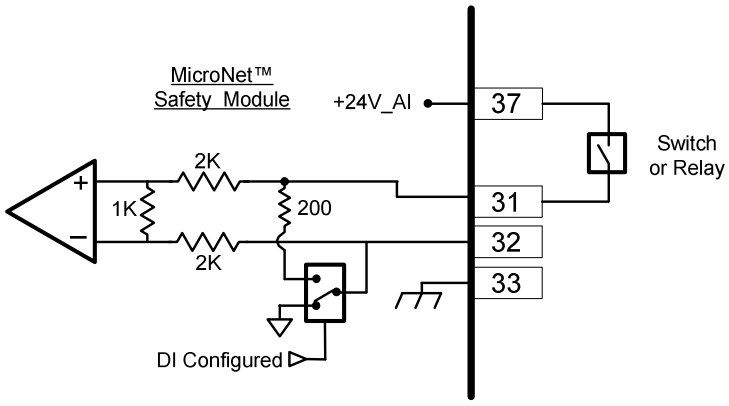



Figure 2-13a. Example Configurable Input Wiring—Discrete Input (Internal Power Option)

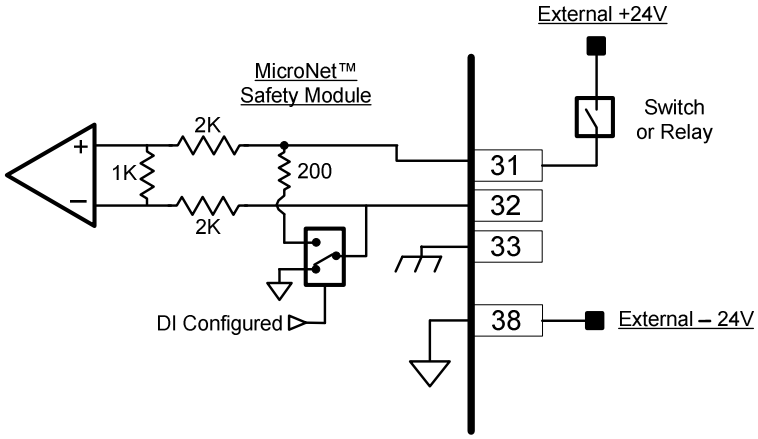



Figure 2-13b. Example Configurable Input Wiring—Discrete Input (External Power Option)

## Configurable Discrete and Analog Inputs—Analog Input Wiring

When a configurable input is programmed to function as an analog input, it accepts a two-wire, ungrounded, loop-powered signal, and must be wired as shown in Figure 2-14 to function properly. The input impedance of the analog input circuit, as indicated in Figure 2-14, is 200 Ω. When configured as an AI, twisted shielded pair wiring must be used. Refer to Chapter 3 (Functionality) of this manual for information on how to program and use each analog input in an application. Refer to the Chapter 3 (Functionality) of this manual for applicable analog input specifications.

Because analog inputs are not fully isolated, take care in their application and maintenance to avoid "ground-loop" type problems. If interfacing to a non-isolated device with one of these inputs, the use of a loop isolator is recommended to break any return current paths, which could result in erroneous readings. Also, if a loop isolator is not used and the non-isolated field device has a signal (or power) reference to PE ground connection, damage may occur to the AI. Damage may occur during PE ground bounce or high current transient ground fault conditions due to large potential differences in the remote PE ground & the local PE ground.

**NOTICE**

**For reliability reasons, Woodward recommends that input circuitry for each module (A, B, C) be fully isolated from the input circuitry of the other two modules. For example, the power source and wiring for module A should not be shared or connected in any way to modules B or C.**

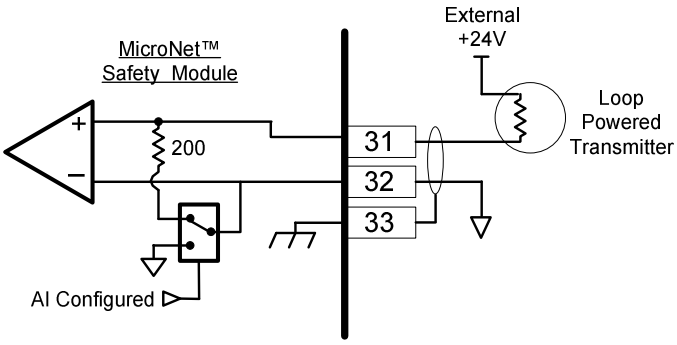



Figure 2-14. Example Configurable Input Wiring—Analog Input

## Analog Output

One programmable 4–20 mA analog output per module (A, B, C) is available to drive a readout meter or interface with other controllers or plant DCS's (distributed control systems). This output is designed to drive into an impedance between 0 to 500 Ω. Twisted shielded pair wiring must be used. Refer to the Chapter 3 (Functionality) of this manual for applicable analog output specifications. Refer to Chapter 3 (Functionality) of this manual for information on how to program and use this analog output in an application.

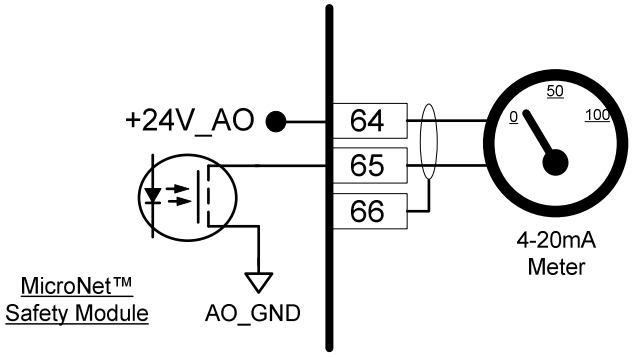



Figure 2-15. Example Analog Output Wiring

## Relay Outputs

Two basic MicroNet Safety Module model variations are available depending on the required trip system architecture: the "Independent Trip Relay" model and the "Voted Trip Relay" model. Either version also has 3 programmable Relay Outputs per module. Refer to Figure 2-16a for the general locations for Trip Relay Output wiring in the two models.

**IMPORTANT**

**Optionally all MicroNet Safety Module models can be configured for de-energize-to-trip or energize-to-trip functionality based on the application action required. However, de-energize to trip is a safer way to fail so that a total power loss to the control will trip a shut down.**

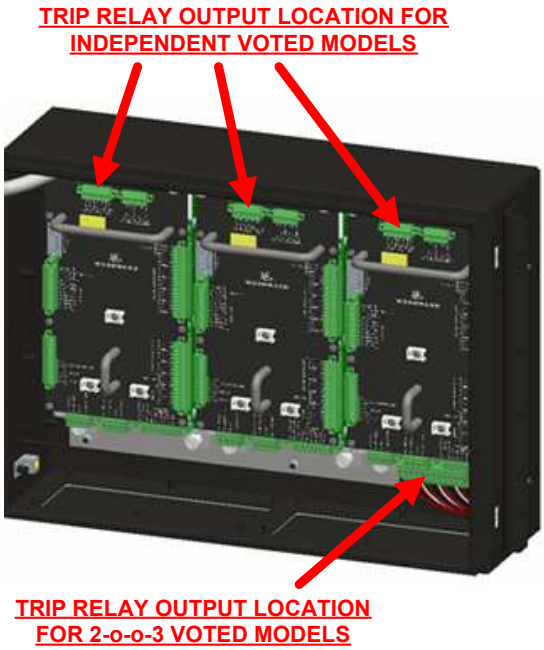



Figure 2-16a. Example Trip Relay Output Wiring

Refer to the Chapter 3 (Functionality) of this manual for all applicable relay output specifications. Refer to Chapter 3 (Functionality) of this manual for information on how to configure and use each programmable relay output in an application.

## Relay Outputs (Independent Trip Relay)

Each MicroNet Safety Module "Independent Trip Relay" model has three independent modules (A, B, C), and each of these modules has five solid-state relay outputs. Each of the five solid-state relays have normally-open type contacts and are rated for 24 V (dc) @ 1 A. Two of these relay outputs are dedicated as redundant trip signal outputs, and the other three relay outputs are user-programmable which can be programmed to function independently as required. The Independent Trip Relay MicroNet Safety Module models are designed so the each set of trip relays drive one of three external independent trip solenoids, typically used in 2-o-o-3 voted trip block assemblies. Refer to Figure 2-16a for relay terminal location and Figure 2-16b or c for wiring information.

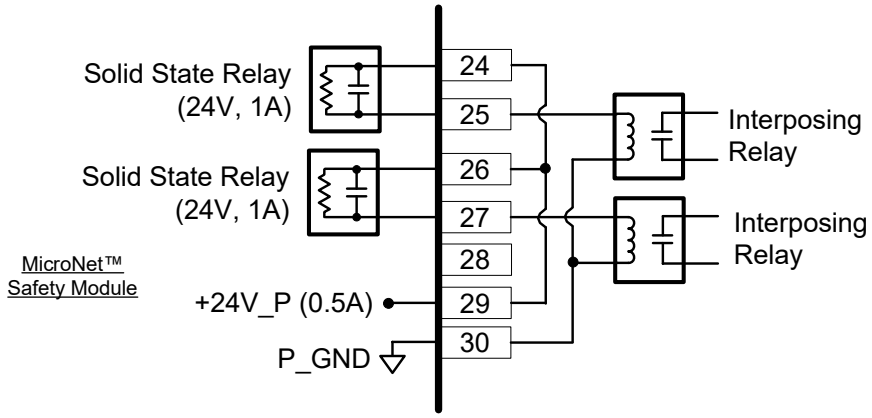



Figure 2-16b. Example Trip Relay Wiring (per Module) (Independent Trip Relay) (Internal Supply)

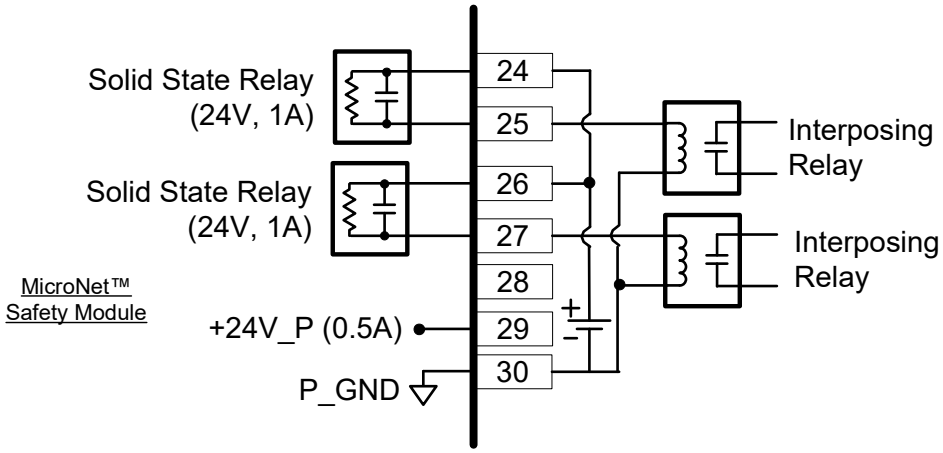



Figure 2-16c. Example Trip Relay Wiring (per Module) (Independent Trip Relay) (External Supply)

## Relay Outputs (Voted Trip Relay)

Each "Voted Trip Relay" MicroNet Safety Module model has three independent modules (A, B, C), and each of these modules has five solid-state relay outputs. Each of the five solid-state relays have normally-open type contacts and are rated for 24 V (dc) @ 1 A. Two of these relay outputs are dedicated as redundant trip signal outputs, and the other three relay outputs are user-programmable which can be programmed to function independently as required. Note that with the "Voted Trip Relay" MicroNet Safety Module models, the two solid-state trip relays located on each module (A, B, C) are not available for use or connection. Each module's trip signal relays are connected internally to the MicroNet Safety Module in a 2-o-o-3 voted fashion to drive two redundant Form-C trip relays. These two redundant have normally-open and normally closed output contacts rated for 220 V (ac) @ 8 A or 24 V (dc) @ 8 A. Refer to Figure 2-16a for relay terminal location and Figure 2-16d for wiring information.

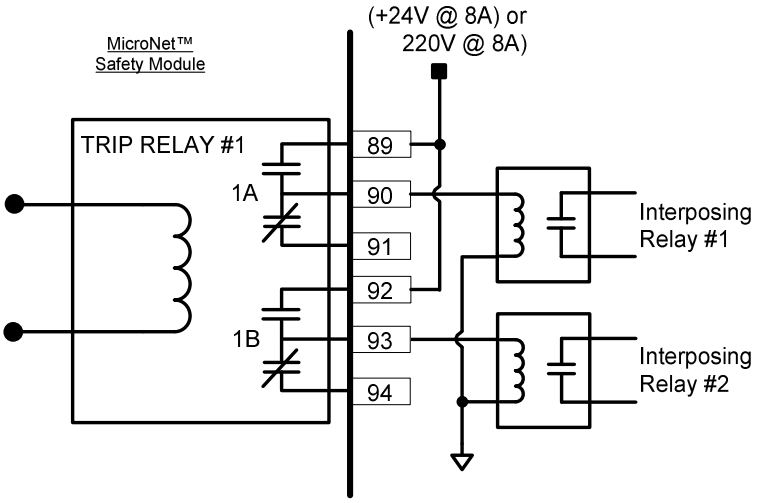



Figure 2-16d. Example Trip Relay Wiring (Voted Trip Relay Models)

## Relay Outputs (Configurable)

In both the Independent & Voted Trip Relay versions, each of the three modules (A, B, C) also have three configurable solid-state relay outputs. These are user-programmable and can be programmed to function as required. The programmable relay outputs have normally-open type contacts and are rated for 24 V (dc) @ 1 A. Refer to Figure 2-16e or f for wiring information.

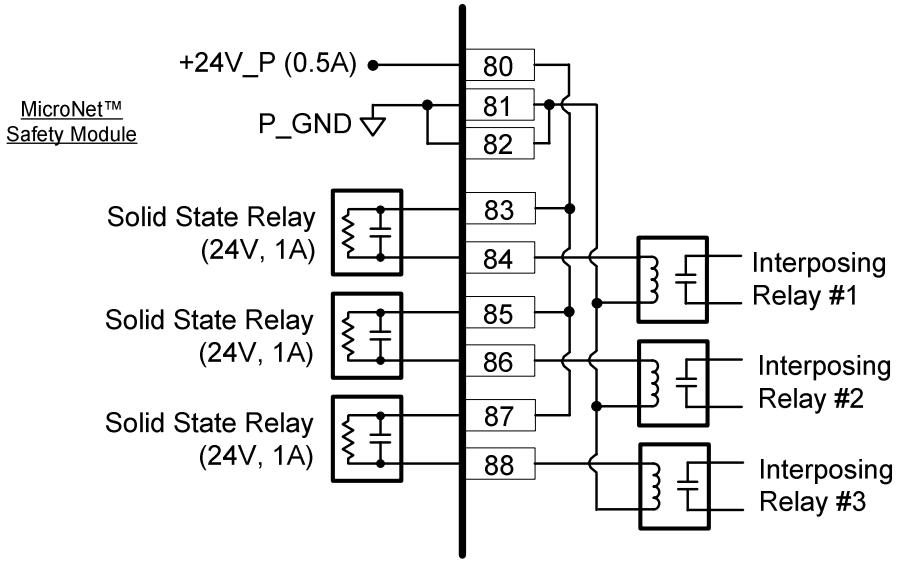



Figure 2-16e. Example Programmable Relay Wiring (Internal Supply)

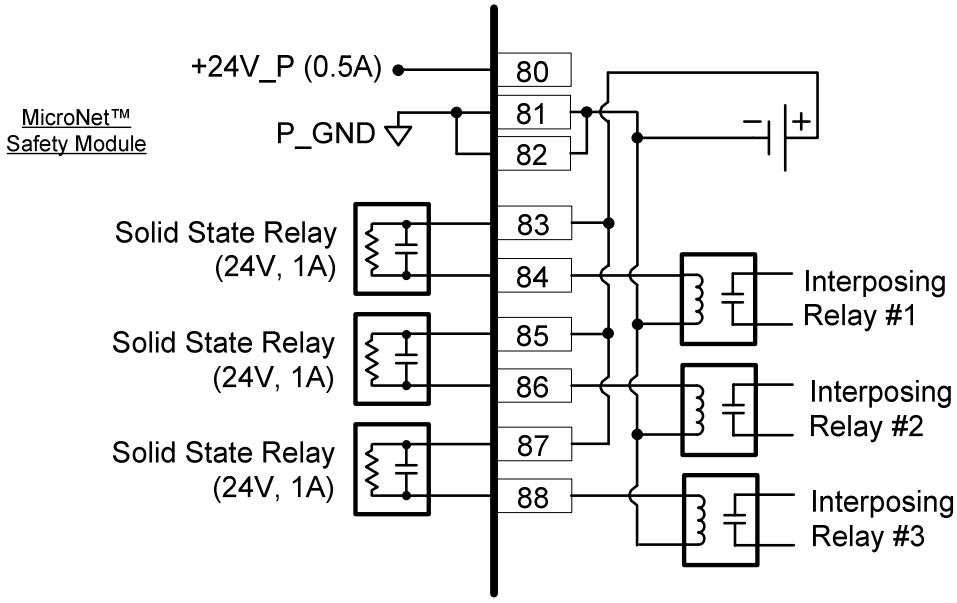



Figure 2-16f. Example Programmable Relay Wiring (External Supply)

## Internal Power Supplies for Discrete Signals

Two internal 24 V power supplies are available within each MicroNet Safety Module's module for Discrete I/O, one for driving external relay coils and one wetting voltage for configurable inputs (when used as discrete input circuits). Each power supply utilizes an internal circuit shutdown to protect the power supply from over-current conditions.

One power supply channel (+24 V_P) is capable of providing 24 V (dc) ±10 % @ 500 mA maximum output current, to power external relays. This is supply is used for relay coils driven by the Independent Trip Relay signals and Programmable Relays. Independent Trip Relay signal connections can be made through terminals 29 and 30 with terminal 30 as common. Coil Voltage for Programmable Relays is on terminals 80, 81, and 82 with terminals 81 and 82 as the commons. Refer to Figure 2-17 for wiring information.

**NOTICE**

**In the Independent Trip Relay models, if total current draw through terminals 30 and 80 exceeds 500 mA the power supply's internal breaker will open. Upon such a condition, all load must be removed from the specified terminals to allow this breaker to reset.**
**In Voted Trip Relay models, if the total current draw through Terminals 80 exceeds 500 mA the power supply's internal breaker will open. Upon such a condition, all load must be removed from the specified terminals to allow this breaker to reset.**

If additional current capability is needed the Voter & Programmable relay connections points may be used as controlled switch contact connection points with an external power supply. An external supply may be used instead of the internal supply only for the independent trip relays or programmable relays as shown in figure 2-16f. The external supply should be referenced to terminal 80 or 81.

**NOTICE**

**In the Independent Trip Relay models, if a customer provided external supply is used for coil voltage, it must not be the input power with a reference connection to the 24 V EXT supply or Discrete Supply. Referencing input power to DISCRETE PWR or 24 V EXT causes the internal supplies to respond more readily to transients on the power bus.**

A second power supply channel (Discrete PWR) is capable of providing 24 V (dc) ±10 % @ 50 mA maximum output current, to power the module's configurable input circuitry (configured as Discrete Inputs). Power connections can be made through terminal 37, with terminal 38 as the common. This power supply is sized to provide power for all ten discrete inputs. Refer to Figure 2-17 for information on the module's internal power supply relationship.

**NOTICE**

**If total current draw through terminals 37 and 38 exceed 80 mA the power supply's internal breaker will open. Upon such a condition, all load must be removed from the specified terminals to allow this breaker to reset.**

If additional current capability is needed, the DI wetting voltage may come from an external source. If an external supply is used it must be an isolated supply.

**NOTICE**

**If DI wetting voltage is from an external supply, it must be an isolated, power supply. The module input power source of 24 V (dc) may not be used. Tying the input power to the Discrete power causes bias offsets which make the supplies susceptible to transients. The supply must also be referenced correctly to Discrete PWR by connecting the two commons.**

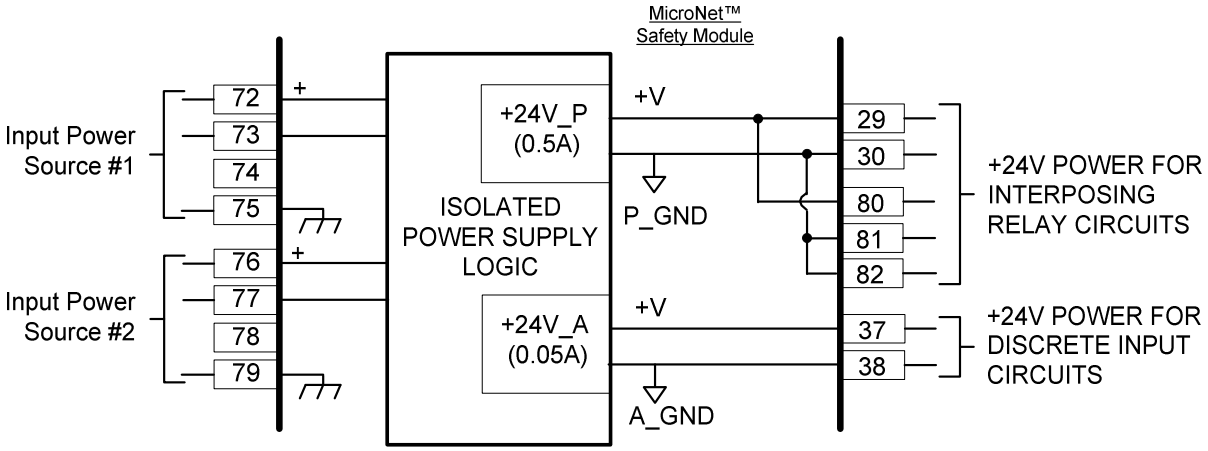



Figure 2-17. Power Supply Relationship Diagram

## Serial Modbus Communications

One serial communications port per module (A, B, C) is available for Modbus communications to a plant DCS (distributed control system) or local HMI (human machine interface). This serial port can be wired and configured for RS-232 or RS-485 communications, depending on the specific application requirements. Refer to Figure 2-18a for RS-232 wiring information, and Figure 2-18b for RS-485 wiring information.

**Note:** only 2-Wire communications is supported.

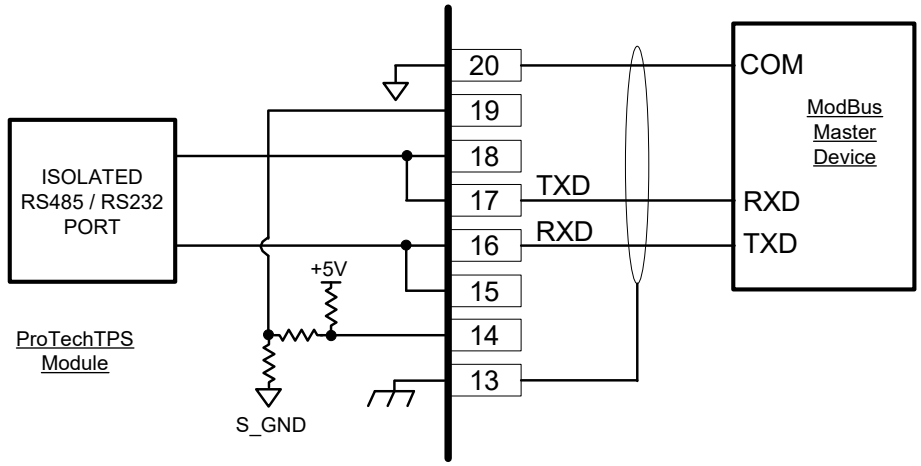



Figure 2-18a. Serial Port Interface Diagram—RS-232

Optional termination resistors for RS-485 communication networks are included within the MicroNet Safety Module control's internal circuitry, and only require terminal block wire jumper(s) for connection to a network, for applications requiring these termination resistors. Refer to Figure 2-18b for jumper connections.

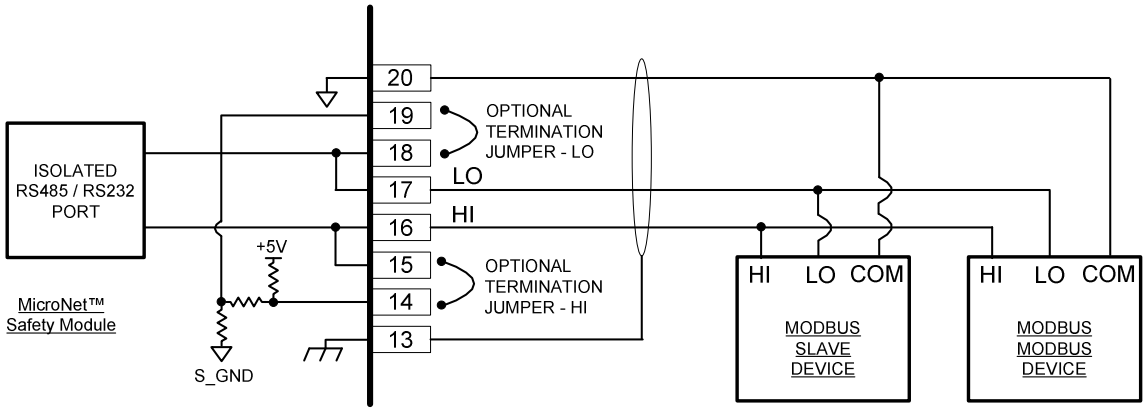



Figure 2-18b. Serial Com Port Interface Diagram —RS-485

## Service Port Communications

One 9-pin Sub-D based service port per module (A, B, C) is available to interface with a computer for loading program settings into the ProTech and for reading stored log files from the ProTech using the Programming and Configuration Tool (PCT). This port is designed to communicate to the computer using a serial DB9 extension (straight-through) type of computer cable.

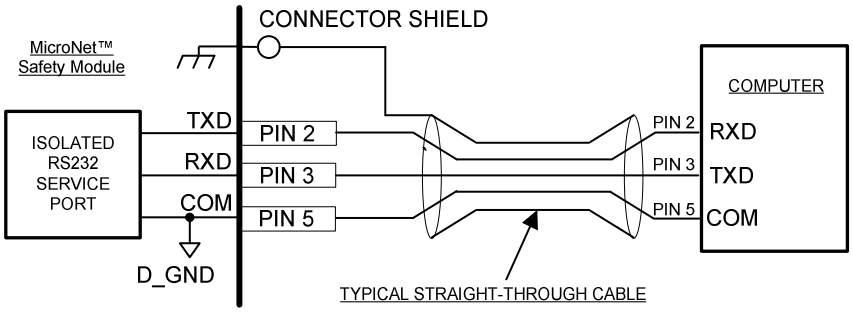



Figure 2-19. Service Tool Cable/Interface Diagram

**IMPORTANT** **The RS-232 serial cable must be disconnected when not in use. The port is a service port only, it is not designed for permanent connection.**

## IRIG-B Time Synchronization

The Real-time clock in the MicroNet Safety Module can be synchronized to an external time source via the IRIG-B time protocol. This allows for a resolution of up to 1 ms when using Sequence of Events log functionality.

The external IRIG time source can be connected to one, two, or all three modules of the MicroNet Safety Module. When connected to only one module, other two modules will be synchronized to that module via the inter-module time synchronization and allows for 1 ms resolution on time stamps for the Sequence of Events log.

If IRIG time synchronization is enabled, a loss of the IRIG signal will be annunciated as an IRIG Signal Lost alarm in the Alarm Latch. On restoring the IRIG Signal, the Alarm needs to be reset by issuing a RESET command.

The IRIG time code format supported by the MicroNet Safety Module is **B002**:

Modulation: Un-modulated – DC Level Shift, pulse-width coded
Carrier Frequency: No carrier (DC Level Shift)
Coded Expressions: $BCD_{TOY}$ (Day, Hours, Minutes, Seconds). Refer to Figure 2-20 for IRIG-B wiring information.

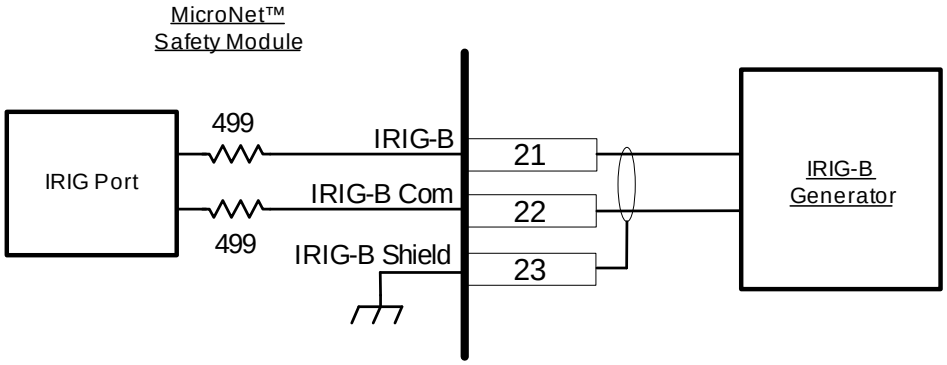



Figure 2-20. IRIG-B Interface Diagram

# Chapter 3. Functionality

The MicroNet™ Safety Module includes all the functionality of the MicroNet Safety Module Total Protection System, but adds MicroNet Safety Module IRIG Time Synchronization and a Sequence Of Events Log with up to 1 ms resolution for Configurable Discrete Inputs.

## Features

### Fault Tolerant Design

Each MicroNet Safety Module consists of three independent modules referred to as A, B and C. Each module accepts one speed input, ten configurable analog / discrete inputs, and three dedicated function discrete inputs. Each module also has three configurable relay outputs and one analog output for the sensed speed output.

The MicroNet Safety Module comes in two basic models – the “Independent Trip Relay” models and the “Voted Trip Relay” models. This relates to the trip signal configuration. The differences between these two models and their application are discussed in detail in the Product Models section of this chapter. Each of the three MicroNet Safety Module modules A, B, and C are fully fault isolated from each other, so that faults in one module do not affect other modules. The modules do not share input or output information but each module is aware of the status of the others.

Normally, each module is configured to operate the same exact application program and with the same exact configuration settings. Monitoring logic is used to validate that all modules are running the same exact application program as the other modules, and the monitoring logic will issue an alarm if it detects that one or more of the modules are not running the exact same application program. Thus if program changes are downloaded to a module, or a change to configuration setting is made to one module, while the MicroNet Safety Module is in normal operation and the turbine or equipment is on-line and operating normally, each module will issue an alarm. Once all application programs are the same again and all configuration settings are the same again, this alarm can be reset.

Some exceptions to this rule are permitted. The user-defined names can be different in each module to allow the specification of unique tag names. Since these may be different, this information is not checked by the Configuration Compare function and is not copied between modules by the Copy Configuration function. In special cases that require a different application to be installed in each module, the Configuration Compare alarm can be disabled.

The MicroNet Safety Module is a SIL-3 (according to IEC-61508) triple modular design that allows users to easily replace any of its modules (A, B, C) while the monitored equipment / turbine is on-line and operating normally. This is also referred to as ‘hot replacement’. Ease of replacement is enhanced by the unit’s backplane plug-and-operate structure and its module-to-module program copying function.

### Programming/Configuring Overview

Each MicroNet Safety Module module includes preset overspeed, over-acceleration, alarm latch, and trip latch functionality and can be custom configured to meet a specific application through a module’s front panel or the provided Programming and Configuration Tool (PCT).

A custom application program is required for use of any of the MicroNet Safety Module configurable inputs, outputs and related functionality. A software-based PCT is included with each MicroNet Safety Module that can be loaded onto a computer, and used to:

- Create and change custom application programs
- Change overspeed and over-acceleration functionality settings
- Save application and configuration settings to a file
- Download application and configuration settings to each MicroNet Safety Module
- Upload application and configuration settings from a MicroNet Safety Module
- Upload and view stored logged files from a MicroNet Safety Module

Configuration and program logic changes are allowed while the service tool is connected (on-line) as long as the module is in a tripped state. Configuration and program logic changes can also be made off-line (service tool not connected) by editing a settings file that is loaded into the module later. Normally, each MicroNet Safety Module is configured to operate the same exact application program and with the same exact configuration settings. Program differences between modules are detected and alarmed.

Although the overspeed and over-acceleration functionality can be programmed from either the PCT or a module's front panel, changes/additions to a custom application program can only be changed via the PCT. Entry of the correct "configuration" level password is required to perform any program changes or download a program into a module.

Refer to Chapters 9 and 10 of this manual for more information on performing program changes.

### Security

The MicroNet Safety Module utilizes two password levels, a Test Level Password and a Config Level Password. The same passwords are used by the Programming and Configuration Tool (PCT) and Front Panel.

The Test Level Password is required to:

- Initiate tests
- Reset logs (except for the Peak Speed/Acceleration Log)
- Change the Test Level Password

The Config Level Password provides access to any function that requires the Test Level Password. Additionally, the Config Level Password is required to:

- Change any program setting
- Download an application program file into a module
- Reset the Peak Speed/Acceleration Log.
- Change the Config Level Password

Each of these passwords meets NERC (North American Electric Reliability Corporation) cyber security requirements.

The default password for Test and Config Level is "AAAAAA".

### Module-to-Module Communications

An isolated communications bus is used between modules to:

- Copy an application program from one module to another module
- Compare module application programs for differences
- Verify the health and state of the other modules before allowing a module test to be performed
- Pass a "module test token" between modules when performing a "Periodic Overspeed Test" routine

## Product Models

Two basic MicroNet Safety Module models are available depending on the required system architecture and related output signal(s).

- The MicroNet Safety Module "Independent Trip Relay" models consist of three independent modules that each accept one speed input and ten configurable analog/discrete inputs, then output two redundant trip commands.
- The MicroNet Safety Module "Voted Trip Relay" models consist of three independent modules that each accept one speed input and 10 configurable analog/discrete inputs, and whose trip output commands are then voted in a 2-out-of-3 fashion to create the 2-out-of-3 trip output command.

Both of these models can be purchased with different mounting options (bulkhead mount or panel mount) and different input power supply options (two high-voltage power supply inputs or one high-voltage and one low-voltage power supply input). Each MicroNet Safety Module model can be configured to function for energize-to-trip and de-energize-to-trip applications. The de-energize-to-trip functionality is implemented such that a complete loss of power to the module results in a trip of that module. The energize-to-trip functionality is implemented such that a complete loss of power to the module does not result in a trip of that module.

**IMPORTANT**

**Optionally all MicroNet Safety Module models can be configured for de-energize-to-trip or energize-to-trip functionality based on the application action required. However, de-energize to trip is a safer way to fail so that a total power loss to the control will trip a shut down.**

## MicroNet Safety Module with "Independent Trip Relay" Outputs

MicroNet Safety Module "Independent Trip Relay" models consist of three independent modules that each accept one speed input and ten configurable analog/discrete inputs, then output two redundant trip commands. The trip command outputs are electrically separated, allowing each module to actuate a separate external relay or trip solenoid. These models are typically used with special 2-out-of-3 voted trip block assemblies or 2-out-of-3 voted trip string relay logic.

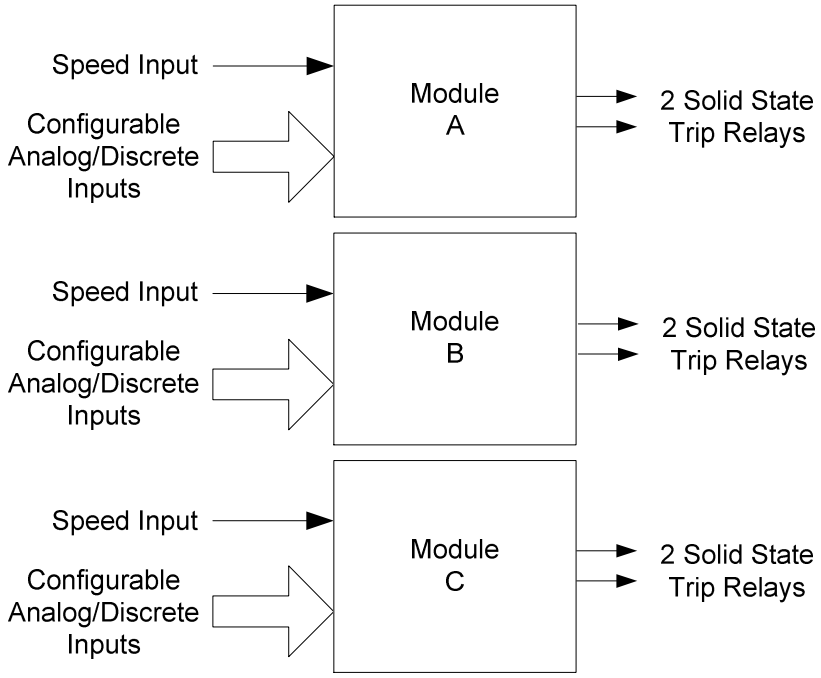



Figure 3-1. Basic Functional Overview of Independent Trip Relay Models

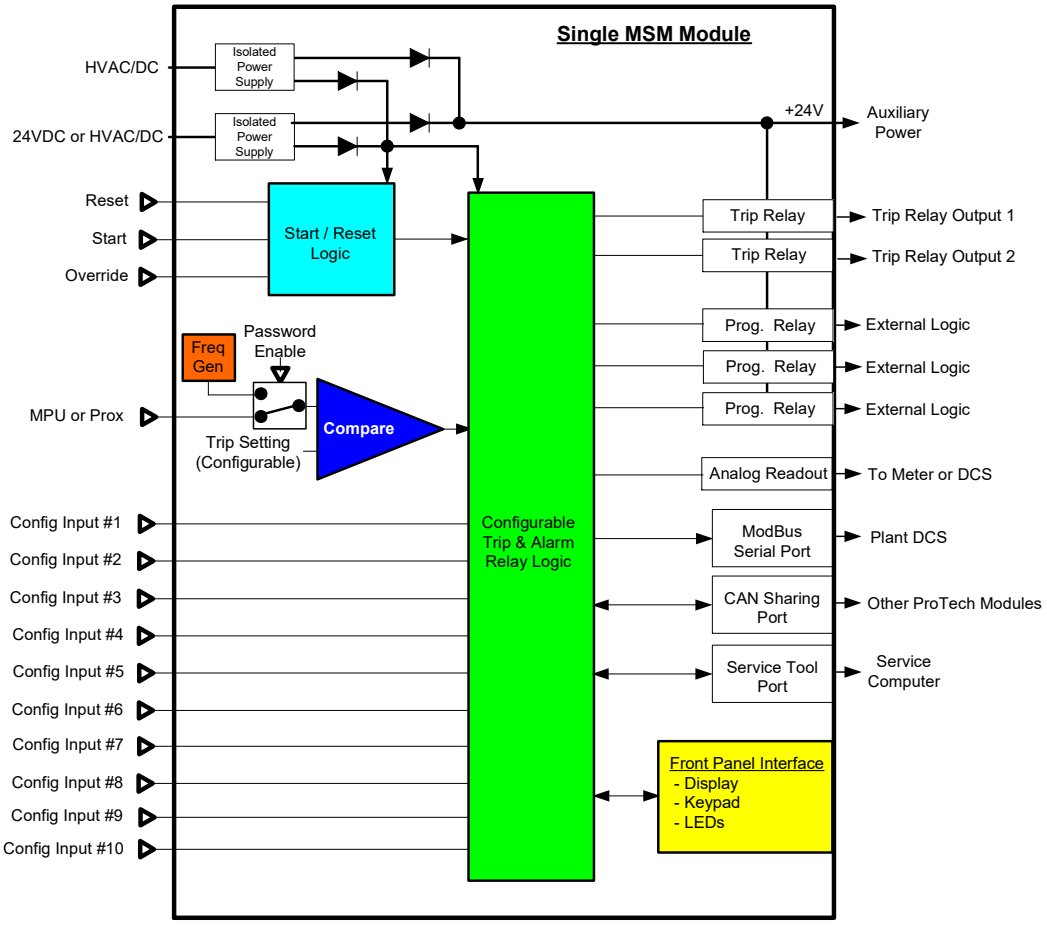



Figure 3-2. Functional Diagram of single MicroNet Safety Module with Independent Trip Relay Outputs

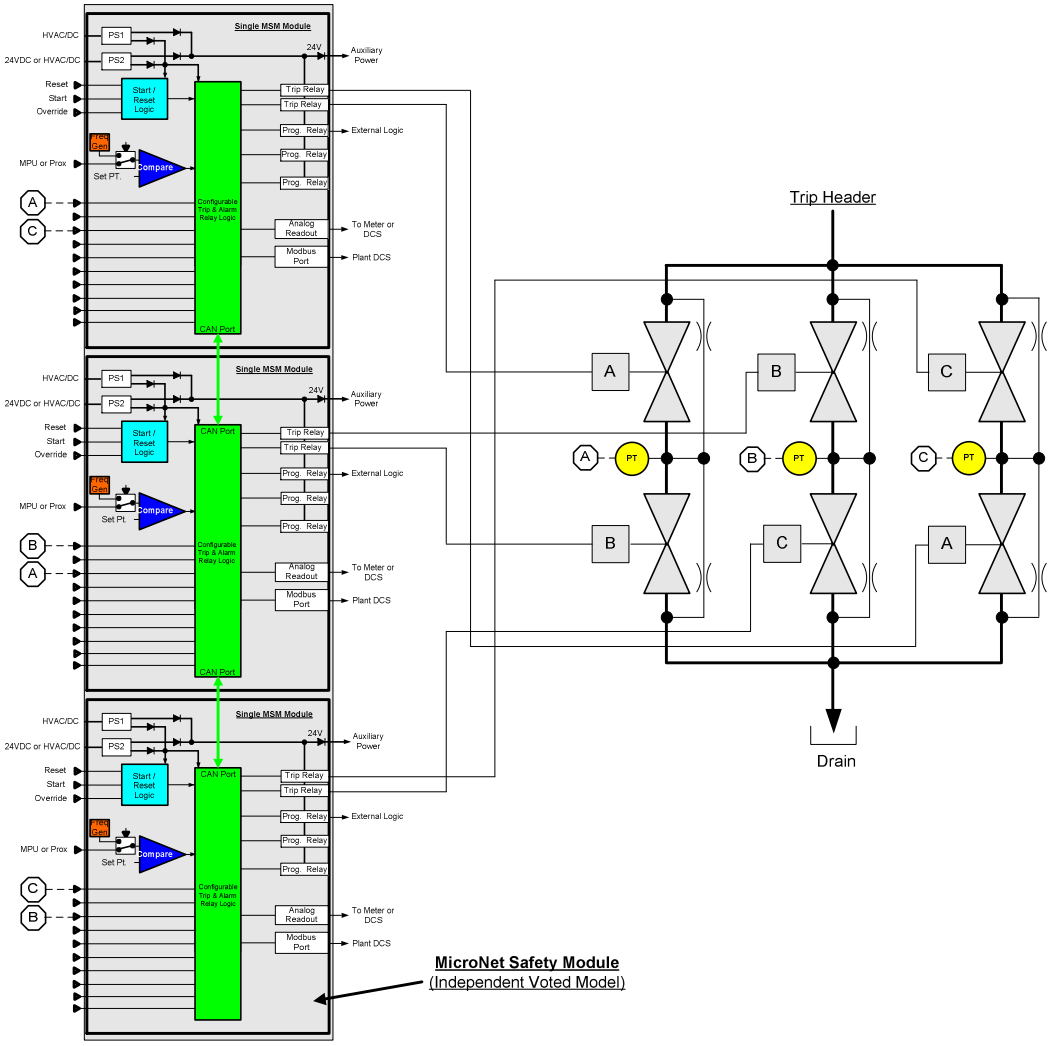



Figure 3-3. Example TMR Trip Block Assembly Interface

Table 3-1. Independent Trip Relay Output Specifications

| | |
|---|---|
| **Number of Channels:** | 2 (actuated simultaneously) |
| **Output Type:** | SPST Solid-state, Normally Open |
| **Current Rating:** | 1 A |
| **Voltage Rating:** | 24 V (32 V max) |
| **Isolation:** | 500 V (ac) from output to chassis and output to all other circuits |
| **Signal Cable Length:** | Must be limited to 305 m / 1000 ft (low capacitance 1.3 mm² / 16 AWG pair) |

## MSM with Voted Trip Relay Output

MicroNet Safety Module “Voted Trip Relay” models consist of three independent modules that each accept one speed input and 10 configurable analog/discrete inputs, and whose trip output commands are then voted in a 2-out-of-3 (2oo3) fashion to create the 2oo3 trip output command. Two redundant “Form-C” 2oo3 voted relays are used in these models providing four isolated relay output signals with normally open and normally closed contacts.

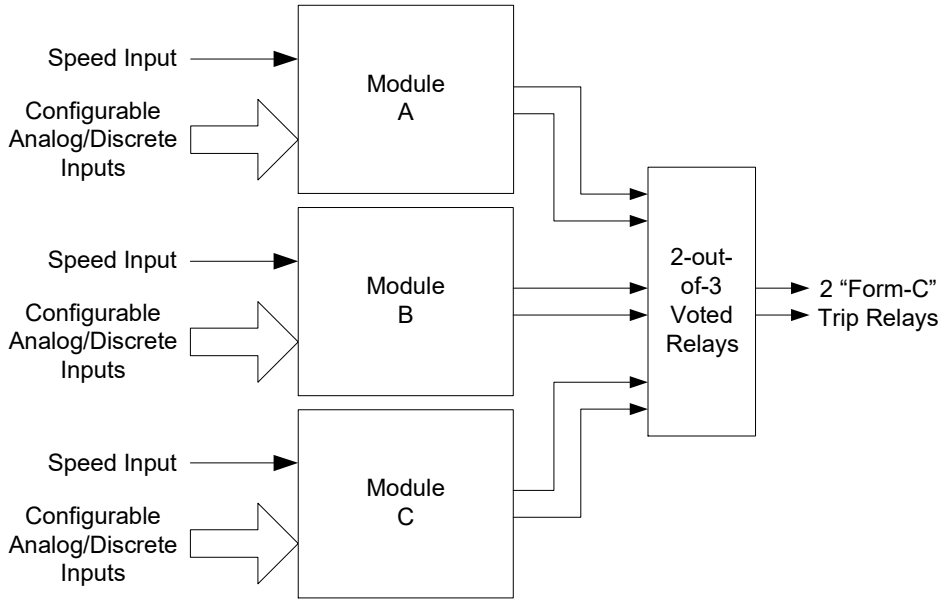



Figure 3-4. Basic Functional Overview of Voted Trip Relay Models

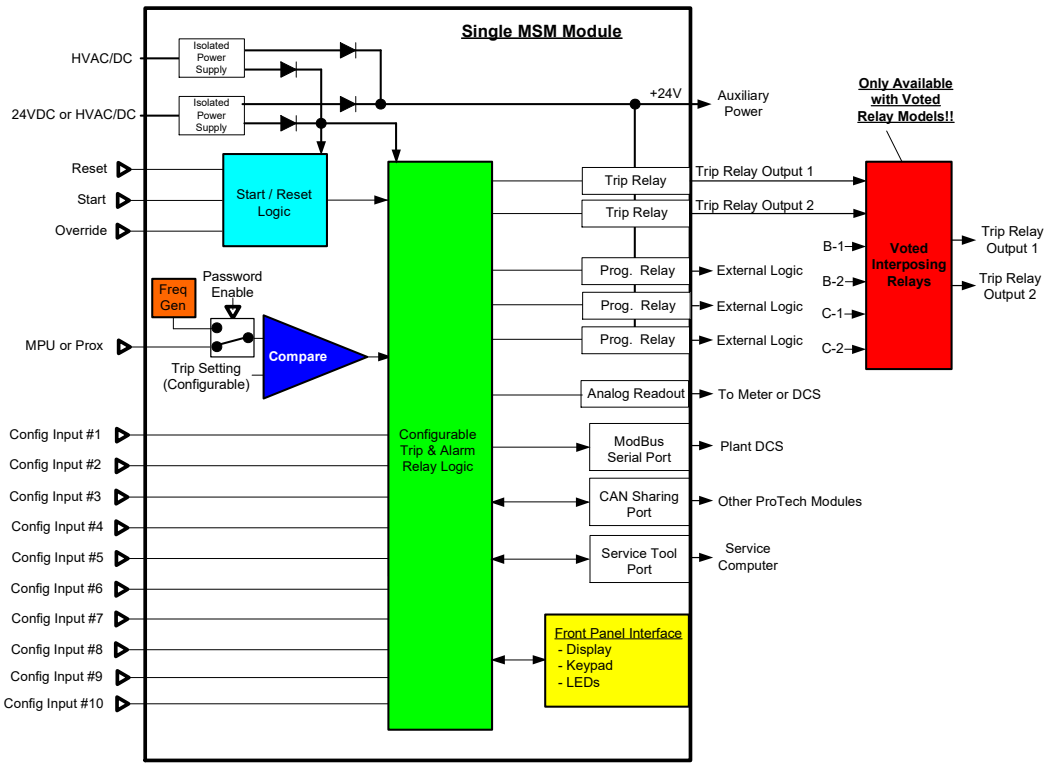



Figure 3-5. Functional Diagram of Single MicroNet Safety Module with Voted Trip Relay Outputs

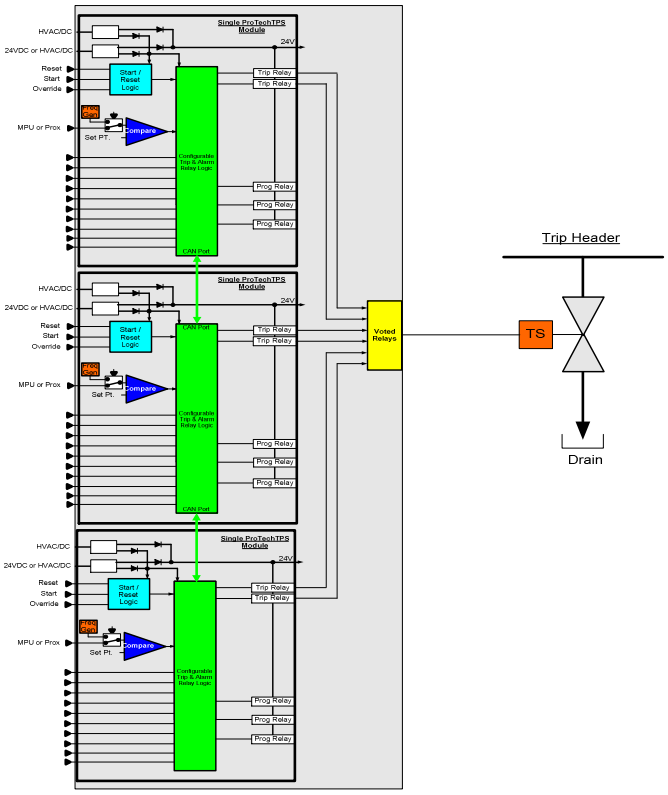



Figure 3-6. Simplex Trip Block Assembly

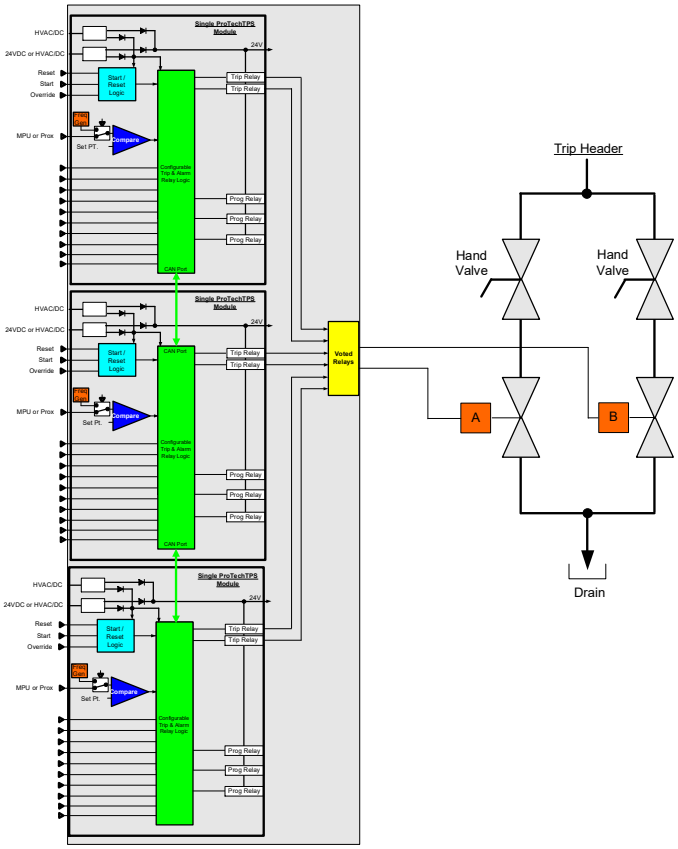



Figure 3-7. Dual Redundant Trip Block Assembly

Table 3-2. Voted Trip Relay Output Specifications

| | |
|---|---|
| **Number of Channels:** | 2 (both channels actuated simultaneously), see wiring and installation |
| **Output Type:** | Form C, dual SPDT |
| **Contact Rating:** | 8 A @ 220 V (ac) / 8 A @ 24 V (dc) |
| **Max. Switching Voltage:** | 220 V (ac) / 150 V (dc) |
| **Max. Switching Power:** | 2000 VA / 192 W |
| **Isolation:** | 1500 V (ac) from contact to chassis and contacts to all other circuits |

## Power Supplies

Each MicroNet Safety Module system consists of three separate internal modules (A, B, C), and each of these three modules accept two input power sources (for redundancy). Depending on the MicroNet Safety Module model purchased, the internal modules will accept either two high-voltage (HV) input power sources or one HV input power source and one low-voltage (LV) input power source. For reliability purposes, each MicroNet Safety Module module will function normally with power sourced to both or either power supply input.

Table 3-3. Power Supply Specifications

| | |
|---|---|
| **Number of Inputs:** | 2, Input range depends on model (see following tables):<br>• 2 High Voltage Inputs OR<br>• 1 High Voltage and 1 Low Voltage |
| **Wiring Constraints:** | Each power supply input must be provided with its own breaker. This is to facilitate both on-line-removal of a module, and also to protect other power supplies from tripping while connected to a common input power circuit. |

Table 3-4. High Voltage Input

| | |
|---|---|
| **Voltage Input Range:** | (90 to 264) V (ac), or (100 to 150) V (dc) |
| **Current Input Max (*Note 1*):** | 0.5 A @ 90 V (ac)<br>0.22 A @ 264 V (ac)<br><br>0.25 Arms @ 110 V (dc)<br>0.18 Arms @ 150 V (dc) |
| **Inrush Curren:t** | 10 A at 115 V (ac), 20 A @ 220 V (ac) |
| **Reverse Polarity Protection:** | Yes, for dc connection |
| **Interrupt Time:** | 45 ms, when operating on one power supply only |

Table 3-5. Low Voltage Input

| | |
|---|---|
| **Voltage Input Range:** | (18 to 32) V (dc) |
| **Current Input Max (*Note 1*):** | 1.5 A @ 18 V (dc)<br>1 A @ 32 V (dc) |
| **Inrush Current:** | 0.05 $A^2$sec |
| **Reverse Polarity Protection:** | Yes |
| **Interrupt Time:** | 3 ms, when operating on one power supply only |

**Note 1:** The input current specifications are for 1 module, measured with the other power supply input disconnected. With both power supply inputs connected, input current will never exceed the maximum specification, however the two power supplies do not load share internally.

## Internally Generated Limited Power Supplies

Table 3-6. Configurable Input Power Supply (24V_AI)

| | |
|---|---|
| **Output Voltage:** | 24 V (dc) ±10 % |
| **Current Limit:** | 50 mA |

**IMPORTANT**

**Avoid using the Configurable Input Power Supply to power any analog input channels. It is intended for use with inputs that are configured for discrete mode only.**

Table 3-7. Relay Output Power Supply (24V_P)

| | |
|---|---|
| **Output Voltage** | 24 V (dc) ±10 % |
| **Current Limit** | 500 mA |

# Inputs and Outputs

## Speed Sensor Inputs

Each module has one speed input which can be programmed to accept a passive MPU (magnetic pickup unit), or an active speed sensor (proximity probe signal or an eddy current probe signal).

When configured as an MPU signal input, special MPU open-wire detection circuitry is used to validate that the MPU is properly connected before turbine operation, and special loss-of-speed detection logic is used to validate speed sensor functionality during turbine operation. Depending on the module's program settings a loss of speed signal or open-wire detection will result in a trip or alarm condition.

**IMPORTANT**

**MPU open-wire detection logic and associated trip/alarm action is only utilized when the speed input is configured a "passive" probe.**

When configured as an MPU signal input, the speed sensor circuitry will sense MPU signals within the voltage range of 1—35 V (rms).

When configured as a proximity (active) probe input or eddy current probe input, a 24 V power supply is provided to power the probe, but an isolated external supply may be used instead, if referenced correctly.

The Number of Gear Teeth and Gear Ratio are configured to convert the frequency input from the speed probe to the unit speed.

**⚠WARNING**

**The Number of Gear Teeth and Gear Ratio must match the actual unit hardware or speed sensing and all association protection and functionality will not work correctly.**

Refer to Chapter 2 of this manual for related speed sensing input installation information.

## Speed Input Specifications

Table 3-8. General Specifications

| | |
|---|---|
| **Number of Inputs:** | 1, selectable as passive or active probe by front panel configuration |
| **Speed Sensing Accuracy:** | Accuracy: ±0.04 % of current speed over (–20 to +60) °C ambient temperature |
| **Acceleration Sensing Accuracy and Range:** | Accuracy: ±1 % of current speed<br>Detectable over-acceleration range: 0 to 25000 rpm/sec |
| **Signal Cable Length:** | Must be limited to 457 m / 1500 ft (low capacitance 1.3 mm² / 16 AWG) |
| **Internal Test Frequency Generator:** | 6 Hz to 32 kHz, selectable in different test modes, see Chapter 4, Configuration and Operation |

Table 3-9. Passive Probe (MPU) Inputs

| | |
|---|---|
| **Input Frequency:** | Passive Probe (MPU): 100 Hz to 32 kHz |
| **Input Amplitude:** | 1 V (rms) to 35 V (rms) |
| **Input Impedance:** | 1.5 kΩ |
| **Isolation:** | 500 V (ac) from input to chassis and input to all other circuits |
| **Open Wire Detection:** | MPU only > 7.5 kΩ |

Table 3-10: Active Probe (Proximity, Eddy Current)

| | |
|---|---|
| **Input Frequency:** | Active Probe (Proximity, Eddy Current): 0.5 Hz to 25 kHz |
| **Input Amplitude:** | Active Probe: 24 V probes |
| **Probe Power:** | 24 V ±10 % @ 1 W, probe power switched on only in active probe mode. |
| **Internal Pull-up Resistor:** | 10 kΩ, input suitable for use with open collector probe outputs (Note 1) |
| **Input Threshold (Vlow):** | < 2 V |
| **Input Threshold (Vhigh):** | > 4 V |
| **Isolation:** | 500 V (ac) from input to chassis and input to all other circuits |

**⚠WARNING**

**When Active Probes are used it is recommended to always enable (USED) the Speed Fail Trip function. Reference the Configuration Guidance section under the Troubleshooting Chapter for more detail.**

***IMPORTANT***

**Each speed input is designed to operate from its own speed probe. Do not connect a speed probe to more than one input. This will compromise the ability of the MicroNet Safety Module to sense open-wire (passive mode only) and interfere with the minimum amplitude sensitivity and accuracy.**

***IMPORTANT***

**When using open collector probes, verify that the signal is being read properly at higher frequencies (>10 kHz). Long cable lengths can significantly reduce the signal strength at higher frequencies. In this case, add an external pull-up resistor of approximately 2 kΩ (0.25 W) from terminals 70 to 69 and verify that the signal is read properly by the MicroNet Safety Module.**

***IMPORTANT***

**Shielded cable is required when connecting to the speed input.**

## Dedicated Discrete Inputs

Each MicroNet Safety Module module (A, B, C) accepts three dedicated discrete inputs. The Preset Contact Inputs are Start, Reset and Speed-Fail-Override.

## Start

This contact input is used as part of the Start Logic “Speed Fail Timeout Trip” function. When this function is enabled, closing the Start contact will start the Speed Fail Timeout timer. This is an edge triggered signal and re-selecting Start will re-start this timer. Refer to the Start Logic section below for additional details.

## Reset

This contact is used to clear module trips and alarms.

## Speed-Fail-Override

This is used as part of the Start Logic “Speed Fail Trip” function. When this function is enabled, closing the Speed-Fail-Override contact overrides the Speed Fail Trip. This is a level sensitive trigger so the contact must remain closed to prevent the Speed Fail Trip until speed is greater than the speed fail setpoint. Refer to the Start Logic section below for additional details.

Table 3-11. Dedicated Discrete Inputs Specifications

| | |
|---|---|
| **Number of Channels:** | 3, (Start, Reset, Speed Fail Override) |
| **Input Thresholds:** | <= 8 V (dc) = “OFF”<br>>= 16 V (dc) = “ON” |
| **Input Current:** | 3 mA ±5 % at 24 V (for externally power wiring, see, Chapter 2) |
| **Wetting Current Supply:** | 24 V at 2 W available (see installation diagrams, Chapter 2). This power supply is current limited. |
| **Max Input Voltage:** | 32 V (for externally power wiring, see, Chapter 2) |
| **Isolation:** | 500 V (ac) from output to chassis and output to all other circuits |

## Configurable Inputs

Each module has 10 configurable analog/discrete inputs. Each input can be configured as Not Used, Analog Input, or Discrete Input. User defined names can be associated with each input.

## Discrete Input Configuration Example

When configured as a discrete Input, the channel accepts a (0 to 24) V (dc) discrete input. NOTE: <6 V (dc) = FALSE, >12 V (dc) = TRUE. The Boolean output associated with the Discrete input can be used in the user configured software.

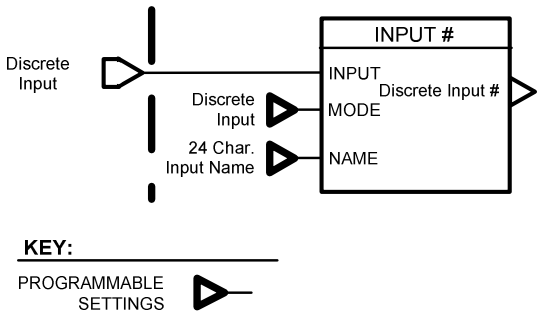



Figure 3-8. Discrete Input Example

## Analog Input Configuration Example

When configured as an analog input, the channel accepts a 4–20 mA analog signal. The accuracy of the analog input is better than ±0.5 % of 20 mA over the temperature range of the product. Engineering units and ranges are assigned to the 4–20 mA current input values. Additionally, low-low (LoLo), low (Lo), high (Hi), and high-high (HiHi) levels can be defined. The Boolean outputs associated with these levels for the analog input can be used in the user configured software. There is also a Range Error output to indicate that the Input is outside a 2–22 mA range.

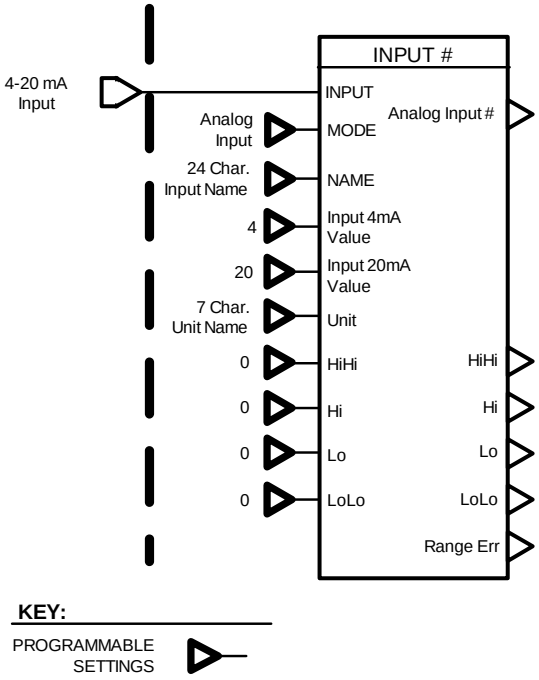



Figure 3-9. Analog Input Example

**WARNING**

**The Analog scaling must match the actual unit hardware, or the signal sensing and all association protection and functionality will not work correctly.**

## Configurable Input Specifications

Table 3-12. General Specifications

| | |
|---|---|
| **Number of Channels:** | 10, user configurable for individual analog or discrete input mode |
| **Signal Cable Length:** | Must be limited to 305 m / 1000 ft (low capacitance 1.3 mm² / 16 AWG) |

Table 3-13. Analog Input Mode

| | |
|---|---|
| **Input Current Range:** | 0 to 25 mA |
| **Common Mode Rejection:** | 45 dB at 60 Hz |
| **Input Common Mode Range:** | ±40 V |
| **Input Impedance:** | 200 Ω ±1 % |
| **Resolution:** | 12 bit |
| **Accuracy:** | ±0.25 % of 25 mA at 25 °C, *(note 1)*<br>±0.5 % of 25 mA over-temperature |
| **Analog Input Fail Thresholds:** | Fixed at 2 mA and 22 mA |
| **Isolation:** | 500 V (ac) from input to chassis and input to all other circuits, not galvanically isolated to other channels in analog mode. Faults or signals on one channel will not affect other channels. |
| **Anti-aliasing Filter:** | 2 poles at 500 Hz |

- Loop power is not provided by the MicroNet Safety Module
- Shielded twisted pair cable is required when connecting to the analog inputs.

**Note 1:** ±0.25 % represents the pk-pk noise of the input. The average accuracy is ±0.1 % of 25 mA.

Table 3-14: Discrete Input Mode

| | |
|---|---|
| **Input Thresholds:** | <= 6 V (dc) = “OFF”<br>>= 12 V (dc) = “ON” |
| **Input Current:** | 5 mA ±5 % at 24 V (5 kΩ input impedance) |
| **Wetting Current Supply:** | 24 V at 2 W available (see installation diagrams, Chapter 2). This power supply is current limited. |
| **Max Input Voltage:** | 32 V |
| **Isolation:** | 500 V (ac) from input to chassis. In discrete mode, the discrete input shares a common internal ground with the other channels that are in discrete mode. |

## Configurable Relay Outputs

Each module has 3 configurable Relay Outputs. Each relay output can be configured to reflect the state of any Boolean value within the module. Each output can be configured to be inverting or non-inverting. If configured as non-inverting, the relay will energize when the configured input is true. The first configurable relay is defaulted to the output of the Alarm Latch.

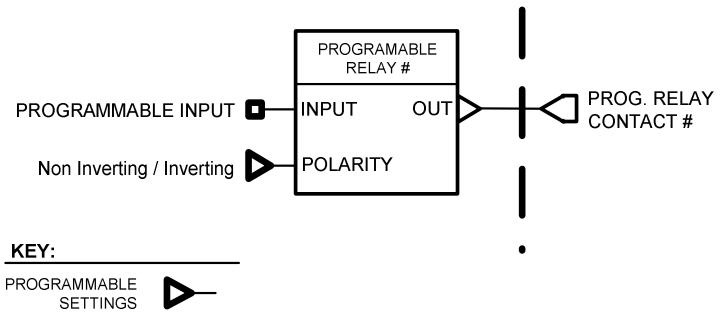



Figure 3-10. Programmable Relay Output Diagram

Table 3-15. Programmable Relay Output Specifications

| | |
|---|---|
| **Number of Channels:** | 3 |
| **Output Type:** | SPST Solid-state, Normally Open |
| **Current Rating:** | 1 A |
| **Voltage Rating:** | 24 V (32 V max) |
| **Isolation:** | 500 V (ac) from output to chassis and output to all other circuits |
| **Signal Cable Length:** | Must be limited to 305 m / 1000 ft (low capacitance 1.3 mm² / 16 AWG) |

## Analog Output

A single 4–20 mA output is provided on each module to indicate the speed sensed by that module. The 4–20 mA range can be configured to any speed range desired. The accuracy of the analog output is better than ±0.5 % of 20 mA over the temperature range of the product.

Table 3-16. Analog Output Specifications

| | |
|---|---|
| **Number of Channels:** | 1 |
| **Output Type:** | 4–20 mA, isolated |
| **Max Current Output:** | 25 mA |
| **Accuracy:** | ±0.1 % at 25 °C, ±0.5 % over temperature |
| **Resolution:** | 12 bit |
| **Response Time:** | < 2 ms (2 to 20 mA) |
| **Min Current Output:** | 0 mA |
| **Min Resistive:** | 0 Ω |
| **Max Resistive Load:** | 500 Ω at 25 mA |
| **Isolation:** | 500 V (ac) from output to chassis and output to all other circuits |
| **Signal Cable Length:** | Must be limited to 305 m / 1000 ft (low capacitance 1.3 mm² / 16 AWG) |

**Note:** Shielded twisted pair cable is required when connecting to the analog outputs.

## IRIG-B Input

A single IRIG-B input is provided to receive IRIG time synchronization signals from a time-base source.

Table 3-17. IRIG-B Input Specifications

| | |
|---|---|
| **Number of Channels:** | 1 |
| **Input Impedance:** | 1 k Ω ±10 % |
| **Input signal description:** | Logic 0: < 0.5 V<br>Logic 1: > 3.5 V |
| **Isolation:** | 500 V (ac) from input to chassis and input to all other circuits |
| **Signal Cable Length:** | Limited to capability of signal source. |

**Note:** Shielded twisted pair cable is required when connecting to the IRIG-B input.

# Overspeed and Over-Acceleration Detection and Trip

Each MicroNet Safety Module includes overspeed and over-acceleration functionality and can be custom configured/set to meet specific application overspeed and over-acceleration requirements. No custom application program is required to be loaded for this functionality to operate normally.

The MicroNet Safety Module senses speed and then compares the sensed speed to its programmed overspeed trip setpoint to detect an overspeed condition and generate a trip command.

**NOTICE**

**For process-safety-based applications where speed is not sensed or used, the speed input can be disabled by putting a jumper across the sensor input terminals and disabling the MicroNet Safety Module control's internal start logic.**

The MicroNet Safety Module derives acceleration from the sensed speed and then compares the sensed acceleration to its programmed over-acceleration trip setpoint to detect an over-acceleration condition and generate a trip command. The MicroNet Safety Module control's acceleration detection function can be configured to be enabled or disabled, or only enabled above a certain speed setpoint, depending on the specific application's requirements. The over-acceleration trip range is configurable from 0 to 25 000 RPM/s.

Peak speed and peak acceleration are tracked and logged for every overspeed and over-acceleration occurrence, the last 20 occurrences logged and can be viewed from a front panel or loaded to a computer via the MicroNet Safety Module Programming and Configuration Tool (PCT).

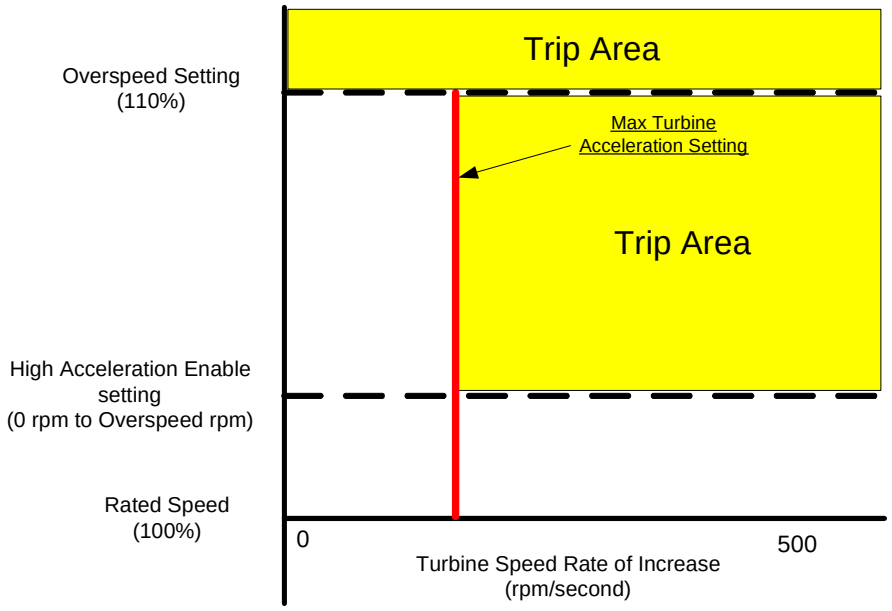



Figure 3-11. Over-Acceleration Enabling Diagram

## Start Logic

The MicroNet Safety Module control's failed speed signal detection logic is used to sense no/zero speed and issue a trip command. However, before a prime mover is started and as its speed gear begins to turn, magnetic speed probes output a zero rpm signal until the speed exceeds the probe's minimum frequency. Two different start logic functions are available to use within the MicroNet Safety Module to override failed speed signal detection logic and allow the prime mover to be started. Either, both, or neither of these methods can be selected. There is also an alarm that can be enabled to indicate any time the Speed is below the Speed Fail Setpoint.

### Speed Fail Trip

If the "Speed Fail Trip" is Enabled, the Speed-Fail-Override is used to override the speed fail trip logic. When the contact is open, the sensed speed must exceed the Speed Fail Setpoint, otherwise a Speed Fail Trip occurs.

For example, if there is a failure in the speed probe before the contact is opened, the Speed Fail Trip function will detect the missing speed signal and trip the module.

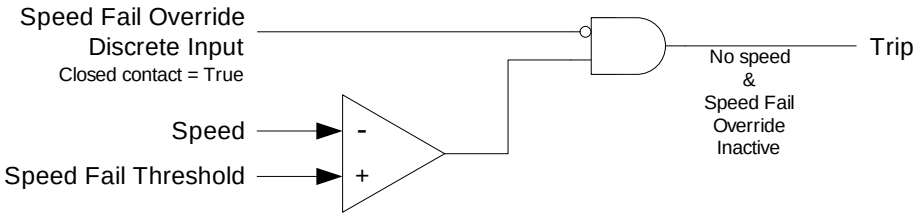



Figure 3-12. Speed Fail Trip Diagram

**WARNING**

**Speed Fail Trip should be utilized whenever possible. See Configuration Guidance section under the Troubleshooting Chapter for more detail.**

### Speed Fail Timeout Trip

If the “Speed Fail Timeout Trip” is Enabled, the sensed speed must exceed the Speed Fail Setpoint within the Speed Fail Timeout Time after a Start signal occurs, otherwise a Speed Fail Timeout Trip occurs.

**IMPORTANT**

**The Speed Fail Timeout trip is cleared by the reset function (the trip and alarm reset function, not the reset input to the timer in the diagram below), even if speed is still below the Speed Fail Setpoint.**

The start signal is generated by selecting the START button on the front panel of a module or by closing the predefined Start contact input. The start signal is edge triggered and re-selecting Start will reset the timer.

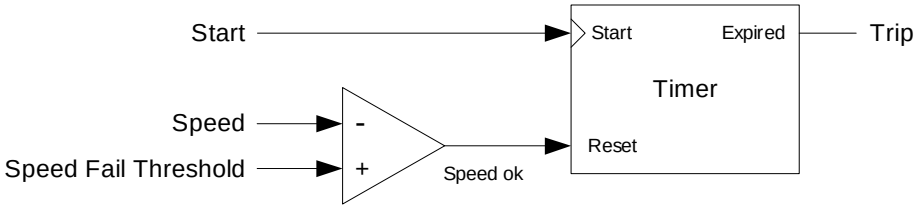



Figure 3-13. Speed Fail Timeout Trip Diagram

### Start Example with Speed Fail Timeout Trip

First, any trips or alarms are cleared by issuing a reset command either by pressing the reset key, or by momentarily closing the reset contact, or by issuing the Reset command via Modbus.

When the turbine is ready to be started, the Speed fail timer is started by pressing the start key, or by momentarily closing the start discrete input. The timer expires when it reaches the Speed fail timeout value. If speed does not exceed the Speed fail set point before the timer expires, the unit trips.

If the unit is being restarted after a normal roll-down (that is, there was no trip), the unit does not require a reset. The Speed fail trip is overridden because the Speed fail timer is cleared whenever speed exceeds the Speed fail set point. The Speed fail timer should be started by the operator when the turbine is ready to be started again.

**NOTICE**

**For the speed fail timeout trip function to provide the intended fault detection, Start must be selected when the turbine is to be started.**

**The timer can only be started when speed is below the Speed Fail Setpoint. Selecting Start has no effect if speed is above the Speed Fail Setpoint.**

## Configurable Logic

The MicroNet Safety Module provides configurable, or user-definable, logic to implement custom safety/protection and test programs. This can be used in conjunction with the configurable inputs and user-definable alarms and trips to monitor values such as lube oil pressure, vibration, trip manifold status, and provide parameter monitoring functions. Configurable logic is also used to implement the user-defined test functionality. It is possible to generate (and reset) module trips, alarms, or events and to use the associated logs and trip cycle time monitoring as part of the safety system test validation.

The logic unit provides configurable logic that allows the user to define how the input signals are used in detecting an unsafe condition and generating a trip signal.

The configurable logic provides the following functions:

- Analog comparators
- Boolean combinatorial logic (AND, OR, NOT, etc.)

- Boolean latches
- Delays
- Timers

The user is responsible to validate that the configured logic unit's input-to-output behavior performs as expected, with the intent of confirming the following:

- Verify that the logic unit was configured as intended;
- Verify that the documentation for the logic unit has been correctly understood and applied;
- Verify that the information presented to the user by the Programming and Configuration Tool (PCT) is correct.

### Functional Examples

**IMPORTANT**

**For robust programming and reliability system fault response, it is recommended that the programming features are used to sense out of range conditions. For example, when using a configurable input in analog mode, this can be done by using the Lo, LoLo, Hi and HiHi setpoints.**

### Process Parameter Monitoring and Trip

The logic unit has inputs to measure process parameters (continuous or discrete signals). These signals might represent such values as lube oil pressure, thrust, vibration, system hydraulic pressure, valve position, additional trip inputs, or other values significant to the safety system. Comparators, Boolean logic, and timers can be used to implement relatively sophisticated algorithms including, noise suppression, test functions, alarming, and trip functions based on these signals.

### Trip System Testing

The system can be programmed to implement the user-defined tests to activate relay outputs (or even generate a trip from the module) to actuate a part of a trip system. The user-configurable inputs can be defined to monitor and log the test results. This might include monitoring a change of pressure or a limit switch to confirm the functionality of the system tested. After the test is completed, or after some time delay if there is a test failure, the trip test sequence can re-store the system to the normal state. When the normal state of the system is confirmed the user-defined test can be reset. The event latch might be used to confirm the progress and success or failure of the test steps.

## Test Routines

Each MicroNet Safety Module module provides a variety of test routines to support common test requirements. The MicroNet Safety Module also supports 3 User-defined Tests.

In general, a test may not be started if any other module is tripped or in test or if the current module is tripped or in test. Also, tests will be aborted if another module trips. One exception to these rules is the Temporary Overspeed Trip Setpoint which can be applied to multiple modules or if another module is tripped. The other is the Lamp Test which can be applied to any module at any time without a password. If a test is not permitted, or aborted, messages displayed on the front panel explain the cause.

**NOTICE**

**The Test Mode Interlock can be disabled in the configurable software.**

Any test may be initiated (or cancelled) from the MicroNet Safety Module Front Panel. Modbus provides commands to initiate the Auto Speed Test or any of the User-defined Tests. User-defined Tests can be started through configurable logic—so a discrete input might be defined to initiate a test. Finally, there is a Periodic Overspeed Test function that will automatically run tests at a user-defined interval.

**NOTICE** **For Modbus commands, a start confirmation is required and an abort is also provided.**

## Temporary Overspeed Setpoint

This feature temporarily replaces the Overspeed Trip setpoint with a different value for testing. This test mode can be applied to all three modules simultaneously. The Temporary Overspeed Setpoint can be higher or lower than the normal overspeed trip setting.

**NOTICE** **When the Temporary Overspeed Setpoint is set above the normal overspeed trip, it should not be set above the maximum speed allowed for the unit.**

The Temporary Overspeed Setpoint is designed to allow users to easily test the module's overspeed function at level lower than the normal overspeed setting or to test the overspeed function of a mechanical bolt or other overspeed protection system at a higher speed that the normal overspeed trip setting.

An alarm is generated when this test is enabled. Also, there is a Temporary Overspeed Trip Timeout feature that prevents an operator from "forgetting" to disable this test. The timeout can be configured from 0 to 30 minutes. When the test is enabled the timer starts, if it reaches the timeout value, the test is automatically aborted.

Once the module is in its tripped state, this test is disabled and the module's overspeed setpoint is returned to its normal setting.

## Simulated Speed Tests

There are three tests that use an internally generated speed signal to test a modules overspeed trip setpoint and trip output function. The MicroNet Safety Module is defaulted to use the Test Mode Interlock so that a module cannot be placed in test while any other unit is tripped or in test. If it is desired to test a unit trip by tripping multiple modules through these simulated speed tests, the Test Mode Interlock can be disabled.

## Manual Simulated Speed Test

This allows the user to manually increase/decrease a modules' internal frequency generator to perform a test of the overspeed trip function of that module. This test can only be performed from the front panel of the MicroNet Safety Module.

When the test is initiated, the frequency generator automatically starts at 100 rpm below the overspeed setpoint. Then the operator can adjust the simulated speed up or down from the front panel of the MicroNet Safety Module.

When the overspeed trip occurs, it is logged in the modules' trip log and noted as a test.

An alarm is generated while this test is enabled. Also, there is a Simulated Speed Timeout feature that prevents an operator from "forgetting" to disable this test. The timeout can be configured from 0 to 30 minutes. When the test is enabled the timer starts, if it reaches the timeout value, the test is automatically aborted. The operator can abort the test at any time.

Auto Simulated Speed Test

This test allows users to easily test the module's overspeed trip function by having the module's frequency generator automatically ramp up to and above the module's overspeed set point. This can be initiated from the front panel or via Modbus. The auto test starts at 100 rpm below setpoint. Then the frequency generator ramps up at approximately 10 rpm/s until the overspeed trip occurs.

When the overspeed trip occurs, it is logged in the modules' trip log and noted as a test.

To initiate the Auto Simulated Speed Test via Modbus, the Initiate Auto Speed Test command (Modbus address 0:0102) must be followed by the Confirm Auto Speed Test (Modbus address 0:0101) within 10 seconds. The intent of the confirmation is to prevent an erroneous signal from initiating a test. The test can be aborted from either the front panel or via Modbus.

## Periodic Overspeed Test

This test is similar to the Auto Simulated Speed Test but allows the MicroNet Safety Module to perform the test automatically on each module on a regular basis. The Test Interval can be configured from 1 to 999 days. The test can be manually initiated from the front panel, and then the test will be automatically repeated at the specified test interval.

This test will automatically be applied to all three modules. First, the test will be performed on the A module, and when the overspeed trip occurs, it is logged in the modules trip log and noted as a test. Then, the A module is automatically reset and the B module is tested. When the B module test is completed, the C module is tested. In this way periodic testing can automatically be performed on a regular basis with no operator intervention.

The operator can disable the periodic test from the front panel of the module. When the Periodic test is disabled, or if any module is in trip or test, the Time Remaining Until Next Test will be prevented from counting below 1 hour. If the timer is already below 1 hour it will be increased to 1 hour. When Enable Periodic Test is selected and no modules are tripped or in test, this function is removed.

Configuration and Management of the Periodic Overspeed Test can only be done through Module A only.

## User-defined Test

Each module supports three user-defined test latches in the configurable logic. These latches allow the users to configure custom test routines as needed to test their system.

These user-defined tests are intended to support automated tests of such systems as trip manifolds, parameter monitoring functions, or other user-specific systems. The associated logic may be simple or complex depending on the nature of the system to be tested.

These tests may include tripping a single module and checking the performance of a single channel in a trip manifold using the trip cycle time monitoring functions, and then resetting the module.

All the test logic must be programmed with the configurable logic. The User-defined Test latches are intended to initiate the tests, to provide the handshaking between modules, and to signify and manage the end of the test including an aborted test.

**NOTICE**

**The logic behind the User-defined Test must be validated by the user for all possible modes of operation including normal test, test failure(s), or test abort.**

These latches share some of the same properties as the implemented test routines. A test cannot be initiated if any other module is tripped or any other test routine is active. User-defined tests can be initiated from the front panel (with password), via Modbus (with confirmation), or through configurable logic (which allows connection to any Boolean value including Discrete Inputs).

An alarm is associated with each test latch. Also, there is a Timeout feature associated with each User-defined Test latch that prevents an operator from “forgetting” to disable this test. The timeout can be configured from 0 to 30 minutes (1800 seconds) with 1 second resolution. When the test is enabled, the timer starts—if it reaches the timeout value, the test latch is automatically reset. The test latches can be reset from the configurable logic, or from the front panel, or via Modbus.

# Alarm, Trip, and Event Latches

The MicroNet Safety Module provides pre-defined, user-configurable and user-defined alarms and trips. This makes it easy to utilize common functions but allows great flexibility to customize the MicroNet Safety Module to meet a user's specific needs. The fully configurable Event latches make it possible to record additional information such as test results or to provide more detail on alarm or trip events.

## Reset Function

The Reset Function is associated with all of the following latches. A Reset can be generated by pressing the reset key on the front panel, from the pre-defined reset contact input, via Modbus, or from the user-defined "Configurable Reset Source".

It is possible to configure one Discrete Input to function as a Resettable Trip input where the Reset Function will clear the associated trip even if the contact is still open. This is used in cases where the MicroNet Safety Module trip must be cleared to reset a trip system which feeds back a trip status that trips the MicroNet Safety Module.

## Alarm Latch

An "alarm" refers to an action of the MicroNet Safety Module module to bring some condition to the attention to the user. When any of the Alarm Latch inputs becomes true, the output of the alarm latch is set TRUE. The yellow ALARM light is illuminated on the front panel. By default, the Configurable Relay #1 is connected to the Alarm latch (but this can be changed with the Programming and Configuration Tool (PCT) software). Each Alarm Input is individually latched, and those latched outputs are available on Modbus. The individual latches are reset by the trip reset function if the input is false. The alarm latch output remains TRUE until the reset function occurs and all inputs are false.

Here is the complete list of possible Alarm Latch inputs:

- Configuration Mismatch (if configured)
- Speed Fail (if configured)
- Internal Fault Alarm
- Power Supply 1 Fault
- Power Supply 2 Fault
- Tmp Ovrspd Setpoint On
- Manual Sim. Speed Test
- Auto Sim. Speed Test
- User Test 1 Active (if configured)
- User Test 2 Active (if configured)
- User Test 3 Active (if configured)
- Trip Cycle Time Mon 1 (if configured)
- Trip Cycle Time Mon 2 (if configured)
- User configurable Alarms 1-50 (if configured)

**Note:** The user can define the Name associated with each user-defined Alarm.

## Trip Latch

In almost every case, the MicroNet Safety Module and associated trip system will be designed such that two modules must be issuing a trip command before the unit will be tripped. This is referred to a 2-out-of-3 (2-o-o-3) trip scheme. In the "Independent Trip Relay" version of the MicroNet Safety Module, the trip action of each module may put part of the trip system into a tripped state and at least two modules must be tripped to trip the unit. In the "Voted Trip Relay" version of the MicroNet Safety Module, at least two modules would have to be in the tripped state for the voter relay to go to its tripped state.

A "trip" of the module refers to the action of the MicroNet Safety Module module changing the state of its Trip output. When any of the Trip Latch inputs becomes true, the output of the trip latch is set TRUE. The red TRIPPED light is illuminated on the front panel. The module trip relays are put in the trip state (which could be configured as energized or de-energized). Each Trip Input is individually latched, and those latched outputs are available on Modbus. The individual latches are reset by the reset function if the input is false.

The first input to set the Trip latch, or First Out (FO), is also latched. This first out indication is available in the trip log and on the Modbus. The Trip latch output remains TRUE and the First Out indication remains unchanged until the reset function occurs and all inputs are false.

**IMPORTANT**

**When configured as de-energize-to-trip, the modules power up in the tripped state. When configured as energize-to-trip, the modules power up such that they do not enter the tripped state unless a trip condition is present.**

**IMPORTANT**

**The logic unit requires that it be in the tripped state in order to change the configuration.**

The user can reset a trip by pressing a button on the unit's front panel, or by activating a discrete input that is dedicated to the reset function.

Here is the complete list of possible trips:

- Power Up Trip
- Configuration Trip
- Parameter Error Trip
- Internal Fault Trip
- Overspeed Trip
- Over-Acceleration Trip (if configured)
- Speed Probe Open Wire (if configured)
- Speed Lost Trip (if configured)
- Speed Fail Trip (if configured)
- Speed Fail Timeout Trip (if configured)
- Resettable Trip Input Trip (if configured)
- User configurable Trips 1-25 (if configured)
  **Note:** The user can define the Name associated with each user-defined Trip

### Event Latches

In each module, three Event Latches are provided. These are to be used in conjunction with the user-defined software and can be used to log any desired event. The latch is structured like the Trip Latch.

For a given Event Latch, when any of the Event Latch inputs becomes true, the output of the Event latch is set TRUE. Each Event Input is individually latched, and those latched outputs are available on the Modbus. The individual latches are reset by the reset function if the input is false. The first input to set the Event latch, or First Out (FO), is also latched. This First Out indication is available in the Event log and on Modbus. The Event latch output remains TRUE and the First Out indication remains constant until the reset function occurs and all inputs are false.

Each event latch provides 25 user-configurable Inputs. The user can define the Name associated with each user-defined Event.

## System Logs

Each Module in the MicroNet Safety Module logs (saves to memory) all trips, alarms, events, trip cycle times, and overspeed events. Peak speed and acceleration are also logged. The logs can be viewed from the front panel of the MicroNet Safety Module or from the PCT tool. With PCT tool, the Configuration Error Log can also be viewed. The logs can be exported from the PCT tool.

The logs are stored in non-volatile memory so loss of power to the MicroNet Safety Module will not affect this information. The log functions use scrolling buffers that keep the most recent data. The individual log sizes are described in the following descriptions. Logs can be cleared from the front panel with the appropriate password. The Test Level Password is needed to Reset All Logs except of the Peak

Speed/Acceleration Log. The Config Level Password is required to Reset the Peak Speed/Acceleration Log.

## Overspeed/Acceleration Log

Any time an overspeed or over-acceleration event occurs, the date and time of the trip, the speed and acceleration values at the trip time, and the maximum speed and acceleration will be recorded. If the trip occurred during testing, this will also be noted in the log. The log will save the last 20 overspeed or over-acceleration events.

## Trip Log

The module logs the last 50 trips. The log holds the trip description, the date and time of the trip, whether it was the “first out” trip, and whether the module was performing a test when the trip occurred.

## Alarm Log

The Alarm Log stores the last 50 alarms. The log holds the alarm description, the date and time of the alarm, and whether the module was performing a test when the alarm occurred.

## Trip Cycle Time Log

If Trip Cycle Time monitoring is configured, the module logs the trip cycle times for the last 20 trips. Whenever a module trip occurs, two trip cycle time monitors can be configured to monitor the milliseconds from the trip until a user-defined Trip Indicator Input is true. The Trip indicator could be configured to be a limit switch which indicates a trip valve has closed, or a pressure comparison that indicates that the system or part of the trip system has actuated. The Trip Cycle Time Monitors are designed to monitor the performance of the trip system and detect any degradation of its response time to warn the user before a potentially dangerous condition exists.

The Maximum Cycle Time for each event can be specified as 1 to 60 000 ms. If this time is exceeded, an alarm will be generated. If the event has not occurred in 10x this maximum cycle time (up to a maximum of 60 seconds), then the trip cycle time will be set to 60 seconds.

## Event Logs

Three event logs are provided. Each log records events seen by Event Latches 1, 2, and 3, respectively. The last 50 events on each Event Latch are logged. Each Event Latch has 25 inputs. Event Latches inputs can be configured to record any Boolean variable and associate a 24-character user-defined name with that event.

## Sequence of Events Log

The Sequence of Events log records events seen on user-definable points in the system. The last 120 events are logged. Up to 20 user-definable points can be configured from any Boolean variable. A 24-character user-defined name can be associated with that event.

If IRIG-B time synchronization is used, the resolution of the Sequence of Events log is up to 1 ms. Events on Configurable Discrete Inputs can be recorded with a resolution of 1 ms; all other events are recorded with the resolution of their rate of execution, for example 4 ms for any Boolean in the Configurable Logic.

If IRIG-B time synchronization is not used, all events are recorded with a maximum resolution of 10 ms.

## Peak Speed/Acceleration Log

The maximum speed and acceleration detected by the module will be logged. This includes values generated by internal simulation testing. As this is intended to be a maximum value capture, no date or time information is associated with these values. This can be reset from the front panel with the Config Level Password.

# Response Time Performance

## Independent Trip Relay

The response time is less than 12 ms (**Note 1**) measured from detection of overspeed or out-of-range process to assertion of the trip relays.

## Voted Trip Relay

The response time is less than 20 ms (**Note 1**) measured from detection of overspeed or out-of-range process to assertion of the trip relays.

No operator intervention via the operator interface is required for the logic unit to perform the safety functions.

**Note 1:** See the following charts for measured response time. The response time specifications are valid for measured frequencies of 2 kHz and higher. For this reason, it is highly recommended that the user use speed wheel gearing that provides the ProTech with a frequency of at least 3 kHz for the normal operating speed. The internal frequency is calculated from rpm and number of gear teeth:

Frequency = (rpm) * (number of teeth) / 60

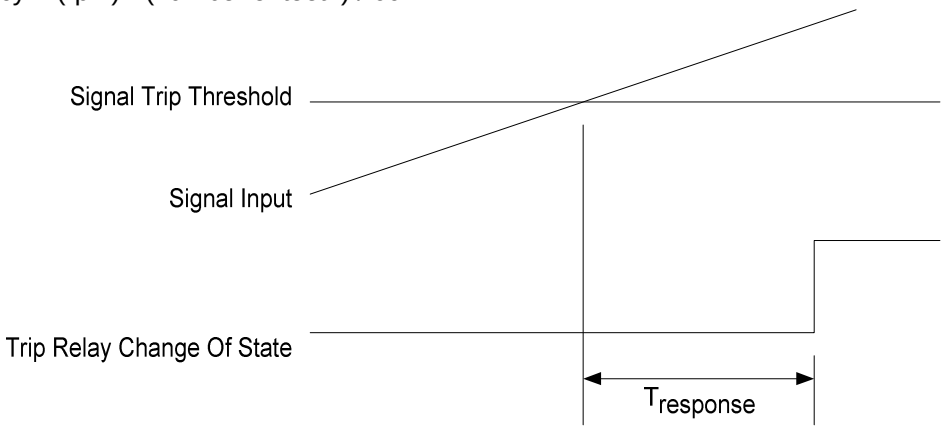



Figure 3-14. Response Time Definition

## Analog Output

The response time of the analog output is less than 10 ms measured from a change in speed to a change in the output current.

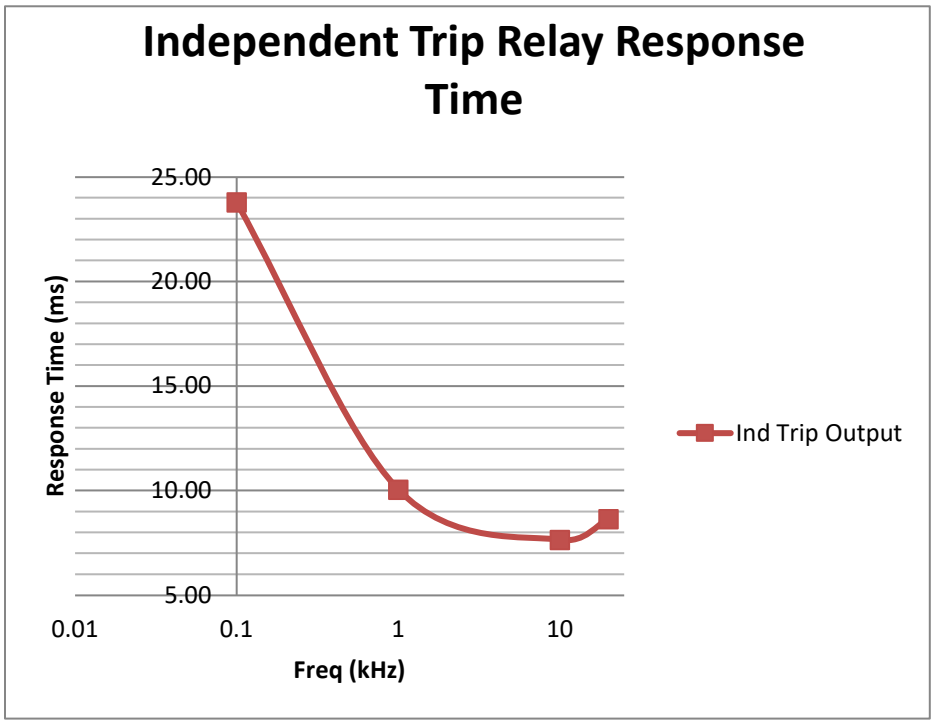



Figure 3-15. Independent Trip Relay Response Time (Typical) Graph

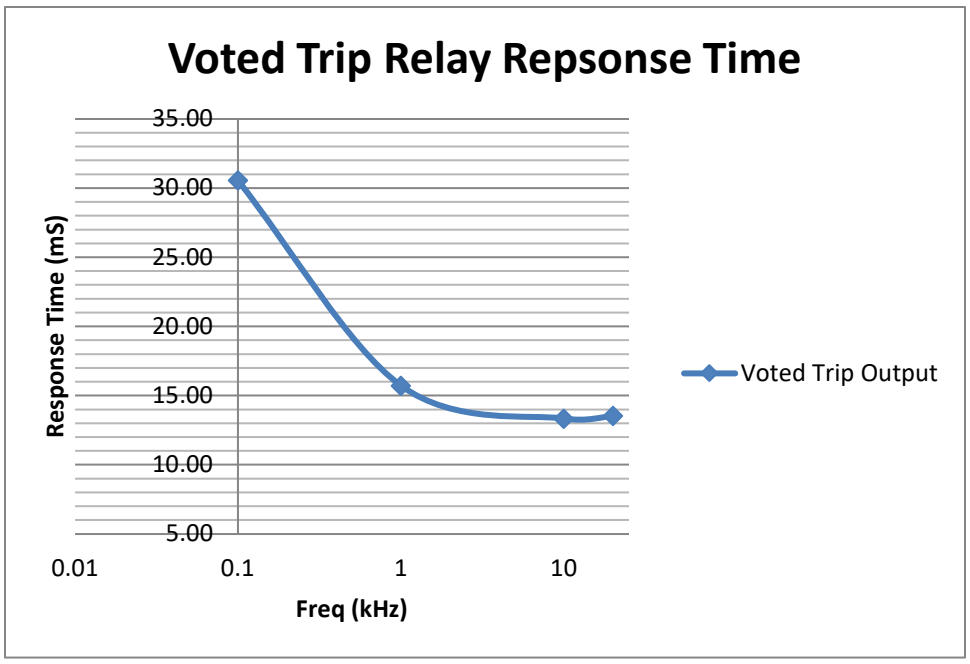



Figure 3-16. Voted Trip Relay Response Time (Typical) Graph

# Chapter 4.
# Modbus Communications

## Modbus Communications

The MicroNet™ Safety Module can communicate with plant distributed control systems and/or CRT based operator control panels through three Modbus communication ports (one port per module). Each of the three modules (A, B, & C) has a serial port for Modbus communications. These ports support RS-232 or RS-485 communications using a standard Remote Terminal Unit (RTU) Modbus transmission protocol. Modbus utilizes a master/slave protocol. This protocol determines how a communication network's master and slave devices establish and break contact, how a sender is identified, how messages are exchanged, and how errors are detected.

Since each module has its own Modbus port, and since each module is fully isolated from the other modules, each Modbus port provides its module's sensed information only (speed, analog inputs, etc.).

Table 4-1. Serial Communication Port (RS-232/RS-485) Specifications

| | |
|---|---|
| **Number of Ports:** | 1 |
| **Comm Type:** | RS-232/RS-485, user selectable (2-Wire Only) |
| **Termination Resistor:** | RS-485 on board, terminal block selectable |
| **Isolation:** | 500 V (ac) from output to chassis and output to all other circuits |
| **Signal Cable Length:** | Must be limited to 305 m / 1500 ft (low capacitance 1.3 mm² / 16 AWG) |

## Monitor Only

Each of the three Modbus communication ports is designed to continually output all Boolean and analog read information and can be configured to accept or ignore "write" commands, depending on the specific application's requirements. This allows the MicroNet Safety Module to be monitored but not controlled from any external device.

Once a Modbus port's "Enable Write Commands" setting is configured "No", the respective MicroNet Safety Module module will not accept "write" commands from an external master device (DCS, etc.). For security purposes, the option to ignore "write" commands can only be enabled or disabled with a configuration-level password.

## Monitor and Control

Once a Modbus port's "Enable Write Commands" setting is configured "Yes", the respective MicroNet Safety Module module will accept "write" commands from an external master device (DCS, etc.). This allows a Modbus compatible device to monitor all read registers and issue "Reset" and "Start/Abort Test Routines" commands only. Modbus ports are independent of each other and can be used simultaneously.

To ensure that a Modbus based test command is valid, both "Initiate Test" and "Confirm Test" commands must be received to initiate a test routine. A Confirm must be received within 10 seconds or the sequence must be re-initiated. The MicroNet Safety Module is designed to allow only one module to be tested at a time. Thus a module will only accept an Initiate Test command and perform the requested test if all three modules are healthy, not tripped, and not in a test mode.

# Modbus Communication

Each MicroNet Safety Module Modbus communications port is designed to function as a slave device on a Modbus network using the industry-standard Modbus RTU (remote terminal unit) transmission protocol. For more information on Modbus networks and the RTU transmission protocol, refer to Modbus Protocol Reference Guide PI–MBUS–300 Rev. J.

A Modbus function code tells the addressed slaves what function to perform. The following table lists the function codes supported by the MicroNet Safety Module:

Table 4-2. Supported Modbus Function Codes

| Code | Definition | Reference Address |
|---|---|---|
| 02 | Boolean Read Registers<br>(Status of Alarms/Shutdowns, Discrete input/outputs) | 1XXXX |
| 04 | Analog Read Registers<br>(Speed, Acceleration, etc) | 3XXXX |
| 05 | Boolean Write Registers<br>(Reset and Test Initiate Commands) | 0XXXX |

As a slave Modbus device, the MicroNet Safety Module is not responsible to sense or annunciate Modbus link communication errors. However, for troubleshooting purposes, the MicroNet Safety Module will display a “Link Error” message in its “Monitor Modbus” screen if a Modbus transaction request is not received within its five-second time-out period. This error message is automatically cleared when Modbus communications are re-established.

# Port Adjustments

Before the MicroNet Safety Module can communicate with the master device, the communication parameters must be verified to match the master device’s protocol settings. For security purposes, these parameters can only be set in the module’s Configuration mode.

Table 4-3. Modbus Communication Port Settings

| Parameter | Range |
|---|---|
| Mode: | RS-232 or RS-485 |
| Baud Rate: | 19200 TO 115200 |
| Comm Parity: | NONE, ODD or EVEN |
| Slave Address: | 1–247 |
| Enable Write Commands: | Yes or No |

# MicroNet Safety Module Parameter Addresses

Each available read or write parameter has a unique Modbus address. A complete list of the available parameters and their addresses is located at the end of this chapter. This list consists of Boolean Write, Boolean Read, and Analog Read parameters. Analog write parameters are not used or available with this device.

All values that can be addressed by Modbus are discrete and numeric. The discrete values are a 1 bit binary on or off value, and the numeric values are 16 bit values. Discrete values are sometimes referred to as coils or digitals, and numeric values are referred to as registers or analogs. All read/write registers are interpreted by the MicroNet Safety Module as signed 16 bit integer values.

Since Modbus can only handle integers, values that require a decimal point in the Modbus Master Device are multiplied by a scaling constant before being sent by MicroNet Safety Module. See the Modbus list for the scaling used on each analog parameter.

## Boolean Writes (Code 05)

Boolean Write registers are used by an external master device (plant DCS, etc.) to issue Boolean commands to a MicroNet Safety Module module. The available write commands are listed in Table 4-2.

Once a Modbus port's "Enable Write Commands" setting is configured "Yes", the respective MicroNet Safety Module module will accept "write" commands from an external master device (DCS, etc.).

**Note:** All write commands are edge-triggered.

Initiating a test mode

Only one test mode can be active at a time. Attempts to start a test are ignored when another test mode is active or another module is tripped or in a test mode.

Speed/user tests must be requested by first setting the Initiate bit, followed by a setting the confirm bit. If the Confirm bit is not set within 10 seconds after the initiate bit is set, then the test will not be requested.

Note that the confirm-initiate addresses are in reverse order so that an initiate followed by a confirm cannot be executed by a single write command. Both bits must be set to 0 before starting the initiate-confirm sequence.

If an Abort command is set to 1, an initiate-confirm sequence shall be ignored.

## Boolean Reads (Code 02)

Boolean Read registers are used by an external master device (plant DCS, etc.) to read the status of internal MicroNet Safety Module module signals (hardware inputs, logic blocks, hardware outputs, etc.). A Boolean read register will have the value 1 if the status of the monitored signal is true and a 0 if false. The available Boolean read registers are listed in Table 4-3.

## Analog Reads (Code 04)

Analog Read registers are used by an external master device (plant DCS, etc.) to read the value of internal MicroNet Safety Module module signals (hardware inputs, logic blocks, hardware outputs, etc.). An example of an analog read value would be actual speed.

With the Modbus protocol, analog values are transmitted as 16-bit integer values ranging from –32767 to +32767 (if signed) or 0 to 65535 (if unsigned). Since Modbus can only handle integers, values that have a decimal point are multiplied by a constant before being sent by Modbus. For example, these input registers may be listed as the Modbus value `x100' within the listed parameter table. Some values, like the Timer values, are sent using more than one register. The available Analog read registers, units (scaling), and range are listed in Table 4-3.

Heartbeat indication (1:1300)

The Heartbeat indication provides an indication that toggles every 1 second between logic 1 and logic 0.

Last Trip time and date indication (3:0701 – 707)

Last Trip Date/Time represents the Date/Time of the most recent first out trip.

Unit Health indication (3:0801)

The unit health status indicates the state of the internal fault trip (if known) as follows:
0 = internal fault trip is TRUE (Unit Health LED is green)
1 = internal fault trip is FALSE (Unit Health LED is amber)
2 = state of the internal fault trip is unknown because of a communication fault (Unit Health LED is off)

Table 4-4. Boolean Write Addresses (Code 05)

| ADDRESS | DESCRIPTION |
|---|---|
| 0:0001 | Reset |
| 0:0101 | Confirm Auto Speed Test |
| 0:0102 | Initiate Auto Speed Test |
| 0:0103 | Abort Auto Speed Test |
| 0:0201 | Confirm User Defined Test 1 |
| 0:0202 | Initiate User Defined Test 1 |
| 0:0203 | Abort User Test 1 |
| 0:0301 | Confirm User Defined Test 2 |
| 0:0302 | Initiate User Defined Test 2 |
| 0:0303 | Abort User Test 2 |
| 0:0401 | Confirm User Defined Test 3 |
| 0:0402 | Initiate User Defined Test 3 |
| 0:0403 | Abort User Test 3 |

Table 4-5. Boolean Read Addresses (Code 02)

| ADDRESS | DESCRIPTION |
|---|---|
| 1:0001 | Internal Fault Trip |
| 1:0002 | Power Up Trip |
| 1:0003 | Module Config Trip |
| 1:0004 | Parameter Error Trip |
| 1:0005 | Over Speed Trip |
| 1:0006 | Over Accel Trip |
| 1:0007 | Open Wire Detected Trip |
| 1:0008 | Speed Lost Trip |
| 1:0009 | Speed Fail Trip |
| 1:0010 | Speed Fail Timeout Trip |
| 1:0011 | Resettable Trip Input Trip |
| 1:0012 to 36 | User Configurable Trips 1 to 25 |
| 1:0101 to 134 | Trip Latch First Out Registers 1-34 |
| 1:0201 | Internal Fault Alarm |
| 1:0202 | Module Config Mismatch Alarm |
| 1:0203 | Power Supply 1 Fault Alarm |
| 1:0204 | Power Supply 2 Fault Alarm |
| 1:0205 | Speed Fail Alarm |
| 1:0206 | Speed Lost Alarm |
| 1:0207 | Temp Overspeed SP is Active Alarm |
| 1:0208 | Simulated Speed Test in Progress Alarm |
| 1:0209 | Auto Speed Test Active Alarm |
| 1:0210 | Periodic OvrSpd Test Active Alarm |
| 1:0211 | User Test 1 Active Alarm |
| 1:0212 | User Test 2 Active Alarm |
| 1:0213 | User Test 3 Active Alarm |
| 1:0214 | Trip Cycle Time Mon 1 Alarm |
| 1:0215 | Trip Cycle Time Mon 2 Alarm |
| 1:0216 | IRIG Signal Lost Alarm |
| 1:0217 to 266 | User Configurable Alarms 1 to 50 |
| 1:0401 to 425 | Event 1 Latched Inputs 1 to 25 |
| 1:0501 to 525 | Event 1 Latch First Outs 1 to 25 |
| 1:0601 to 625 | Event 2 Latched Inputs 1 to 25 |
| 1:0701 to 725 | Event 2 Latch First Outs 1 to 25 |
| 1:0801 to 825 | Event 3 Latched Inputs 1 to 25 |
| 1:0901 to 925 | Event 3 Latch First Outs 1 to 25 |
| 1:1001 | Speed Fail Override |
| 1:1002 | Overspeed Trip Non-Latched |
| 1:1003 | Overacceleration Trip Non-Latched |
| 1:1004 | Speed Fail Trip Non-Latched |
| 1:1005 | Reserved (Do not use) |
| 1:1006 | Speed Lost Alarm Non-Latched |
| 1:1007 | Speed Lost Trip Non-Latched |
| 1:1008 | Speed Probe Open Wire Non-Latched |
| 1:1009 | Tmp Ovrspd Setpoint On |
| 1:1010 | Simulated Speed Active |
| 1:1011 | Auto Test Speed Active |
| 1:1012 | Periodic OvrSpd Test Active |
| 1:1013 | User Defined Test 1 |
| 1:1014 | User Defined Test 2 |
| 1:1015 | User Defined Test 3 |
| 1:1016 | Configuration Mismatch Non-Latched |
| 1:1017 | Speed Fail Alarm Non-Latched |
| 1:1018 | Trip |
| 1:1019 | Alarm |
| 1:1020 | Event Latch 1 |
| 1:1021 | Event Latch 2 |
| 1:1022 | Event Latch 3 |
| 1:1023 | Analog Input 1 HiHi |
| 1:1024 | Analog Input 1 Hi |
| 1:1025 | Analog Input 1 Lo |
| 1:1026 | Analog Input 1 LoLo |

| ADDRESS | DESCRIPTION |
|---|---|
| 1:1027 | Analog In 1 Range Err |
| 1:1028 | Discrete Input 1 |
| 1:1029 | Analog Input 2 HiHi |
| 1:1030 | Analog Input 2 Hi |
| 1:1031 | Analog Input 2 Lo |
| 1:1032 | Analog Input 2 LoLo |
| 1:1033 | Analog In 2 Range Err |
| 1:1034 | Discrete Input 2 |
| 1:1035 | Analog Input 3 HiHi |
| 1:1036 | Analog Input 3 Hi |
| 1:1037 | Analog Input 3 Lo |
| 1:1038 | Analog Input 3 LoLo |
| 1:1039 | Analog In 3 Range Err |
| 1:1040 | Discrete Input 3 |
| 1:1041 | Analog Input 4 HiHi |
| 1:1042 | Analog Input 4 Hi |
| 1:1043 | Analog Input 4 Lo |
| 1:1044 | Analog Input 4 LoLo |
| 1:1045 | Analog In 4 Range Err |
| 1:1046 | Discrete Input 4 |
| 1:1047 | Analog Input 5 HiHi |
| 1:1048 | Analog Input 5 Hi |
| 1:1049 | Analog Input 5 Lo |
| 1:1050 | Analog Input 5 LoLo |
| 1:1051 | Analog In 5 Range Err |
| 1:1052 | Discrete Input 5 |
| 1:1053 | Analog Input 6 HiHi |
| 1:1054 | Analog Input 6 Hi |
| 1:1055 | Analog Input 6 Lo |
| 1:1056 | Analog Input 6 LoLo |
| 1:1057 | Analog In 6 Range Err |
| 1:1058 | Discrete Input 6 |
| 1:1059 | Analog Input 7 HiHi |
| 1:1060 | Analog Input 7 Hi |
| 1:1061 | Analog Input 7 Lo |
| 1:1062 | Analog Input 7 LoLo |
| 1:1063 | Analog In 7 Range Err |
| 1:1064 | Discrete Input 7 |
| 1:1065 | Analog Input 8 HiHi |
| 1:1066 | Analog Input 8 Hi |
| 1:1067 | Analog Input 8 Lo |
| 1:1068 | Analog Input 8 LoLo |
| 1:1069 | Analog In 8 Range Err |
| 1:1070 | Discrete Input 8 |
| 1:1071 | Analog Input 9 HiHi |
| 1:1072 | Analog Input 9 Hi |
| 1:1073 | Analog Input 9 Lo |
| 1:1074 | Analog Input 9 LoLo |
| 1:1075 | Analog In 9 Range Err |
| 1:1076 | Discrete Input 9 |
| 1:1077 | Analog Input 10 HiHi |
| 1:1078 | Analog Input 10 Hi |
| 1:1079 | Analog Input 10 Lo |
| 1:1080 | Analog Input 10 LoLo |
| 1:1081 | Analog In 10 Range Err |
| 1:1082 | Discrete Input 10 |
| 1:1083 | Analog Comparator 1 |
| 1:1084 | Analog Comparator 2 |
| 1:1085 | Analog Comparator 3 |
| 1:1086 | Analog Comparator 4 |
| 1:1087 | Analog Comparator 5 |

Table 4-6 (continued). Boolean Read Addresses (Code 02)

| ADDRESS | DESCRIPTION |
|---|---|
| 1:1088 | Analog Comparator 6 |
| 1:1089 | Analog Comparator 7 |
| 1:1090 | Analog Comparator 8 |
| 1:1091 | Analog Comparator 9 |
| 1:1092 | Analog Comparator 10 |
| 1:1093 | Logic Gate 1 |
| 1:1094 | Logic Gate 2 |
| 1:1095 | Logic Gate 3 |
| 1:1096 | Logic Gate 4 |
| 1:1097 | Logic Gate 5 |
| 1:1098 | Logic Gate 6 |
| 1:1099 | Logic Gate 7 |
| 1:1100 | Logic Gate 8 |
| 1:1101 | Logic Gate 9 |
| 1:1102 | Logic Gate 10 |
| 1:1103 | Logic Gate 11 |
| 1:1104 | Logic Gate 12 |
| 1:1105 | Logic Gate 13 |
| 1:1106 | Logic Gate 14 |
| 1:1107 | Logic Gate 15 |
| 1:1108 | Logic Gate 16 |
| 1:1109 | Logic Gate 17 |
| 1:1110 | Logic Gate 18 |
| 1:1111 | Logic Gate 19 |
| 1:1112 | Logic Gate 20 |
| 1:1113 | Logic Gate 21 |
| 1:1114 | Logic Gate 22 |
| 1:1115 | Logic Gate 23 |
| 1:1116 | Logic Gate 24 |
| 1:1117 | Logic Gate 25 |
| 1:1118 | Logic Gate 26 |
| 1:1119 | Logic Gate 27 |
| 1:1120 | Logic Gate 28 |
| 1:1121 | Logic Gate 29 |
| 1:1122 | Logic Gate 30 |
| 1:1123 | Logic Gate 31 |
| 1:1124 | Logic Gate 32 |
| 1:1125 | Logic Gate 33 |
| 1:1126 | Logic Gate 34 |
| 1:1127 | Logic Gate 35 |
| 1:1128 | Logic Gate 36 |
| 1:1129 | Logic Gate 37 |
| 1:1130 | Logic Gate 38 |
| 1:1131 | Logic Gate 39 |
| 1:1132 | Logic Gate 40 |
| 1:1133 | Logic Gate 41 |
| 1:1134 | Logic Gate 42 |
| 1:1135 | Logic Gate 43 |
| 1:1136 | Logic Gate 44 |
| 1:1137 | Logic Gate 45 |
| 1:1138 | Logic Gate 46 |
| 1:1139 | Logic Gate 47 |
| 1:1140 | Logic Gate 48 |
| 1:1141 | Logic Gate 49 |
| 1:1142 | Logic Gate 50 |
| 1:1143 | Latch 1 |
| 1:1144 | Latch 2 |
| 1:1145 | Latch 3 |
| 1:1146 | Latch 4 |
| 1:1147 | Latch 5 |
| 1:1148 | Latch 6 |
| 1:1149 | Latch 7 |
| 1:1150 | Latch 8 |
| 1:1151 | Latch 9 |
| 1:1152 | Latch 10 |

| ADDRESS | DESCRIPTION |
|---|---|
| 1:1153 | Delay 1 |
| 1:1154 | Delay 2 |
| 1:1155 | Delay 3 |
| 1:1156 | Delay 4 |
| 1:1157 | Delay 5 |
| 1:1158 | Delay 6 |
| 1:1159 | Delay 7 |
| 1:1160 | Delay 8 |
| 1:1161 | Delay 9 |
| 1:1162 | Delay 10 |
| 1:1163 | Delay 11 |
| 1:1164 | Delay 12 |
| 1:1165 | Delay 13 |
| 1:1166 | Delay 14 |
| 1:1167 | Delay 15 |
| 1:1168 | Timer 1 HiHi |
| 1:1169 | Timer 1 Hi |
| 1:1170 | Timer 2 HiHi |
| 1:1171 | Timer 2 Hi |
| 1:1172 | Timer 3 HiHi |
| 1:1173 | Timer 3 Hi |
| 1:1174 | Timer 4 HiHi |
| 1:1175 | Timer 4 Hi |
| 1:1176 | Timer 5 HiHi |
| 1:1177 | Timer 5 Hi |
| 1:1178 | Timer 6 HiHi |
| 1:1179 | Timer 6 Hi |
| 1:1180 | Timer 7 HiHi |
| 1:1181 | Timer 7 Hi |
| 1:1182 | Timer 8 HiHi |
| 1:1183 | Timer 8 Hi |
| 1:1184 | Timer 9 HiHi |
| 1:1185 | Timer 9 Hi |
| 1:1186 | Timer 10 HiHi |
| 1:1187 | Timer 10 Hi |
| 1:1188 | Timer 11 HiHi |
| 1:1189 | Timer 11 Hi |
| 1:1190 | Timer 12 HiHi |
| 1:1191 | Timer 12 Hi |
| 1:1192 | Timer 13 HiHi |
| 1:1193 | Timer 13 Hi |
| 1:1194 | Timer 14 HiHi |
| 1:1195 | Timer 14 Hi |
| 1:1196 | Timer 15 HiHi |
| 1:1197 | Timer 15 Hi |
| 1:1198 | Unit Delay 1 |
| 1:1199 | Unit Delay 2 |
| 1:1200 | Unit Delay 3 |
| 1:1201 | Unit Delay 4 |
| 1:1202 | Unit Delay 5 |
| 1:1203 | Unit Delay 6 |
| 1:1204 | Unit Delay 7 |
| 1:1205 | Unit Delay 8 |
| 1:1206 | Unit Delay 9 |
| 1:1207 | Unit Delay 10 |
| 1:1208 | Reserved (Do not use) |
| 1:1209 | Reserved (Do not use) |
| 1:1210 | Reserved (Do not use) |
| 1:1211 | Internal Fault Trip Non-Latched |
| 1:1212 | Internal Fault Alarm Non-Latched |
| 1:1213 | Configuration Trip Non-Latched |
| 1:1214 | Resettable Trip Non-Latched |
| 1:1215 | Power Supply 1 Alarm Non-Latched |
| 1:1216 | Power Supply 2 Alarm Non-Latched |
| 1:1217 | Parameter Error Trip Non-Latched |
| 1:1218 | IRIG Signal Lost Non-Latched |
| 1:1301 | Heartbeat |

Table 4-7. Analog Read Addresses (Code 04)

| ADDRESS | DESCRIPTION | UNITS | RANGE |
|---|---|---|---|
| 3:0001 | Speed | RPM | 0-50000 |
| 3:0002 | Acceleration | RPM/Sec | -32768 - 32767 |
| 3:0101 | Analog Input 1 | mA x 100 | 0-2400 |
| 3:0102 | Analog Input 2 | mA x 100 | 0-2400 |
| 3:0103 | Analog Input 3 | mA x 100 | 0-2400 |
| 3:0104 | Analog Input 4 | mA x 100 | 0-2400 |
| 3:0105 | Analog Input 5 | mA x 100 | 0-2400 |
| 3:0106 | Analog Input 6 | mA x 100 | 0-2400 |
| 3:0107 | Analog Input 7 | mA x 100 | 0-2400 |
| 3:0108 | Analog Input 8 | mA x 100 | 0-2400 |
| 3:0109 | Analog Input 9 | mA x 100 | 0-2400 |
| 3:0110 | Analog Input 10 | mA x 100 | 0-2400 |
| 3:0201 | Trip Cycle Time 1 | milliseconds | 0-65535 |
| 3:0202 | Trip Cycle Time 2 | milliseconds | 0-65535 |
| 3:0301 | Test Mode Time Remaining | seconds | 0-65535 |
| 3:0401 | Speed Fail Time Remaining | seconds | 0-65535 |
| 3:0501 | Timer 1 Seconds Value | seconds | 0-65535 |
| 3:0502 | Timer 1 Milliseconds Value | milliseconds | 0-999 |
| 3:0503 | Timer 2 Seconds Value | seconds | 0-65535 |
| 3:0504 | Timer 2 Milliseconds Value | milliseconds | 0-999 |
| 3:0505 | Timer 3 Seconds Value | seconds | 0-65535 |
| 3:0506 | Timer 3 Milliseconds Value | milliseconds | 0-999 |
| 3:0507 | Timer 4 Seconds Value | seconds | 0-65535 |
| 3:0508 | Timer 4 Milliseconds Value | milliseconds | 0-999 |
| 3:0509 | Timer 5 Seconds Value | seconds | 0-65535 |
| 3:0510 | Timer 5 Milliseconds Value | milliseconds | 0-999 |
| 3:0511 | Timer 6 Seconds Value | seconds | 0-65535 |
| 3:0512 | Timer 7 Milliseconds Value | milliseconds | 0-999 |
| 3:0513 | Timer 8 Seconds Value | seconds | 0-65535 |
| 3:0514 | Timer 8 Milliseconds Value | milliseconds | 0-999 |
| 3:0515 | Timer 9 Seconds Value | seconds | 0-65535 |
| 3:0516 | Timer 9 Milliseconds Value | milliseconds | 0-999 |
| 3:0517 | Timer 10 Seconds Value | seconds | 0-65535 |
| 3:0518 | Timer 10 Milliseconds Value | milliseconds | 0-999 |
| 3:0519 | Timer 11 Seconds Value | seconds | 0-65535 |
| 3:0520 | Timer 11 Milliseconds Value | milliseconds | 0-999 |
| 3:0521 | Timer 12 Seconds Value | seconds | 0-65535 |
| 3:0522 | Timer 12 Milliseconds Value | milliseconds | 0-999 |
| 3:0521 | Timer 13 Seconds Value | seconds | 0-65535 |
| 3:0522 | Timer 13 Milliseconds Value | milliseconds | 0-999 |
| 3:0521 | Timer 14 Seconds Value | seconds | 0-65535 |
| 3:0522 | Timer 14 Milliseconds Value | milliseconds | 0-999 |
| 3:0521 | Timer 15 Seconds Value | seconds | 0-65535 |
| 3:0522 | Timer 15 Milliseconds Value | milliseconds | 0-999 |
| 3:0601 | Temp Overspeed SetPoint | RPM | 0-65535 |
| 3:0602 | Simulated Speed RPM | RPM | 0-65535 |
| 3:0701 | Last Trip Month | Months | 1-12 |
| 3:0702 | Last Trip Day | Days | 1-31 |
| 3:0703 | Last Trip Year | Years | 2000-2099 |
| 3:0704 | Last Trip Hour | Hours | 0-23 |
| 3:0705 | Last Trip Minute | Minutes | 0-59 |
| 3:0706 | Last Trip Second | seconds | 0-59 |
| 3:0707 | Last Trip Milli-Second | milliseconds | 0-999 |
| 3:0801 | Unit Health Status | | 0-2 (Note 1) |
| 3:0901 | Periodic test Status | Enum | 0-3 |

Note 1:
0 = Unit Health Bad
1 = Unit Health Good
2 = Unit Health Unknown

# Chapter 5. Troubleshooting

Many troubleshooting features are available from the front panel of each module. In general, the following high level approach can be used to troubleshoot the MicroNet™ Safety Module system.

1. Check the front panel LEDs
2. View the trip and alarm logs by pressing the corresponding view buttons on the front panel
3. Use the messages in the trip and alarm logs to assist in troubleshooting. The messages are summarized in the tables below.
4. Use the Monitor Menu from the front panel to trace and branch to potential I/O, configuration, and programming problems.
5. For more in depth help, use the service tool provided with the MicroNet Safety Module.

The entry point for troubleshooting the MicroNet Safety Module is the state of the three LEDs on lower part of the front panel. The Trip Log and the Alarm Log can also be viewed from the front panel. The service tool also provides more detailed information in the log pages.

**UNIT HEALTH LED**

The UNIT HEALTH LED indicates module health status.

Green – Unit OK and functioning properly.

Red – Safety Functionality is not running/internal fault trip is present.

Unlit – Status unknown because of a communication fault with the front panel or the module is not powered.

**TRIPPED LED**

The TRIPPED LED indicates the state of the trip latch.

Unlit – Unit not tripped or the module is not powered.

Red – Unit tripped, press VIEW button below the LED to see the trip log log or navigate to the Monitor Trip Latch screen to see the active status on each trip input.

**ALARM LED**

The ALARM LED indicates the state of the alarm latch.

- Unlit – No alarms or the module is not powered.
- Yellow – Active alarms, press VIEW button below LED to see the alarm log or navigate to the Monitor Alarm Latch screen to see the active status on each alarm input.

# I/O Troubleshooting

| Problem or Diagnostic Indication | Possible Cause | Suggested Actions |
|---|---|---|
| Power Supply Inputs not working properly. Power supply input alarm present. | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Power source breaker or fuse open. | Verify breaker or fuse. |
| | Only one power supply is connected. | On the front panel, press the VIEW button under the ALARM LED and check for Power Supply 1 or 2 Fault. |
| | Power supply input out of range or insufficient rating. | Check input voltage level and verify it is within acceptable range per electrical specifications. Also check that power supply has appropriate rating to power the MicroNet Safety Module. |
| Speed Input not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Configuration | On the front panel, check the Speed Input Configure Menu and verify that all proper configuration options are selected. |
| | Alarms and Faults | Verify that there are no alarms or faults that may indicate a setup problem (open wire trip, speed lost, speed fail, etc.) |
| | Signal level | Verify that the input signal levels are within the electrical specifications. Also verify shield connections. |
| | Active Probe Power | If using an active probe, verify probe power is correct by disconnecting the probe and measuring from terminals 69 to 71. The voltage should be 24 V ±10 %. Attach probe and measure again to verify that the probe is not overloading the voltage provided by the MicroNet Safety Module. |
| Dedicated discrete input not working (Start, Reset or Speed Fail Override) | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Configuration | On the front panel, check the Dedicated Discrete Inputs Monitor Menu and verify logic state is correct. |
| | Signal source not working correctly or not within acceptable electrical specifications. | Check signal level and verify it is within acceptable range per electrical specifications. |
| | Internally supplied wetting voltage fault. | Measure voltage from terminal 1 to terminal 81 and verify it is 23 V ±2 V. If out of range, return unit to Woodward. |

| Problem or Diagnostic Indication | Possible Cause | Suggested Actions |
|---|---|---|
| Configurable Input – Discrete input not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Configuration | On the front panel, check the Configurable Inputs Monitor Menu and verify logic state is correct.<br><br>Using the PCT, verify that the input is configured as discrete input. |
| | Signal source not working correctly or not within acceptable electrical specifications. | Check signal level and verify it is within acceptable range per electrical specifications. |
| | Internally supplied wetting voltage fault. | Measure voltage from terminal 37 to terminal 38 and verify it is 24 V ±10 %. If out of range, remove wiring and measure again to verify that the voltage source is not being overloaded.. |
| Configurable Input – Analog Input not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Configuration | On the front panel, check the Configurable Inputs Monitor Menu and verify the correct analog input level is displayed. A “signal out of range” indicates the input is less than 2 mA or greater than 22 mA.<br><br>Using the PCT, verify that the input is configured as analog input and the Lo, LoLo, Hi, HiHi limits are set correctly.. |
| | Signal source not working correctly or not within acceptable electrical specifications. | Check signal level and verify it is within acceptable range per electrical specifications. Verify shield connection. |
| Trip relays not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Configuration | Using the service tool or front panel, check to see that the trip configuration is set correctly. Energize to trip vs. de-energize to trip will invert the polarity on the relays. |
| | External supplies | Check the power supplies that provide voltage to the relay output. If using the 24 V EXT available from the MicroNet Safety Module, measure voltage between terminals 80, 81 and verify 24 V ±10 %. If it is not, remove the wiring from the 24 V EXT to unload the output and measure again to verify the voltage is not being overloaded. |

| Problem or Diagnostic Indication | Possible Cause | Suggested Actions |
|---|---|---|
| Programmable relay output not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. |
| | Configuration | Using the PCT, check to see that the polarity is set correctly and the correct internal signal is selected to drive the output. |
| | External supplies | Check the power supplies that provide voltage to the relay output. If using the 24 V EXT available from the MicroNet Safety Module, measure voltage between terminals 80, 81 and verify 24 V ±10 %. If it is not, remove the wiring from the 24 V EXT to unload the output and measure again to verify the voltage is not being overloaded. |
| Analog Output not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections.<br><br>On the front panel, check the Monitor Analog Output Menu and verify that the analog output is reading an expected output value.<br><br>Measure the current from terminal 64 and verify that is corresponds to the previous step.<br><br>Verify the load on the analog output is within the electrical specifications. |
| | Configuration | Using the PCT or front panel, verify that the scaling is correct. |
| MODBUS not working | Wiring fault, terminal block loose. | Verify wiring and terminal block connections. In particular, verify that the HI and LO wires are terminated to the correct terminals for RS-485 and the likewise for TXD and RXD for RS-232. Also verify the terminations jumpers are installed for RS-485 mode |
| | Configuration | Using the PCT or front panel, verify that the correct settings are selected. |
| Service Tool not working | Wiring and connection | Verify cable that is plugged into DB9 port is not a crossover. A straight-through cable is required. |
| | COM Port | Check that there is power applied to the MicroNet Safety Module module that the service tool is connected.<br><br>Verify the correct COM port is selected when establishing communications and that Auto Detection BAUD rate is selected. |

# Trip Indications

| Problem or Diagnostic Indication | Description | Possible Cause | Suggested Actions |
|---|---|---|---|
| Internal Fault trip | The module tripped on an internal fault | Various | Connect the PCT and view the Module Faults Log. This log expands the Internal Fault annunciation.<br><br>In general, it is not possible to fix internal faults without returning the unit to Woodward. |
| Power Up Trip | The module has lost power and has been restored. | Power source fault or breaker reset. | Verify power source, breaker, fuse and wiring integrity. The Reset function will reset the module. |
| Configuration Trip | Trip is issued internally to keep the module in tripped state while the module is actively saving a configuration. | The module is actively saving a configuration. | Wait for module to finish saving configuration. Reset function will reset the module. |
| Parameter Error | An error has been detected in the internally stored parameters. Internally stored parameters are constantly checked for data integrity. | Non-volatile memory hardware fault or internal fault. | Reload configuration settings using the PCT. Cycle input power.<br><br>If Parameter Error persists return unit to Woodward according to the instructions in Chapter 8 of this manual. |
| Overspeed Trip | The module tripped on an overspeed event. | Turbine overspeed | Check trip system prior to operating turbine, including MicroNet Safety Module built-in simulated speed tests to verify MicroNet Safety Module functionality. |
| | | Configuration | Using the PCT or front panel, verify that the correct settings are selected. |
| Over-acceleration Trip | The module tripped on an over-acceleration event. | Rapid turbine acceleration | Check trip system prior to operating turbine, including MicroNet Safety Module built-in simulated speed tests to verify MicroNet Safety Module functionality. |
| | | Configuration | Using the PCT or front panel, verify that the correct settings are selected. |

| Problem or Diagnostic Indication | Description | Possible Cause | Suggested Actions |
|---|---|---|---|
| Speed Probe Open Wire | The module has detected an open wire condition on the speed probe (Passive, or MPU probe only) | Wiring fault or probe fault. | Check wiring continuity and probe integrity. |
| Speed Lost Trip | Sudden Speed Loss is configured as Trip and the module has detected a sudden speed loss. | Wiring fault or probe fault. | Check wiring continuity and probe integrity. |
| Speed Fail Trip | Start logic – Speed Fail Trip is enabled and the module has detected the Speed Fail Override contact input is open while speed is below the user configured Speed Fail Setpoint. | Wiring fault, speed probe fault<br><br>Speed Fail Override contact input operation not correct.<br><br>Incorrect speed fail setpoint configured, | Check wiring continuity and probe integrity.<br><br>Check contact and wiring operation.<br><br>See manual for description of function. Use PCT to verify proper configuration settings. |
| Speed Fail Timeout | Start logic – The module has not detected speed within the time set by the Speed Fail Timeout setting. | Wiring fault, speed probe fault<br><br>Incorrect speed fail timeout time configured | Check wiring continuity and probe integrity.<br><br>See manual for description of function. Use PCT to verify proper configuration settings. |

# Alarm Indications

| Problem or Diagnostic Indication | Description | Possible Cause | Suggested Actions |
|---|---|---|---|
| Internal Fault Alarm | The module has an internal fault that is annunciated an alarm and not a trip. | Various | Connect the service tool and view the Trip And Alarm Log. This log expands the Internal Fault Alarm annunciation. |
| Configuration Mismatch | Configuration data does not match between modules. | Different settings loaded than in one or both of the other two modules. | Copy configurations between modules using Configuration Management in the Config Menu, or load settings from service tool. |
| Power Supply 1 Fault | The module has detected a fault on Power Supply 1. | Power supply input 1 is either faulted or the power is disconnected. | Check the power source, breaker, fuse and connections. Note the module will continue to operate normally on power supply 2. |
| Power Supply 2 Fault | The module has detected a fault on Power Supply 2. | Power supply input 2 is either faulted or the power is disconnected. | Check the power source, breaker, fuse and connections. Note the module will continue to operate normally on power supply 1. |
| Speed Fail Alarm | Start logic – Speed Fail Alarm is enabled and the module has detected the Speed Fail Override contact input is open while speed is below the user configured Speed Fail Setpoint. | Wiring fault, speed probe fault<br><br>Speed Fail Override contact input operation not correct.<br><br>Incorrect speed fail setpoint configured, | Check wiring continuity and probe integrity.<br><br>Check contact and wiring operation.<br><br>See manual for description of function. Use PCT or front panel to verify proper configuration settings. |
| Speed Lost Alarm | Sudden Speed Loss is configured as Alarm and the module has detected a sudden speed loss. | Wiring fault or probe fault. | Check wiring continuity and probe integrity. |
| Tmp Overspd Setpoint On | Indicates the temporary overspeed setpoint has been activated. | User initiated temporary setpoint test. | See manual for description and limitations.<br><br>Use PCT or front panel to verify settings. |
| Manual Sim. Speed Test | Indicates the manual simulated overspeed test has been activated. | User initiated simulated speed test. | See manual for description and limitations. |
| Auto Sim. Speed Test | Indicates the automated simulated overspeed test has been activated. | User initiated simulated speed test. | See manual for description and limitations. |

| Problem or Diagnostic Indication | Description | Possible Cause | Suggested Actions |
|---|---|---|---|
| Periodic Overspd Test | Indicates the automated Periodic Overspeed Test has been activated. | User enabled the simulated speed test or test interval time expired and test started. | See manual for description and limitations.<br><br>Use PCT or Module A front panel to verify settings. |
| User Defined Test 1 | Indicates the User Defined Test 1 has been activated | User enabled the User Defined Test or the configured Set Input was true. | Connect PCT and verify settings. Check the set and reset functions are correct. Note specifically the effect of the timeout setting. |
| User Defined Test 2 | Indicates the User Defined Test 2 has been activated | User enabled the User Defined Test or the configured Set Input was true. | Connect PCT and verify settings. Check the set and reset functions are correct. Note specifically the effect of the timeout setting. |
| User Defined Test 3 | Indicates the User Defined Test 3 has been activated | User enabled the User Defined Test or the configured Set Input was true. | Connect PCT and verify settings. Check the set and reset functions are correct. Note specifically the effect of the timeout setting. |
| Trip Cycle Time Mon 1 Alarm | Indicates the Trip Cycle Monitor Time 1 Alarm has been set. | Trip Cycle Monitor Time 1 Alarm is set when the maximum cycle time has been exceeded during a trip cycle time test. | Check the Trip Cycle Time Monitor Menu and note the trip cycle time to see if the cycle time indicator signal is reaching the MicroNet Safety Module.<br><br>Connect PCT and verify settings. Verify the trip indicator input is from the correct source and the max cycle time setting is correct.<br><br>Check external system by following the trip signal around the loop until it returns back to the MicroNet Safety Module input that is designated as the trip indicator input. |

| Problem or Diagnostic Indication | Description | Possible Cause | Suggested Actions |
|---|---|---|---|
| Trip Cycle Time Mon 2 Alarm | Indicates the Trip Cycle Monitor Time 2 Alarm has been set. | Trip Cycle Monitor Time 2 Alarm is set when the maximum cycle time has been exceeded during a trip cycle time test. | Check the Trip Cycle Time Monitor Menu and note the trip cycle time to see if the cycle time indicator signal is reaching the MicroNet Safety Module.<br><br>Connect PCT and verify settings. Verify the trip indicator input is from the correct source and the max cycle time setting is correct.<br><br>Check external system by following the trip signal around the loop until it returns back to the MicroNet Safety Module input that is designated as the trip indicator input. |
| IRIG Signal Lost Alarm | Indicates that IRIG Time synchronization is enabled but the module does not receive any valid IRIG time messages. | IRIG signal has been disconnected or IRIG input is faulted. | Check the wiring of the IRIG signal. |

## Configuration Guidance

The ProTech MSM is a fault tolerant safety control device that is fully configured by customers for each unique site application. These products have many functional options available and the system is designed to continually provide its primary function, even when one fault occurs anywhere in the ProTech system.

It has come to our attention that some user configurations of these products, may not react as expected when a second fault occurs in the ProTech system.

These safety products are all configurable by the user, so it is important to emphasize the following points:

- On any configurable device – it is possible to have a valid configuration that may not do all that is expected, verification of customer and installers requirements and unit testing at site commissioning is required to ensure the appropriate response to faults in the system.
- On any fault tolerant system, a single fault should be investigated and addressed. Depending on the configuration, running the system in a prolonged mode with an active alarm, leaves it in a state where a second fault could cause a trip or prevent the unit from performing its primary function.

If your configuration settings are using Active probes (not MPU's) and your configuration has Speed Fail Trip set to "NOT USED" your configuration may be at risk in the event of a second fault.

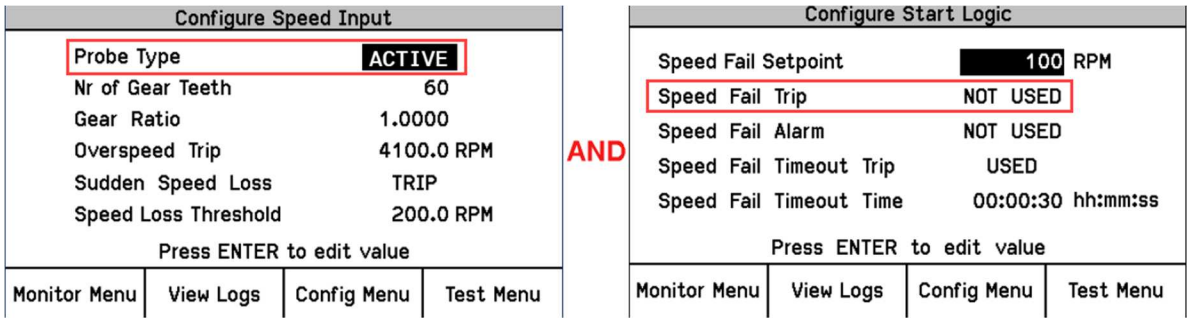



Figure 5-1. Configuration Guide - Front Panel Interface with Active Probe

It is recommended that on ProTech MSM products, the option Speed Fail Trip always be set to “USED” whenever the configuration of the speed input probe type is “Active”.

This can be complete using the Front Panel Interface as shown above or can be completed using the PCT (Programming and Configuration Tool) as shown below:

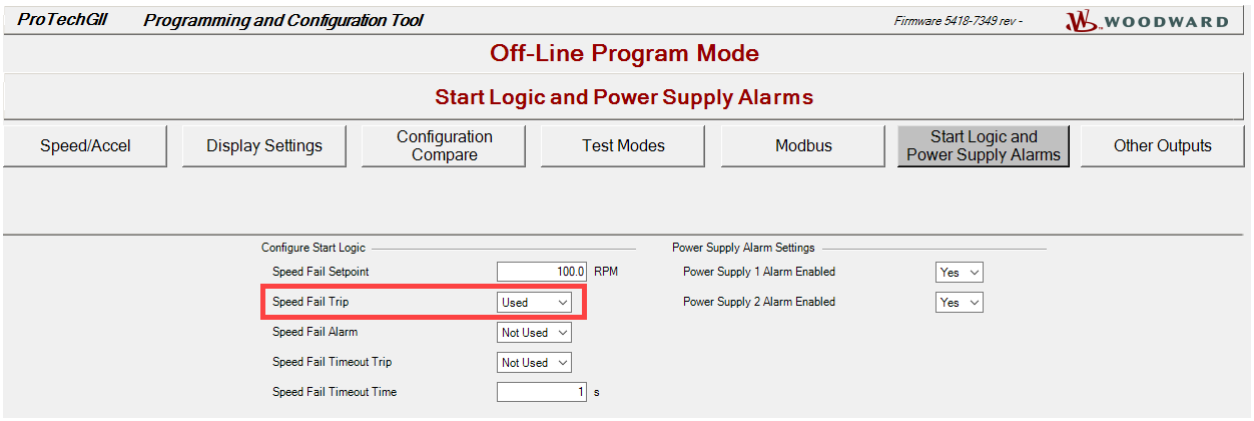
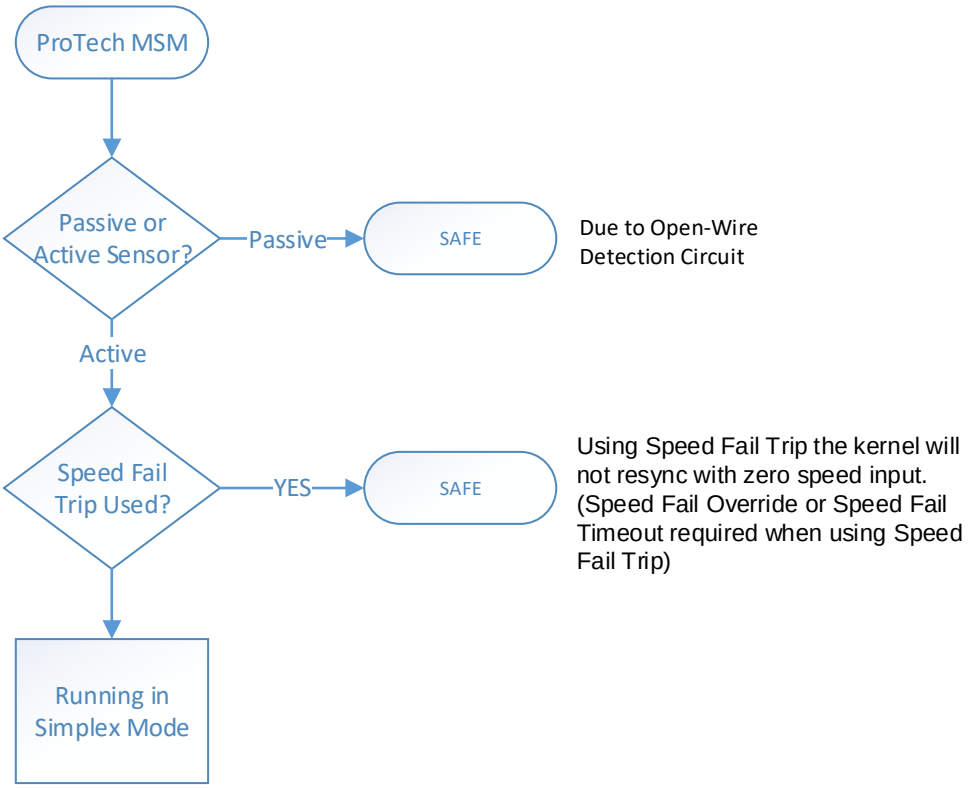



Figure 5-2. Speed Fail Trip Using PCT

To determine the recommended configuration settings for detecting failed speed probes in systems that utilize Active Speed probes, reference the flowchart in Figure 5-3 below:




- Turn Speed Fail Trip to USED.
- If Speed Fail Trip cannot be used, then enable Speed Failure Alarm – will give notification of an issue but will not trip.
- Customer should verify speed on the modules before and after reset.
- Using Reset then issuing Start will validate the speed input and will trip if not above Speed Set point by end of start command.

Figure 5-3. Configuration Guidance Flowchart

# Chapter 6.
# Safety Management

## Product Variations Certified

The functional safety requirement in this manual applies to all MicroNet™ Safety Module variations.

These products are certified for use in applications up to SIL3 according to IEC61508.

## Safe State

The MicroNet Safety Module is designed so that the safe state can be configured for either de-energize or energize to trip. De-energize to trip will place trip relays into their unpowered, normally open state.

The de-energize-to-trip functionality is implemented such that a complete loss of power to the module results in a trip of that module. The energize-to-trip functionality is implemented such that a complete loss of power to the module does not result in a trip of that module.

When configured as de-energize-to-trip, the modules power up in the tripped state. When configured as energize-to-trip, the modules power up such that they do not enter the tripped state unless a trip condition is present.

Table 6-1. Module Configuration, Power Loss, and Power Up

| Configuration | Module Power Loss State | Module Power Up State |
|---|---|---|
| De-energize to trip | Tripped | Tripped |
| Energize to trip | Not Tripped | Not Tripped, unless trip condition present. |

## SIL Specifications

PFD and PFH calculations have been performed on the MicroNet Safety Module according IEC61508. For SIL3, IEC states the following requirements.

Table 6-2. SIL 3 Calculation Types and Values

| Type | SIL 3 Value |
|---|---|
| PFH | $10^{-8}$ to $10^{-7}$ |
| PFD | $10^{-4}$ to $10^{-3}$ |
| SFF | > 90 % |

Table 6-3. MicroNet Safety Module SIL3 numbers:

| PFH |
|---|
| 7.8E-8 1/h |

| PFD | |
|---|---|
| **PFD** | **Proof Test Interval** |
| 3.7E-5 | 6 month |
| 5.6E-5 | 9 month |
| 7.5E-5 | 1year |

| Safe Failure Fraction |
|---|
| SFF > 90 % |

| Diagnostic Coverage |
|---|
| DC > 90 % |

## Failure Rate Data

The Mean Time to Failure (MTTF) is a measure of time between failures that cause a complete process shutdown. In determining this number, IEC61508 evaluation takes into account safe failure and dangerous detected failures that cause a module trip.

Table 6-4. Mean Time to Failure (MTTF)

| MTTF |
|---|
| > 54 000 years |

Because of the nature of the 2-o-o-3 voting structure, a single module trip does not shut down the process.

## Response time data

The response time for a safety system must be less than the process safety time. The system integrator must determine the process safety time and the response time of all elements (sensors, MicroNet Safety Module, actuators, etc.) that make up the total process safety time. For this purpose, the MicroNet Safety Module response time is given below.

Table 6-5. Response Time

| Response Time | |
|---|---|
| Independent Trip Relay Versions | < 12 ms |
| Voted Trip Relay Versions | < 20 ms |

The response time of the MicroNet Safety Module is the time from when a signal is received at the MicroNet Safety Module terminal blocks that is out of a range as defined by the programming (i.e. speed, analog input) to the point where the trip relays have changed state.

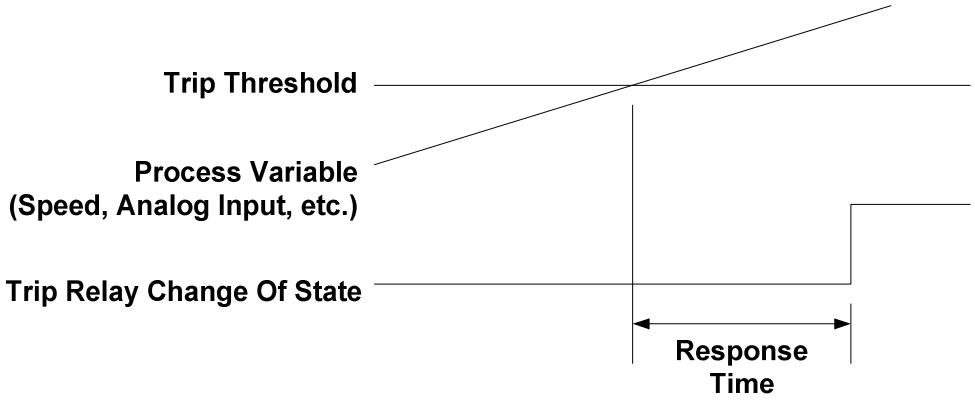



Figure 6-1. MicroNet Safety Module Response Time

## Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the product life of the MicroNet Safety Module is 20 years.

Table 6-6. Environmental Specifications:

| | |
|---|---|
| **Operating Temperature** | (–20 to +60) °C |
| **Storage Temperature (Non-operational)** | (–20 to +65) °C |
| **Relative humidity** | up to 95 % non-condensing |
| **Vibration** | 2 hrs/axis, 1.04 Grms, 10–500 Hz, three axis |
| **Shock:** | ±3 pulses, 30 G, 11 ms half sine shock, three axis |
| **IP rating** | 56 |
| **Altitude** | up to 3000 meters above sea level |
| **Electromagnetic Compatibility** | Emissions: EN61000-6-4<br>Immunity: EN61000-6-2 |

## Management of Functional Safety

The MicroNet Safety Module is intended for use according the requirements of a safety lifecycle management process such as IEC61508 or IEC61511. The safety performance numbers in this chapter can be used for the evaluation of the overall safety lifecycle.

## Restrictions

The user must complete a full functional check of the MicroNet Safety Module after initial installation, and after any modification of the programming or configuration of the device. This functional check should include as much of the safety system as possible, such as sensors, transmitters, actuators and trip blocks. The MicroNet Safety Module has programming capability to facilitate the automatic checkout and periodic maintenance of the safety system. For help on programming, see the chapters on functionality, configuration and the example applications.

The MicroNet Safety Module must be used within the published specification in this manual.

## Competence of Personnel

All persons involved in the initial design or modification of the programmable software, installation and maintenance must have appropriate training. Training and guidance materials include this manual, the MicroNet Safety Module service tool, and training programs available at Woodward. See Chapter 8 (Service Options) for more information.

## Operation and Maintenance Practice

A periodic proof (functional) test of the MicroNet Safety Module is required to verify that no dangerous faults not detected by internal run-time diagnostics remain undetected. More information is in the “Proof Test” section of this chapter. The frequency of the proof test is determined by the overall safety system design, of which the MicroNet Safety Module is part of the safety system. The safety numbers are given in the following sections to help the system integrator determine the appropriate test interval. This will require password access to the front panel menus.

## Installation and Site Acceptance Testing

Installation and use of the MicroNet Safety Module must conform to the guidelines and restrictions included in this manual. No other information is needed for installation, programming, and maintenance. This will require password access to the front panel menus.

## Functional Testing after Initial Installation

A functional test of the MicroNet Safety Module is required prior to use as a safety system. This should be done as part of the overall safety system installation check and should include all I/O interfaces to and from the MicroNet Safety Module that are part of the safety system. For guidance on the functional test, see the proof test procedure below. This will require password access to the front panel menus.

## Functional Testing after Changes

A functional test of the MicroNet Safety Module is required after making any changes that affect the safety system. Although there are functions in the MicroNet Safety Module that are not directly safety related, it is recommended that a functional test is performed after any change. This will require password access to the front panel menus.

## Proof Testing (Functional Test)

The MicroNet Safety Module must be periodically proof tested to ensure there are no dangerous faults present that are not detected by on-line diagnostics. Because of the 2-o-o-3 configuration of the MicroNet Safety Module, it is possible to perform the proof test while the MicroNet Safety Module is on-line. Many built-in test modes are included. The test procedure will set the trip outputs on the module under test into a trip state (de-energized for a de-energize-to-trip configuration and energized in an energized to trip configuration). It is possible to automate several steps of the proof test procedure shown below using the programmability and test mode configurability of the MicroNet Safety Module, but the intent of the steps below must be met.

With the procedure below, the user can expect 99 % test coverage of the dangerous failures that are not tested by online diagnostics.

## Functional Verification (Proof) Test Procedure (module level):

This procedure requires a digital multimeter for resistance and voltage measurement. This will require password access to the front panel menus.

1. Cycle Power on the module and verify there are no internal faults on the Alarm Latch page of the monitor menu.
2. Remove power from one power supply input (power supply input 1 or 2) at a time and verify the correct fault is read on the Alarm Latch page of the monitor menu.
3. Measure external 24 V EXT (terminals 80–81; 23 V ±1 V).
4. Verify proper Discrete Input voltage (terminals 37–38; 23 V ±1 V).
5. Measure SPEED PWR (terminals 69–71). Insure active probe mode is selected in Speed Configuration Menu, make the measurement, and insure probe type is in original configuration (23 V ±1 V).
6. Test Speed input by using one of the internal speed test modes in the Test Menu. Resistance measurement of each of the voter outputs is required. Verify as follows:
   a. With module not tripped, resistance measurement from 1A – 1B, or 2A – 2B must be less than 100 Ω.
   b. With module tripped, resistance measurement from 1A – 1B, or 2A – 2B must be greater than 1 MΩ.
7. Test any configurable inputs that are set to analog mode to make sure that all inputs are operational. The analog signal must be varied from a steady state value. Verify the proper signal by monitoring the respective input on the Monitor Menu\Configurable Input page of the front panel.
8. Test any configurable inputs that are set to discrete mode to make sure that all inputs are operational and not stuck in the ON or OFF state. Inputs must be cycled from ON to OFF and OFF to ON. Verify the proper signal by monitoring the respective input on the Monitor Menu\Configurable Input page of the front panel.
9. Test Programmable Outputs if used as part of the safety system.
10. Cycle dedicated inputs and verify the proper signal by monitoring the respective input on the Monitor Menu/Dedicated Discrete Input page of the front panel.
11. If possible, compare external speed with measured speed reading on the MicroNet Safety Module display.
12. If used as part of the safety system, verify the analog output. Measure this output by performing an automated overspeed trip test as described in step 6.
13. Chassis isolation checks using resistance measurement. Measure from terminals 39, 66, 67 to a point on the MicroNet Safety Module chassis (the grounding braid is a good place for this measurement): < 1 Ω.
14. Perform a lamp test from front panel Test Menu.

# Chapter 7.
# Asset Management

## Product Storage Recommendations

The unit may be stored in its original shipping container until it is ready for installation. Protect the device from weather and from extreme humidity or temperature fluctuations during storage. This product is designed for continuous storage in IP56 rated locations with an ambient temperature range of (–20 to +65) °C.

To ensure product shelf life, Woodward recommends that a stored MicroNet™ Safety Module be powered up (power source applied to each module) for
5 minutes every 24 to 36 months. This procedure re-establishes an electrical charge into the product's electrolytic capacitors, extending their shelf life. (See the Unpacking section in the chapter on Installation for unpacking.)

## Refurbishment Period Recommendation

This product is designed for continuous operation in a typical industrial environment and includes no components that require periodic service. However, to take advantage of related product software and hardware improvements, Woodward recommends that your product be sent back to Woodward or to a Woodward authorized service facility after every five to ten years of continuous service for inspection and component upgrades. Please refer to the service programs in the following chapter.


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

# Chapter 8.
# Product Support and Service Options

## Product Support Options

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

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

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

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

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

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

## Product Service Options

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

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

**Replacement/Exchange:** Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty 5-09-0690 North American Terms and Conditions of Sale (Industrial Business Segment).

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

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

**Flat Rate Repair:** Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty 5-09-0690 North American Terms and Conditions of Sale (Industrial Business Segment) on replaced parts and labor.

**Flat Rate Remanufacture:** Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty 5-09-0690 North American Terms and Conditions of Sale (Industrial Business Segment). This option is applicable to mechanical products only.

## Returning Equipment for Repair

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

When shipping the item(s), attach a tag with the following information:
- Return authorization number
- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part number(s) and serial number(s)
- Description of the problem
- Instructions describing the desired type of repair

### Packing a Control

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

**NOTICE**

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

# Replacement Parts

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

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

# Engineering Services

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

- Technical Support
- Product Training
- Field Service

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

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

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

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

# Contacting Woodward's Support Organization

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

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

### Products Used in Electrical Power Systems

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

### Products Used in Engine Systems

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

### Products Used in Industrial Turbomachinery Systems

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

# Technical Assistance

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

## General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

## Prime Mover Information

Manufacturer _____

Turbine Model Number _____

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

Power Output Rating _____

Application (power generation, marine, etc.) _____

## Control/Governor Information

**Control/Governor #1**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

**Control/Governor #2**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

**Control/Governor #3**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

## Symptoms

Description _____

_____

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

# Appendix.
# Modbus Ethernet Gateway Information

## Introduction

For customers who want to use Modbus Ethernet communications or put the ProTech® on the plant network, Woodward recommends the following Ethernet-to-Serial Gateways:

1. B&B Electronics –
   Model: MESR901
   Serial: RS-232, RS-485, or RS-422
   Power Input: 10–48 Vdc

   B&B Electronics Mfg. Co.
   707 Dayton Road
   P.O. Box 1040
   Ottawa, IL 61350
   USA

   Phone: (815) 433-5100 (8-5:00 CST, M-F)
   Email: orders@bb-elec.com
   Web: www.bb-elec.com

2. Lantronix –
   Model: UDS100-Xpress DR IAP
   Serial: RS-232, RS-485, or RS-422
   Power Input: 9–30 Vdc, 9–24 Vac

   Lantronix
   15353 Barranca Parkway
   Irvine, CA 92618
   USA

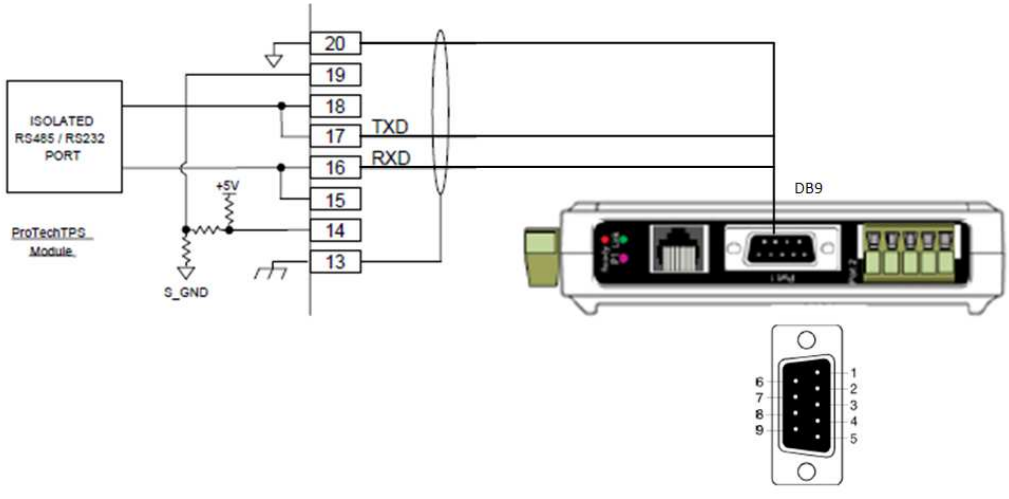
   Phone: 1-800-422-7055
   Email: sales@lantronix.com
   Web: www.lantronix.com


## B&B Electronics Setup

Below you will find the wiring setup and software configuration for the MESR901. Remember that the pictures below are for reference—you will need to set up the serial configuration to match the settings you chose in the ProTech. When multi-dropping the 3 modules together using RS-485/422, you will need to assign each module a unique node address, which can be found in the Modbus configuration screen on the ProTech.

## Wiring

**RS-232**

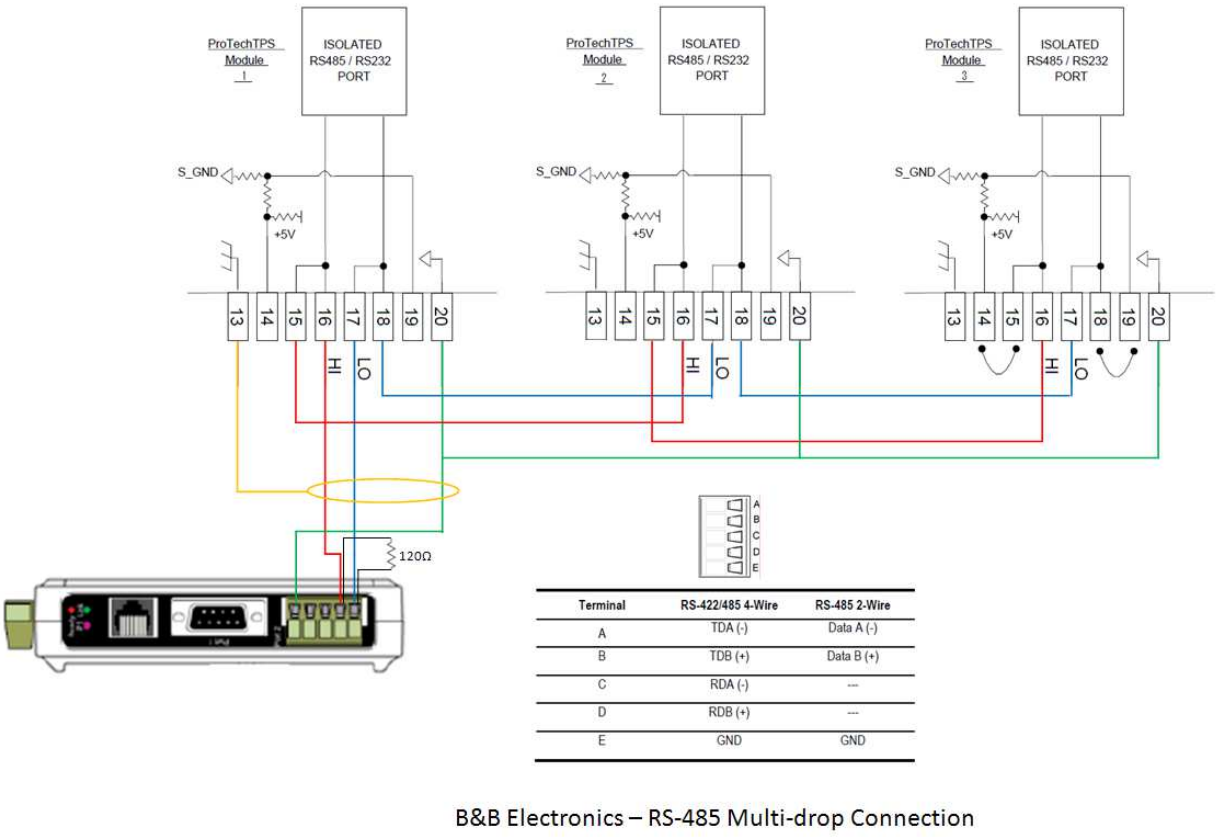



| DB9 M Pin | Direction | RS-232 |
|---|---|---|
| 1 | Input | DCD |
| 2 | Input | RXD |
| 3 | Output | TXD |
| 4 | Output | DTR |
| 5 | --- | GND |
| 6 | Input | DSR |
| 7 | Output | RTS |
| 8 | Input | CTS |
| 9 | Input | RI |

B&B Electronics – RS-232

**Note**: The Serial DB9 connection is used for RS-232 communication only.

**RS-485 2-wire**




| Terminal | RS-422/485 4-Wire | RS-485 2-Wire |
|---|---|---|
| A | TDA (-) | Data A (-) |
| B | TDB (+) | Data B (+) |
| C | RDA (-) | --- |
| D | RDB (+) | --- |
| E | GND | GND |

B&B Electronics – RS-485 Multi-drop Connection

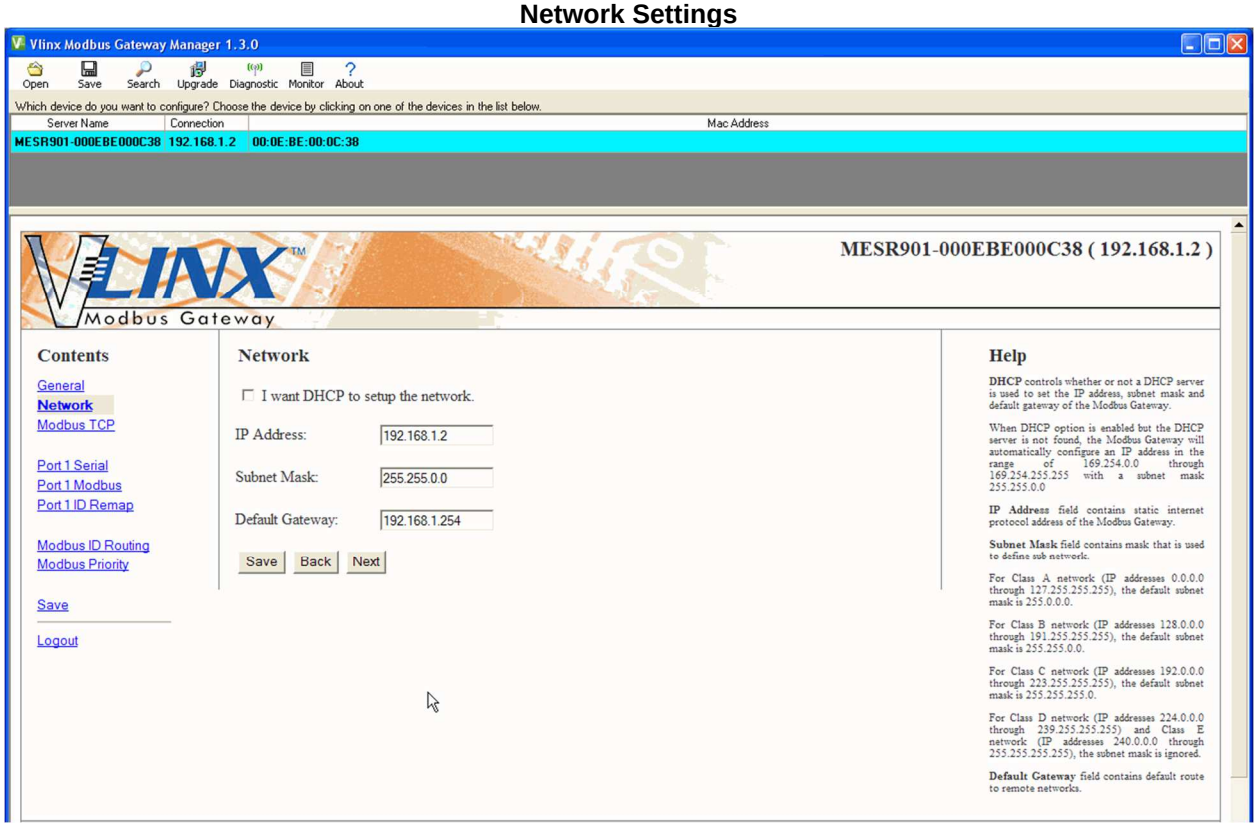
**Note**: Use the terminal block for wiring of RS-485 communications.

When configuring for RS-485, termination resistors (120 ς) are needed at each end of the network. Note the location of the resistor on the device. The ProTech has the termination resistor built into the module, jumpers are necessary between terminals 14 – 15 and 18 – 19 to activate the termination.

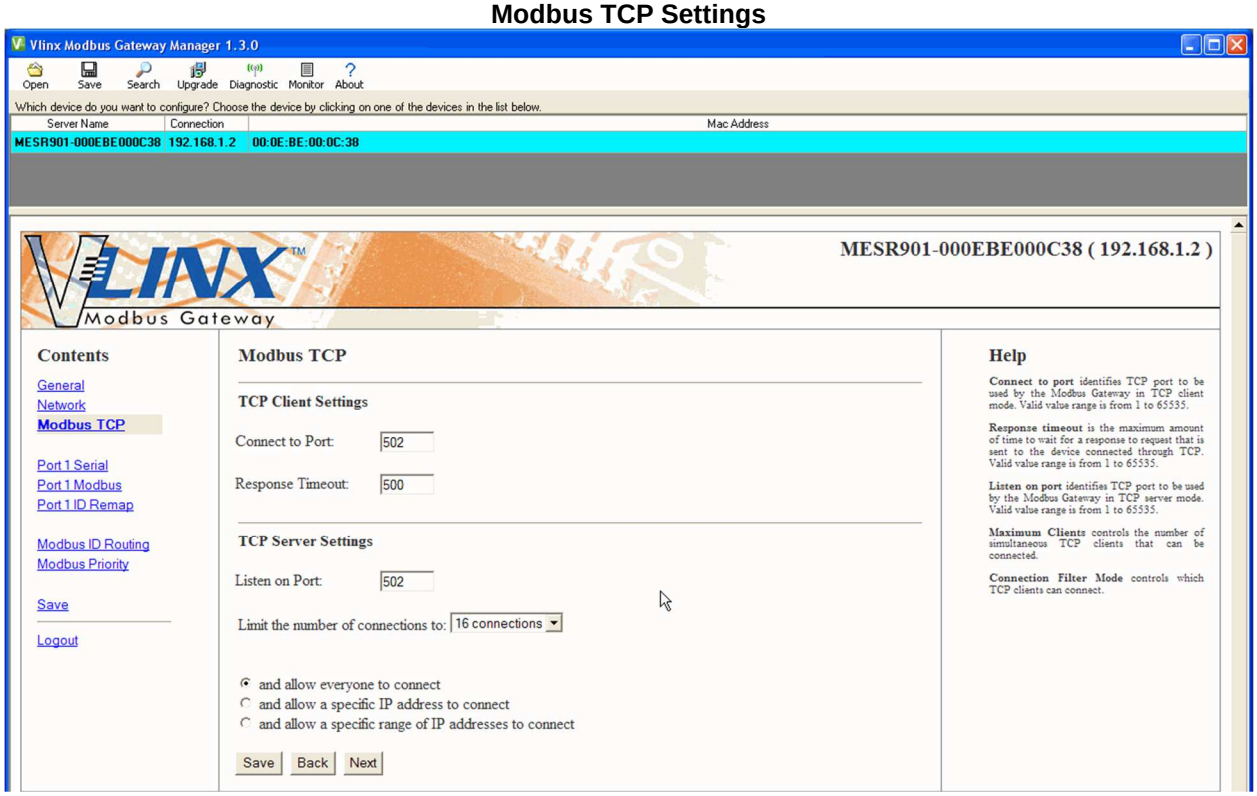
## Configuration

Configuration of the MESR901 is done through Vlinx Modbus Gateway Manager. The configuration software is provided with the device.

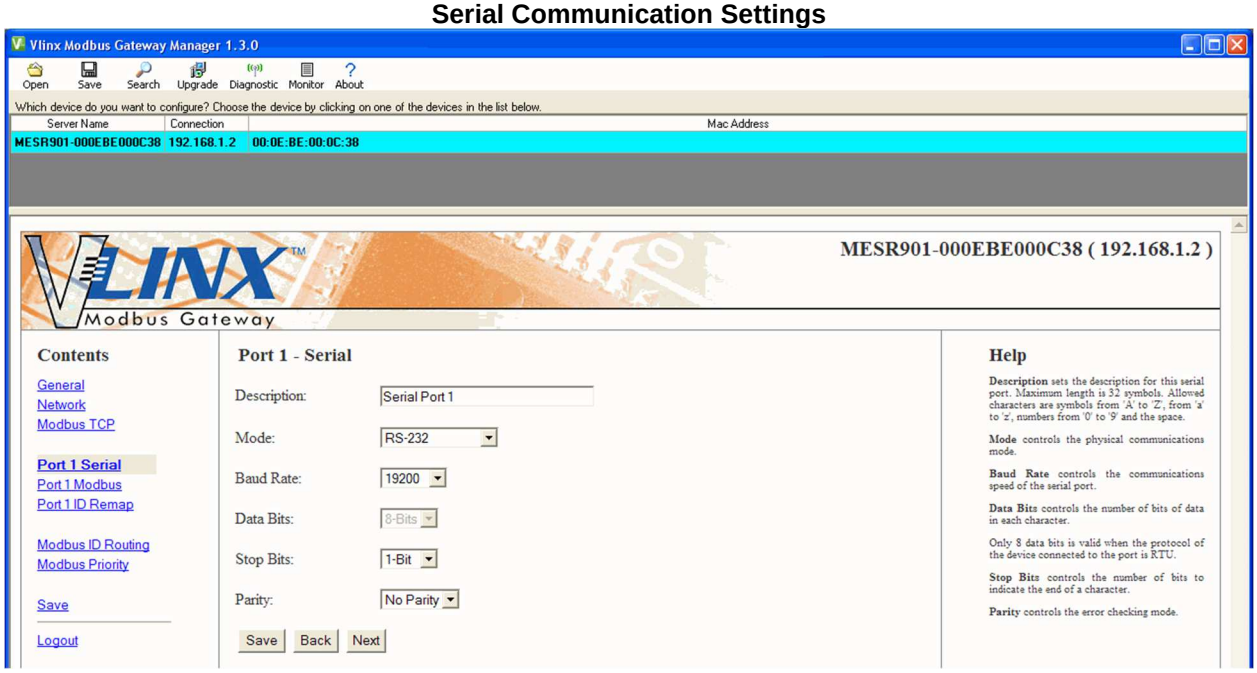
### Network Settings




### Modbus TCP Settings

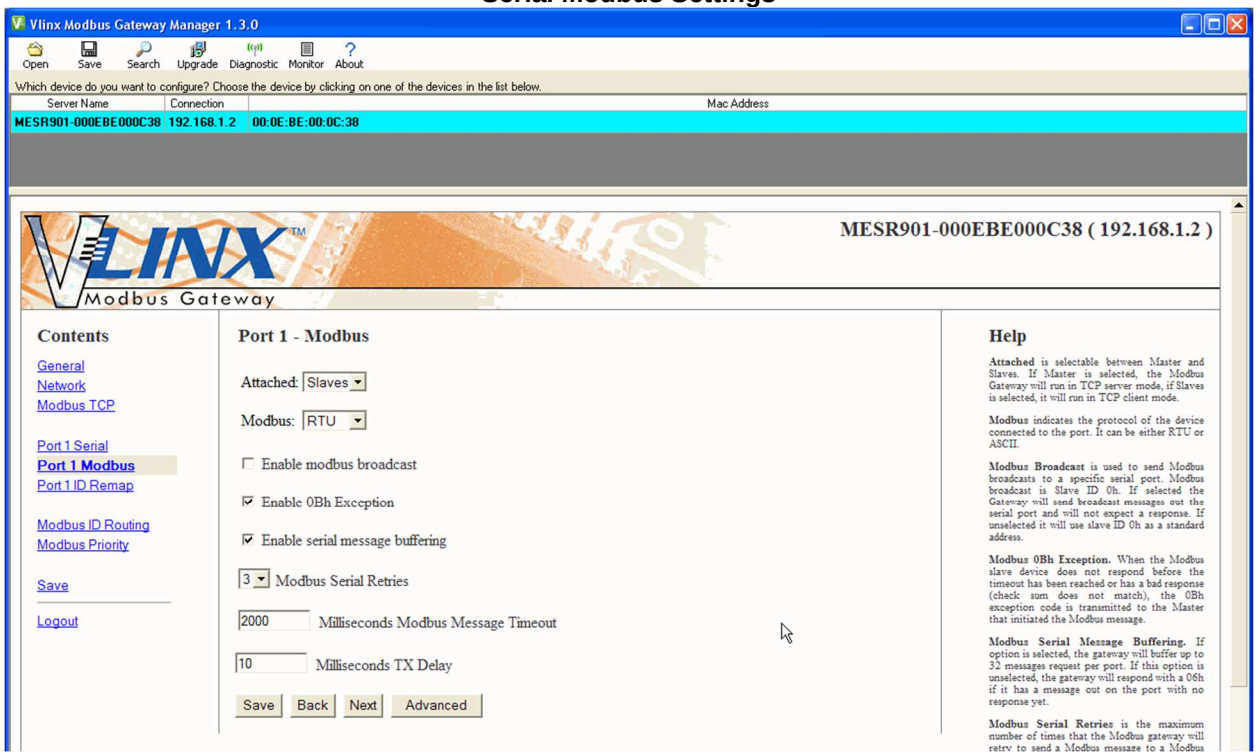


## Serial Communication Settings




**Note**: For RS-485 communication, select RS-485 under Mode, and use the terminal block connections. The DB9 port is for RS-232 communications only.

## Serial Modbus Settings

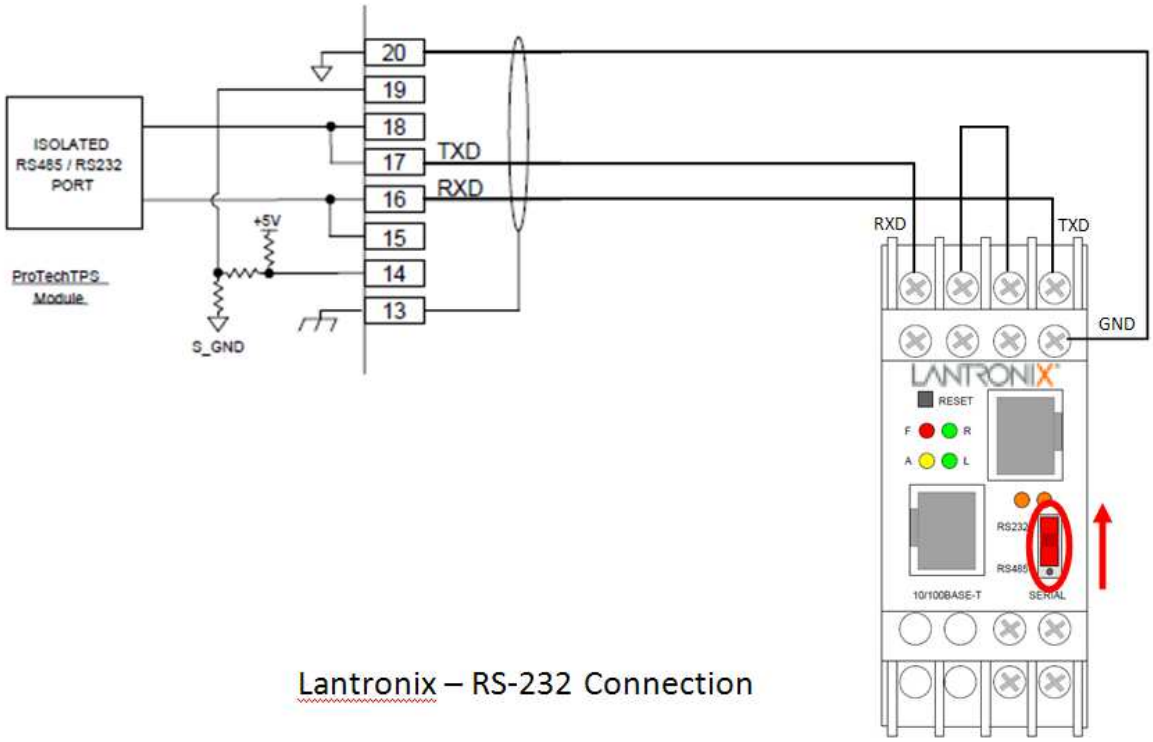


# Lantronix Setup

Below you will find the wiring setup and software configuration for the UDS100-Xpress DR IAP. Remember that the pictures below are for reference, you will need to setup the serial configuration to match the settings you chose in the ProTech. When multi-dropping the 3 modules together using RS-485/422, you will need to assign each module a unique node address, which can be found in the Modbus configuration screen on the ProTech.

## Wiring

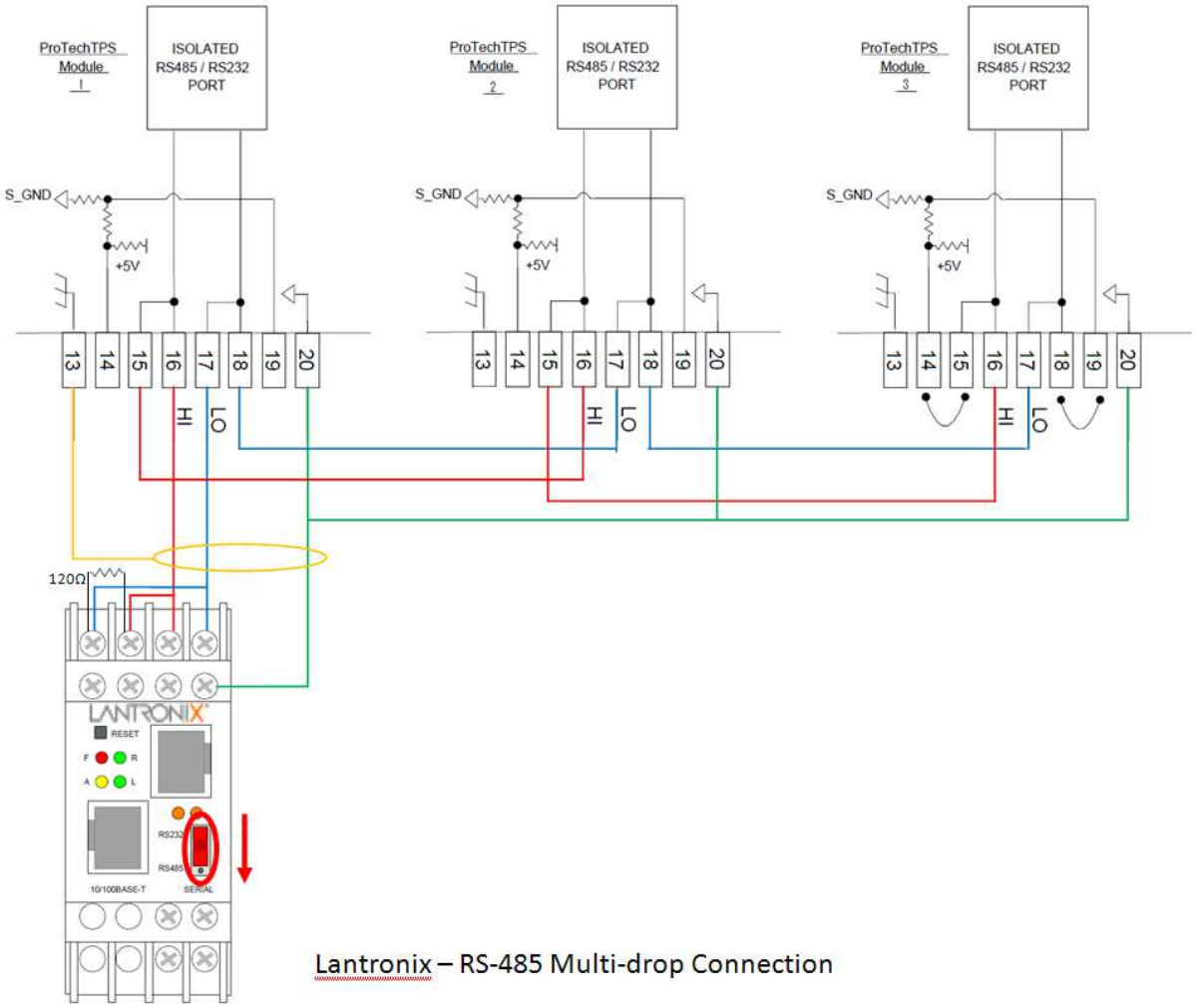
**RS-232**




Lantronix – RS-232 Connection

Verify that the dip switch on the front of the device is in the up position, indicating RS-232 communications.

**RS-485 2-wire**



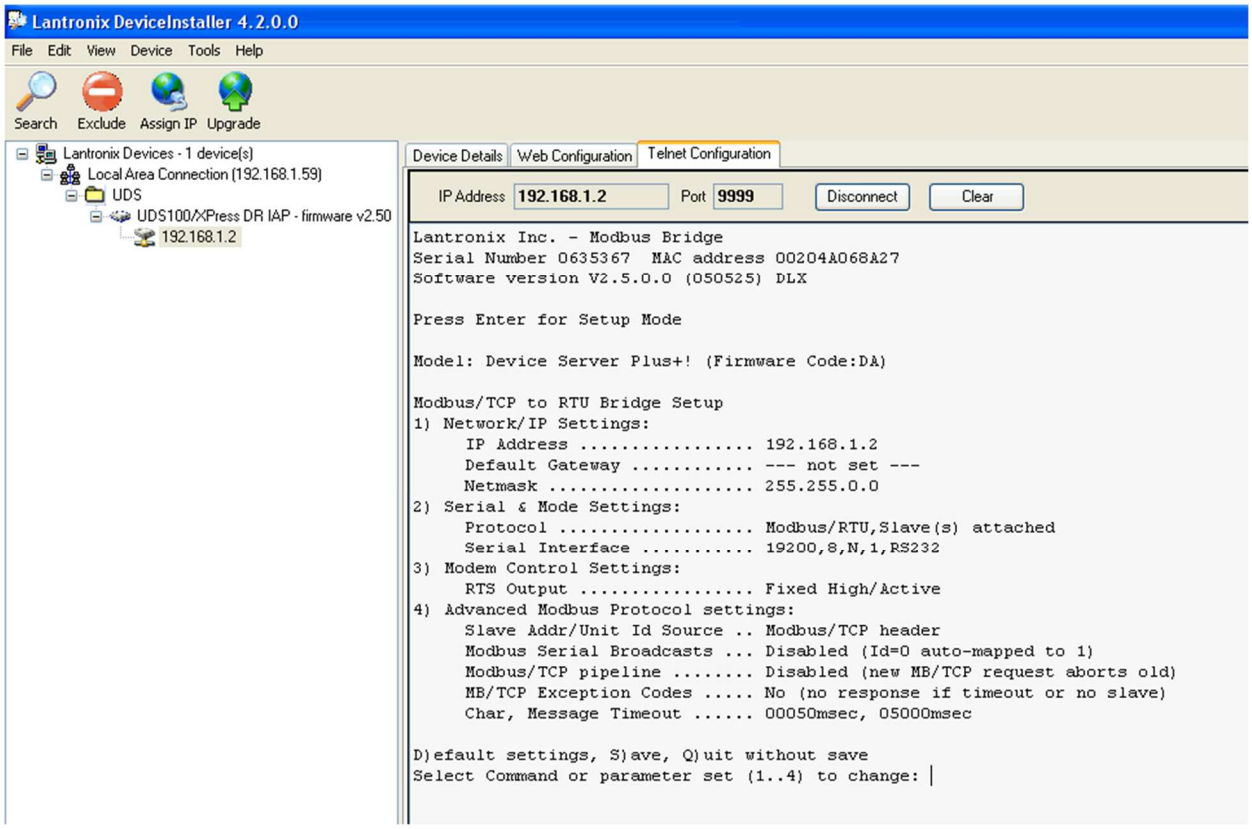

Lantronix – RS-485 Multi-drop Connection

Verify that the dip switch on the front of the device is in the down position, indicating RS-485 communications. When configuring for RS-485, termination resistors (120 ς) are needed at each end of the network. Note the location of the resistor on the device. The ProTech has the termination resistor built into the module, jumpers are necessary between terminals 14 – 15 and 18 – 19 to activate the termination.

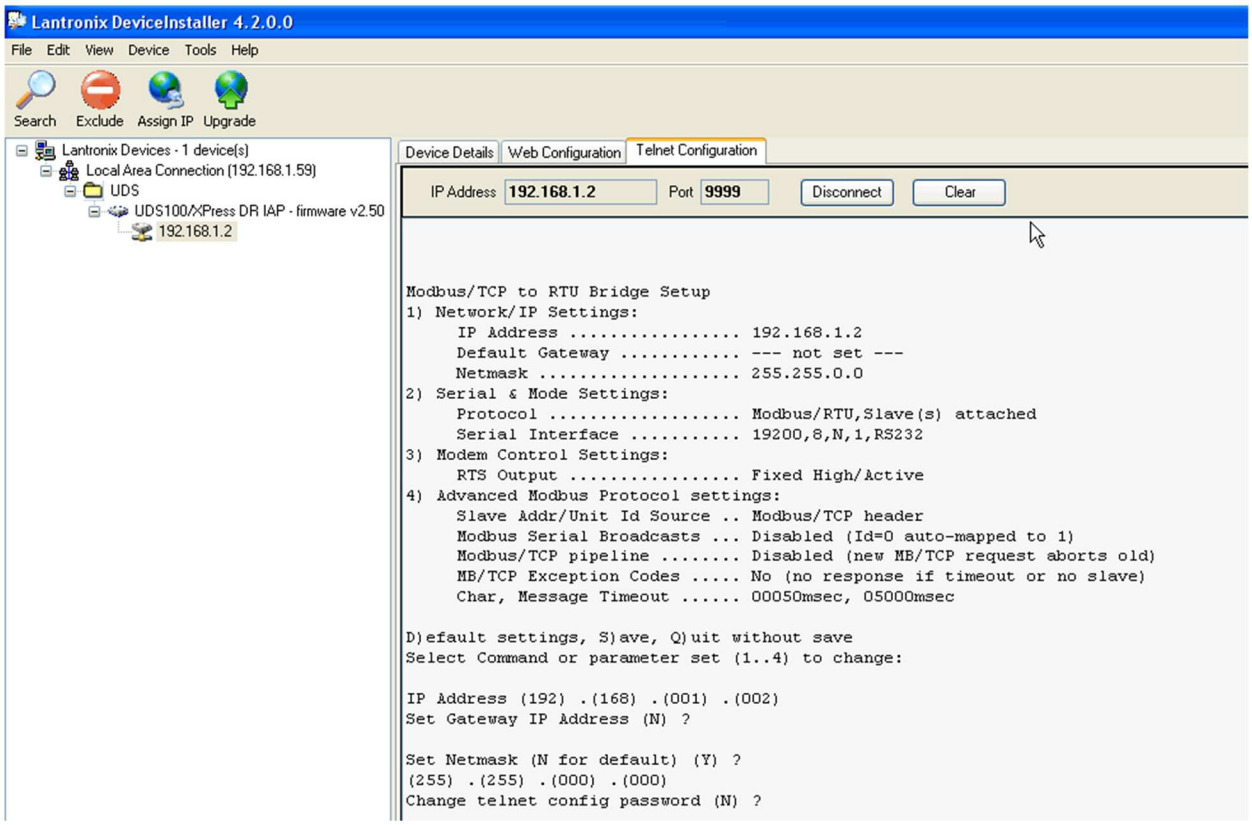
## Configuration

Configuration of the UDS100-Xpress DR IAP is done through DeviceInstaller. The configuration software is provided with the device.

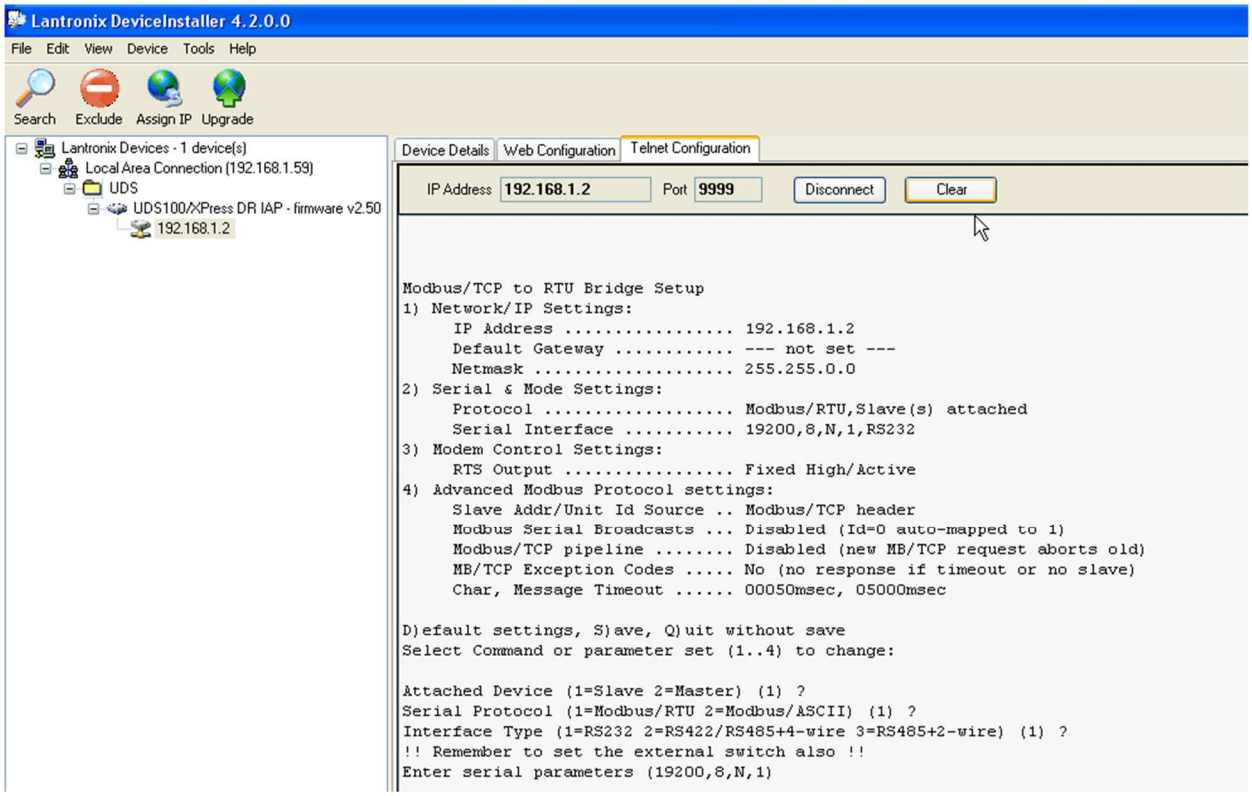
**Overview**



## Network Menu

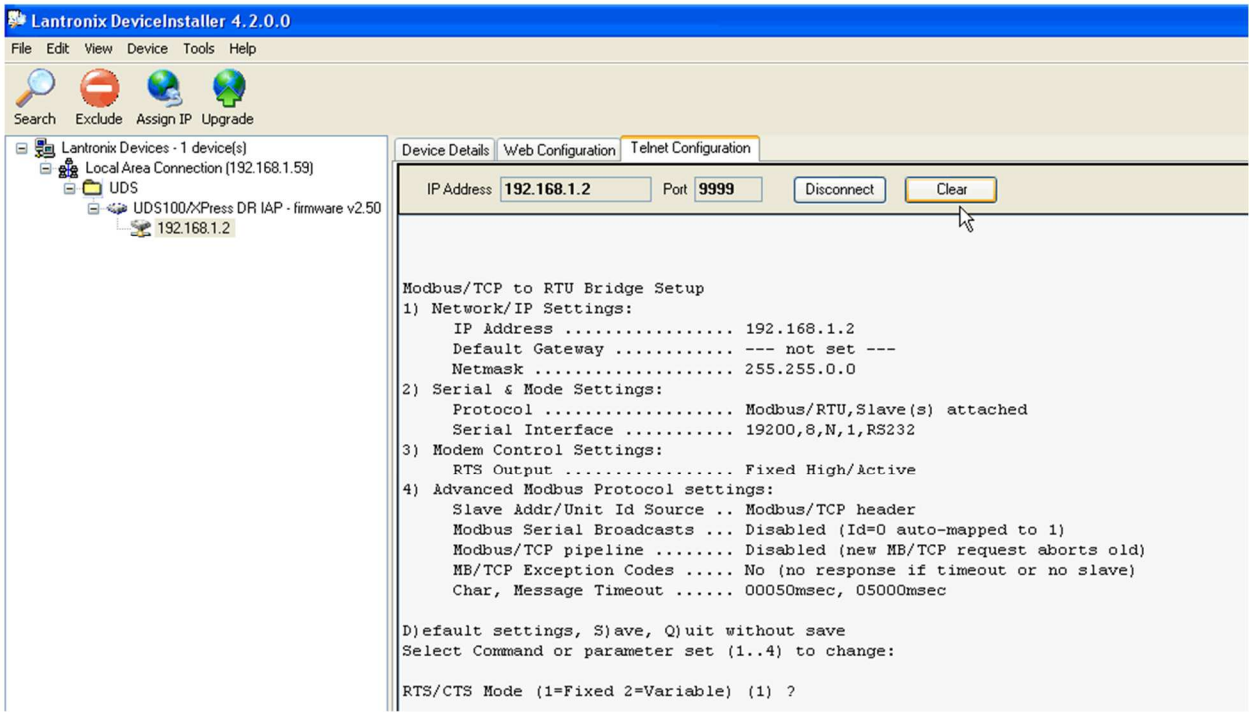



## Serial Settings Menu

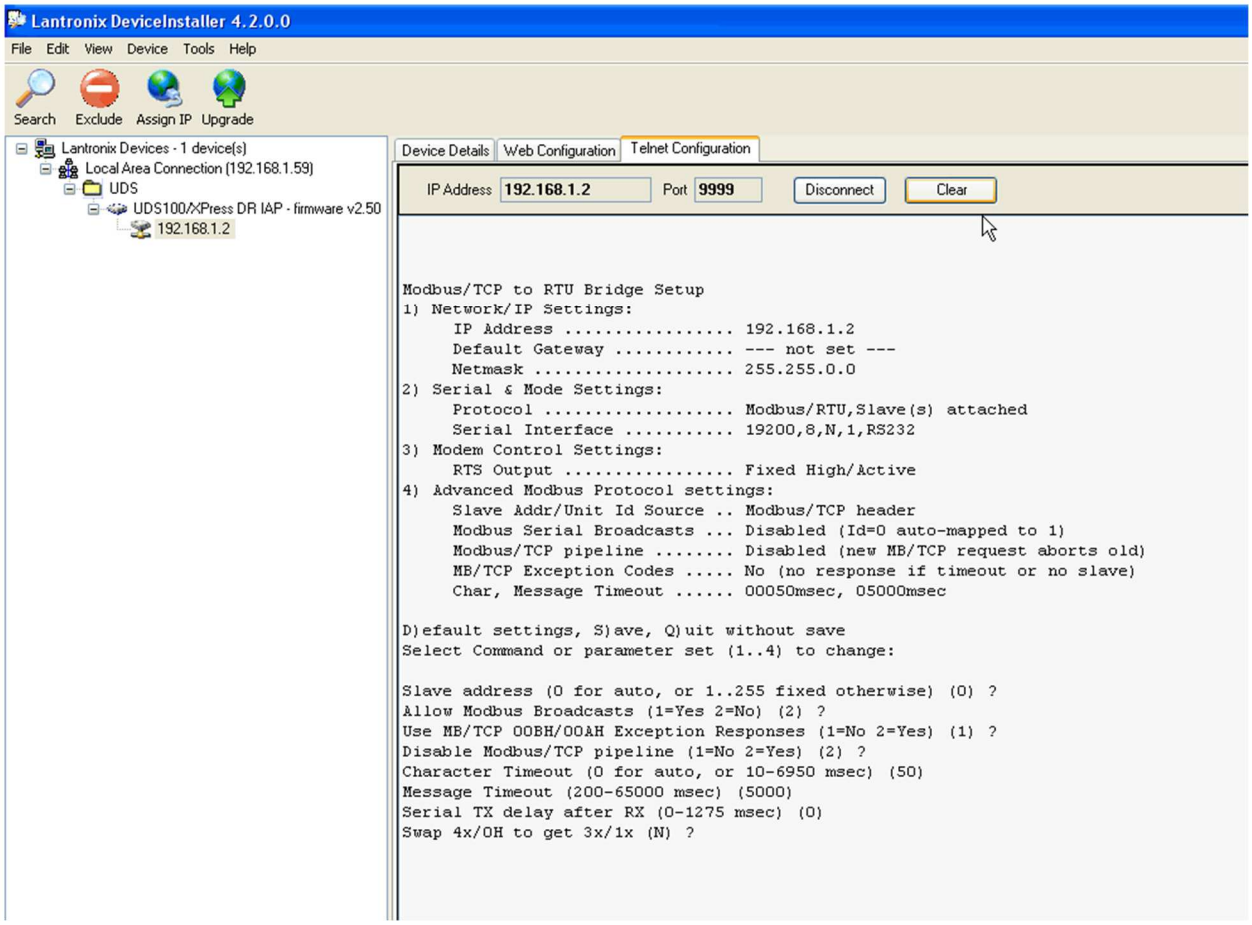



**Note**: For RS-485 communications, choose option 3 under interface type and don't forget to set the dip switch on the front of the device.

## Modem Control Menu




## Advanced Menu



# Revision History

**Changes in Revision G—**

- A note was added to the first paragraph on Pg. 44
- Added Warning Boxes to Pgs. 55 and 60
- Added 2-Wire Only to the first row in Table 4-1
- Installed Configuration Guidance section in Chapter 5

**Changes in Revision F—**

- Made the following changes to the Regulatory Compliance section
  - Updated the ATEX PED and RoHS Directives
  - Deleted WEE, EuP, and C-Tick Compliance
  - Added Australia (& New Zealand) RCM Compliance

**Changes in Revision E—**

- Updated Regulatory and Compliance Section
- Updated DOC/DOI

**Changes in Revision D—**

- Updated manual to reflect changes to MPU input threshold and impedance

**Changes in Revision C—**

- Updated part numbers in Table 1-1

# Declarations

## EU DECLARATION OF CONFORMITY

| | |
|---|---|
| **EU DoC No.:** | 00396-04-EU-02-01 |
| **Manufacturer's Name:** | WOODWARD INC. |
| **Manufacturer's Contact Address:** | 1041 Woodward Way<br>Fort Collins, CO 80524 USA |
| **Model Name(s)/Number(s):** | ProTech®-GII, ProTech® TPS, and the MicroNet® Safety Module |
| **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<br><br>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)<br><br>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:** | Ex Category 3 Group II G, Ex nA IIC T4 X |
| **Applicable Standards:** | EN61000-6-2:2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments<br><br>EN61000-6-4:2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments<br><br>EN60079-15, 2010: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n'<br><br>EN60079-0, 2012/A11:2013: Electrical apparatus for explosive gas atmospheres – Part 0: General requirements<br><br>EN61010-1, 2001: Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1:General Requirements |
| **Last two digits of the year in which the CE marking was affixed for the first time:** | 10 |

**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**

13-JUL-2016

**Date**

5-09-1183 Rev 26

Released

**We appreciate your comments about the content of our publications.**

**Send comments to: icinfo@woodward.com**

**Please reference publication 26547V1.**

B 2 6 5 4 7 V 1 : G

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Phone +1 (970) 482-5811

**Email and Website—www.woodward.com**

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