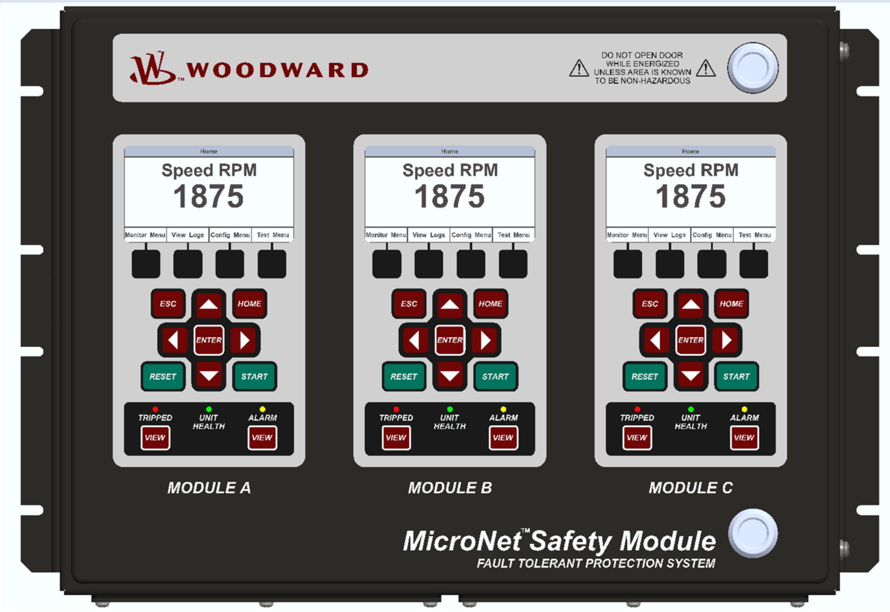
Released

Product Manual 26711V1
(Revision G, 12/2022)
Original Instructions



MicroNet™ Safety Module
Fault Tolerant Protection System

With Voted Inputs

Manual 26711 consists of 2 volumes (26711V1 & 26711V2)

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	**This publication may have been revised or updated since this copy was produced. The latest version of most publications is available on the Woodward website.** **http://www.woodward.com** **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	**If the cover of this publication states "Translation of the Original Instructions" please note:** **The original source of this publication may have been updated since this translation was made. The latest version of most publications is available on the Woodward website.** **www.woodward.com/publications** **Always compare with the original for technical specifications and for proper and safe installation and operation procedures.** **If your publication is not on the Woodward website, please contact your customer service representative to get the latest copy.**

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

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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. After removing the old PCB from the control cabinet, immediately place it in the antistatic protective bag.

Regulatory Compliance

These listings apply to stationary industrial markets only and are limited only to those units bearing the 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 making electrical equipment available on the market that is designed for use within certain voltage limits.
ATEX 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. Ex II 3 G, Ex ec nC IIC T4 Gc

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.

United Kingdom Compliance for UKCA Marking:
These listings are limited only to those units bearing the UKCA Marking.

S.I. 2016 No. 1107	Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016 Ex II 3 G, Ex ec nC IIC T4 Gc
S.I. 2016 No. 1091	Electromagnetic Compatibility Regulations 2016
S.I. 2016 No. 1101	The Electrical Equipment (Safety) Regulations 2016

Other UKCA Compliance:
Compliance with the following UKCA regulations or standards does not qualify this product for application of the UKCA Marking:

Hazardous Substances and Packaging:	S.I. 2020 No. 1647: The Hazardous Substances and Packaging (Legislative Functions and Amendments) (EU Exit) Regulations 2020. This product is intended to be sold and used only as equipment which is specifically designed, and is to be installed, as part of another type of equipment that is excluded or does not fall within the scope of this Regulation, which can fulfil its function only if it is part of that equipment, and which can be replaced only by the same specifically designed equipment, and therefore fulfills the requirements stated in Part 2 of Schedule1 clause 16, and as such, is excluded from the scope of the Regulation. This product is intended to be sold and used only as repair, updating, or upgrading of EEE (as defined in part 3 of schedule 1) that either was excluded from the scope of the Directive at the time of placing on

	the market (as defined in Schedule 1, part 2) or which benefited from an exemption, and which was placed on the market before that exemption expired (per schedule 1 part 3).

Other International Compliance:

Australia (& New Zealand)	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	RCM on Woodward 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 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.*
IECEx:	Certified for use in explosive atmospheres per Certificate: IECEx TUR 21.0042X Ex ec nC IIC T4 Gc.
TUV:	TÜV certified for SIL-3 per IEC 61508 Parts 1-7, Functional Safety of Electrical / Electronic / Programmable Electronic Safety Related Systems.

North American Compliance :

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

Other Compliance :

Gas Corrosion:	IEC60068-2-60:1995 Part 2.60 Methods 1 and 4 (conformal coating).
Machinery Protection:	API670, API612, & API-611 compliant.

Regulatory Compliance – 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.

For hazardous location installations, 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.

⚠WARNING Explosion Hazard	**Due to the Hazardous Locations Listings associated with this product, proper wire type and wiring practices are critical to the operation.**

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 60 °C.

The risk of electrostatic discharge is reduced by permanent installation of this device, proper connection of the equipotential ground lugs, and care when cleaning. This device must not be cleaned or wiped off unless the area is known to be non-hazardous.

⚠WARNING Explosion Hazard	**The external ground lugs shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere. Cleaning by hand or water spray must be performed while the area is known to be non-hazardous to prevent an electrostatic discharge in an explosive atmosphere.**

ATEX/IECEx Zone 2, Category 3G applications require the final installation location to provide an IP-54 or higher ingress protection enclosure against dust and water per IEC 60529. The enclosure must meet IEC 60079-0 Design & Test Requirements.

For Zone 2 installations, transient protection for the MSM/Protech Control is to be provided externally by the end user at the supply terminals of the control. The transient protection device is to be set at a level not exceeding 140% of the peak rated voltage (36Vdc for low voltage or 264 Vac for high voltage power input module).

Personnel must discharge their electrostatic build up to the cabinet ground point or use an ESD strap prior to touching the MSM/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.**

⚠WARNING Explosion Hazard	**Do not remove covers or connect/disconnect electrical connectors unless power has been switched off and the area is known to be non-hazardous.**

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.

The MSM/Protech Control (front panel version) shall not be installed in areas exceeding Pollution Degree 2 as defined in IEC 60664-1.

The control must be mounted in a vertical position. The installer shall ensure the maximum surrounding air temperature of the control does not exceed +60°C at the final location.

⚠WARNING Explosion Hazard	**MOUNTING** **The control must be mounted in a vertical position.** **The installer shall ensure the maximum surrounding air temperature of the control does not exceed +60°C at the final location.**

⚠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 the area is known to be non-hazardous.** **Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.**

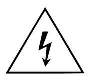
⚠AVERTISSEMENT	**Risque d'explosion—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.** **La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2 ou Zone 2.**

Safety Symbols

 Direct current

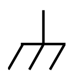
 Alternating current

 Both alternating and direct current

 Caution, risk of electrical shock

 Caution, refer to accompanying documents

 Protective conductor terminal

 Frame or chassis terminal

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 MicroNet Safety Module Service Tool (.wset).
MSM	MicroNet Safety Module

Chapter 1.
General Information

Description

The MicroNet Safety Module is an overspeed safety device designed to safely shut down steam, gas, and hydro turbines of all sizes upon sensing an overspeed or over-acceleration event. This device accurately monitors turbine rotor speed and acceleration via active or passive MPUs (magnetic pickups) and issues a shutdown command to the turbine's trip valve(s) or corresponding trip system. In addition, it has 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, dependent upon model used, are either independent or voted in a 2-out-of-3 configuration. An isolated bus architecture is used to share all inputs and latch status information between the three modules. Optionally each MicroNet Safety Module can be configured to use only its sensed "local" input signals or the voted result of all three modules' signals in its event latch decision logic. Optionally module trip and alarm latch statuses can also be configured to be shared with all other modules.

The MicroNet Safety Module includes Overspeed and Over-acceleration functions as well as time stamped Alarm, and Trip logs. Indication that a test was active at the time of the event is provided on all logs and first-out indications are provided for Trip and Event 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 allows the user to view current values, and to perform certain configuration and test functions. All 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.

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
8237-1492	MSM – Bulkhead Mount, HV/LV, Ind relay, voted inputs
8237-1493	MSM – Bulkhead Mount, HV/HV, Ind relay, voted inputs
8237-1494	MSM – Bulkhead Mount, HV/LV, voted relays, voted inputs
8237-1495	MSM – Bulkhead Mount, HV/HV, voted relays, voted inputs
8237-1496	MSM – Panel Mount, HV/LV, Ind relay, voted inputs
8237-1497	MSM – Panel Mount, HV/HV, Ind relay, voted inputs
8237-1498	MSM – Panel Mount, HV/LV, voted relays, voted inputs
8237-1499	MSM – Panel Mount, HV/HV, voted relays, voted inputs
5437-1132	Spare Module for MSM models 8237-1494, -1498
5437-1133	Spare Module for MSM models 8237-1495, -1499
5437-1134	Spare Module for MSM models 8237-1492, -1496
5437-1135	Spare Module for MSM models 8237-1493, -1497

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. The device's fast response time (8–26 milliseconds depending on model and configuration), 0.5 to 32 000 rpm speed range, and integrated overspeed and acceleration detection/protection functionality, make it ideal for applications 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 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) are a concern or necessity.

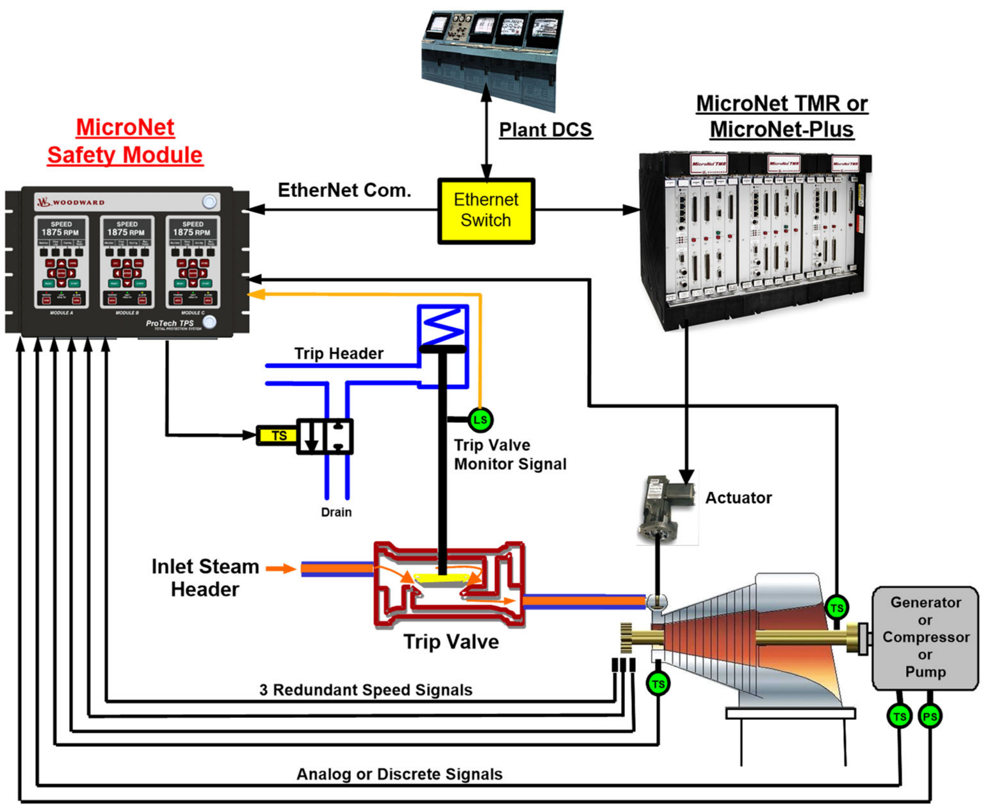


Figure 1-1. Typical MicroNet Safety Module Application (Voted Trip Relay Models)

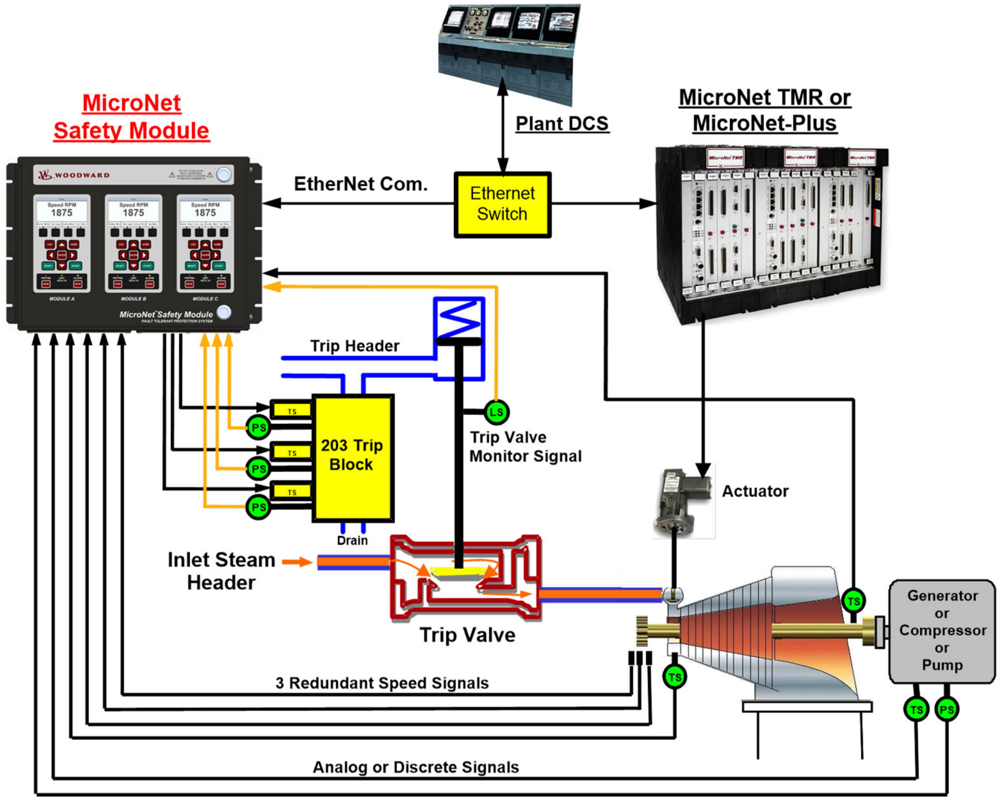


Figure 1-2. Typical MicroNet Safety Module Application (Independent Trip Relay Models)

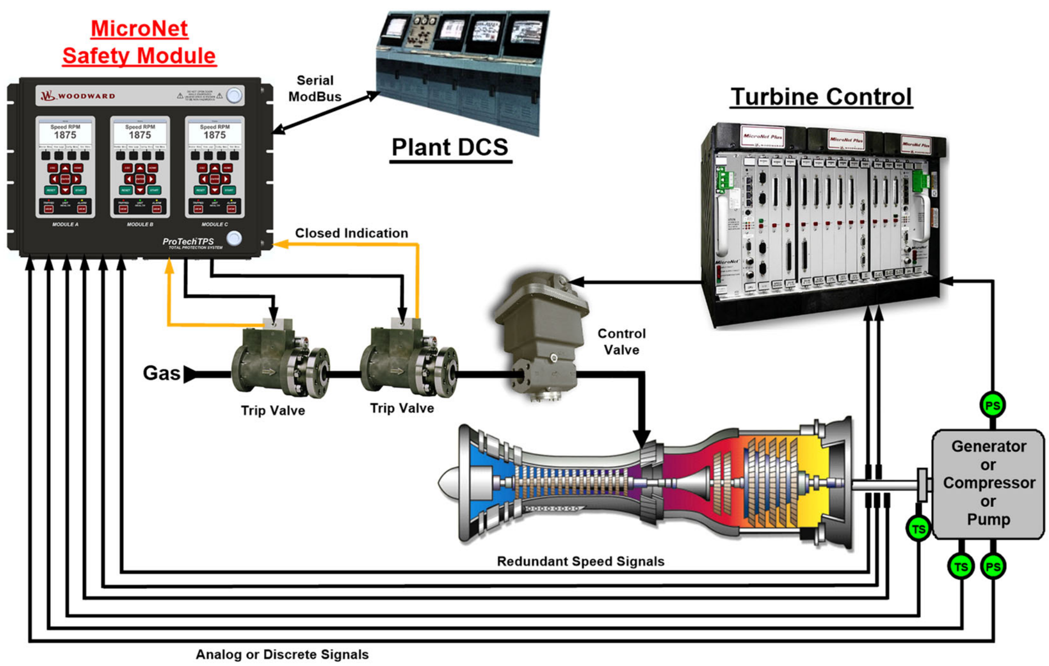


Figure 1-3. Typical Gas Turbine Application (Voted Trip Relay Models)

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.

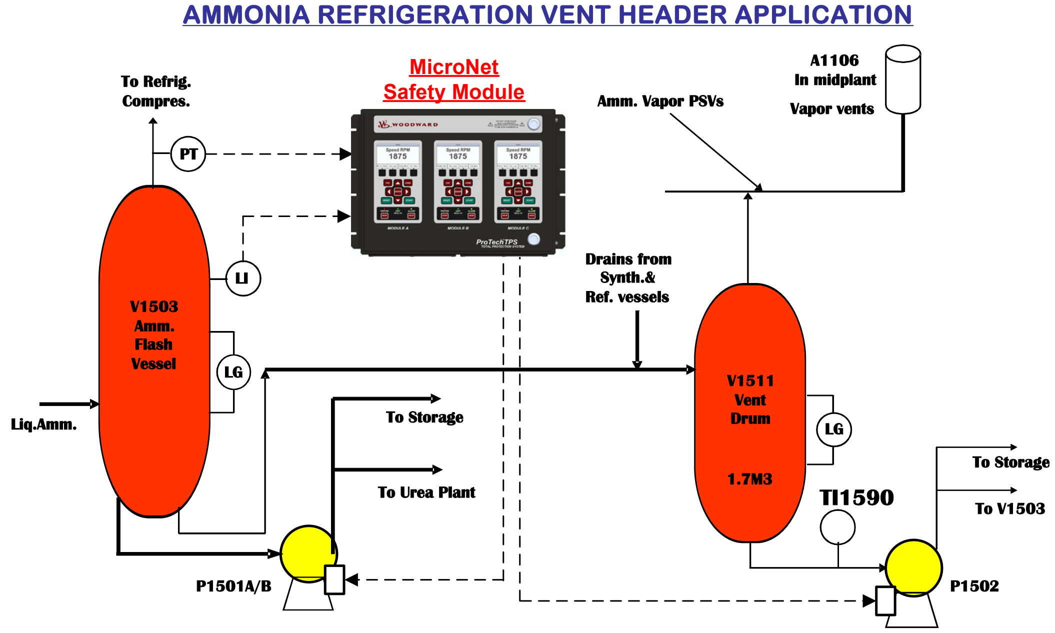


Figure 1-4. Typical Safety PLC Application (Voted Trip Relay Models)

Chapter 2.
Installation

Introduction

This chapter provides instructions on how to mount and connect the MicroNet Safety Module overspeed safety device 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.

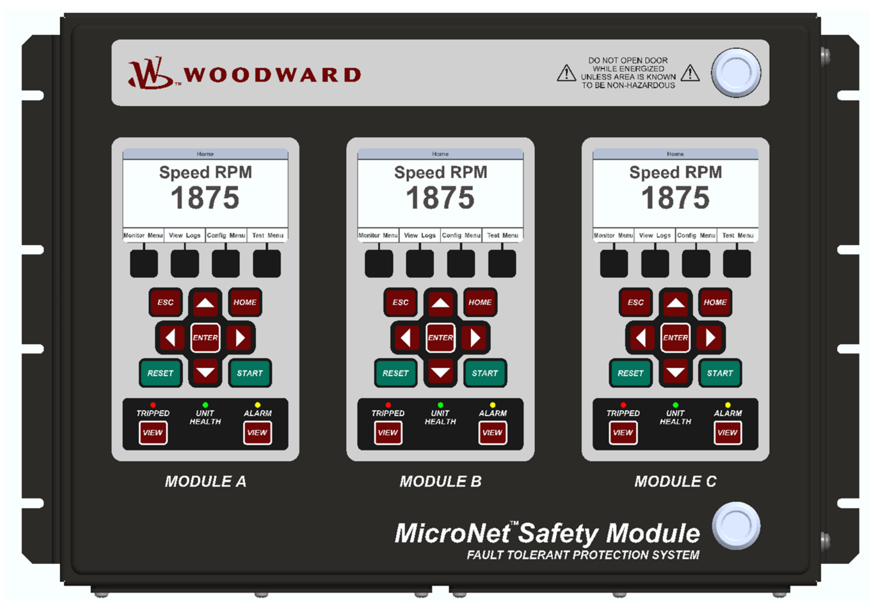


Figure 2-1. Typical MicroNet Safety Module Bulkhead Package—Front View

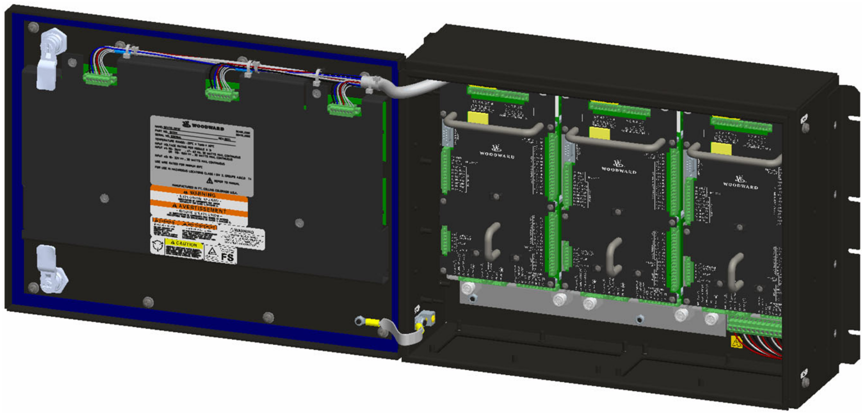


Figure 2-2a. Typical MicroNet Safety Module Bulkhead Package—Front Door Open

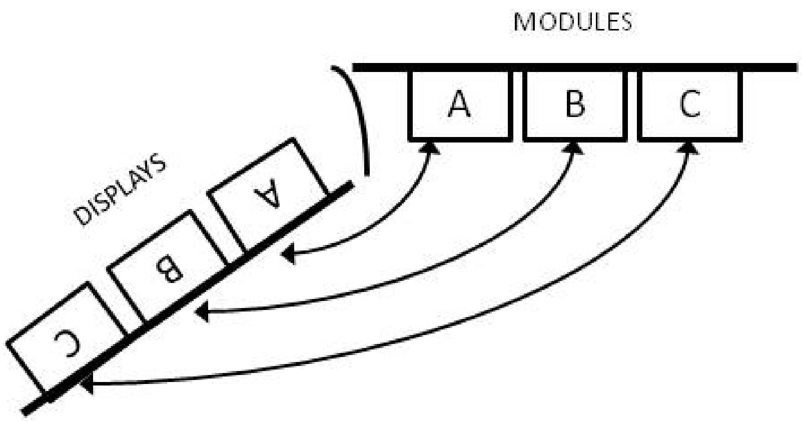


Figure 2-2b. Bulkhead Schematic Showing Front Panel A Connection to Module A and Front Panel C Connection to Module C—Top View

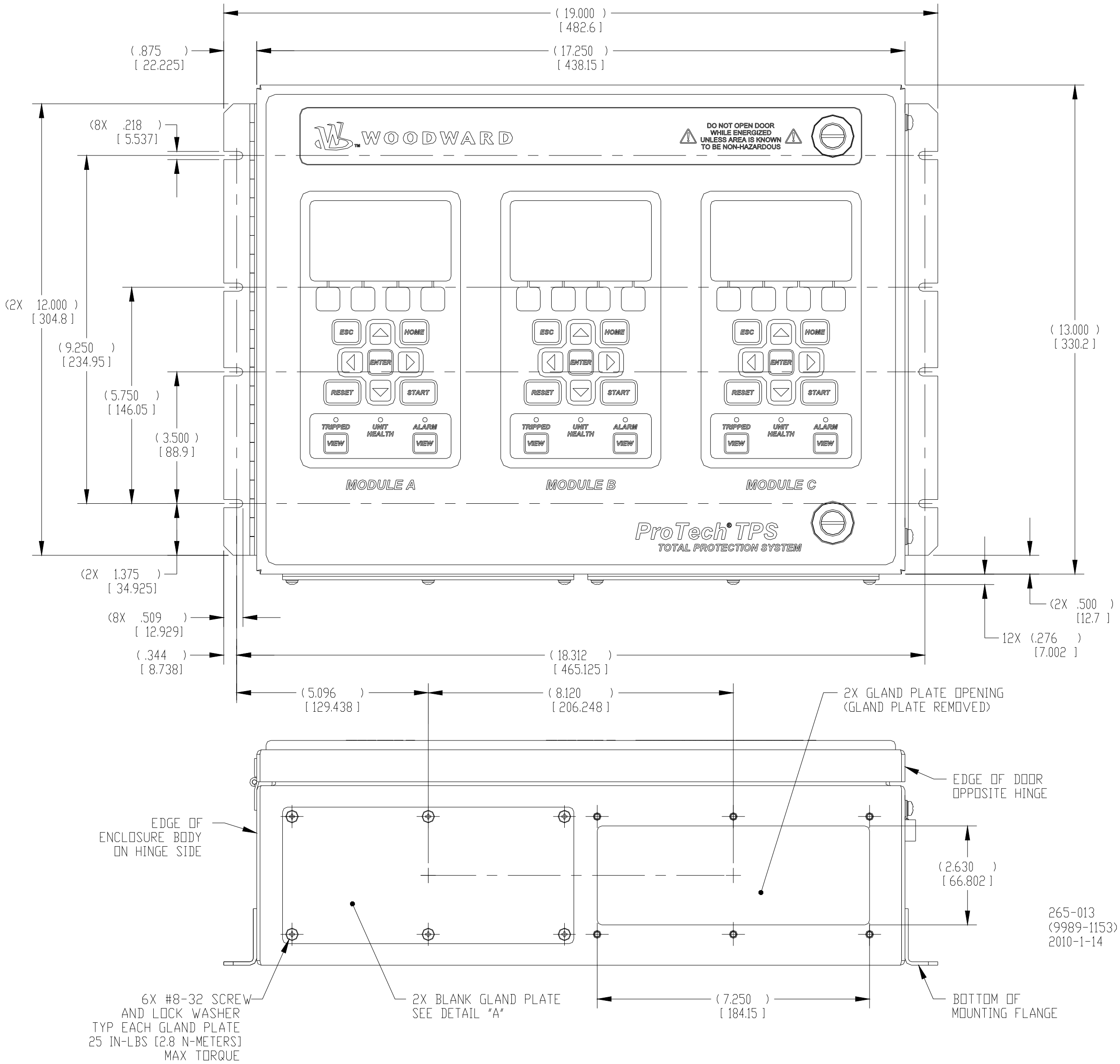


Figure 2-3. Mounting Outline Diagram for Bulkhead-Mounted Models

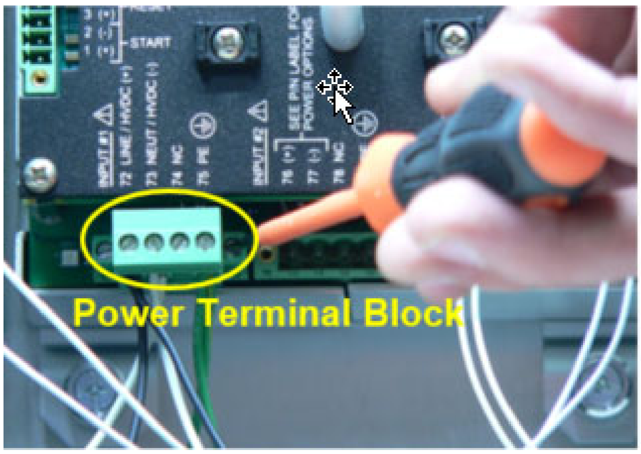
Module Removal and Installation—Bulkhead Mount Package

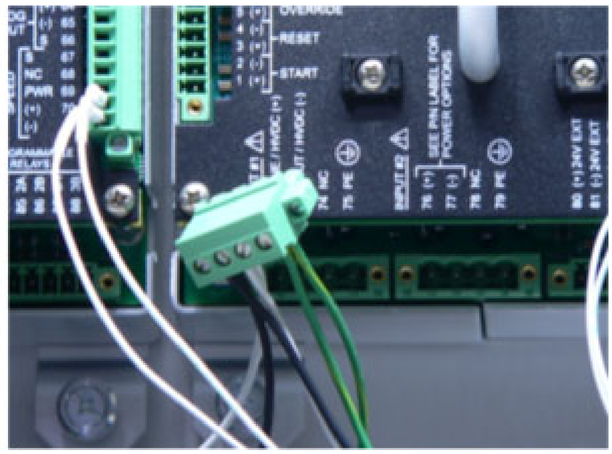
> **⚠WARNING** **Currently, display circuit boards are not replaceable. Users should not attempt to remove or install any display board. If a display board is unresponsive, contact Woodward for a recommendation regarding service options. DO NOT ATTEMPT TO REPAIR!**

Follow this procedure for module removal and installation:

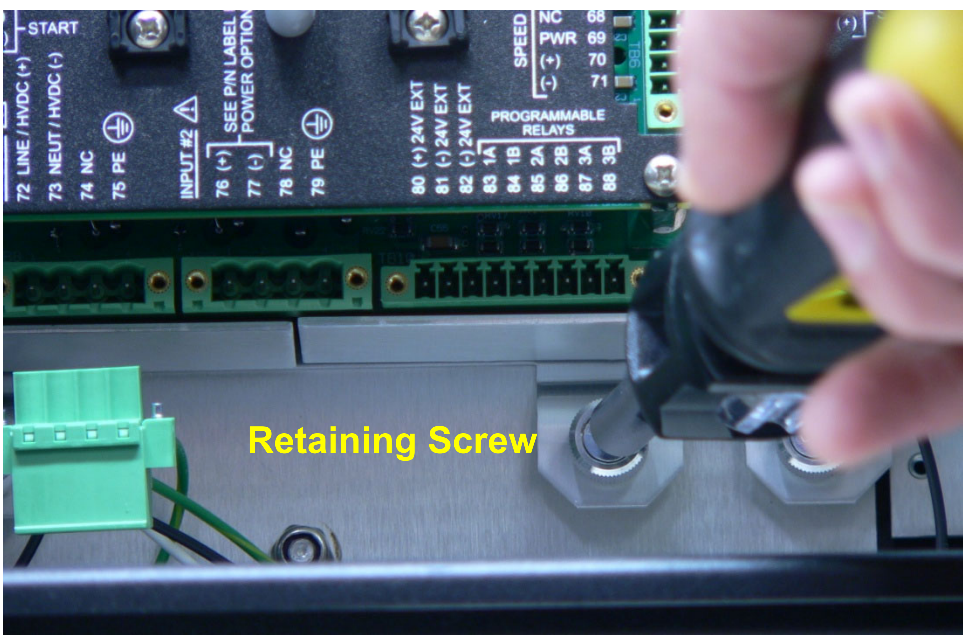
Removal:

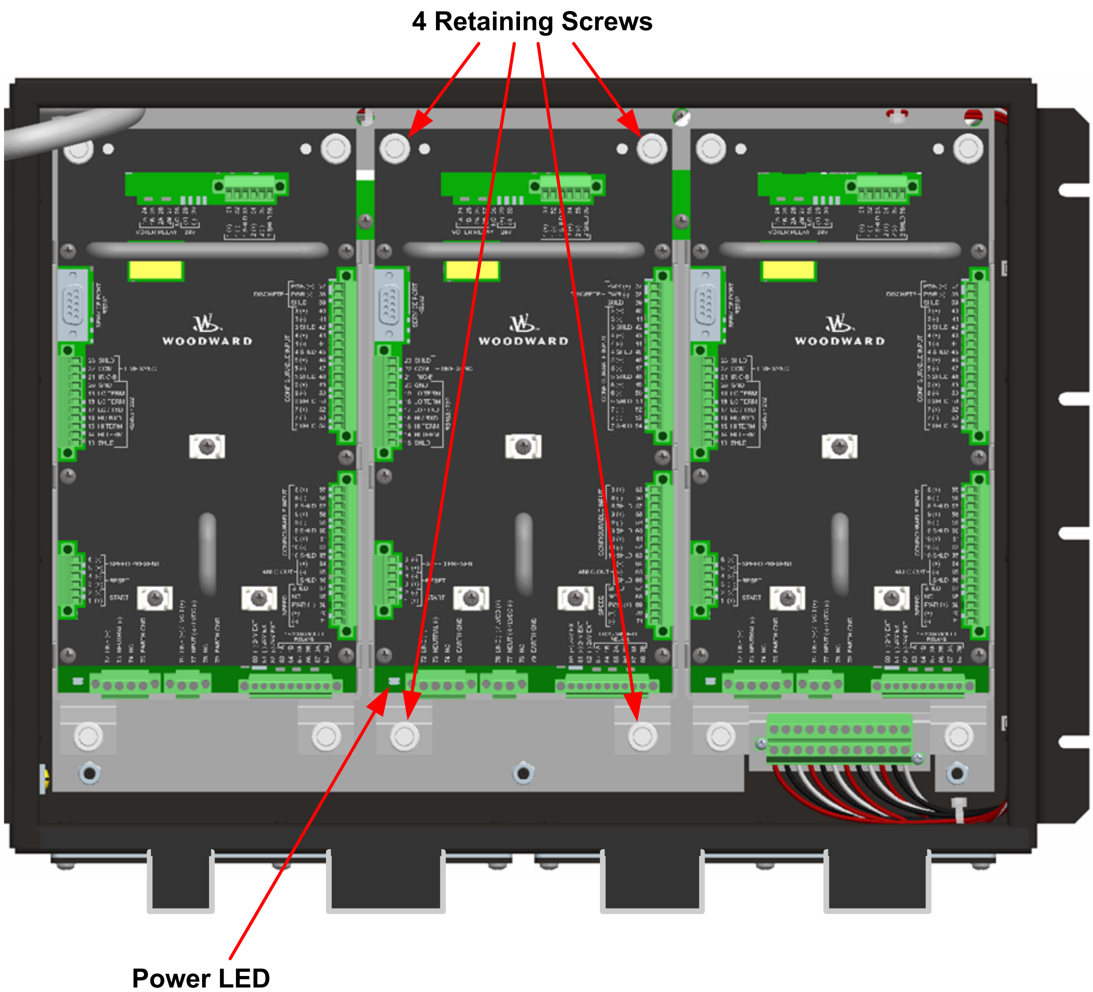
1. Disconnect power from the module to be removed



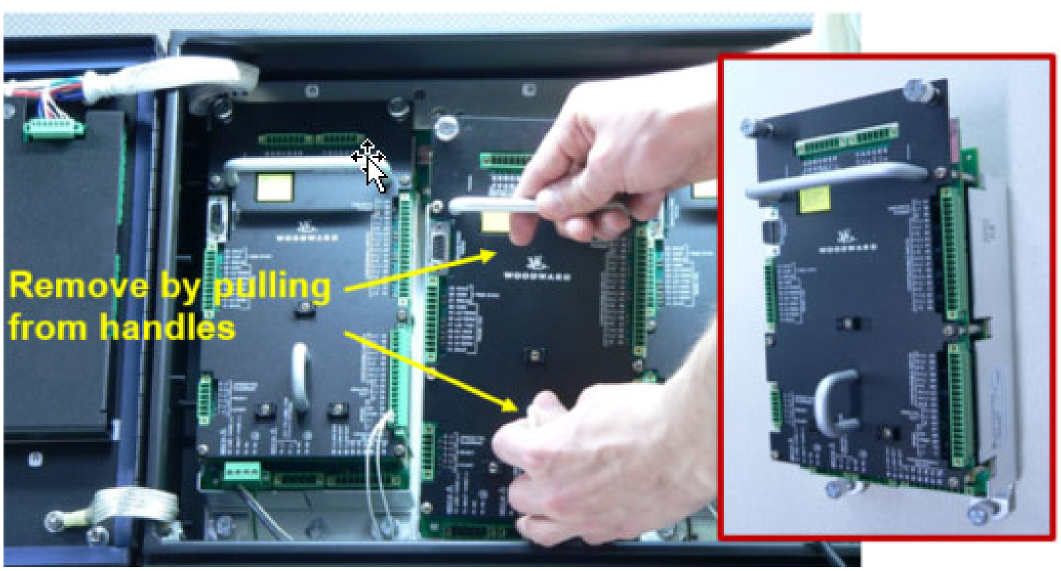


2. Verify power removed by observing power LED is OFF
3. Remove terminal blocks from module terminals
4. Loosen 4 module retention screws

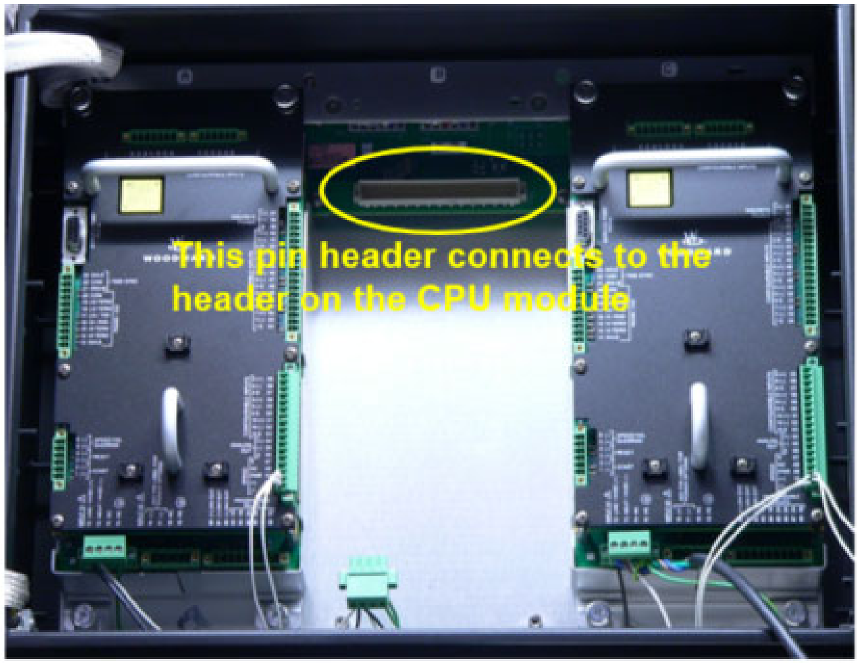


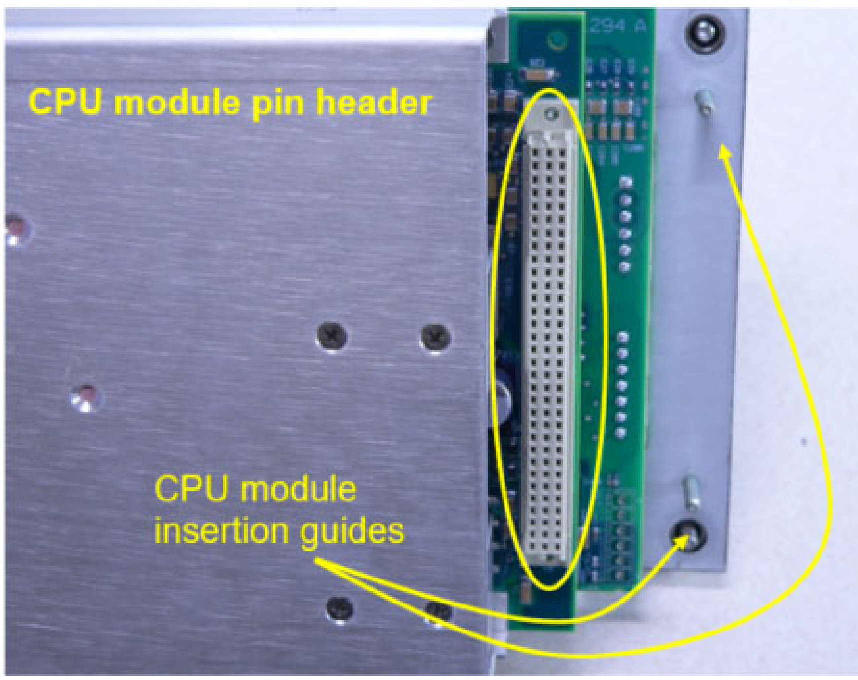


5. Remove module by pulling the two handles simultaneously



Installation:





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

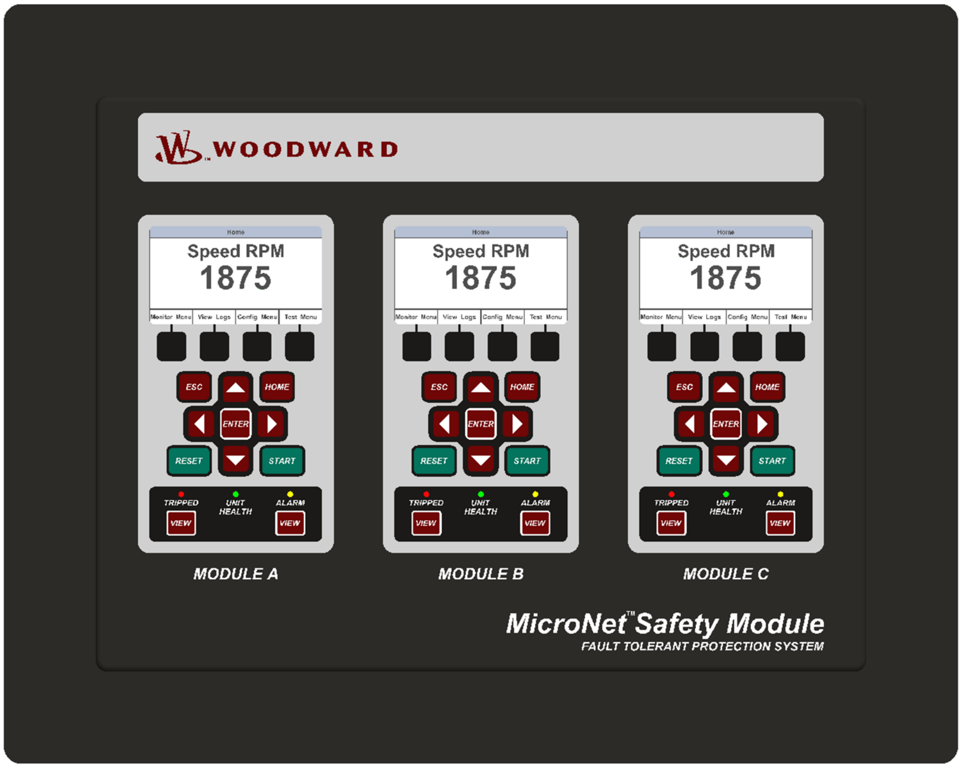


Figure 2-4a. Typical MicroNet Safety Module Panel Mount Package—Front View

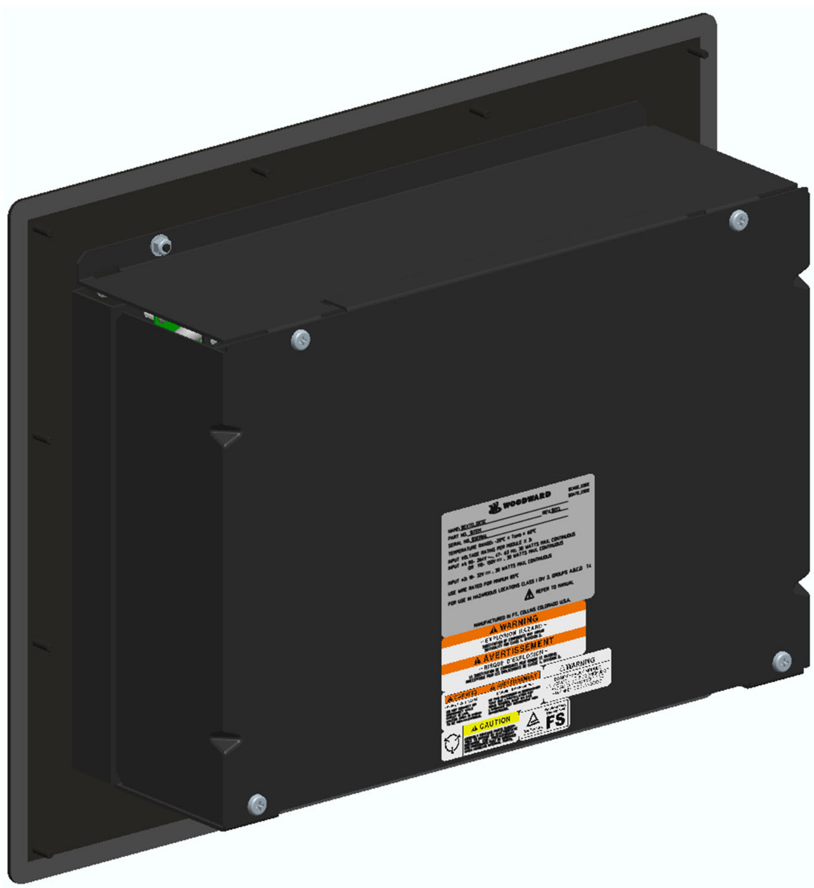


Figure 2-4b. Typical MicroNet Safety Module Panel Mount Package—Rear View With Cover

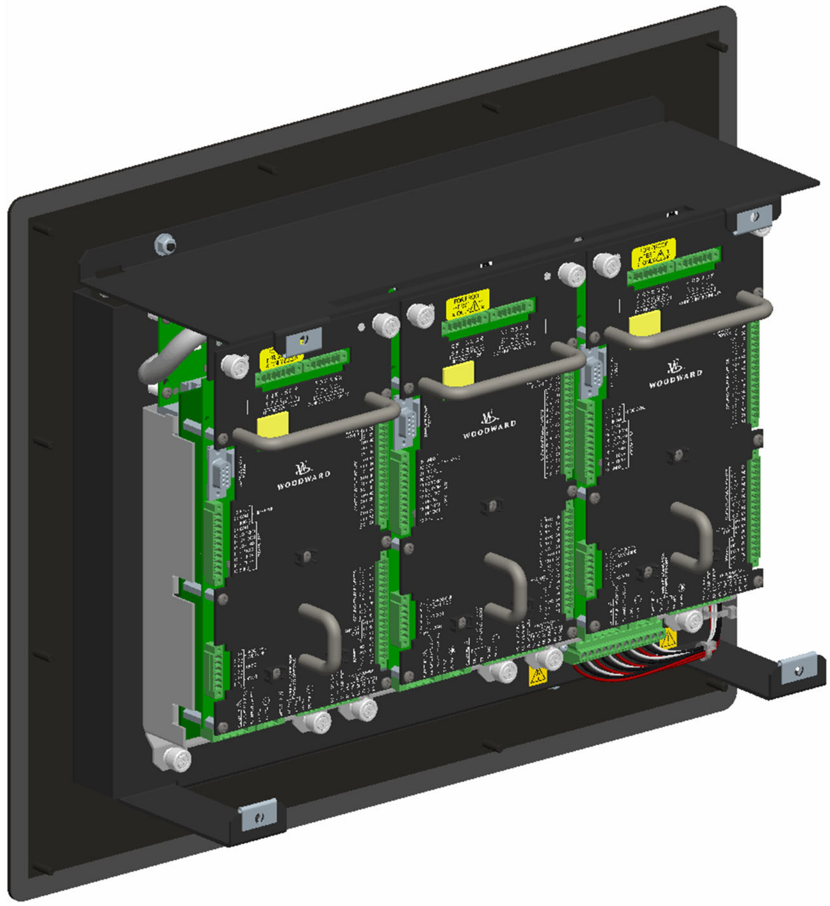


Figure 2-4c. Typical MicroNet Safety Module Panel Mount Package—Rear View Without Cover

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.**

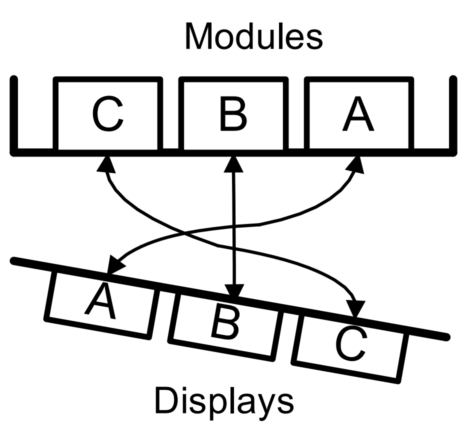


Figure 2-4d. Panel Mount Schematic Showing Front Panel A Connection to Module A and Front Panel C Connection to Module C—Top View

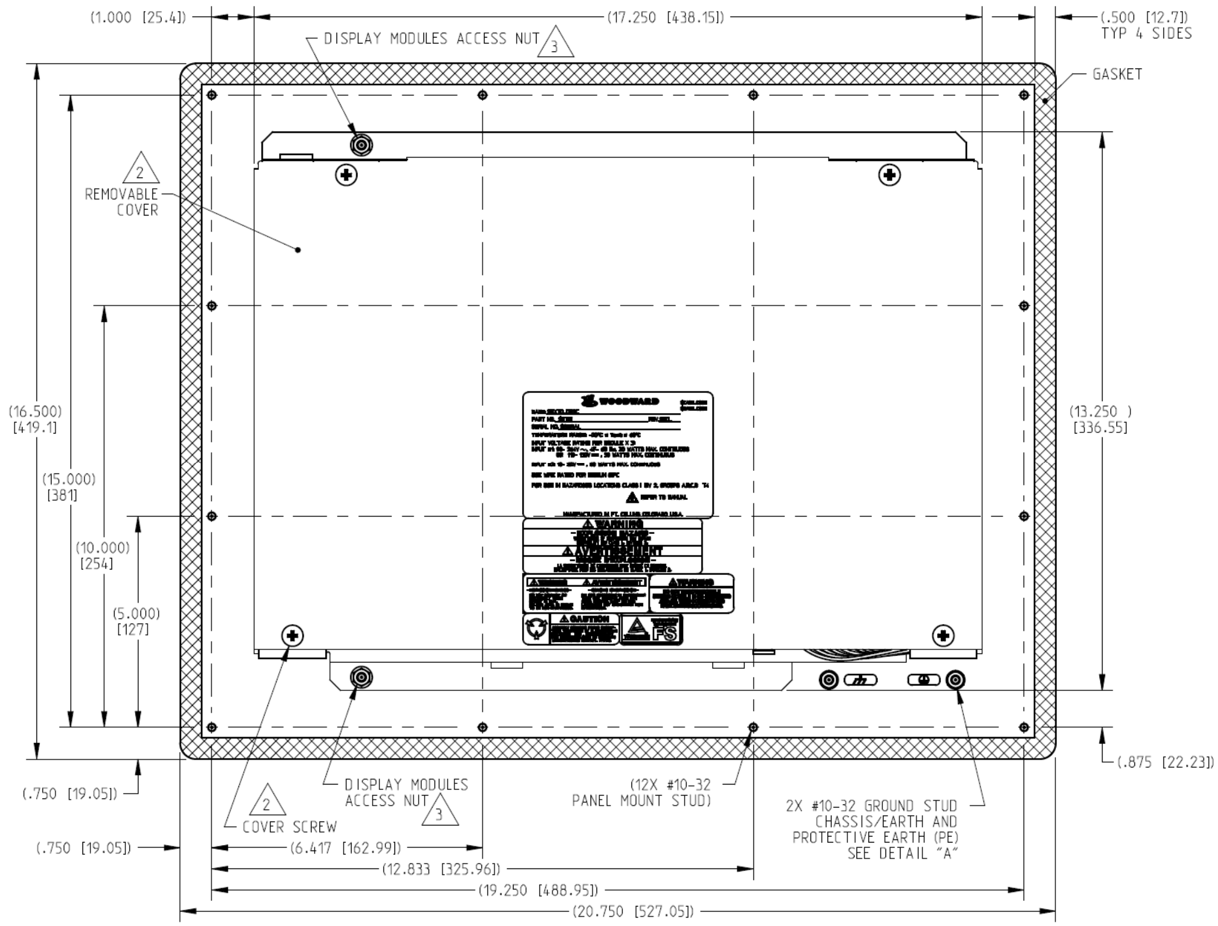


Figure 2-5a. Mounting Outline Diagram for Panel-Mount Models

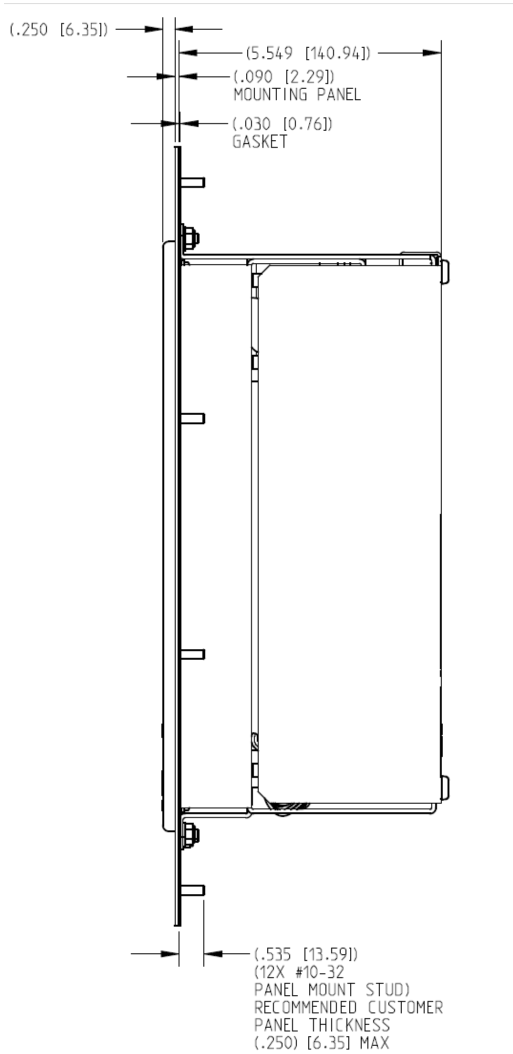


Figure 2-5b. Mounting Outline Diagram for Panel-Mount Models

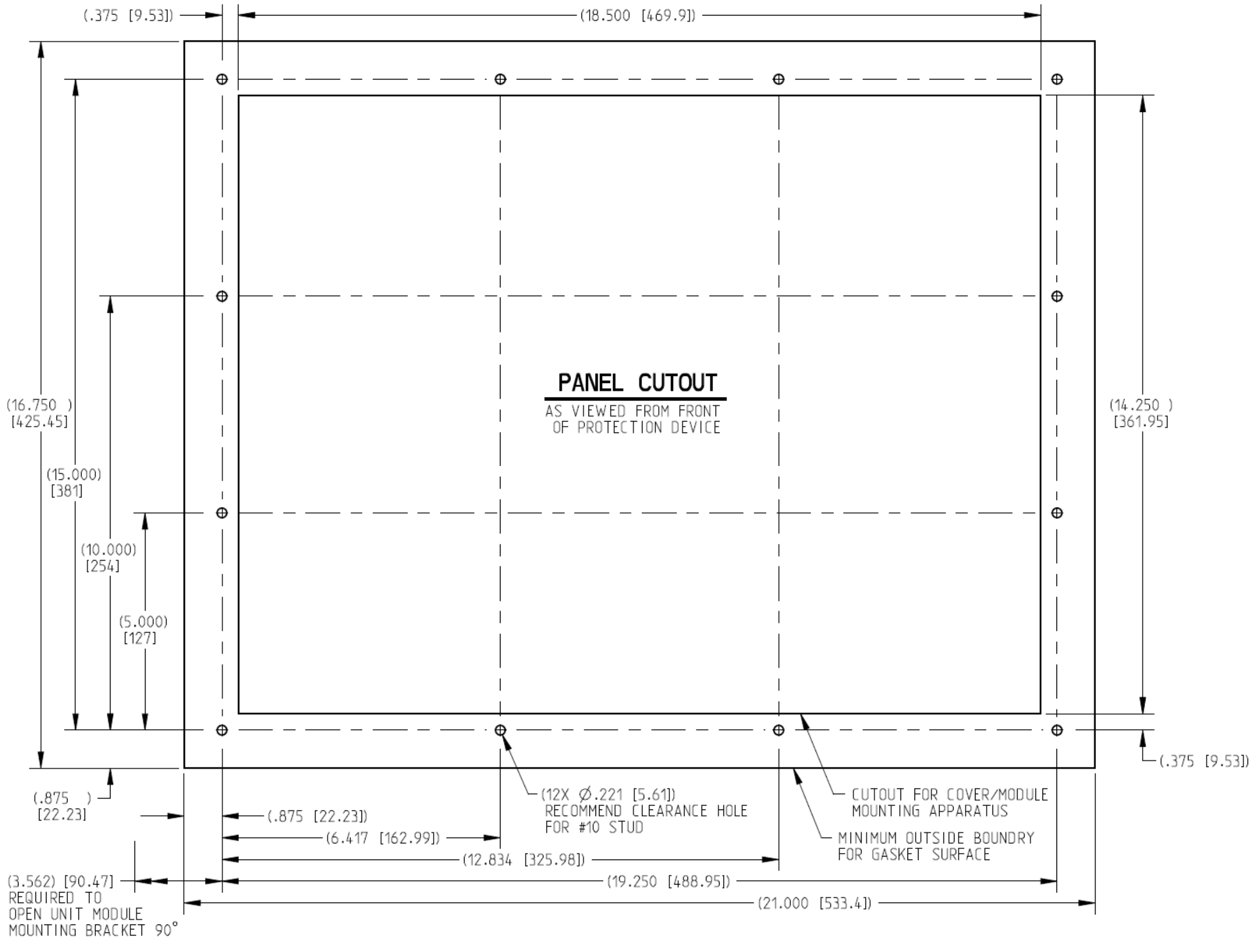


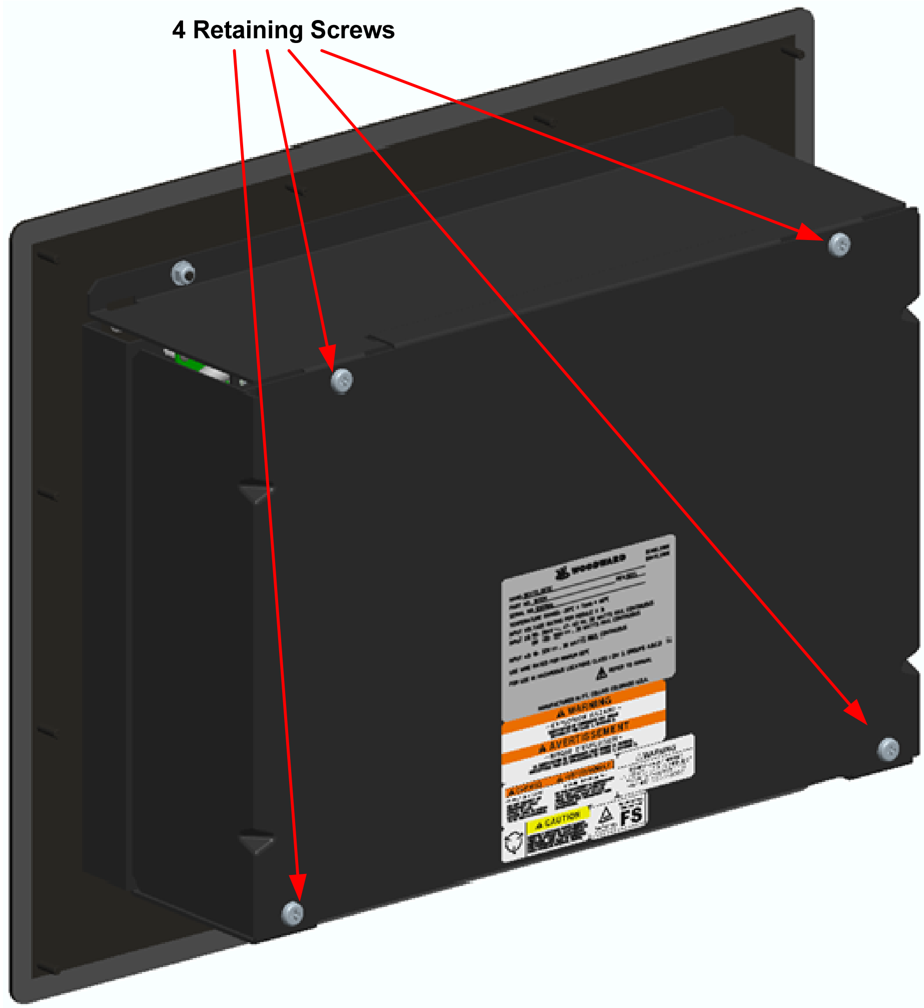
Figure 2-5c. Panel Cutout Diagram for Panel-Mount Models

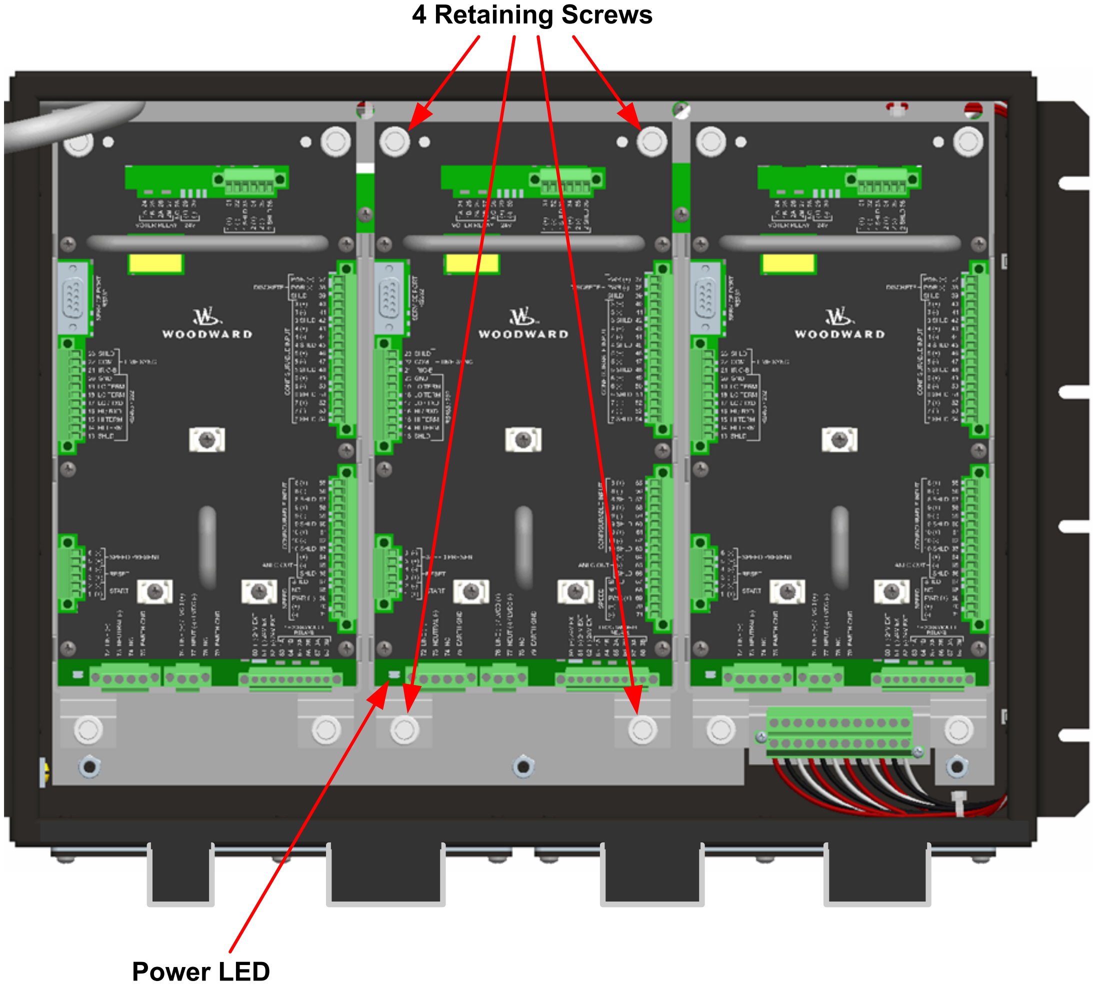
Module Removal and Installation—Panel Mount Package

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.


4 Retaining Screws



Installation:
1. Insert module into slot by pressing firmly on handles. The module has guides to assist in location.
2. Tighten four module retaining screws.
3. Install back panel.
4. Install four 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

Table 2-1. Environmental Specifications

Operating Temperature:	(–20 to +60) °C / (–4 to +140) °F
Storage Temperature (nonoperational):	(–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 (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 will function normally with power sourced to both or either power supply input.

Table 2-1a. Power Supply Specifications, Input

Number of Inputs	2, Input range depends on model (see following tables): • 2 High Voltage Inputs OR • 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 to protect other power supplies from tripping while connected to a common input power circuit.

Table 2-1b. Power Supply Specifications, High Voltage Input

Voltage Input Range	90 – 264 Vac, or 100 – 150 Vdc
Current Input Max (*Note 1)*	0.5 A @ 90 Vac 0.22 A @ 264 Vac 0.25 Arms @ 110 Vdc 0.18 Arms @ 150 Vdc
Inrush Current	10 A at 115 Vac, 20 A @ 220 Vac
Reverse Polarity Protection	Yes, for dc connection
Interrupt Time	45 ms, when operating on one power supply only

Table 2-1c. Power Supply Specifications, Low Voltage Input

Voltage Input Range	18 – 32 Vdc
Current Input Max (*Note 1)*	1.5 A @ 18 Vdc 1 A @ 32 Vdc
Inrush Current	0.05 A^2sec
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 2-2a. Configurable Input Power Supply (24V_AI)

Output Voltage	24 Vdc ±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 2-2b. Relay Output Power Supply (24V_P)

Output Voltage	24 Vdc ±10%
Current Limit	500 mA

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 connected 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.**

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 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.**

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.

IMPORTANT	**When wiring to each MicroNet Safety Module, in order to allow hot replacement of a module in the event of a failure, it is important to make connections such that any single module's terminal blocks and power supplies can be completely disconnected without affecting the rest of the system.**

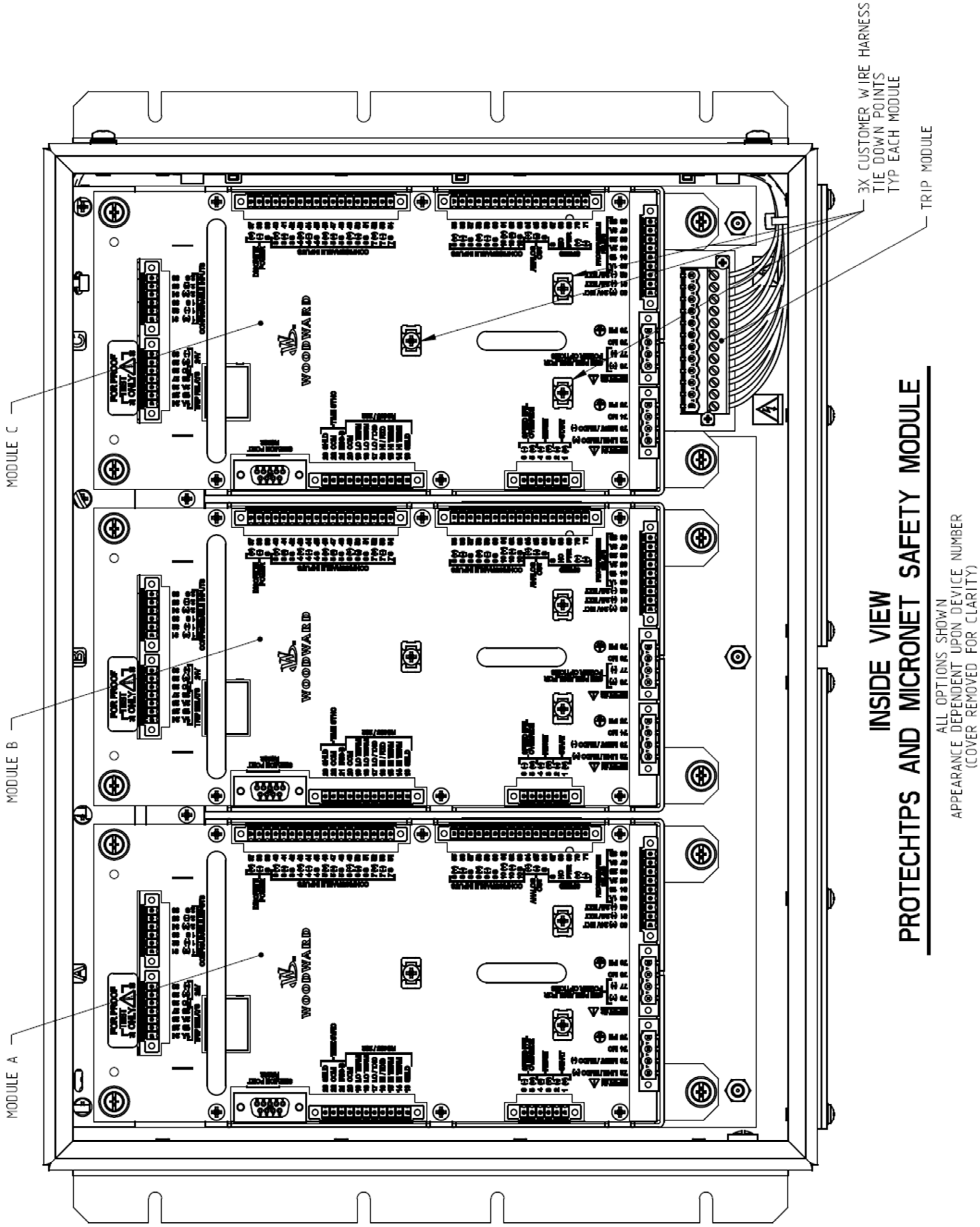


Figure 2-7. Inside View of MicroNet Safety Module

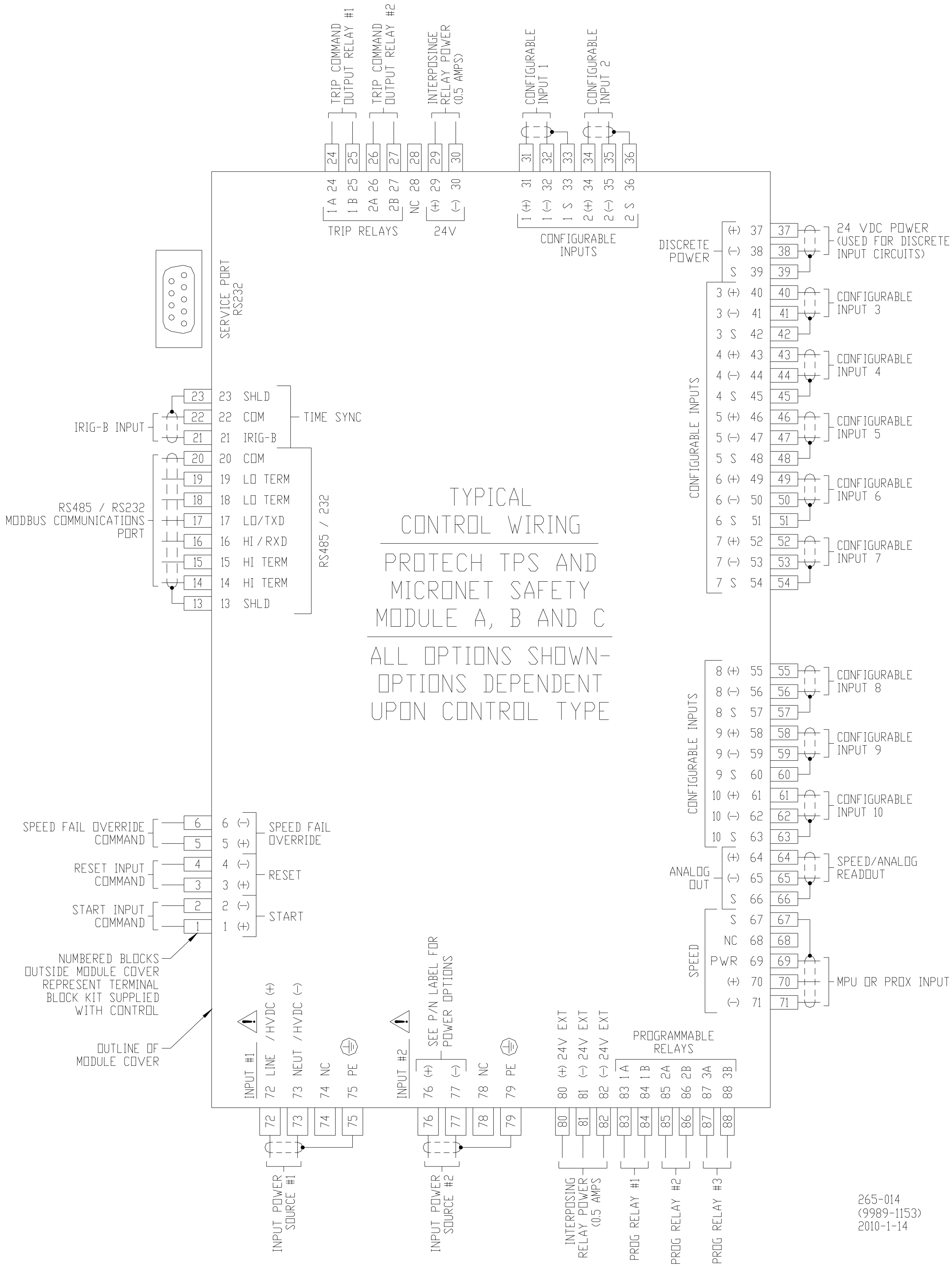


Figure 2-8. MicroNet Safety Module Control Wiring Diagram

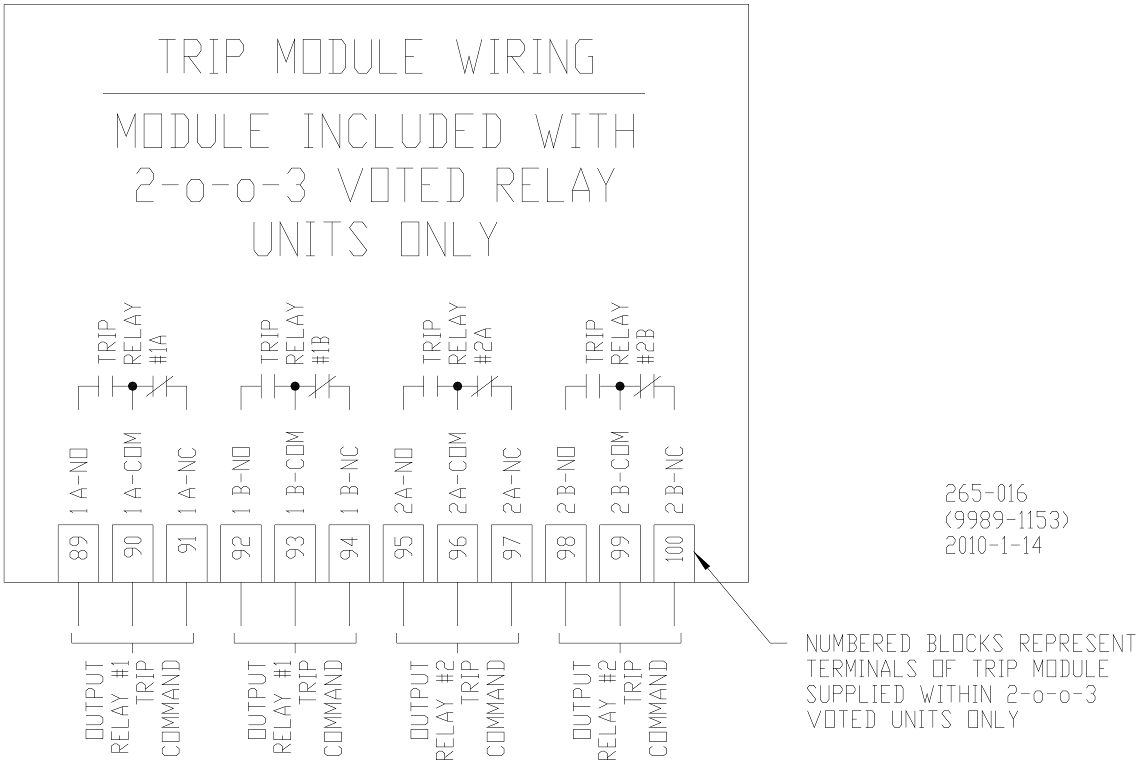


Figure 2-9. Trip Module – Included within Voted Trip Relay Units Only

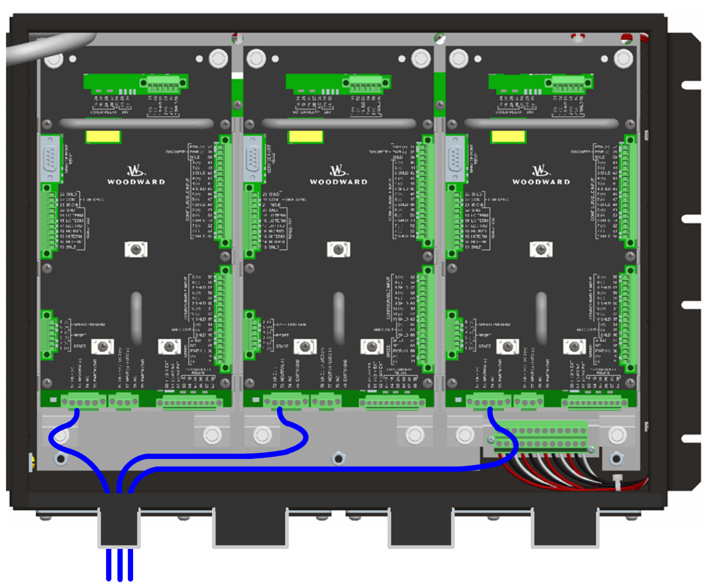


Figure 2-10a. Power Supply Field Wiring Routing & Stress Relief Diagram

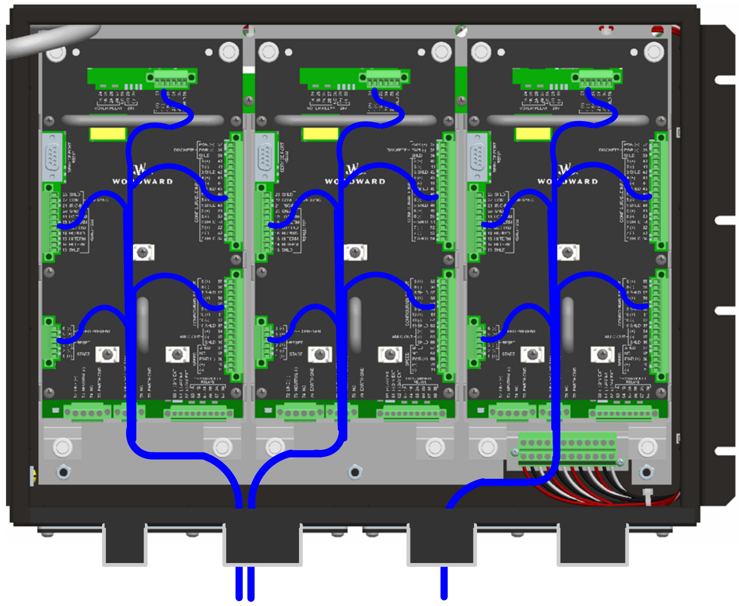


Figure 2-10b. Configurable I/O Wiring Routing & Stress Relief Diagram

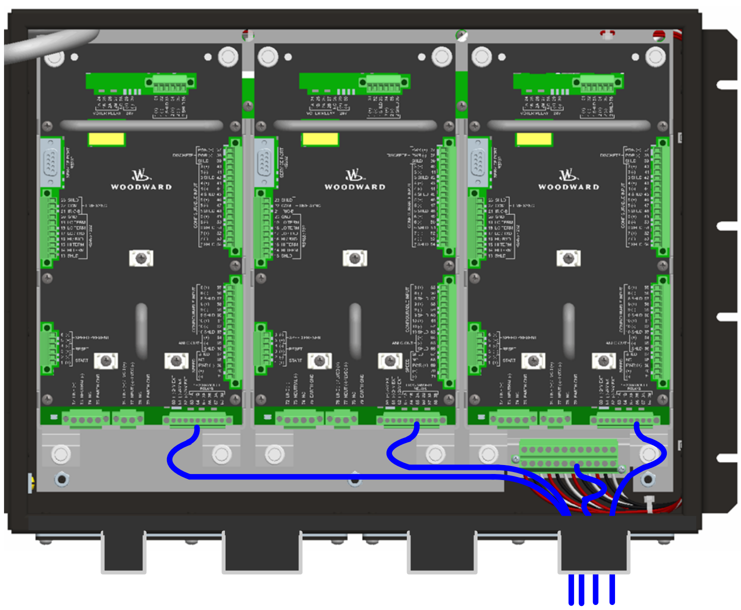


Figure 2-10c. Relay Output Field Wiring Routing & Stress Relief Diagram

Speed Sensor Inputs

To sense speed, each MicroNet Safety Module's module (A, B, C) accepts a signal from a speed sensor mounted on a gear connected to the turbine rotor or engine crankshaft. 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 or equipment 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 of this manual 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 the output signal must meet Vlow and Vhigh threshold values specified in Chapter 3, Inputs and Outputs section. 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.

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.

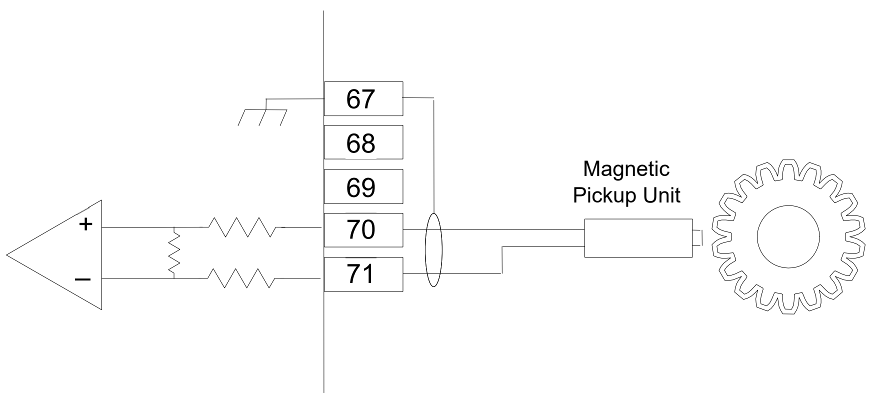


Figure 2-11a. Example MPU (Passive Magnetic Pickup Unit) Wiring

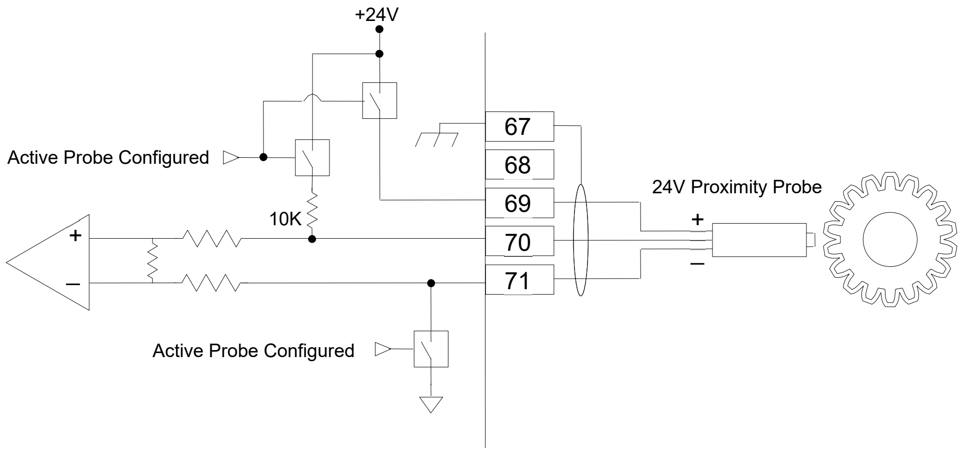


Figure 2-11b. Example Proximity Probe (Active Magnetic Pickup Unit) Wiring (Internal Power)

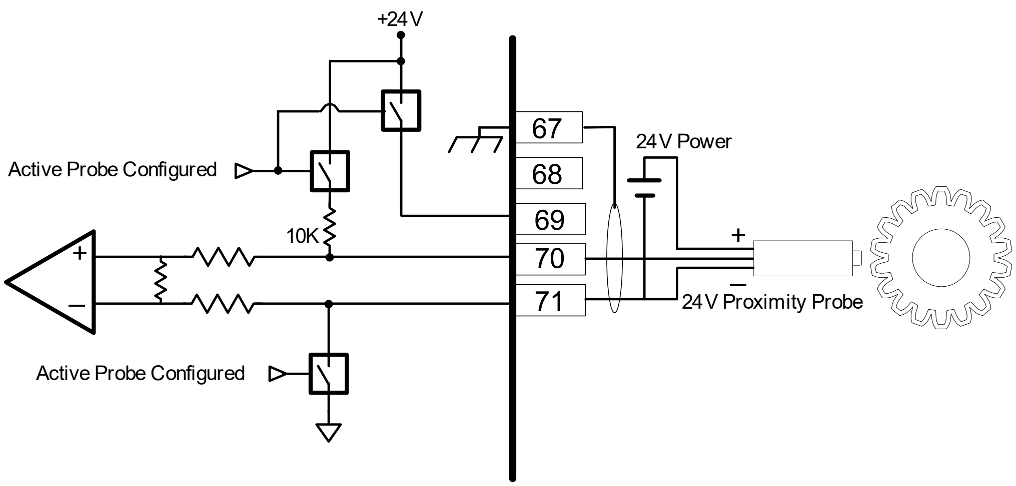


Figure 2-11c. Example Proximity Probe (Active Magnetic Pickup Unit) Wiring (External Power, Non-preferred)

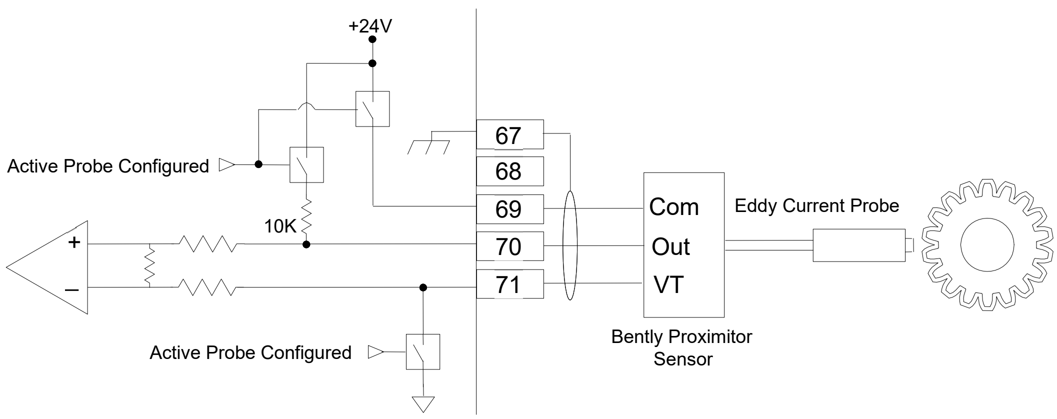


Figure 2-11d. Example Eddy Current Probe (Active Magnetic Pickup Unit) Wiring

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 8 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.

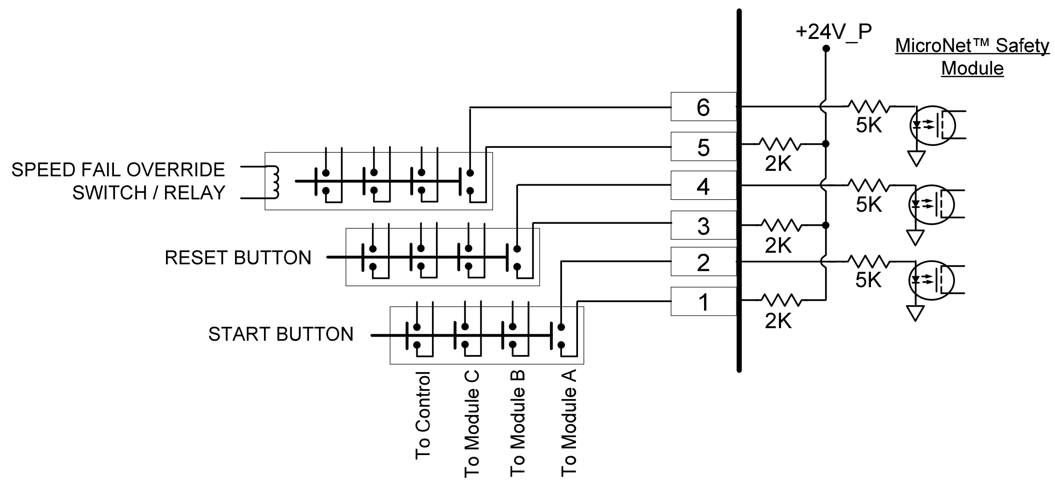


Figure 2-12a. Example Standard Discrete Input Wiring (Internal Power Option)

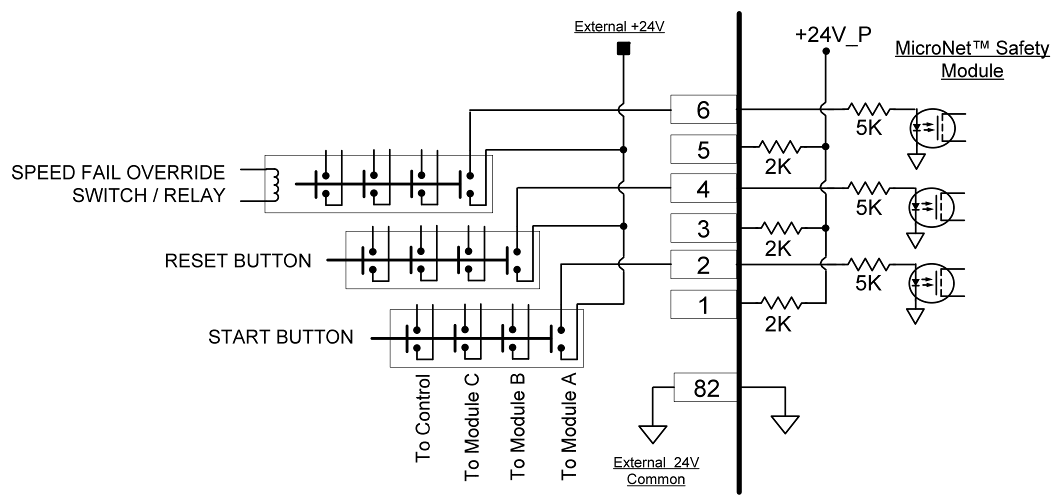


Figure 2-12b. Example Standard Discrete Input Wiring (External Power Option)

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 with the MicroNet Safety Module Programming and Configuration Tool (PCT) to function as a 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 DIs, and both power & common must run with the signal wire for MicroNet Safety Module powered DI's. Shielded DIs 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 eight 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 loads 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 sources 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.

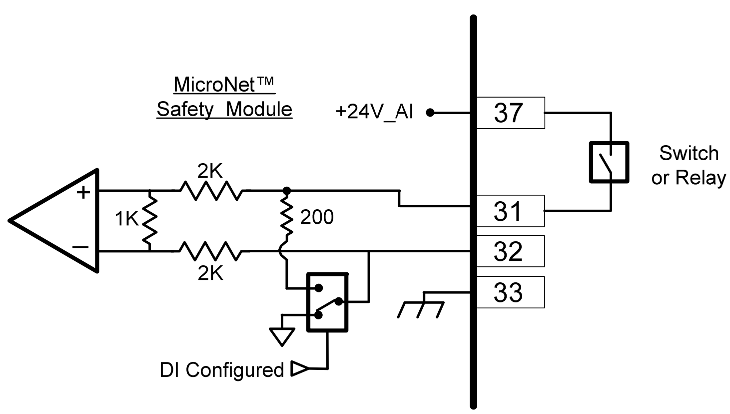


Figure 2-13a. Example Configurable Input Wiring—Discrete Input (Internal Power Option)

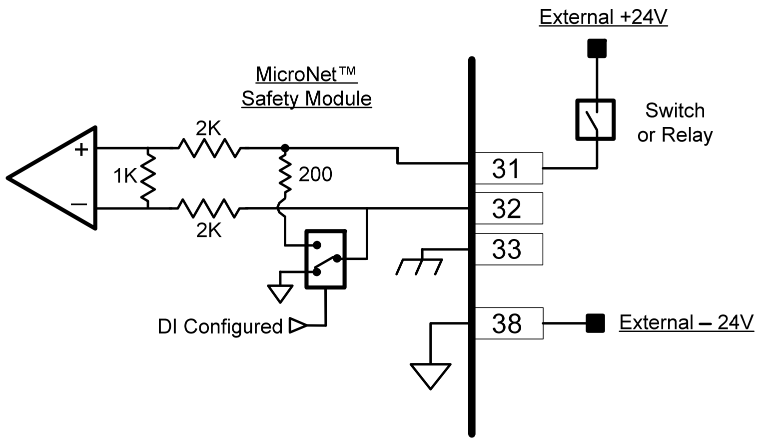


Figure 2-13b. Example Configurable Input Wiring—Discrete Input (External Power Option)

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.

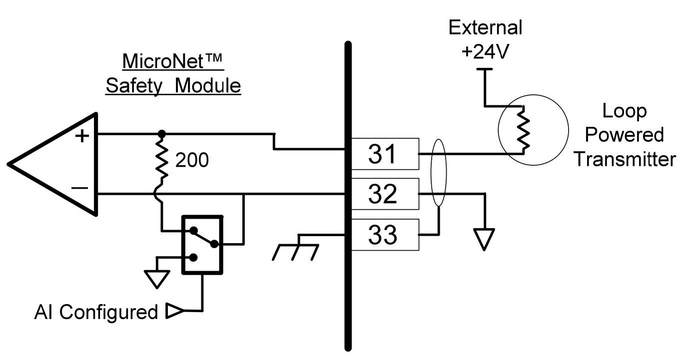


Figure 2-14. Example Configurable Input Wiring—Analog Input

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 Chapter 3 (Functionality) of this manual for applicable analog output specifications and for information on how to program and use this analog output in an application.

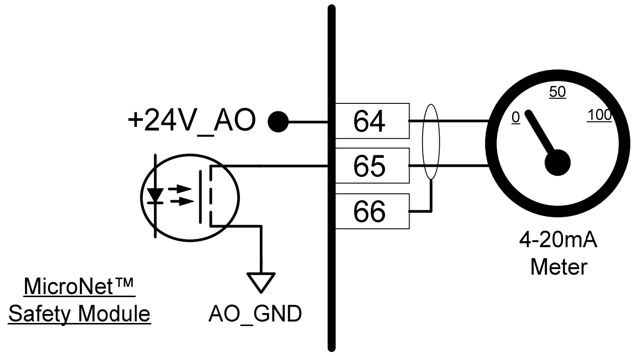


Figure 2-15. Example Analog Output Wiring

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 three 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 the prime mover.**

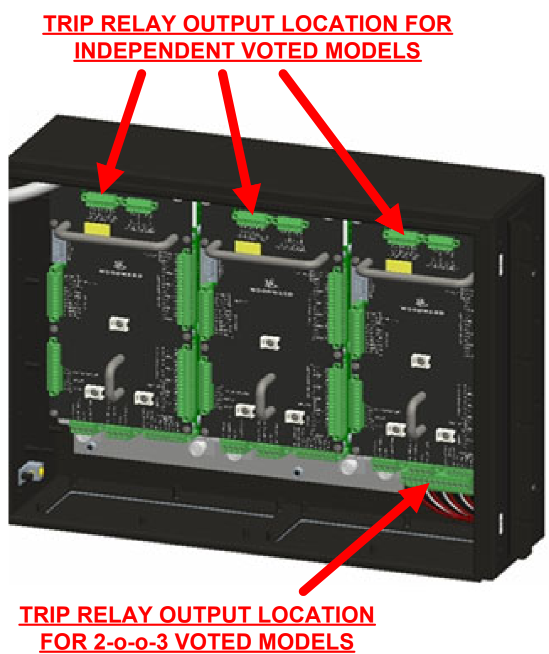


Figure 2-16a. Example Trip Relay Output Wiring

Refer to the Chapter 3 (Functionality) of this manual for all applicable relay output specifications and 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 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.

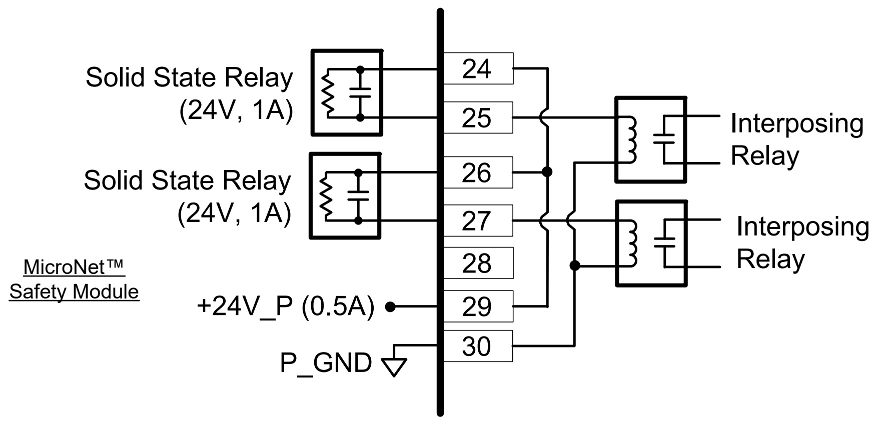


Figure 2-16b. Example Trip Relay Wiring (per Module) (Independent Trip Relay) (Internal Supply)

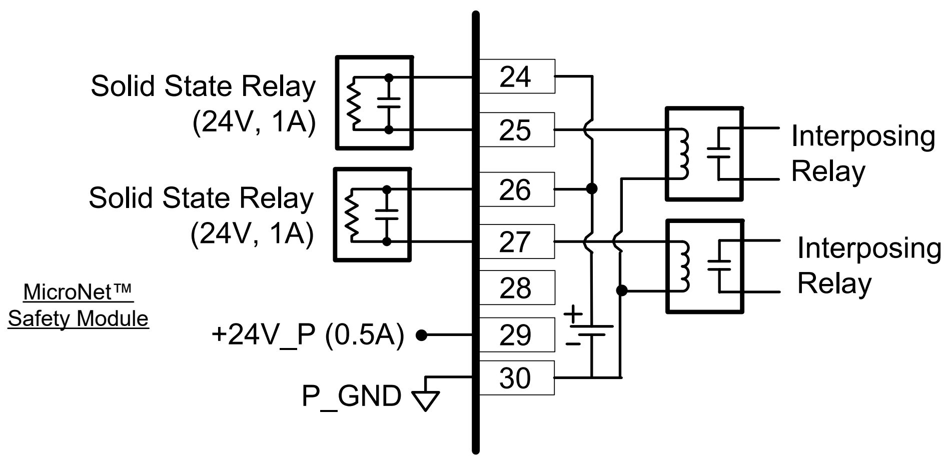


Figure 2-16c. Example Trip Relay Wiring (per Module) (Independent Trip Relay) (External Supply)

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 to drive the MSM's 2-out-of-3 voted relay module, and the other three relay outputs are user-programmable which can be programmed to function independently as required.

Note: 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 on the unit's 2-out-of-3 voted relay module. These two redundant relays 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.

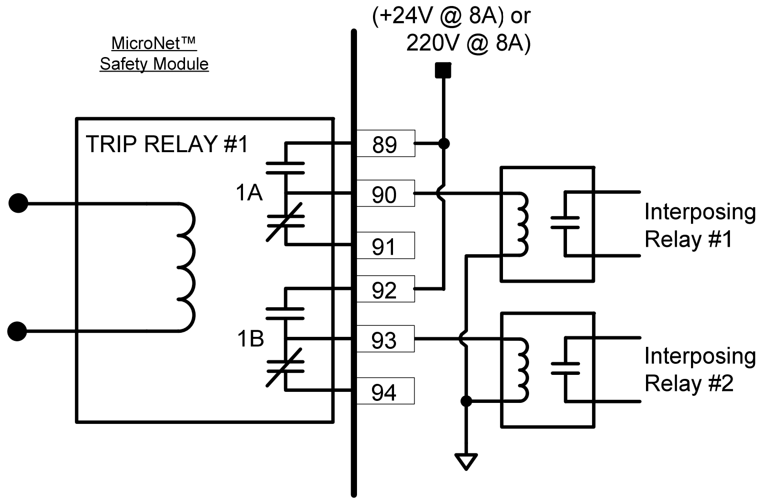


Figure 2-16d. Example Trip Relay Wiring (Voted Trip Relay Models)

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.

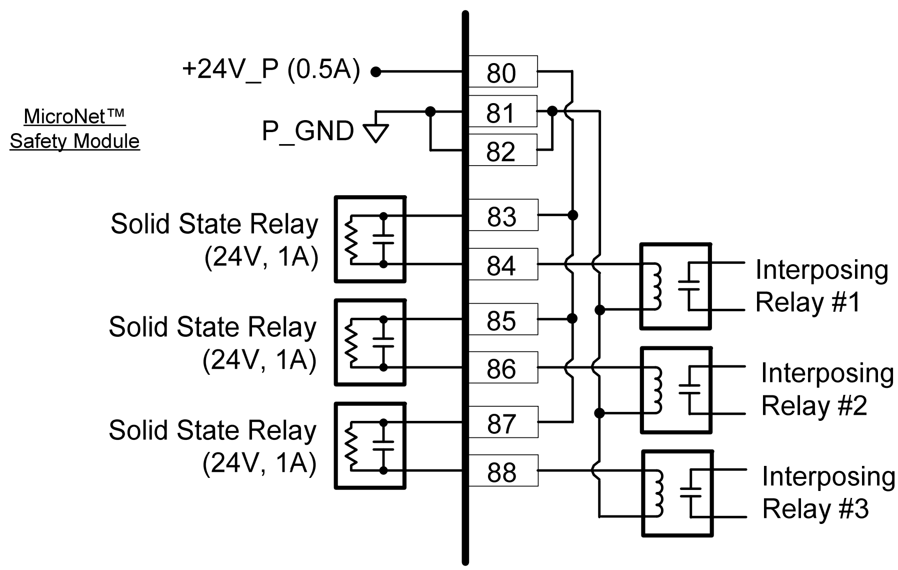


Figure 2-16e. Example Programmable Relay Wiring (Internal Supply)

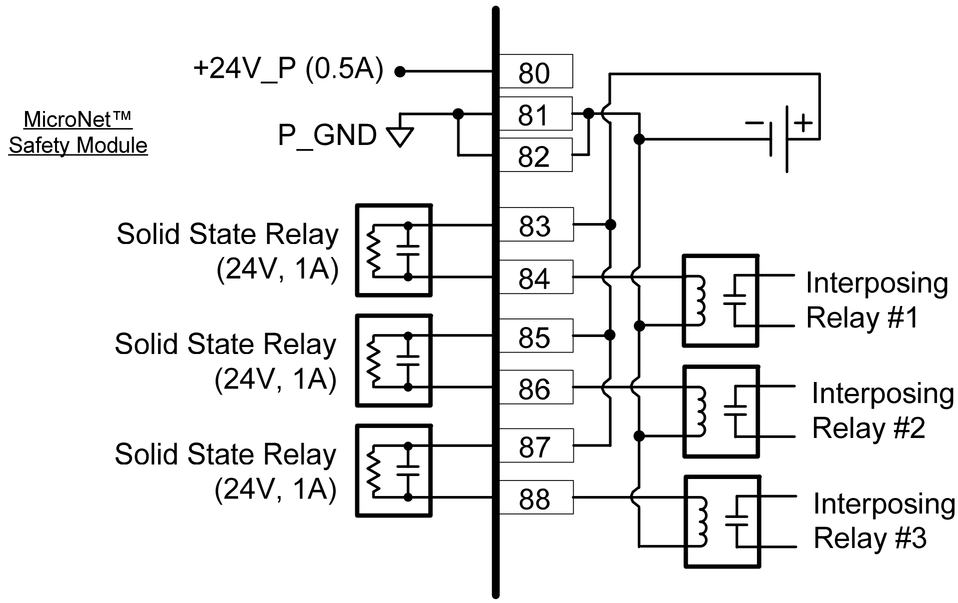


Figure 2-16f. Example Programmable Relay Wiring (External Supply)

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) can provide 24 V (dc) ±10 % @ 500 mA maximum output current, to power external relays. This 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 loads 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 loads 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) can provide 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 loads 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.**

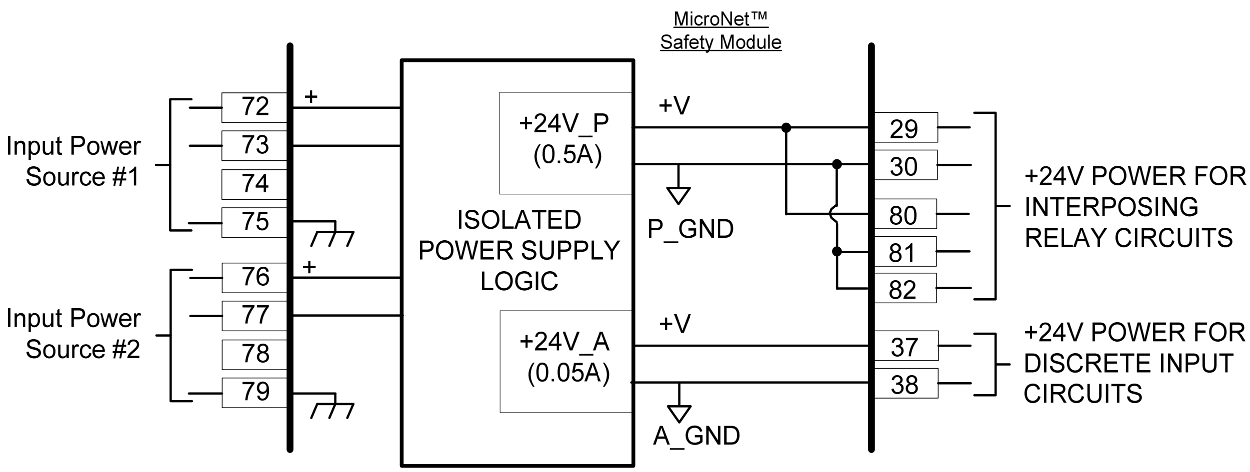


Figure 2-17. Power Supply Relationship Diagram

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 are supported.

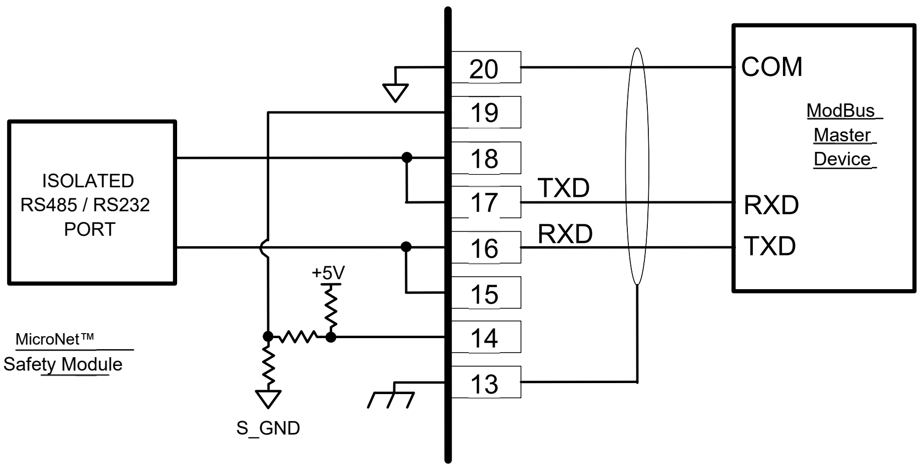


Figure 2-18a. Serial Port Interface Diagram—RS-232

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.

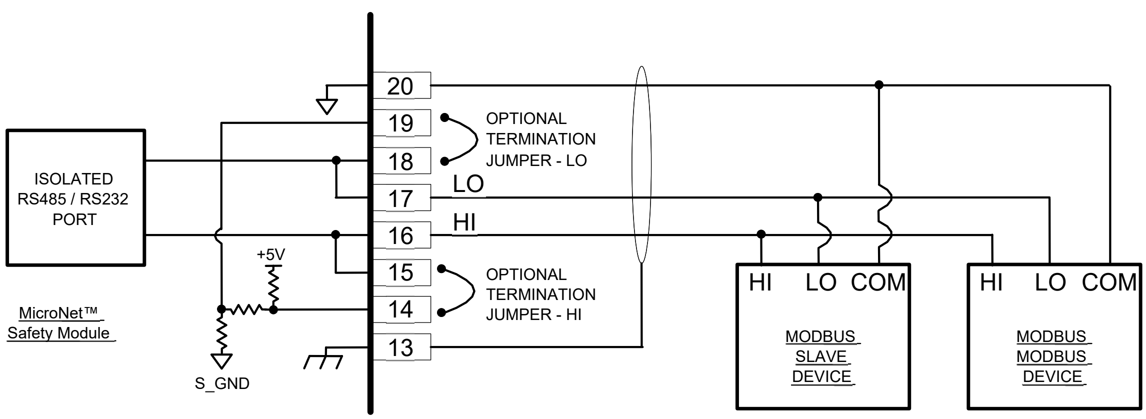


Figure 2-18b. Serial Com Port Interface Diagram —RS-485

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 MicroNet Safety Module and for reading stored log files from the MicroNet Safety Module 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.

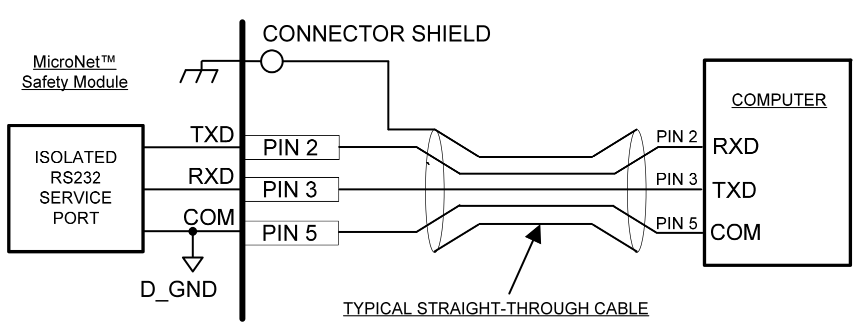


Figure 2-19. Service Tool Cable/Interface Diagram

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, and Seconds). Refer to Figure 2-20 for IRIG-B wiring information.

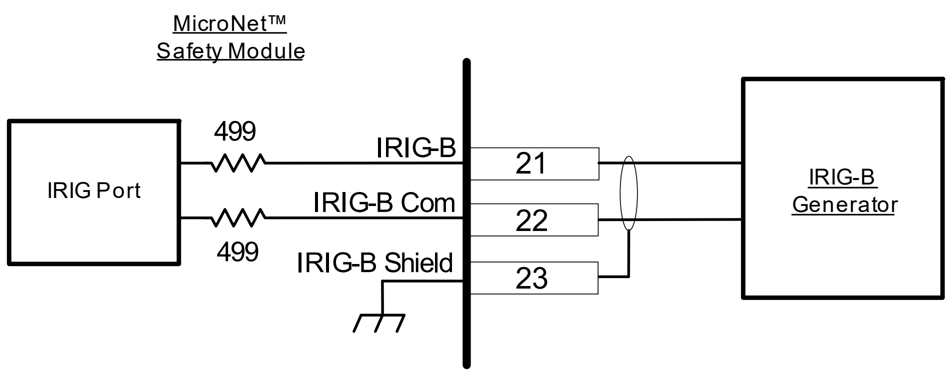


Figure 2-20. IRIG-B Interface Diagram

Chapter 3. Functionality

The MicroNet Safety Module is an overspeed safety device designed to safely shut down steam, gas, and hydro turbines of all sizes upon sensing an overspeed or over-acceleration event. This device accurately monitors turbine rotor speed and acceleration via active or passive MPUs (magnetic pickups) and issues a shutdown command to the turbine's trip valve(s) or corresponding trip system.

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

Depending on the system design, the MicroNet Safety Module can be purchased with two dual redundant trip relay outputs using a 2-out-of-3 voted architecture, or with three independent non-voted trip relay outputs. Individual alarm relays, 4–20 mA speed readouts, and Modbus communications make this overspeed device easy to integrate into any turbine safety system.

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 are connected via a safety certified CAN network which allows the sharing of all module input information (speed, acceleration, analog/discrete inputs, and dedicated-function discrete inputs) and module configuration information. The MicroNet Safety Module's configuration copy function also utilizes this network to transfer/copy configuration data from one module to another.

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. Home Screen selection, Home Screen on Trip configuration, and Modbus Slave Address are also exceptions. 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 overspeed device is certified for use in IEC-61508 SIL-3 based applications. This overspeed device's triple modular design 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.

Each MicroNet Safety Module shares its input values (speed, acceleration, analog/discrete inputs, and dedicated-function discrete inputs) and its trip and alarm latch outputs with the other two modules. Users can then optionally configure the module's trip and alarm logic to use or not use the shared input and latch information. This type of redundancy allows users the choice of using one two or three speed sensors and connecting to (wiring to) three modules, two modules or only one module and using the sharing and voting logic to manage logic in all three modules. Refer to Figure 3-1 for more information on module to module sharing logic.

IMPORTANT	**For system reliability purposes, it is recommended that all critical parameters utilize three independent sensors or circuits and be individually wired into the MicroNet Safety Module's three independent modules.**

Programming / Configuring Overview

Each MicroNet Safety 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). Refer to Figures 3-1 to 3-5 for functional logic diagrams.

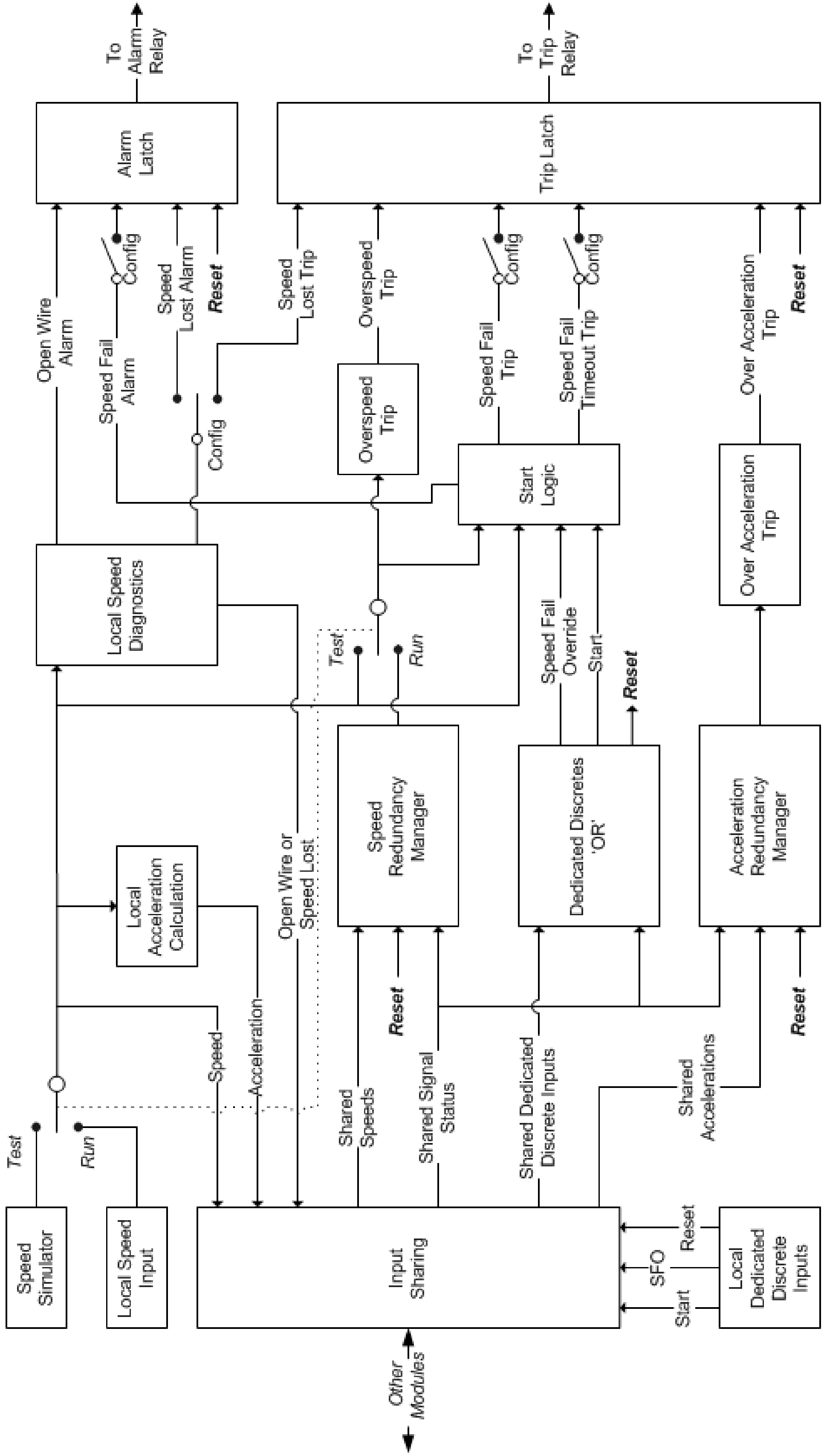


Figure 3-1. Module Diagram with Speed Redundancy Manager Configured
(Configurable Analog/Digital Inputs, Logic Blocks, and Output Relays Not Shown)

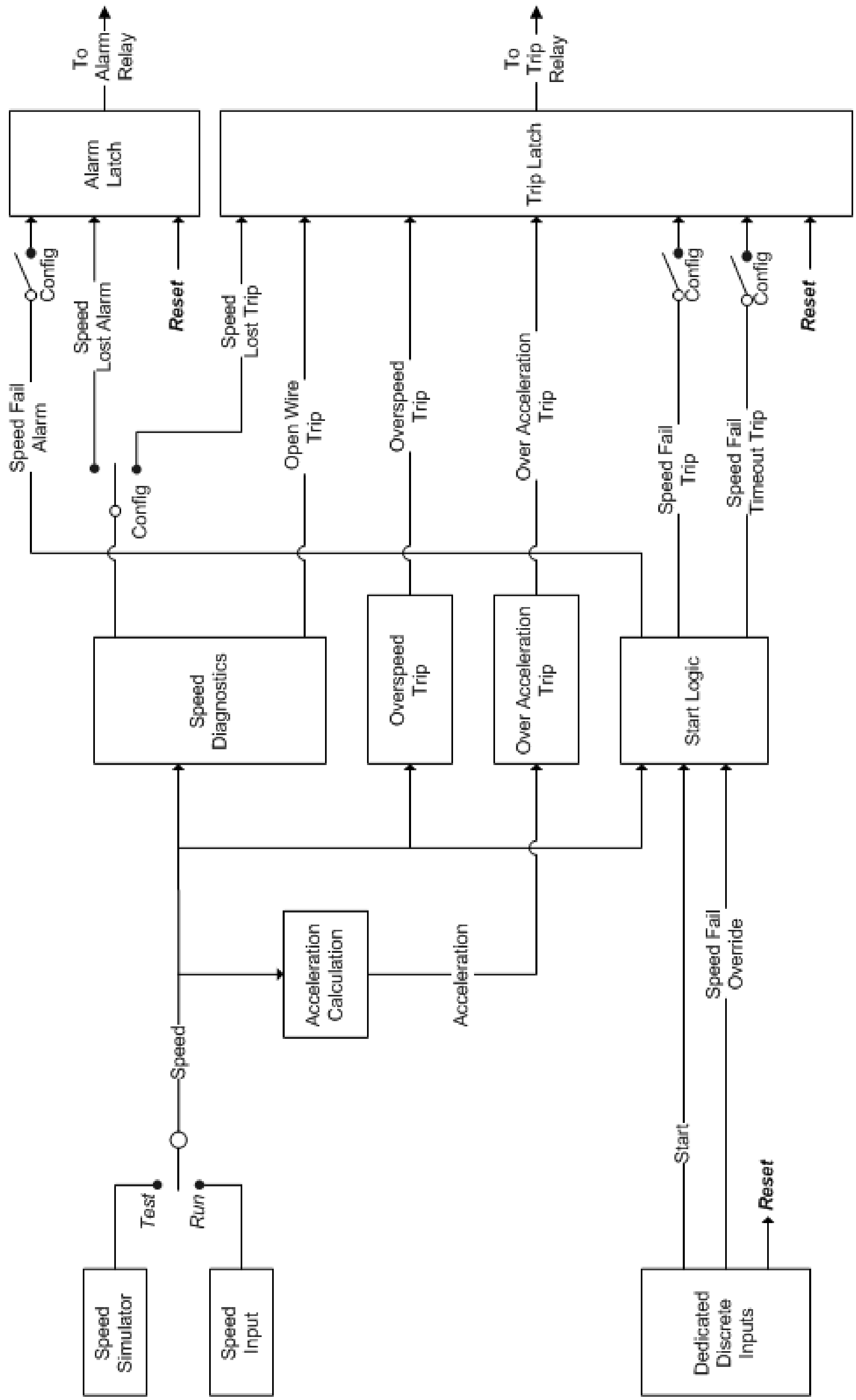


Figure 3-2. Module Diagram <u>Without</u> Speed Redundancy Manager Configured
(Configurable Analog/Digital Inputs, Logic Blocks, and Output Relays Not Shown)

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

- Create and change custom application programs.
- Change all module functional settings (i.e., overspeed and over-acceleration functionality settings).
- Configure speed and acceleration redundancy manager logic.
- Save application and configuration settings to a file.
- Upload application and configuration settings to each MicroNet Safety Module.
- Download application and configuration settings to each MicroNet Safety Module.
- Download 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.

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

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.
- Upload configuration settings file into a module using the PCT.
- 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:

- Share module input signals and event latch status information.
- 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 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.

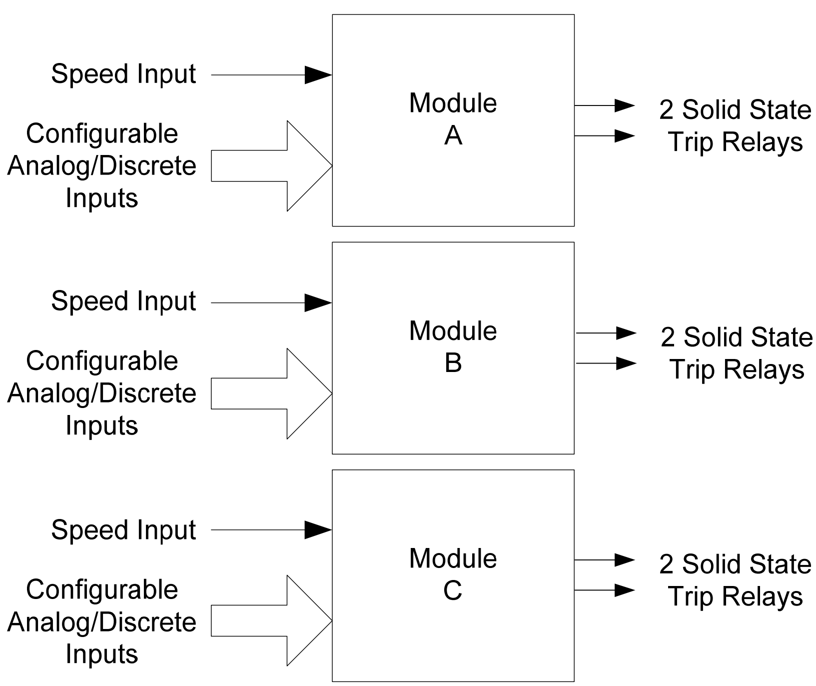


Figure 3-3. Basic Functional Overview of Independent Trip Relay Models

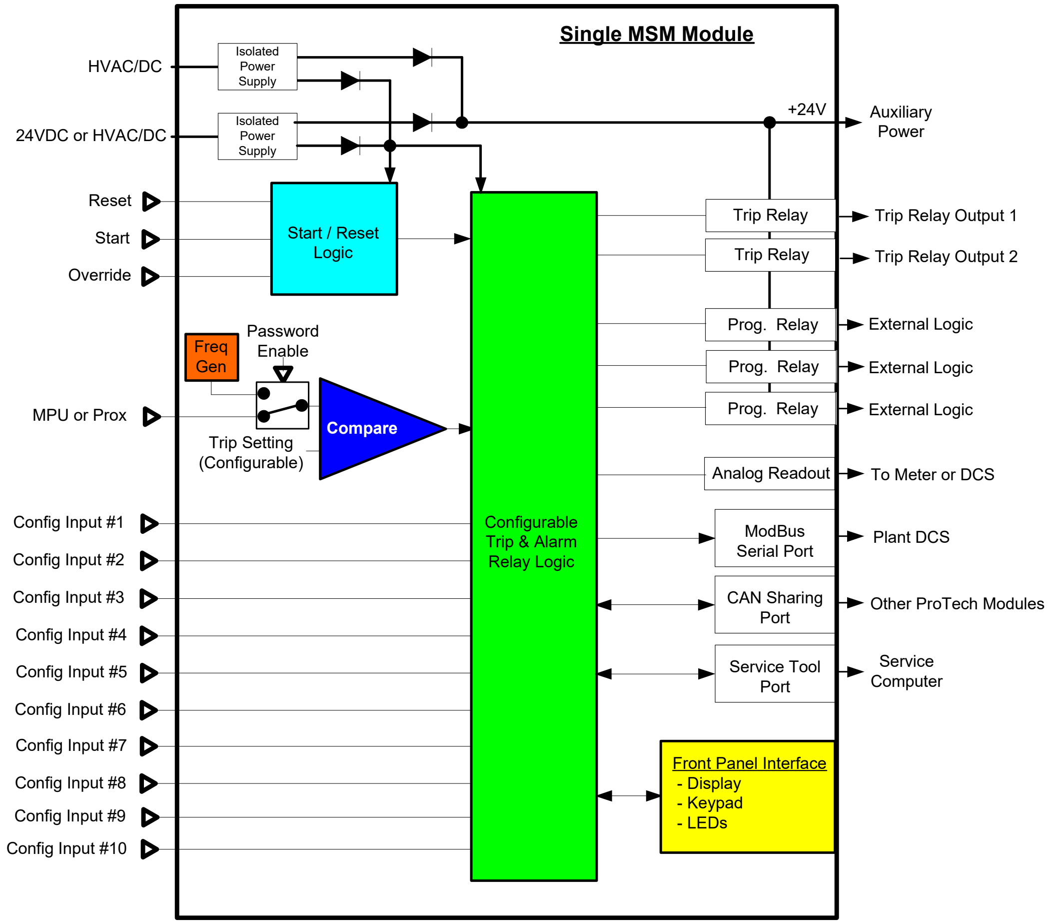


Figure 3-4. Functional Diagram of Single MicroNet Safety Module with Independent Trip Relay Outputs

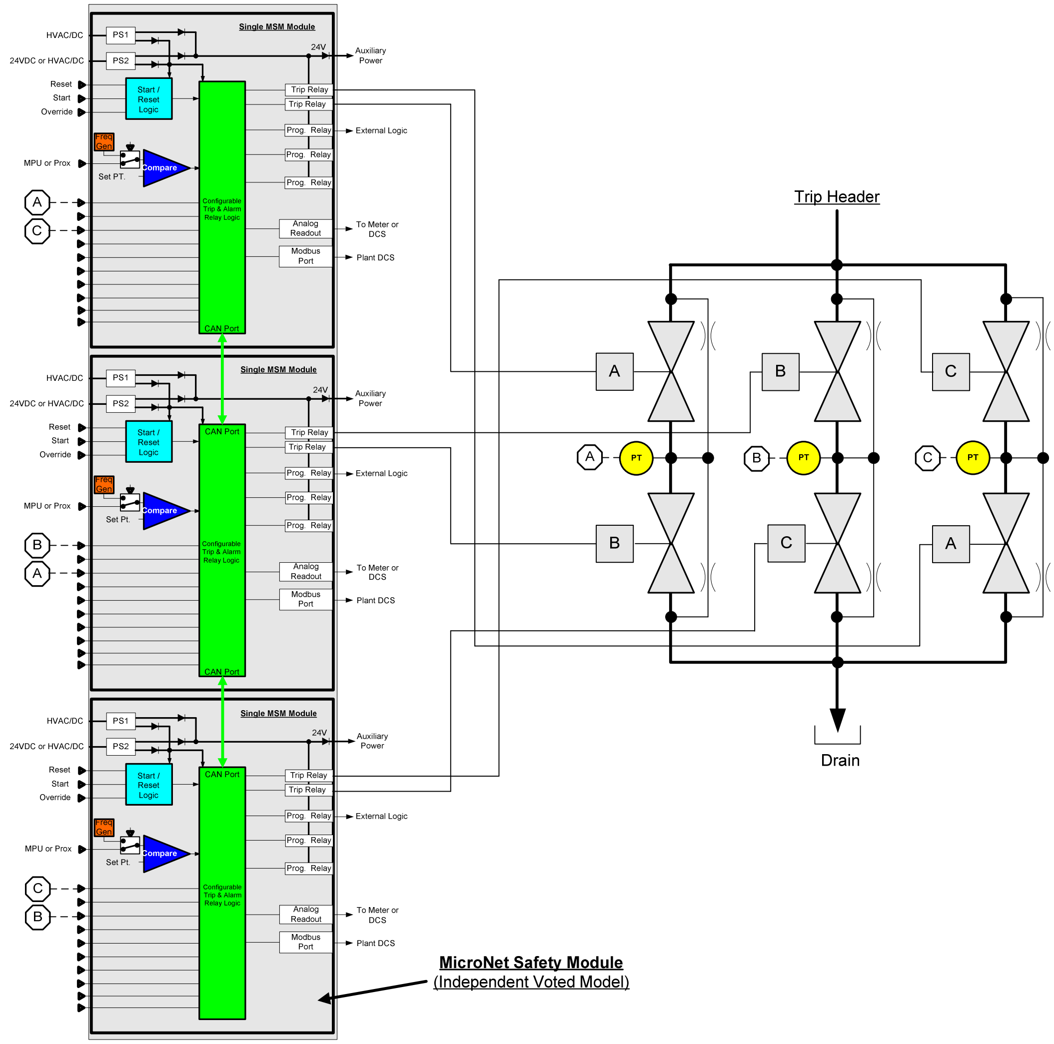


Figure 3-5. Example TMR Trip Block Assembly Interface

Table 3-1a. Independent Trip Relay 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.

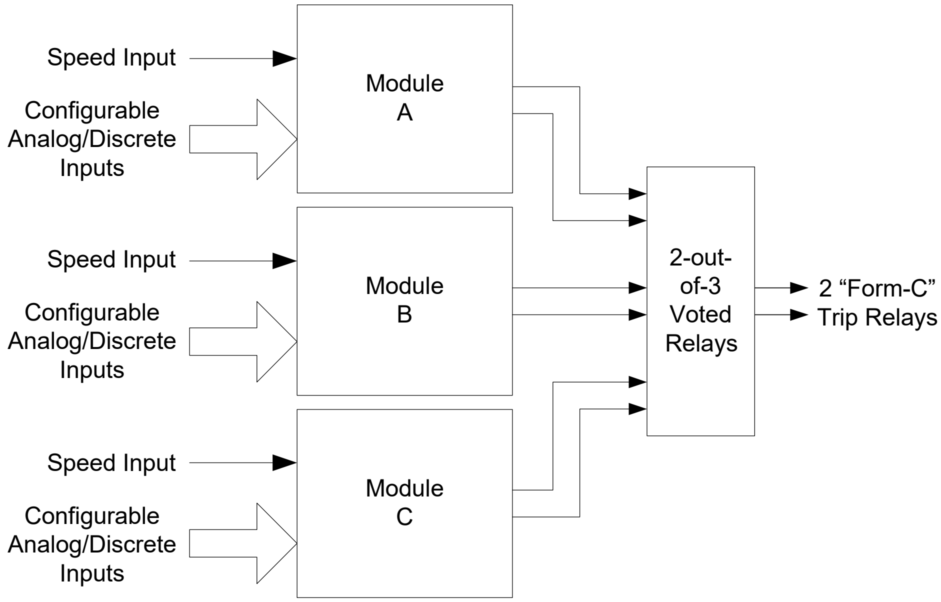


Figure 3-6. Basic Functional Overview of Voted Trip Relay Models

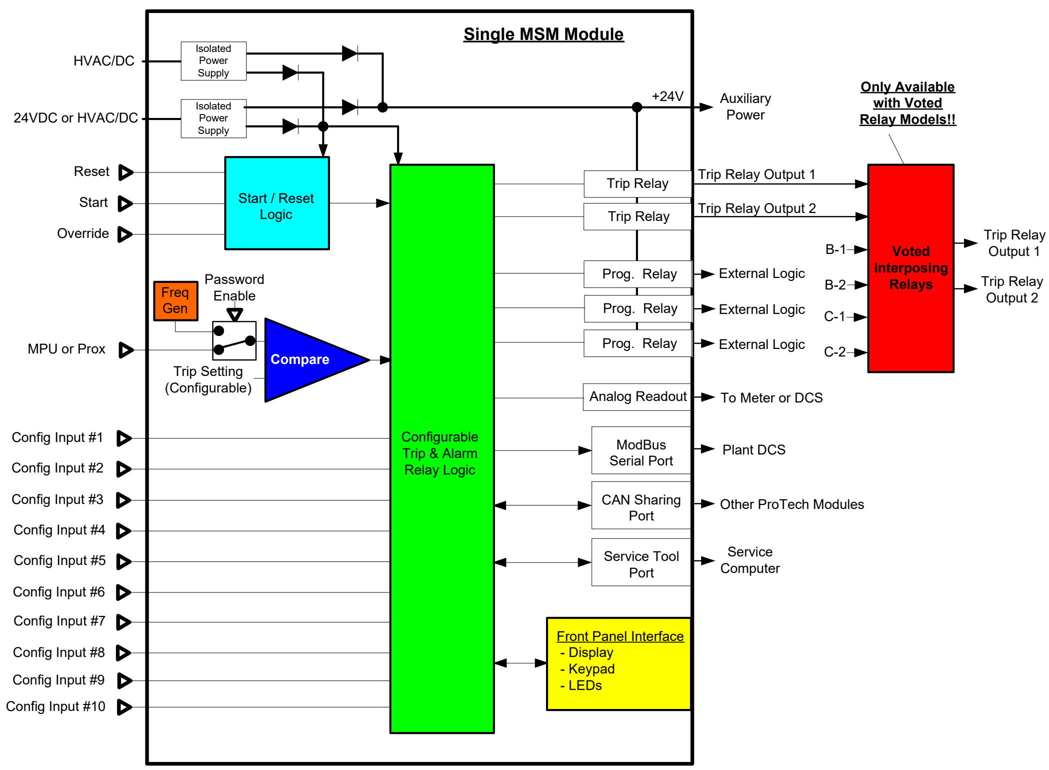


Figure 3-7. Functional Diagram of Single MicroNet Safety Module with Voted Trip Relay Outputs

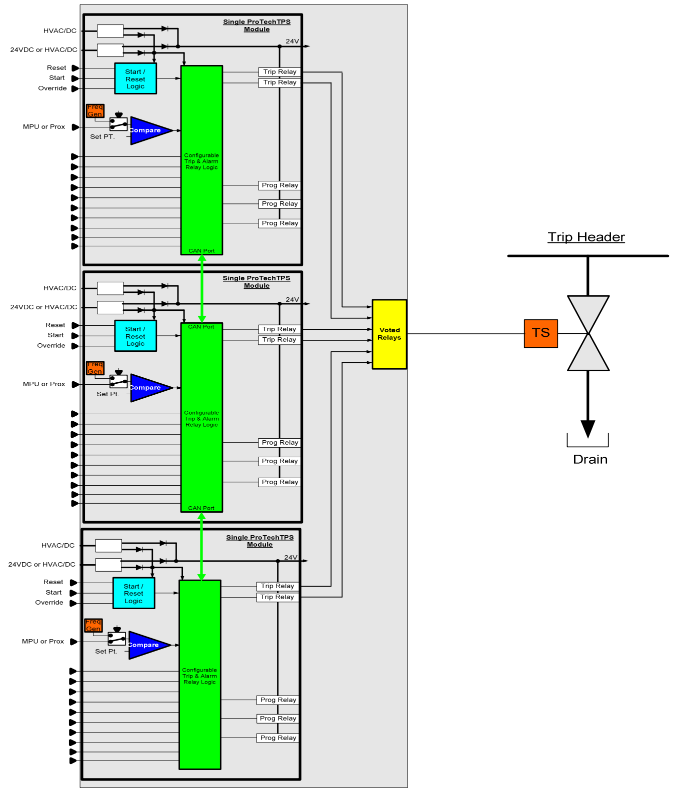


Figure 3-8. Simplex Trip Block Assembly

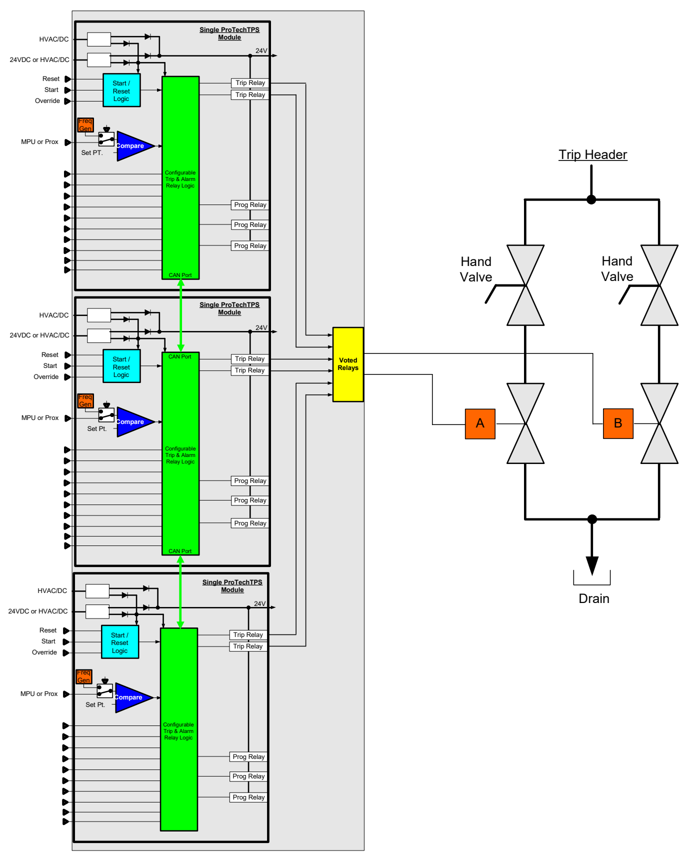


Figure 3-9. Dual Redundant Trip Block Assembly

Table 3-1b. Voted Trip Relay 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

Inputs and Outputs

Input Redundancy

Each MicroNet Safety Module shares its input values (speed, acceleration, analog/discrete inputs, and dedicated-function discrete inputs) and its trip and alarm latch outputs with the other two modules. Users can then optionally configure the module's trip and alarm logic to use or not use the shared input and latch information. Configurable redundancy manager blocks are available for the speed, acceleration, analog, and Boolean signal redundancy logic. Optionally, one or all the module's dedicated-function discrete inputs can be configured with "ORed" logic. This type of redundancy allows users the choice of using one two or three speed sensors and connecting to (wiring to) three modules, two modules or only one module and using the sharing and voting logic to manage logic in all three modules.

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 associated protection and functionality will not work correctly.**

If the MicroNet Safety Module's speed redundancy manager is not configured for use, then each module simply uses its local speed sensor signal and compares it to the overspeed setpoint to determine an overspeed event.

If the MicroNet Safety Module's speed redundancy manager is configured for use, then each module uses its local sensed speed signal and the shared speed signals from the other two modules to select/vote the signal to use in its overspeed detection logic. The speed redundancy manager can be configured to vote the median, highest or lowest speed signal to use in its overspeed detection logic and can be configured to change its voting logic based on the number of healthy speed probes/signals.

Note: The Speed Redundancy Manager allows users to elect to use three speed sensing probes, two speed sensing probes, or only one speed sensing probe depending on the specific application's requirements. If only two probes are used, then the third module can be configured to only use and vote on the shared speed signals (from the other modules) to use in its overspeed and over-acceleration detection logic. Although not recommended, if only one probe is used, then the second and third modules can be configured to only use and vote on the shared speed signal (from the first module) to use in their overspeed and over-acceleration detection logic.

If the unit is configured for only two probes (or just one probe), there will be a configuration mismatch and associated alarm. This alarm can be disabled in the Configuration Management Menu.

Speed Input Specifications

Table 3-2. General I/O 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 Detectable over-acceleration range: 0 to 25000 rpm
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 3-3a. Passive Probe Specifications

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 3-3b. Active Probe Specifications

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 (A, B, C) accepts three dedicated discrete inputs. The Dedicated Discrete Inputs are Start, Reset and Speed-Fail-Override. Each module can be configured to use only its local discrete input signals (start, reset, and speed fail override) or the "ORed" result of its local discrete inputs and the other two modules' discrete inputs. This is useful if only one or two discrete contacts are available from a specific circuit or application.

Start Input

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.

If it is desired to use one module's contact inputs to also "Start" the other modules Speed Fail Timeout Trip functions, each module's Boolean Input Manager logic function can be configured to do so. Each module's Boolean Input Manager function can be configured to accept, only its local Start contact input, or a specific module's Start contact input, or all modules' Start contact inputs.

Note: The Start button is physically connected to the Start contact input.

Reset Input

This contact is used to clear/reset all local module trip and alarm events from the trip and alarm latches.

If it is desired to use one module's contact inputs to also "Reset" the other modules trip and alarm latches, each module's Boolean Input Manager logic function can be configured to do so. Each module's Boolean Input Manager function can be configured to accept, only its local Reset contact input, or a specific module's Reset contact input, or all modules' Reset contact inputs.

Note—The Reset button on the front of the module is a local module command only and cannot be connected to nor affect the "ORed" Reset contact input logic on other modules.

Speed-Fail-Override Input

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.

If it is desired to use one module's contact inputs to also function as the "Speed Fail Override Input" for the other modules, the module's Boolean Input Manager logic function can be configured to do so. Each module's Boolean Input Manager function can be configured to accept, only it's local Speed-Fail-Override contact input, or a specific module's Speed-Fail-Override contact input, or all modules' Speed-Fail-Override contact inputs.

Table 3-4. Dedicated Discrete Input Specifications

Number of Channels	3, (Start, Reset, Speed Fail Override)
Input Thresholds	<= 8 V (dc) = "OFF" >= 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.

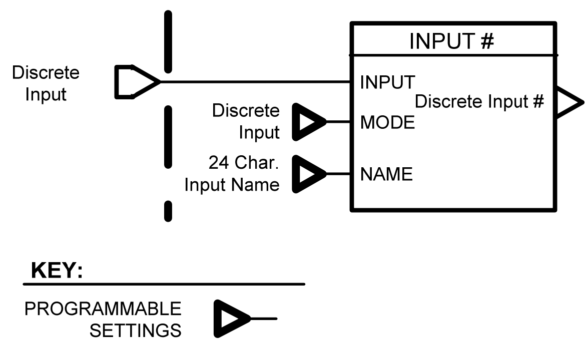


Figure 3-10. Discrete Input Example

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.

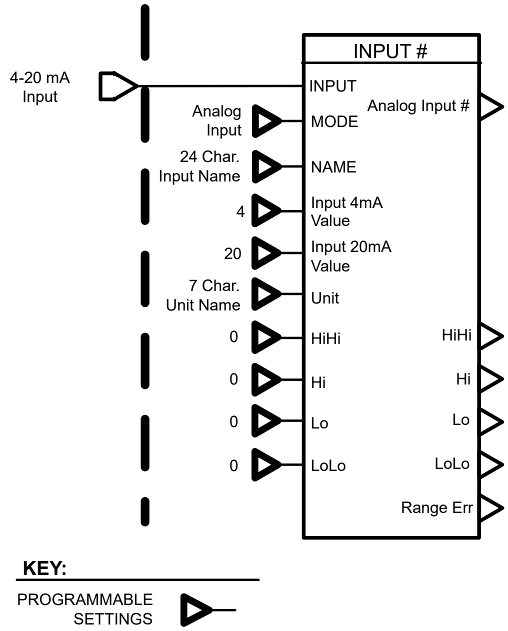


Figure 3-11. Analog Input Example

⚠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 3-5a. Configurable Input 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 3-5b. Configurable Input Analog Input Mode Specifications

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)* ±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 3-5c. Configurable Input Discrete Input Mode Specifications

Input Thresholds	<= 6 V (dc) = "OFF" >= 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 three 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.

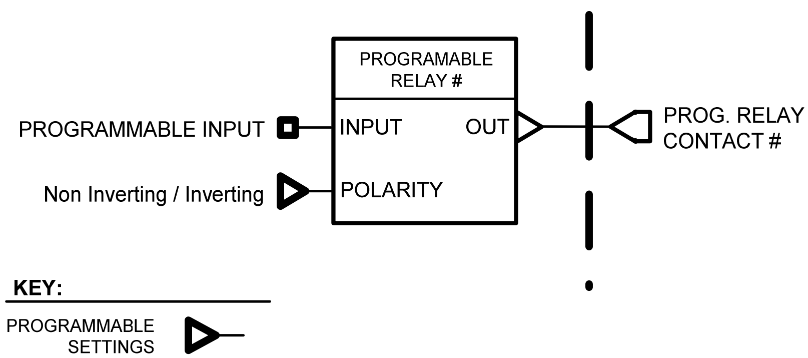


Figure 3-12. Programmable Relay Output Diagram

Table 3-5d. Configurable Input 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.

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

Table 3-6. 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)

IRIG-B Input

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

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

Table 3-7. IRIG-B Input Specifications

Number of Channels	1
Input Impedance	1 k Ω ±10 %
Input signal description	Logic 0: < 0.5 V 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.

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 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 or voted speed to its programmed overspeed trip setpoint to detect an overspeed condition and generate a trip command.

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. With the configuration of the acceleration redundancy manager each MicroNet Safety Module uses the acceleration values from all three modules to select/vote the acceleration value to compare to the configured over-acceleration trip setpoint and detect an over-acceleration condition. The MicroNet Safety Module control's acceleration detection function can be configured to be enabled, disabled, or only enabled above a certain speed setpoint. 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 are logged and can be viewed from the front panel or loaded to a computer via the MicroNet Safety Module Programming and Configuration Tool (PCT).

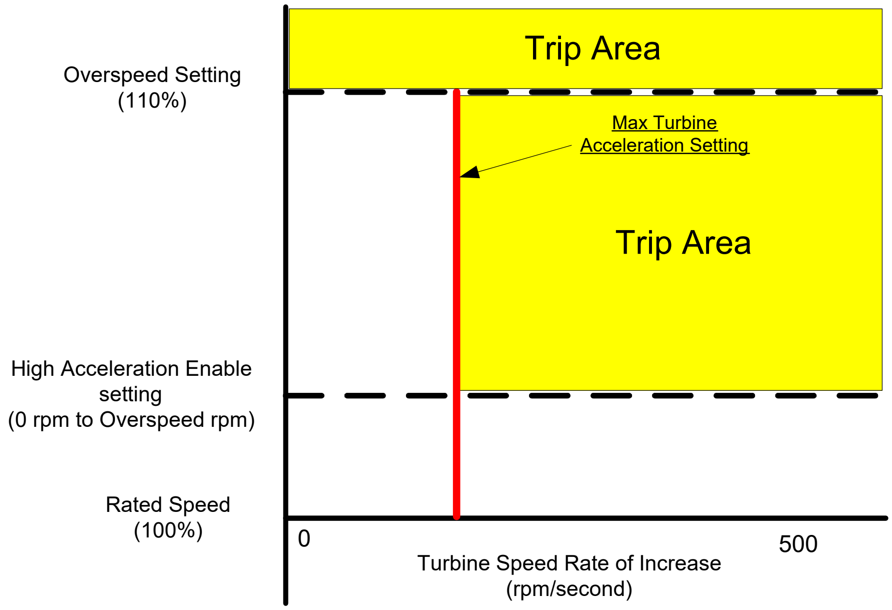


Figure 3-13. Over-Acceleration Enabling Diagram

Speed Redundancy Manager

The configuration/use of the Speed Redundancy Manager is not required to use either the independent voted or 2-out-of-3 voted ProTechMSM models. Independent voted and 2-out-of-3 voted logic is based on the ProTechMSM's output voting architecture and not its inputs. If the ProTechMSM's speed redundancy manager is not configured for use, then each module simply uses its local speed sensor signal and compares it to its internal/local overspeed setpoint to determine an overspeed event.

The use of the Speed Redundancy Manager allows users to elect to use three speed sensing probes, or two speed sensing probes or only one speed sensing probe in each module's overspeed logic depending on the specific application's requirements. If only two probes are used, then the third module can be configured to only use and vote on the shared speed signals (from the other modules) to use in its overspeed and over-acceleration detection logic. Although not recommended, if only one probe is used then the second and third modules can be configured to only use and vote on the shared speed signal (from the first module) to use in their overspeed and over-acceleration detection logic.
Note: If a speed probe is not connected to a ProTechMSM module the "Probe type" setting must be set to "Not Used".

If the module's Speed Redundancy Manager is configured for use, then each module uses its local sensed speed signal and the shared speed signals from the other two modules to select/vote the signal to use in its overspeed detection logic. Each module's Speed Redundancy manager can be configured as follows depending on the number of used or healthy speed signals:

1. Three used/healthy speed signals condition (Base Function):
   a. Median signal (middle signal)
   b. Highest signal
   c. Lowest signal

2. Two used/healthy speed signals condition (Fallback Function):
   a. Highest signal
   b. Lowest signal

3. One used/healthy speed signal condition (Two Inputs Failed Action):
   a. Used/sensed healthy speed signal
   b. Issue a trip command

In the Speed Redundancy Manager there is the Difference Alarm Limit and the Difference Alarm Time. The Difference Alarm time is the time a difference is allowed before an alarm is set.

⚠WARNING **If Speed Redundancy is used and Speed Fail Trip cannot be used, it is suggested to use HSS for both the Base and Fallback function. See Configuration Guidance section under the Troubleshooting Chapter for more detail.**

NOTICE **When the Speed Redundancy Manager is used, losing one of the speed signals will result in an alarm in all three modules. Once that speed signal is fixed, all three modules will need to be reset to clear the alarms (If the Reset inputs are shared, then one reset may reset multiple modules). Verify speed on modules before and after reset.**

Acceleration Redundancy Manager

The configuration/use of the Acceleration Redundancy Manager is not required. If the ProTechMSM's acceleration redundancy manager is not configured for use, then each module simply uses its local speed sensor signal and compares its calculated acceleration rate to the modules' over-acceleration setpoint to determine an over-acceleration event.

If the ProTechMSM's acceleration redundancy manager is configured for use, then each module uses its local calculated acceleration rate (calculated from the local speed signal) and the shared acceleration rates from the other two modules to select/vote the signal to use in its over-acceleration detection logic. The acceleration redundancy manager can be configured to vote the median, highest or lowest acceleration rate signal to use in its over-acceleration detection logic and can be configured to change its voting logic based on the number of healthy speed probes/signals.

If the module's Acceleration Redundancy Manager is configured for use, then each module uses its local derived acceleration signal and the shared acceleration signals from the other two modules to select/vote the signal to use in its over-acceleration detection logic. Each module's Acceleration Redundancy Manager can be configured as follows depending on the number of used or healthy speed signals:

1. Three used/healthy speed/acceleration signals condition (Base Function):
   a. Median signal (middle signal)
   b. Highest signal
   c. Lowest signal

2. Two used/healthy speed/acceleration signals condition (Fallback Function):
   a. Highest signal
   b. Lowest signal

3. One used/healthy speed/acceleration signal condition (Two Inputs Failed Action):
   a. Used/sensed healthy speed/acceleration signal
   b. Issue a trip command

Start Logic

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

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.

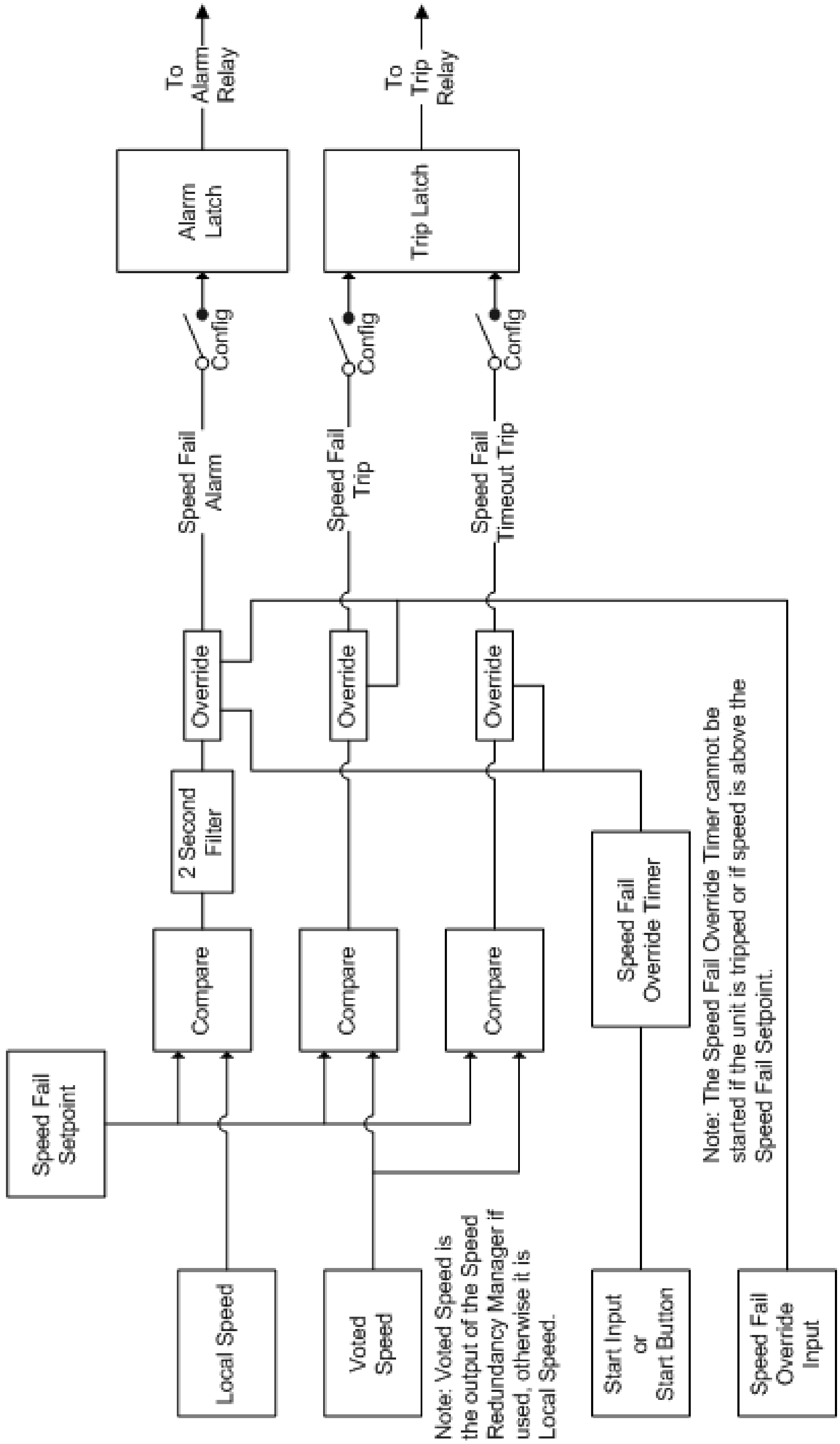


Figure 3-14. Start Logic Diagram

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.

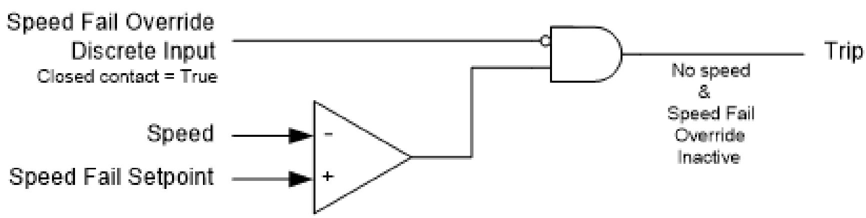


Figure 3-15. Speed Fail Trip Diagram

⚠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.

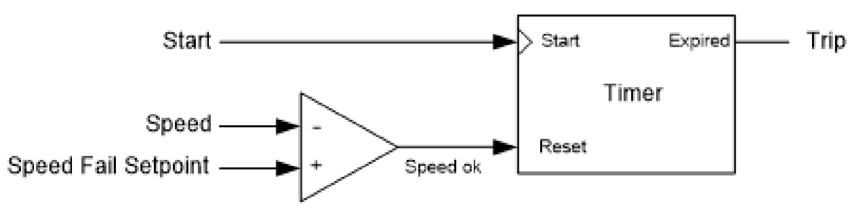


Figure 3-16. Speed Fail Timeout Trip Diagram

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 or equipment 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 where 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 or equipment 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 or equipment 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
- Analog Redundancy Managers
- Boolean Redundancy Managers
- Boolean combinatorial logic (AND, OR, NOT, etc.)
- Boolean Latches
- Delays
- Timers
- Lags
- Difference Detection

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

There is a configurable test mode permissive that is provided to prevent a test from being started if any module is tripped, in test, or in alarm. This permissive can be configured: Not Tripped—if another module is tripped or in a test; Not In Alarm—if another module is in alarm or in a test; or None—for no permissive. Selecting None means that tests can be run on any module regardless of the condition of the other modules. A test will always be prevented from running if the current module is tripped or in test. Also, tests will be aborted if another module trips or alarms, depending on the test mode permissive setting. One exception to these rules is the Temporary Overspeed Trip Setpoint which can be applied to multiple modules even if another module is tripped or in alarm. Another exception is the Auto-Sequence Test, which will never be allowed to run if any module is tripped in test or in alarm. Finally, 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.

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 an Auto Sequence Test function that will automatically run the Auto Speed Test on all three modules 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 a 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 than the electronic 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 highest level Test Mode Permissive so that a module cannot be placed in test while any other unit is tripped, in test, or in alarm. If it is desired to test a unit trip by tripping multiple modules through these simulated speed tests, the Test Mode Permissive can be set to a lower level.

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. If the test fails, a test failed alarm is generated and logged in the module's alarm log.

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.

Auto Sequence 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 can be initiated from the front panel, from configurable logic/inputs or by a configurable timer. If the configurable timer is used, the test Interval can be configured from 1 to 999 days. When initiated from the front panel or configurable logic/inputs, the test interval will be reset.

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 test can be configured to pause after each module is tested and wait for a continue/acknowledge signal from configurable logic/inputs. The test will wait for a configurable amount of time and if that time is exceeded, the test will abort.

The operator can disable the Auto Sequence test from the front panel of the module. When the Auto Sequence test is disabled, or if any module is in trip, alarm, or test, the Time Remaining Until Next Test will be prevented from counting below 1 hour. If the timer is already below one hour, it will be increased to 1 hour. When Auto Sequence Test is enabled again, and no modules are in trip, alarm, or test, this limit on the timer will no longer be in effect.

Configuration and initiation of the Auto Sequence Test can only be performed on Module A.

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 tests share some of the same properties as the built in test routines. A test cannot be initiated if any other module is tripped, in alarm or any other test routine is active depending on the test mode permissive. 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. Also, there is a Timeout feature associated with each User-defined Test 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 is automatically reset. The test can be reset from configurable logic, 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 latch makes 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 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 a 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, and 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:

- Internal Fault Alarm
- Configuration Mismatch (if configured)
- Power Supply 1 Fault (if configured)
- Power Supply 2 Fault (if configured)
- Speed Fail Alarm (if configured and speed input is used)
- Speed Lost Alarm (if configured and speed input is used)
- MPU Open Wire Alarm (if speed redundancy manager is used and speed input is Passive)
- Speed Redundancy Manager Input Difference Alarm (if speed redundancy manager is used)
- Speed Redundancy Manager Input 1 Invalid (if speed redundancy manager input 1 is used)
- Speed Redundancy Manager Input 2 Invalid (if speed redundancy manager input 2 is used)
- Speed Redundancy Manager Input 3 Invalid (if speed redundancy manager input 3 is used)
- Temporary Overspeed Setpoint Enabled Alarm
- Manual Simulate Speed Test Enabled Alarm
- Auto Simulated Speed Test Enabled Alarm
- Auto Simulated Speed Test Failed Alarm
- Auto-Sequence Test Active Alarm
- Auto-Sequence Continue Input Timeout Alarm (if continue input is used)
- 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)
- IRIG Signal Lost (if configured)
- TRIP (if configured)
- User configurable alarms 1-75 (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 as 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 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 the RESET button on the unit's front panel, or by activating the discrete input that is dedicated to the reset function.

Here is the complete list of possible trips:

- Internal Fault Trip
- Power Up Trip (if configured for De-energize to trip)
- Configuration Trip
- Parameter Error Trip
- Overspeed Trip (if speed redundancy manager is used or speed input is used)
- Over-Acceleration Trip (if configured and speed redundancy manager is used, or speed input is used)
- Speed Redundancy Manager Trip (if speed redundancy manager is used)
- Speed Probe Open Wire Trip (if speed redundancy manager is not used and the speed input is Passive)
- Speed Lost Trip (if configured and the speed input is used)
- Speed Fail Trip (if configured and the speed input or speed redundancy manager is used)
- Speed Fail Timeout Trip (if configured and the speed input or speed redundancy manager is used)
- 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 Latch

In each module, one Event Latch is provided. It is 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.

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 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.

The 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, overspeed, and over-acceleration events and the time and date the event occurred. Peak speed and peak acceleration are also logged with the time and date of the last peak. 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. Also, the logs can be exported using the PCT tool.

The logs, except the Configuration Error Log, 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 below. Logs can be cleared from the front panel with the appropriate password. The Test Level Password is needed to Reset All Logs except the Peak Speed/Acceleration Log. The Config Level Password is required to Reset the Peak Speed/Acceleration Log.

Overspeed/Acceleration Log

Each module logs the time and date of the last 20 overspeed or over-acceleration events, the speed and acceleration levels sensed upon issuing a system trip command, and the related maximum speed and acceleration values detected during the trip condition. This includes values generated by internal simulation testing. If the trip occurred during testing, this will also be indicated in the log.

Trip Log

Each module logs the last 50 trip events sensed. This log stores the trip description, time, and date of the event, “first out” trip indication, and indication if the module was performing a test when the trip occurred. Pressing the TRIPPED VIEW button on the MicroNet Safety Module’s front panel will display the Trip Log screen. This screen displays the most recent TRIP event at the top of the list and allows users to scroll through all logged events.

Alarm Log

Each module logs the last 50 alarms sensed. This log stores the alarm description, time and date of the event, and indication if the module was performing a test when the trip occurred. Pressing the ALARM VIEW button on the MicroNet Safety Module’s front panel will display the Alarm Log screen. This screen displays the most recent ALARM event at the top of the list and allows users to scroll through all logged events.

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 Log

Each module logs the last 50 events seen by the Event Latch. This log stores the event description, time, and date of the event, “first out” indication, and indication if the module was performing a test when the event occurred. This screen displays the most recent event at the top of the list and allows users to scroll through all logged events.

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 each user-definable point.

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

This log stores the maximum speed and acceleration levels, and associated time of the latest maximum since the last time the log was reset/cleared. This includes the speed and acceleration levels sensed during an automatic or manual overspeed testing routine. This log can be reset from the front panel with the use of the Config Level Password.

Response Time Performance

The MicroNet Safety Module's total throughput response time can be as fast as four milliseconds or as slow as 19 milliseconds for frequencies above 1000 Hz depending on the following:

- Independent Trip Relay or 2oo3 Voted Relay models
- Sensed frequency at overspeed trip point
- Configuration/use of the Speed Redundancy Manager function

The definition of "total throughput response time" as used within this manual and is displayed within the below graphs is the following: "the average time difference between a change of input speed at the input terminal is made to the time a change of output relay state at the output terminal is detected". Average time difference is displayed as event occurrence to module sample time differences can result in a ±2 millisecond time difference.

Since the MicroNet Safety Module's 2oo3 Voted Relay models utilize extra internal interposing relays to perform the 2-out-of-3 voting logic, the response time for these models is longer than that of the MicroNet Safety Module's Independent Voted Relay models. Refer to the graphs below to understand the system response differences between models.

As can be verified by the following graphs, the faster the input frequency, the faster a module's speed detection logic can sense and accurately calculate a speed signal.

Since the Speed Redundancy Manager function requires the sharing of all speed signals between all modules, the total throughput response time of each module configured is longer when the Speed Redundancy Manager function is configured. Refer to below graphs to understand the system response differences.

Independent Trip Relay Models—Response Graphs

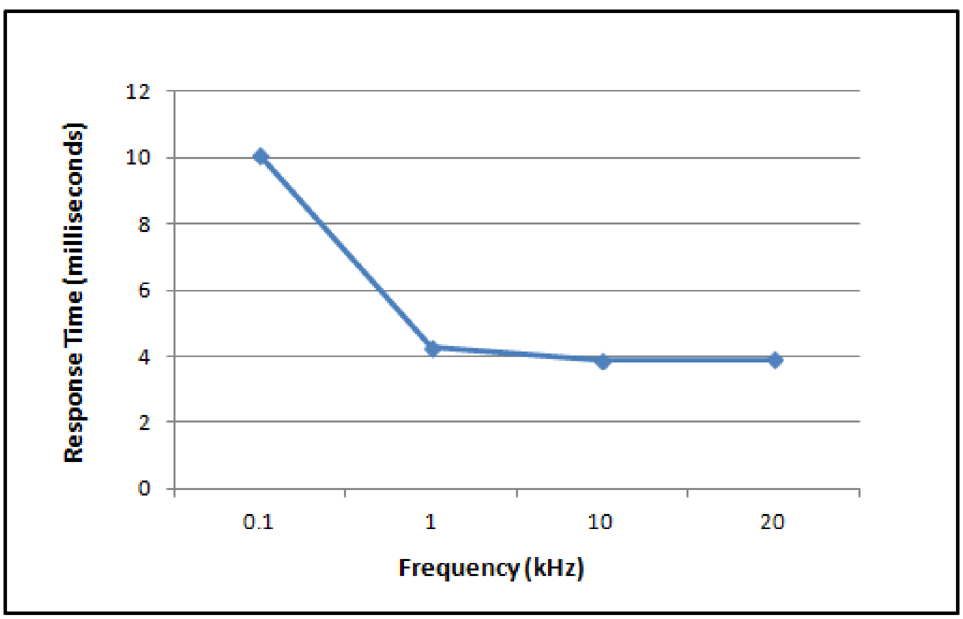


Figure 3-17. Total System Response Time Based on Sensed Frequency Level for Independent Trip Relay Models When Speed Redundancy Manager Function is Not Configured

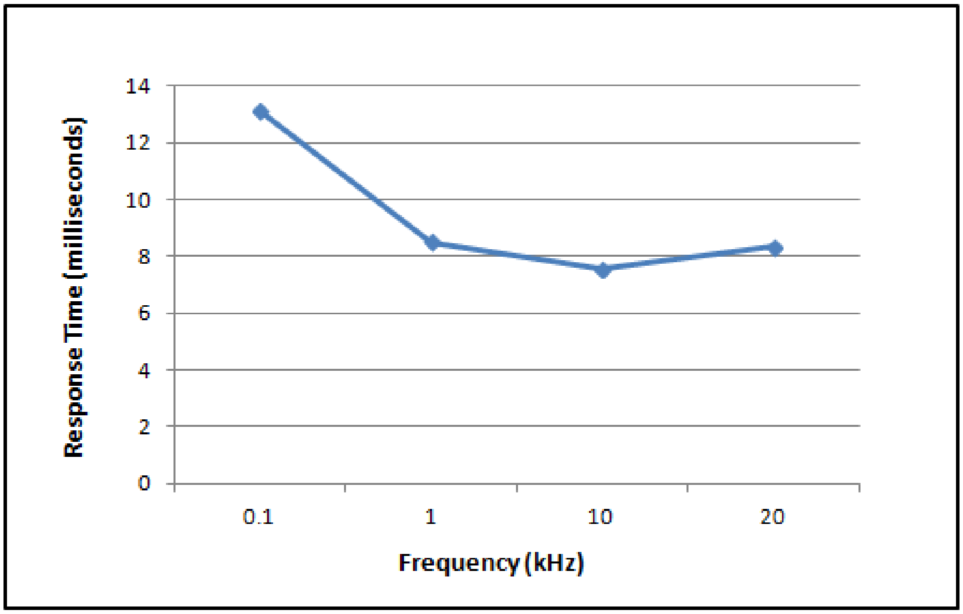


Figure 3-18. Total System Response Time Based on Sensed Frequency Level for Independent Trip Relay Models When Speed Redundancy Manager Function is Configured

Voted Trip Relay Models—Response Graphs

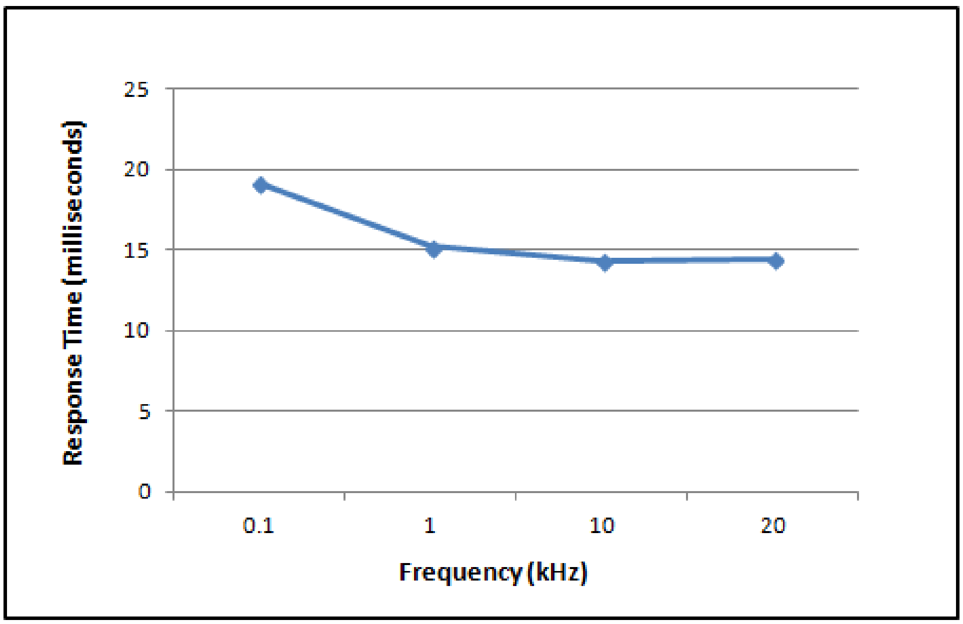


Figure 3-19. Total System Response Time Based on Sensed Frequency Level for 2oo3 Voted Trip Relay Models When Speed Redundancy Manager Function is Not Configured

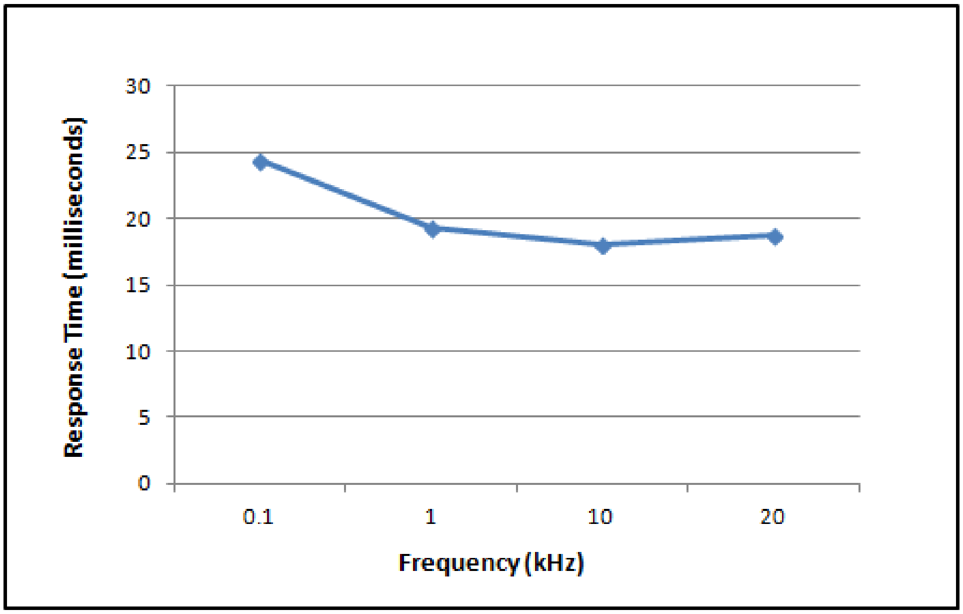


Figure 3-20. Total System Response Time Based on Sensed Frequency Level for 2oo3 Voted Trip Relay Models When Speed Redundancy Manager Function is Configured

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

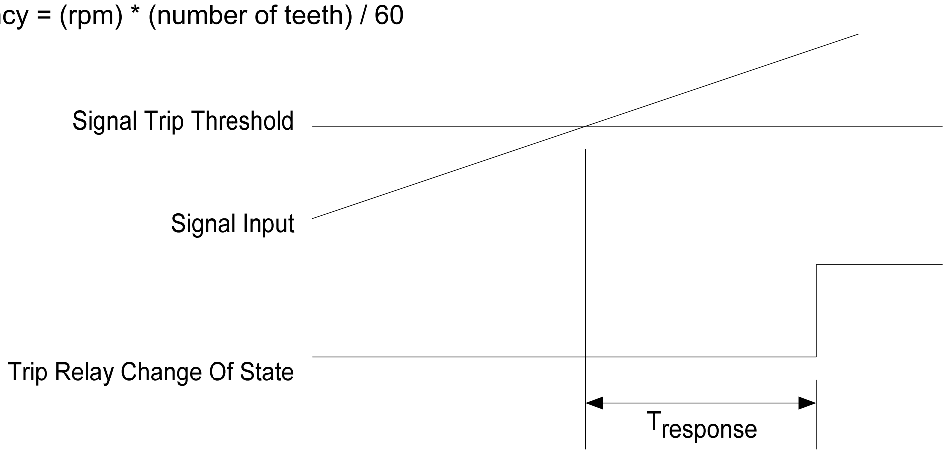


Figure 3-21. Response Time Definition

Analog Output

The response time of the analog output is less than 12 ms measured from a change in speed to a change in the output current.

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.

Each module's Modbus port is fully isolated from the other modules and provides all module-based information (Input/Output channel state information, alarm and trip relay information, first-out indication, etc.). However, it can also be used to sense the following information from the other two modules:
- Sensed speed – other two modules
- Acceleration – other two modules
- Alarm Latch State – other two modules
- Trip Latch State – other two modules
- 10 Discrete Inputs – other two modules
- 10 Analog Inputs – other two modules

Note: Modbus-based write commands (for test purposes) to each module can only be given to the module via its respective Modbus port.

Serial Communication Port (RS-232/RS-485) Specifications

Table 4-1. Serial Port 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.

If a Modbus port's "Enable Write Commands" setting is configured "No", the respective MicroNet Safety 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

If 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 command to trigger a module test 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 of the Initiate command; otherwise, 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, not in a test mode, and optionally not in alarm.

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 (Read Input Status) (Status of Alarms/Shutdowns, Discrete input/outputs)	1XXXX
04	Analog Read (Read Input Registers) (Speed, Acceleration, etc.)	3XXXX
05	Boolean Write (Force Single Coil)	0XXXX
08	Loopback Diagnostic Test – Diagnostic code 0 only	

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 Serial 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. Reserved address ranges can be read, but they are undefined for MicroNet Safety Module.

All values that can be addressed by Modbus are considered to be 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. No password is required when issuing a command using Modbus. The available write commands are listed in Table 4-3.

Once a Modbus port's "Enable Write Commands" setting is configured "Yes", the respective MicroNet Safety 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. Depending on the "Test Mode Permissive" setting, attempts to start a test may be ignored when another test mode is active, another module is tripped, another module is in a test mode, or another module is in alarm.

Speed/user tests must be requested by first setting the Initiate bit, followed by 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 4-4.

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 4-5.

Heartbeat indication (1:1501)
The Heartbeat indication provides an indication that toggles every 1 second between logic 1 and logic 0.

Last Trip time and date indication (3:1001 - 1007)
Last Trip Date/Time represents the Date/Time of the most recent first out trip.

Unit Health indication (3:1101)
This register indicates the state of the internal fault trip (if known) as follows:
0 = internal fault trip is TRUE (Unit Health LED is red)
1 = internal fault trip is FALSE (Unit Health LED is green)
2 = state of the internal fault trip is unknown because of a communication fault (Unit Health LED is off)

Auto-Sequence Test Status (3:1201)
This register indicates the state of the Auto Sequence Test as follows:
0 = Not Started
1 = Passed
2 = Failed
3 = Not Completed

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

Released

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

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:0001	Internal Fault Trip	1:1003	Over-acceleration
1:0002	Power Up Trip	1:1004	Speed Fail Trip Non-Latched
1:0003	Configuration Trip	1:1005	Speed Fail Timeout
1:0004	Parameter Error Trip	1:1006	Speed Lost Alarm Non-Latched
1:0005	Over Speed Trip	1:1007	Speed Lost Trip Non-Latched
1:0006	Over Accel Trip	1:1008	Speed Probe Open Wire Trip Non-Latched
1:0007	Speed Redundancy Manager Trip	1:1009	Tmp Ovrspd Setpoint On
1:0008	Speed Probe Open Wire Trip	1:1010	Simulated Speed Active
1:0009	Speed Lost Trip	1:1011	Auto Speed Test Active
1:0010	Speed Fail Trip	1:1012	Auto Speed Test Failed
1:0011	Speed Fail Timeout Trip	1:1013	Auto Sequence Test Active
1:0012	Resettable Trip Input Trip	1:1014	Auto Sequence Continue Timeout
1:0013 to 0037	User Configurable Trips 1 to 25	1:1015	User Defined Test 1
1:0101 to 0137	Trip Latch First Outs 1 to 37	1:1016	User Defined Test 2
1:0201	Internal Fault Alarm	1:1017	User Defined Test 3
1:0202	Module Config Mismatch Alarm	1:1018	Configuration Mismatch
1:0203	Power Supply 1 Fault Alarm	1:1019	Speed Fail Alarm Non-Latched
1:0204	Power Supply 2 Fault Alarm	1:1020	Trip Latch Output
1:0205	Speed Fail Alarm	1:1021	Alarm Latch Output
1:0206	Speed Lost Alarm	1:1022	Event Latch Output
1:0207	Speed Probe Open Wire Alarm	1:1023	Discrete Input 1
1:0208	Speed Red Mgr Input Difference Alarm	1:1024	Discrete Input 2
1:0209	Speed Red Mgr Input 1 Invalid Alarm	1:1025	Discrete Input 3
1:0210	Speed Red Mgr Input 2 Invalid Alarm	1:1026	Discrete Input 4
1:0211	Speed Red Mgr Input 3 Invalid Alarm	1:1027	Discrete Input 5
1:0212	Temp Overspeed SP is Active Alarm	1:1028	Discrete Input 6
1:0213	Simulated Speed Test in Progress Alarm	1:1029	Discrete Input 7
1:0214	Auto Speed Test Active Alarm	1:1030	Discrete Input 8
1:0215	Auto Speed Test Failed Alarm	1:1031	Discrete Input 9
1:0216	Auto Sequence Test Active Alarm	1:1032	Discrete Input 10
1:0217	Auto Sequence Continue Timeout Alarm	1:1033	Analog Input 1 Hi
1:0218	User Test 1 Active Alarm	1:1034	Analog Input 2 Hi
1:0219	User Test 2 Active Alarm	1:1035	Analog Input 3 Hi
1:0220	User Test 3 Active Alarm	1:1036	Analog Input 4 Hi
1:0221	Trip Cycle Time Mon 1 Alarm	1:1037	Analog Input 5 Hi
1:0222	Trip Cycle Time Mon 2 Alarm	1:1038	Analog Input 6 Hi
1:0223	IRIG Signal Lost Alarm	1:1039	Analog Input 7 Hi
1:0224	Trip Latch Output Alarm	1:1040	Analog Input 8 Hi
1:0225 to 0299	User Configurable Alarms 1 to 75	1:1041	Analog Input 9 Hi
1:0401 to 0425	Event Latched Inputs 1 to 25	1:1042	Analog Input 10 Hi
1:0501 to 0525	Event Latch First Outs 1 to 25	1:1043	Analog Input 1 HiHi
1:1001	Speed Fail Override	1:1044	Analog Input 2 HiHi
1:1002	Overspeed	1:1045	Analog Input 3 HiHi

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

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:1046	Analog Input 4 HiHi	1:1099	Logic Gate 2
1:1047	Analog Input 5 HiHi	1:1100	Logic Gate 3
1:1048	Analog Input 6 HiHi	1:1101	Logic Gate 4
1:1049	Analog Input 7 HiHi	1:1102	Logic Gate 5
1:1050	Analog Input 8 HiHi	1:1103	Logic Gate 6
1:1051	Analog Input 9 HiHi	1:1104	Logic Gate 7
1:1052	Analog Input 10 HiHi	1:1105	Logic Gate 8
1:1053	Analog Input 1 Lo	1:1106	Logic Gate 9
1:1054	Analog Input 2 Lo	1:1107	Logic Gate 10
1:1055	Analog Input 3 Lo	1:1108	Logic Gate 11
1:1056	Analog Input 4 Lo	1:1109	Logic Gate 12
1:1057	Analog Input 5 Lo	1:1110	Logic Gate 13
1:1058	Analog Input 6 Lo	1:1111	Logic Gate 14
1:1059	Analog Input 7 Lo	1:1112	Logic Gate 15
1:1060	Analog Input 8 Lo	1:1113	Logic Gate 16
1:1061	Analog Input 9 Lo	1:1114	Logic Gate 17
1:1062	Analog Input 10 Lo	1:1115	Logic Gate 18
1:1063	Analog Input 1 LoLo	1:1116	Logic Gate 19
1:1064	Analog Input 2 LoLo	1:1117	Logic Gate 20
1:1065	Analog Input 3 LoLo	1:1118	Logic Gate 21
1:1066	Analog Input 4 LoLo	1:1119	Logic Gate 22
1:1067	Analog Input 5 LoLo	1:1120	Logic Gate 23
1:1068	Analog Input 6 LoLo	1:1121	Logic Gate 24
1:1069	Analog Input 7 LoLo	1:1122	Logic Gate 25
1:1070	Analog Input 8 LoLo	1:1123	Logic Gate 26
1:1071	Analog Input 9 LoLo	1:1124	Logic Gate 27
1:1072	Analog Input 10 LoLo	1:1125	Logic Gate 28
1:1073	Analog Input 1 Range Error	1:1126	Logic Gate 29
1:1074	Analog Input 2 Range Error	1:1127	Logic Gate 30
1:1075	Analog Input 3 Range Error	1:1128	Logic Gate 31
1:1076	Analog Input 4 Range Error	1:1129	Logic Gate 32
1:1077	Analog Input 5 Range Error	1:1130	Logic Gate 33
1:1078	Analog Input 6 Range Error	1:1131	Logic Gate 34
1:1079	Analog Input 7 Range Error	1:1132	Logic Gate 35
1:1080	Analog Input 8 Range Error	1:1133	Logic Gate 36
1:1081	Analog Input 9 Range Error	1:1134	Logic Gate 37
1:1082	Analog Input 10 Range Error	1:1135	Logic Gate 38
1:1083	Analog Comparator 1	1:1136	Logic Gate 39
1:1084	Analog Comparator 2	1:1137	Logic Gate 40
1:1085	Analog Comparator 3	1:1138	Logic Gate 41
1:1086	Analog Comparator 4	1:1139	Logic Gate 42
1:1087	Analog Comparator 5	1:1140	Logic Gate 43
1:1088	Analog Comparator 6	1:1141	Logic Gate 44
1:1089	Analog Comparator 7	1:1142	Logic Gate 45
1:1090	Analog Comparator 8	1:1143	Logic Gate 46
1:1091	Analog Comparator 9	1:1144	Logic Gate 47
1:1092	Analog Comparator 10	1:1145	Logic Gate 48
1:1093	Analog Comparator 11	1:1146	Logic Gate 49
1:1094	Analog Comparator 12	1:1147	Logic Gate 50
1:1095	Analog Comparator 13	1:1148	Latch 1
1:1096	Analog Comparator 14	1:1149	Latch 2
1:1097	Analog Comparator 15	1:1150	Latch 3
1:1098	Logic Gate 1	1:1151	Latch 4

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

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:1152	Latch 5	1:1205	Reserved (Do not use)
1:1153	Latch 6	1:1206	Internal Fault Trip Non-Latched
1:1154	Latch 7	1:1207	Internal Fault Alarm Non-Latched
1:1155	Latch 8	1:1208	Configuration Error
1:1156	Latch 9	1:1209	Resettable Trip Input
1:1157	Latch 10	1:1210	Power Supply 1 Fault
1:1158	Delay 1	1:1211	Power Supply 2 Fault
1:1159	Delay 2	1:1212	Parameter Error
1:1160	Delay 3	1:1213	Irig Signal Lost
1:1161	Delay 4	1:1214	Analog Red Mgr 1 Input 1 Invalid
1:1162	Delay 5	1:1215	Analog Red Mgr 1 Input 2 Invalid
1:1163	Delay 6	1:1216	Analog Red Mgr 1 Input 3 Invalid
1:1164	Delay 7	1:1217	Analog Red Mgr 2 Input 1 Invalid
1:1165	Delay 8	1:1218	Analog Red Mgr 2 Input 2 Invalid
1:1166	Delay 9	1:1219	Analog Red Mgr 2 Input 3 Invalid
1:1167	Delay 10	1:1220	Analog Red Mgr 3 Input 1 Invalid
1:1168	Delay 11	1:1221	Analog Red Mgr 3 Input 2 Invalid
1:1169	Delay 12	1:1222	Analog Red Mgr 3 Input 3 Invalid
1:1170	Delay 13	1:1223	Analog Red Mgr 4 Input 1 Invalid
1:1171	Delay 14	1:1224	Analog Red Mgr 4 Input 2 Invalid
1:1172	Delay 15	1:1225	Analog Red Mgr 4 Input 3 Invalid
1:1173	Delay 16	1:1226	Analog Red Mgr 5 Input 1 Invalid
1:1174	Delay 17	1:1227	Analog Red Mgr 5 Input 2 Invalid
1:1175	Delay 18	1:1228	Analog Red Mgr 5 Input 3 Invalid
1:1176	Delay 19	1:1229	Analog Red Mgr 6 Input 1 Invalid
1:1177	Delay 20	1:1230	Analog Red Mgr 6 Input 2 Invalid
1:1178	Delay 21	1:1231	Analog Red Mgr 6 Input 3 Invalid
1:1179	Delay 22	1:1232	Analog Red Mgr 7 Input 1 Invalid
1:1180	Delay 23	1:1233	Analog Red Mgr 7 Input 2 Invalid
1:1181	Delay 24	1:1234	Analog Red Mgr 7 Input 3 Invalid
1:1182	Delay 25	1:1235	Analog Red Mgr 8 Input 1 Invalid
1:1183	Timer 1 HiHi	1:1236	Analog Red Mgr 8 Input 2 Invalid
1:1184	Timer 1 Hi	1:1237	Analog Red Mgr 8 Input 3 Invalid
1:1185	Timer 2 HiHi	1:1238	Analog Red Mgr 9 Input 1 Invalid
1:1186	Timer 2 Hi	1:1239	Analog Red Mgr 9 Input 2 Invalid
1:1187	Timer 3 HiHi	1:1240	Analog Red Mgr 9 Input 3 Invalid
1:1188	Timer 3 Hi	1:1241	Analog Red Mgr 10 Input 1 Invalid
1:1189	Timer 4 HiHi	1:1242	Analog Red Mgr 10 Input 2 Invalid
1:1190	Timer 4 Hi	1:1243	Analog Red Mgr 10 Input 3 Invalid
1:1191	Timer 5 HiHi	1:1244	Analog Red Mgr 11 Input 1 Invalid
1:1192	Timer 5 Hi	1:1245	Analog Red Mgr 11 Input 2 Invalid
1:1193	Unit Delay 1	1:1246	Analog Red Mgr 11 Input 3 Invalid
1:1194	Unit Delay 2	1:1247	Analog Red Mgr 12 Input 1 Invalid
1:1195	Unit Delay 3	1:1248	Analog Red Mgr 12 Input 2 Invalid
1:1196	Unit Delay 4	1:1249	Analog Red Mgr 12 Input 3 Invalid
1:1197	Unit Delay 5	1:1250	Analog Red Mgr 13 Input 1 Invalid
1:1198	Unit Delay 6	1:1251	Analog Red Mgr 13 Input 2 Invalid
1:1199	Unit Delay 7	1:1252	Analog Red Mgr 13 Input 3 Invalid
1:1200	Unit Delay 8	1:1253	Analog Red Mgr 14 Input 1 Invalid
1:1201	Unit Delay 9	1:1254	Analog Red Mgr 14 Input 2 Invalid
1:1202	Unit Delay 10	1:1255	Analog Red Mgr 14 Input 3 Invalid
1:1203	Reserved (Do not use)	1:1256	Analog Red Mgr 15 Input 1 Invalid
1:1204	Reserved (Do not use)	1:1257	Analog Red Mgr 15 Input 2 Invalid

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

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:1252	Analog Red Mgr 13 Input 3 Invalid	1:1304	Bool Red Mgr 11 Input 1 Invalid
1:1253	Analog Red Mgr 14 Input 1 Invalid	1:1305	Bool Red Mgr 11 Input 2 Invalid
1:1254	Analog Red Mgr 14 Input 2 Invalid	1:1306	Bool Red Mgr 11 Input 3 Invalid
1:1255	Analog Red Mgr 14 Input 3 Invalid	1:1307	Bool Red Mgr 12 Input 1 Invalid
1:1256	Analog Red Mgr 15 Input 1 Invalid	1:1308	Bool Red Mgr 12 Input 2 Invalid
1:1257	Analog Red Mgr 15 Input 2 Invalid	1:1309	Bool Red Mgr 12 Input 3 Invalid
1:1258	Analog Red Mgr 15 Input 3 Invalid	1:1310	Bool Red Mgr 13 Input 1 Invalid
1:1259	Bool Red Mgr Output 1	1:1311	Bool Red Mgr 13 Input 2 Invalid
1:1260	Bool Red Mgr Output 2	1:1312	Bool Red Mgr 13 Input 3 Invalid
1:1261	Bool Red Mgr Output 3	1:1313	Bool Red Mgr 14 Input 1 Invalid
1:1262	Bool Red Mgr Output 4	1:1314	Bool Red Mgr 14 Input 2 Invalid
1:1263	Bool Red Mgr Output 5	1:1315	Bool Red Mgr 14 Input 3 Invalid
1:1264	Bool Red Mgr Output 6	1:1316	Bool Red Mgr 15 Input 1 Invalid
1:1265	Bool Red Mgr Output 7	1:1317	Bool Red Mgr 15 Input 2 Invalid
1:1266	Bool Red Mgr Output 8	1:1318	Bool Red Mgr 15 Input 3 Invalid
1:1267	Bool Red Mgr Output 9	1:1319	Difference Detection 1
1:1268	Bool Red Mgr Output 10	1:1320	Difference Detection 2
1:1269	Bool Red Mgr Output 11	1:1321	Difference Detection 3
1:1270	Bool Red Mgr Output 12	1:1322	Difference Detection 4
1:1271	Bool Red Mgr Output 13	1:1323	Difference Detection 5
1:1272	Bool Red Mgr Output 14	1:1324	Difference Detection 6
1:1273	Bool Red Mgr Output 15	1:1325	Difference Detection 7
1:1274	Bool Red Mgr 1 Input 1 Invalid	1:1326	Difference Detection 8
1:1275	Bool Red Mgr 1 Input 2 Invalid	1:1327	Difference Detection 9
1:1276	Bool Red Mgr 1 Input 3 Invalid	1:1328	Difference Detection 10
1:1277	Bool Red Mgr 2 Input 1 Invalid	1:1329	Difference Detection 11
1:1278	Bool Red Mgr 2 Input 2 Invalid	1:1330	Difference Detection 12
1:1279	Bool Red Mgr 2 Input 3 Invalid	1:1331	Difference Detection 13
1:1280	Bool Red Mgr 3 Input 1 Invalid	1:1332	Difference Detection 14
1:1281	Bool Red Mgr 3 Input 2 Invalid	1:1333	Difference Detection 15
1:1282	Bool Red Mgr 3 Input 3 Invalid	1:1334	Speed Red Mgr Input 1 Invalid
1:1283	Bool Red Mgr 4 Input 1 Invalid	1:1335	Speed Red Mgr Input 2 Invalid
1:1284	Bool Red Mgr 4 Input 2 Invalid	1:1336	Speed Red Mgr Input 3 Invalid
1:1285	Bool Red Mgr 4 Input 3 Invalid	1:1337	Speed Red Mgr Input Difference
1:1286	Bool Red Mgr 5 Input 1 Invalid	1:1338	Accel Red Mgr Input 1 Invalid
1:1287	Bool Red Mgr 5 Input 2 Invalid	1:1339	Accel Red Mgr Input 2 Invalid
1:1288	Bool Red Mgr 5 Input 3 Invalid	1:1340	Accel Red Mgr Input 3 Invalid
1:1289	Bool Red Mgr 6 Input 1 Invalid	1:1341	Speed Probe Open Wire Alarm Non-Latched
1:1290	Bool Red Mgr 6 Input 2 Invalid	1:1342	Speed Red Mgr Trip Non-Latched
1:1291	Bool Red Mgr 6 Input 3 Invalid	1:1343	Reserved (Do Not Use)
1:1292	Bool Red Mgr 7 Input 1 Invalid	1:1344	Reserved (Do Not Use)
1:1293	Bool Red Mgr 7 Input 2 Invalid	1:1345	Reserved (Do Not Use)
1:1294	Bool Red Mgr 7 Input 3 Invalid	1:1401	Module A Discrete Input 1
1:1295	Bool Red Mgr 8 Input 1 Invalid	1:1402	Module A Discrete Input 2
1:1296	Bool Red Mgr 8 Input 2 Invalid	1:1403	Module A Discrete Input 3
1:1297	Bool Red Mgr 8 Input 3 Invalid	1:1404	Module A Discrete Input 4
1:1298	Bool Red Mgr 9 Input 1 Invalid	1:1405	Module A Discrete Input 5
1:1299	Bool Red Mgr 9 Input 2 Invalid	1:1406	Module A Discrete Input 6
1:1300	Bool Red Mgr 9 Input 3 Invalid	1:1407	Module A Discrete Input 7
1:1301	Bool Red Mgr 10 Input 1 Invalid	1:1408	Module A Discrete Input 8
1:1302	Bool Red Mgr 10 Input 2 Invalid	1:1409	Module A Discrete Input 9
1:1303	Bool Red Mgr 10 Input 3 Invalid	1:1410	Module A Discrete Input 10

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

ADDRESS	DESCRIPTION
1:1411	Module B Discrete Input 1
1:1412	Module B Discrete Input 2
1:1413	Module B Discrete Input 3
1:1414	Module B Discrete Input 4
1:1415	Module B Discrete Input 5
1:1416	Module B Discrete Input 6
1:1417	Module B Discrete Input 7
1:1418	Module B Discrete Input 8
1:1419	Module B Discrete Input 9
1:1420	Module B Discrete Input 10
1:1421	Module C Discrete Input 1
1:1422	Module C Discrete Input 2
1:1423	Module C Discrete Input 3
1:1424	Module C Discrete Input 4
1:1425	Module C Discrete Input 5
1:1426	Module C Discrete Input 6
1:1427	Module C Discrete Input 7
1:1428	Module C Discrete Input 8
1:1429	Module C Discrete Input 9
1:1430	Module C Discrete Input 10
1:1431	Module A Trip Latch Out
1:1432	Module A Alarm Latch Out
1:1433	Module B Trip Latch Out
1:1434	Module B Alarm Latch Out
1:1435	Module C Trip Latch Out
1:1436	Module C Alarm Latch Out
1:1501	Heartbeat
1:1411	Module B Discrete Input 1

Table 4-6. Analog Read Addresses (Code 04)

ADDRESS	DESCRIPTION	UNITS	RANGE
3:0001	Speed (after Speed Red Mgr, if used)	RPM	0 to 32500
3:0002	Acceleration (after Accel Red Mgr, if used)	RPM/s	-32500 to 32500
3:0003	Module A Speed	RPM	0 to 32500
3:0004	Module A Acceleration	RPM/s	-32500 to 32500
3:0005	Module B Speed	RPM	0 to 32500
3:0006	Module B Acceleration	RPM/s	-32500 to 32500
3:0007	Module C Speed	RPM	0 to 32500
3:0008	Module C Acceleration	RPM/s	-32500 to 32500
3:0009	Overspeed Setpoint (Local)	RPM	0 to 32500
3:0101 to 0110	Analog Inputs (Local) 1 to 10	User Units	-32768 to 32767
3:0201 to 0210	Module A Analog Inputs 1 to 10	User Units	-32768 to 32767
3:0301 to 0310	Module B Analog Inputs 1 to 10	User Units	-32768 to 32767
3:0401 to 0410	Module C Analog Inputs 1 to 10	User Units	-32768 to 32767
3:0501	Trip Cycle Time 1	ms	0 to 65535
3:0502	Trip Cycle Time 2	ms	0 to 65535
3:0601	Test Mode Time Remaining	s	0 to 65535
3:0701	Speed Fail Time Remaining	s	0 to 65535
3:0801	Timer 1 Seconds	s	0 to 65535
3:0802	Timer 1 Milliseconds	ms	0 to 999
3:0803	Timer 2 Seconds	s	0 to 65535
3:0804	Timer 2 Milliseconds	ms	0 to 999
3:0805	Timer 3 Seconds	s	0 to 65535
3:0806	Timer 3 Milliseconds	ms	0 to 999
3:0807	Timer 4 Seconds	s	0 to 65535
3:0808	Timer 4 Milliseconds	ms	0 to 999
3:0809	Timer 5 Seconds	s	0 to 65535
3:0810	Timer 5 Milliseconds	ms	0 to 999
3:0901	Temp Overspeed Setpoint	RPM	0 to 65535
3:0902	Simulated Speed RPM	RPM	0 to 65535
3:1001	Last Trip Month	Months	1 to 12
3:1002	Last Trip Day	Days	1 to 31
3:1003	Last Trip Year	Years	2000 to 2099
3:1004	Last Trip Hour	Hours	0 to 23
3:1005	Last Trip Minute	Minutes	0 to 59
3:1006	Last Trip Second	Sec	0 to 59
3:1007	Last Trip Millisecond	ms	0 to 999
3:1101	Unit Health Status	Enum	0 to 2
3:1201	Auto-Sequence Test Status	Enum	0 to 3

Note: The Last Trip time and date indication registers (3:1001 - 1007) are provided for use to timestamp when a trip condition occurs. With this logic, when a trip condition occurs the first sensed trip condition will be indicated by one of the registers (1:0101 - 0137) changing to a true state. When one of those registers change to a true state, then the Last Trip time and date indication registers (3:1001 - 1007) will indicate the sensed date and time of the event. This Date/Time will remain in locked in these registers until the next trip condition occurs.

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 Programming and Configuration 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 Programming and Configuration Tool also provides more detailed information in the log pages.

UNIT HEALTH LED
The UNIT HEALTH LED indicates module health status.
1. Green – Unit OK and functioning properly.
2. Red – Safety Functionality is not running/internal fault trip is present.
3. 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.
1. Unlit – Unit not tripped, or the module is not powered.
2. Red – Unit tripped, press VIEW button below the LED to see the trip 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.
1. Unlit – No alarms or the module is not powered.
2. 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

Table 5-1. 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 the 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 the power supply has appropriate rating to power the MicroNet Safety Module.
Speed Input not working	Wiring fault, terminal block loose.	Verify the wiring and terminal block connections.
	Configuration	On the front panel, check the Speed Input Configure Menu and verify all proper configuration options are selected.
	Alarms and Faults	Verify there are no alarms or faults that may indicate a setup problem (open wire trip, speed lost, speed fail, etc.)
	Signal level	Verify 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 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 the wiring and terminal block connections.
	Configuration	On the front panel, check the Dedicated Discrete Inputs Monitor Menu and verify the 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 the wiring and terminal block connections.
	Configuration	On the front panel, check the Configurable Inputs Monitor Menu and verify the logic state is correct. Using the Programming and Configuration Tool, verify 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 the voltage source is not being overloaded.
Configurable Input – Analog Input not working	Wiring fault, terminal block loose.	Verify the 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. Using the Programming and Configuration Tool, verify 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 the wiring and terminal block connections.
	Configuration	Using the Programming and Configuration Tool or front panel, check to see if 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 the wiring and terminal block connections.
	Configuration	Using the Programming and Configuration Tool, check to see if 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 the wiring and terminal block connections. On the front panel, check the Monitor Analog Output Menu and verify that the analog output is reading an expected output value. Measure the current from terminal 64 and verify it corresponds to the previous step. Verify the load on the analog output is within the electrical specifications.
	Configuration	Using the Programming and Configuration Tool or front panel, verify the scaling is correct.
MODBUS not working	Wiring fault, terminal block loose.	Verify the wiring and terminal block connections. In particular, verify the HI and LO wires are terminated to the correct terminals for RS-485 and likewise for TXD and RXD for RS-232. Also verify the terminations jumpers are installed for RS-485 mode
	Configuration	Using the Programming and Configuration Tool or front panel, verify the correct settings are selected
Programming and Configuration Tool not working	Wiring and connection	Verify the cable plugged into the DB9 port is not a crossover. A straight-through cable is required.
	COM Port	Check that power is applied to the MicroNet Safety Module module and the service tool is connected. Verify the correct COM port is selected when establishing communications and that Auto Detection BAUD rate is selected.

Trip Indications

Table 5-2. 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. In general, it is not possible to fix internal faults without returning the unit to Woodward.
Power Up Trip (if configured for de-energize to 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 was issued from the front panel to enter configuration mode or issued internally to keep module in a tripped state while saving a configuration.	The module is actively being configured or a configuration is being saved.	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. If Parameter Error persists return unit to Woodward according to the instructions in Chapter 8 of this manual.
Overspeed Trip (if speed redundancy or the speed probe is used)	The module tripped on an overspeed event.	Turbine or equipment 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 the correct settings are selected.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
Over-acceleration Trip (if speed redundancy or the speed probe is used)	The over-acceleration function is enabled, and the module tripped on an over-acceleration event.	Rapid turbine or equipment acceleration. Configuration.	Check trip system prior to operating turbine or equipment, including MicroNet Safety Module built-in simulated speed tests to verify MicroNet Safety Module functionality. Using the PCT or front panel, verify the correct settings are selected.
Speed Probe Open Wire (if speed redundancy is not used)	The module 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 Redundancy Manager Trip (if speed redundancy is used)	This trip will indicate that the MicroNet Safety Module has too many failed probes to run.	Can be configured to trip on loss of 1 or 2 probes	Check wiring continuity and probe integrity.
Speed Lost Trip (if the speed probe is used)	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 (if speed redundancy or the speed probe is used)	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. Speed Fail Override contact input operation is not correct. Incorrect speed fail setpoint configured.	Check wiring continuity and probe integrity. Check contact and wiring operation. See manual for description of function. Use PCT to verify proper configuration settings.
Speed Fail Timeout (if speed redundancy or the speed probe is used)	Start logic – Speed Fail Timer is enabled, and the module has not detected speed within the time set by the Speed Fail Timeout setting.	Wiring fault, speed probe fault. Incorrect speed fail timeout time configured.	Check wiring continuity and probe integrity. See manual for description of function. Use PCT to verify proper configuration settings.

Alarm Indications

Table 5-3. Alarm Indications

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
Internal Fault Alarm	The module has an internal fault that annunciated an alarm and not a trip.	Various	Connect the Programming and Configuration Tool and view the Trip And Alarm Log. This log expands the Internal Fault Alarm annunciation.
Configuration Mismatch	Configuration Compare is enabled, and 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 the Programming and Configuration Tool.
Power Supply 1 Fault	Power supply 1 fault is enabled, and 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	Power supply 2 fault is enabled, and 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 (if the speed probe is used)	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. Speed Fail Override contact input operation is not correct. Incorrect speed fail setpoint configured.	Check wiring continuity and probe integrity. Check contact and wiring operation. 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.
Speed Probe Open Wire Alarm (if speed redundancy is used)	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 RM Difference (if speed redundancy is used)	One of the speed probes is reading different from the others.	Wiring fault, speed probe fault. Incorrect speed gear ratio or number of teeth configured,	Check wiring continuity and probe integrity, replace probe. Check speed sensor configuration.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
Speed RM In 1 Invalid (if speed redundancy is used)	The Input 1 signal to the speed redundancy manager block is failed (may be from the other module).	Wiring fault or probe fault.	Verify which module speed input is connect to input #1, then check wiring continuity and probe integrity, replace probe.
Speed RM In 2 Invalid (if speed redundancy is used)	The Input 2 signal to the speed redundancy manager block is failed (may be from the other module).	Wiring fault or probe fault.	Verify which module speed input is connect to input #2, then check wiring continuity and probe integrity, replace probe.
Speed RM In 3 Invalid (if speed redundancy is used)	The Input 3 signal to the speed redundancy manager block is failed (may be from the other module).	Wiring fault or probe fault.	Verify which module speed input is connect to input #3, then check wiring continuity and probe integrity, replace probe.
Tmp Overspd Setpoint On	Indicates the temporary overspeed setpoint has been activated.	User initiated temporary setpoint test.	See manual for description and limitations. 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.
Auto Sim Spd Test Failed	Indicates the automated simulated overspeed test failed.	Internal problem with the unit.	Return unit to Woodward.
Auto Sequence Test	Indicates the automated Auto Sequence Test has been activated.	User enabled the auto sequence test or test interval time expired, and test started.	See manual for description and limitations. 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.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
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. Connect PCT and verify settings. Verify the trip indicator input is from the correct source and the max cycle time setting is correct. Check external system by following the trip signal around the loop until it returns to the MicroNet Safety Module input that is designated as the trip indicator input.
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. Connect PCT and verify settings. Verify the trip indicator input is from the correct source and the max cycle time setting is correct. Check external system by following the trip signal around the loop until it returns 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.

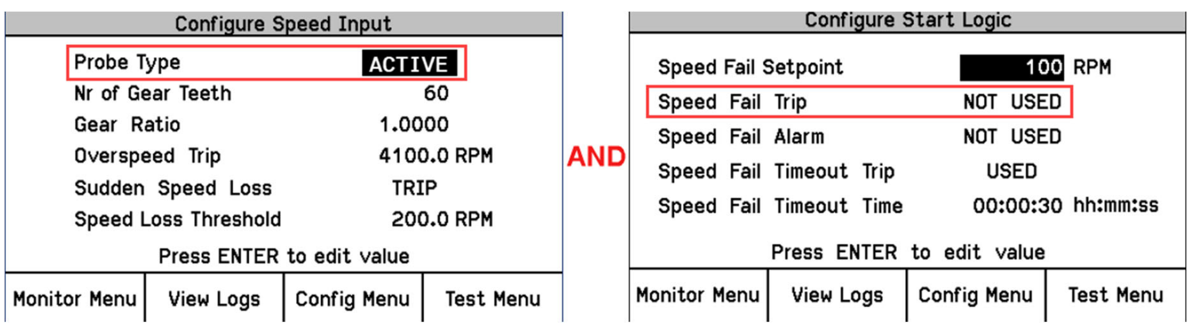


Figure 5-1. Configuration Guide - Front Panel Interface with Active Probe

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". If this is not desired, due to a need to have other Safety Instrumented Functions (SIF) protected in all 3 kernels, then use the "Speed Redundancy Management" option and configure both "Base Function" and "Fallback Function" to be HSS.

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:

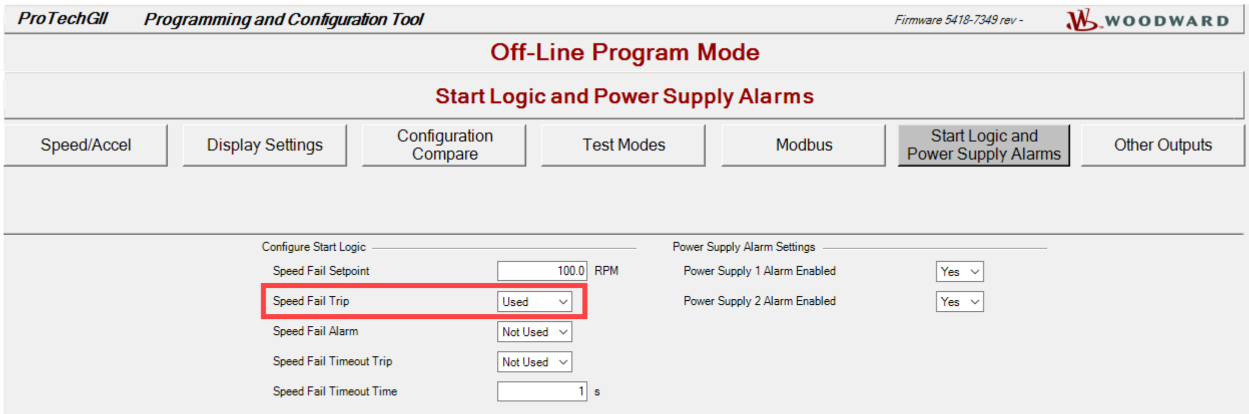
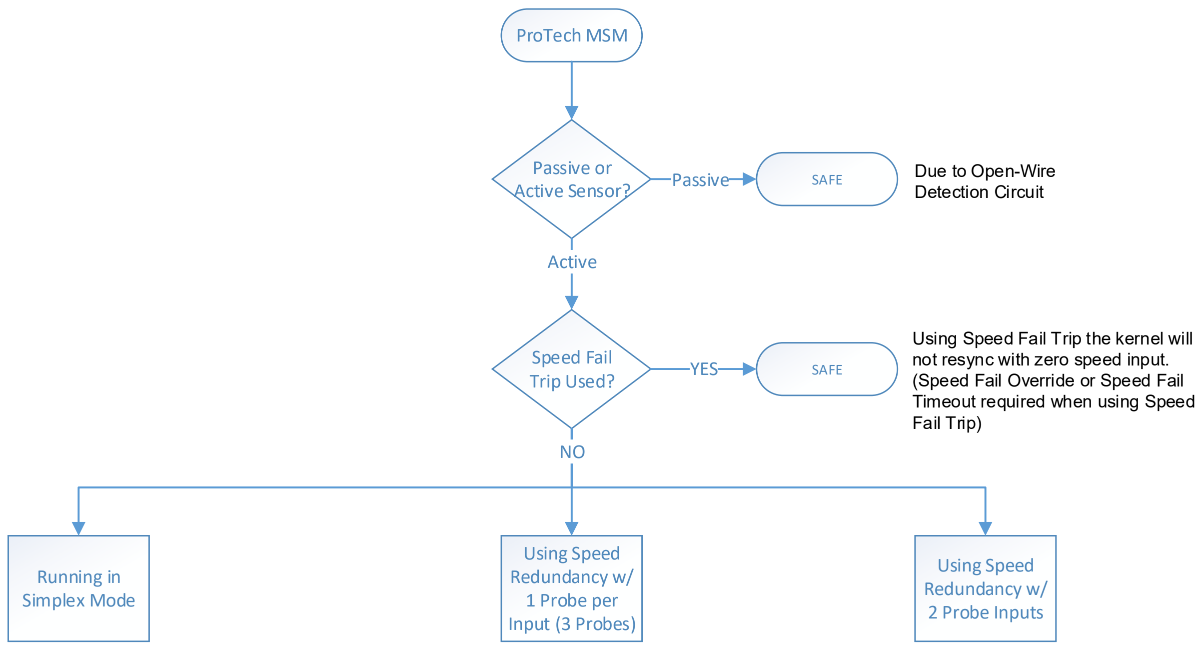


Figure 5-2. Speed Fail Trip Using PCT

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.

- Turn Speed Fail Trip to USED.
- If Speed Fail Trip cannot be used, configure the Base Function and Fallback Function to HSS.

Additional Actions:
- Can 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.

- Turn Speed Fail Trip to USED.
- If Speed Fail Trip cannot be used, configure the Base Function and Fallback Function to HSS.

Additional Actions:
- Can 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.

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. Trip Relay Safe State Configuration

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 = Probability of Failure to perform a safety function on Demand
PFH = Probability of a dangerous Failure per Hour (High Demand or Continuous mode of operation)
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 Specifications

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

The MicroNet Safety Module meets SIL3 with the following numbers:

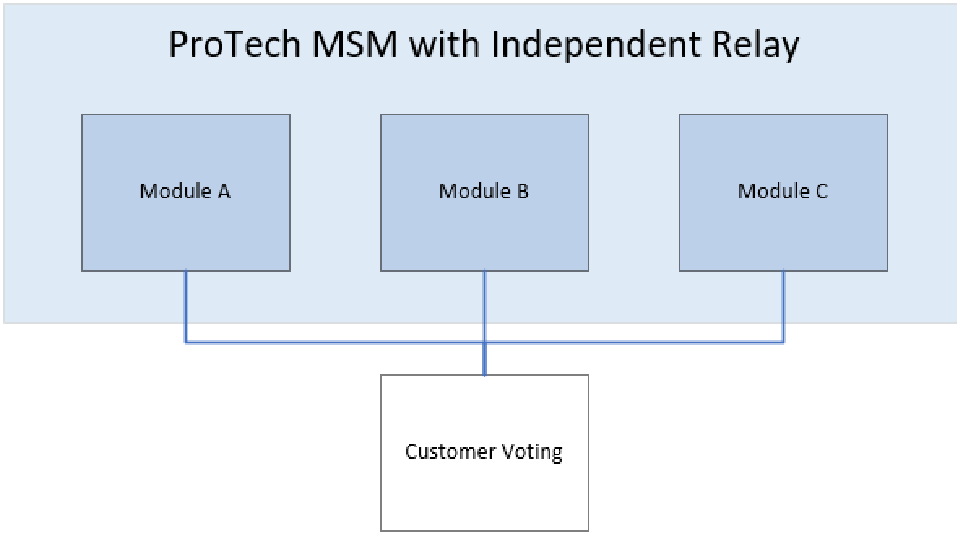
PFH
7.8E-8 1/h

PFD

PFD	Proof Test Interval
3.2E-5	6 months
5.2E-5	9 months
7.5E-5	1 year

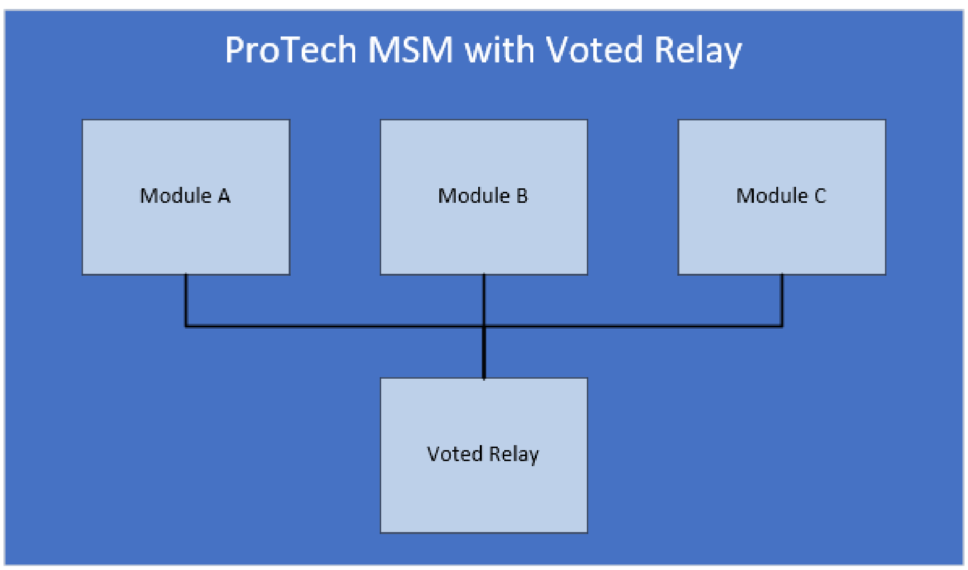
Safe Failure Fraction
SFF > 90 %

Diagnostic Coverage
DC > 90 %



ProTech MSM with Independent Relay	HFT	λ_s	λ_{DD}	λ_{DU}	SFF	β	βD
ProTech module A/B/C	2oo3	1.06E-05	1.68E-06	5.69E-07	95.57%	2.00%	2.00%

Figure 6-1. ProTech MSM with Independent Relay



Protech MSM with Voted Relay	HFT	λ_s	λ_{DD}	λ_{DU}	SFF	β	βD
ProTech module A/B/C	2oo3	1.06E-05	1.68E-06	5.69E-07	95.57%	2.00%	2.00%
1x Voting relay	1oo1	1.11E-07	3.84E-08	3.88E-10	99.74%	-	-

Figure 6-2. ProTech MSM with Voted Relay

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 in this manual. Refer to Chapter 3 of this manual and Figures 3-17 to 3-21 for MicroNet Safety Module based response time information.

Limitations

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

Management of Functional Safety

The MicroNet Safety Module is intended for use according to 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 2oo3 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). Ensure active probe mode is selected in Speed Configuration Menu, make the measurement, and ensure 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 °C 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.

⚠WARNING	**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/local-partner**

Product Service Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (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 one of the Full-Service Distributors listed at www.woodward.com/local-partner.

Contacting Woodward's Support Organization

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

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

Products Used in Electrical Power Systems

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

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+ 82 (32) 422-5551
The Netherlands	+31 (23) 5661111
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

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

General

Your Name ____________________

Site Location ____________________

Phone Number ____________________

Fax Number ____________________

Prime Mover Information

Manufacturer ____________________

Turbine Model Number ____________________

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

Power Output Rating ____________________

Application (power generation, marine, etc.) ____________________

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number ____________________

Control/Governor #2

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number ____________________

Control/Governor #3

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number ____________________

Symptoms

Description ____________________

____

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

Appendix. Modbus Ethernet Gateway Information

Introduction

For customers who want to use Modbus Ethernet communications or put the MicroNet Safety Module 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

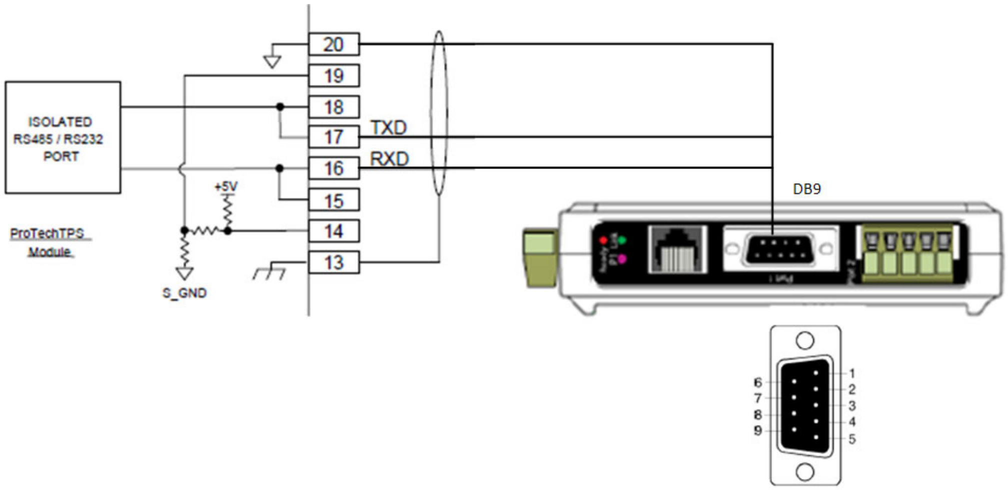
   Phone: 1-800-422-7055
   Email: sales@lantronix.com
   Web: www.lantronix.com

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 MicroNet Safety Module. 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 MicroNet Safety Module.

Wiring

RS-232

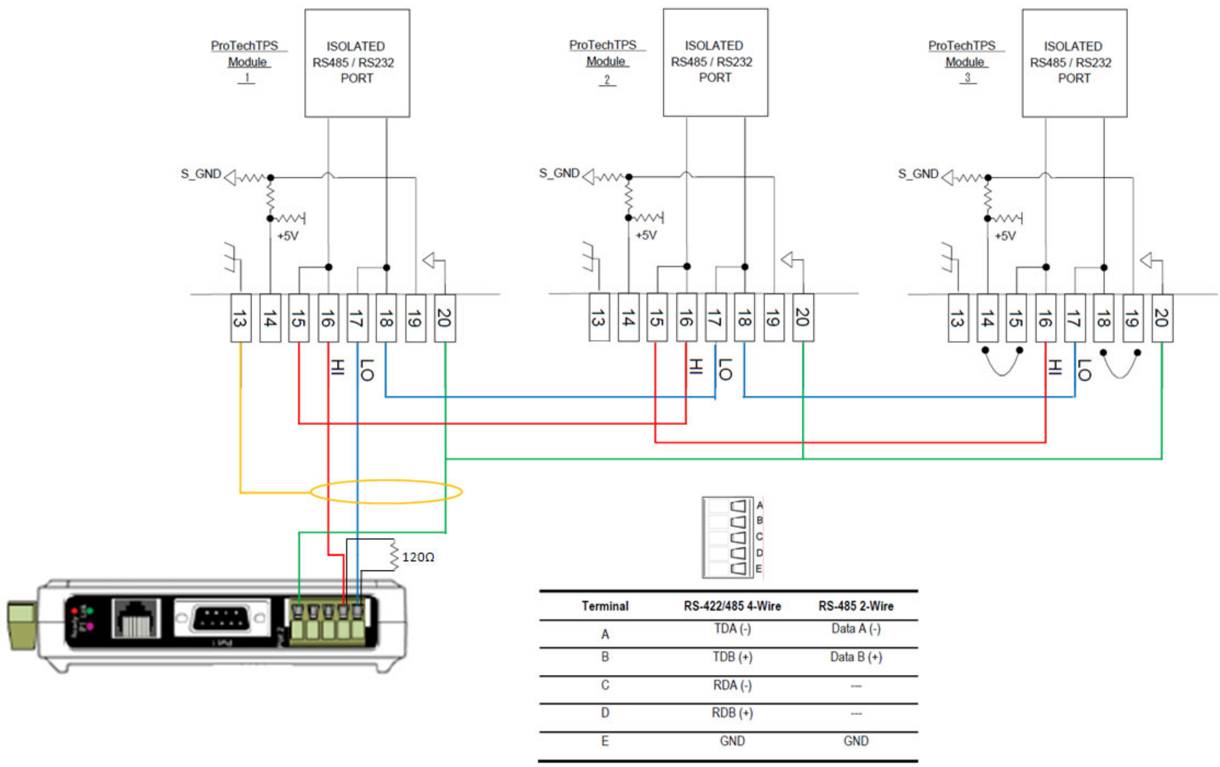


B&B Electronics – RS-232

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

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

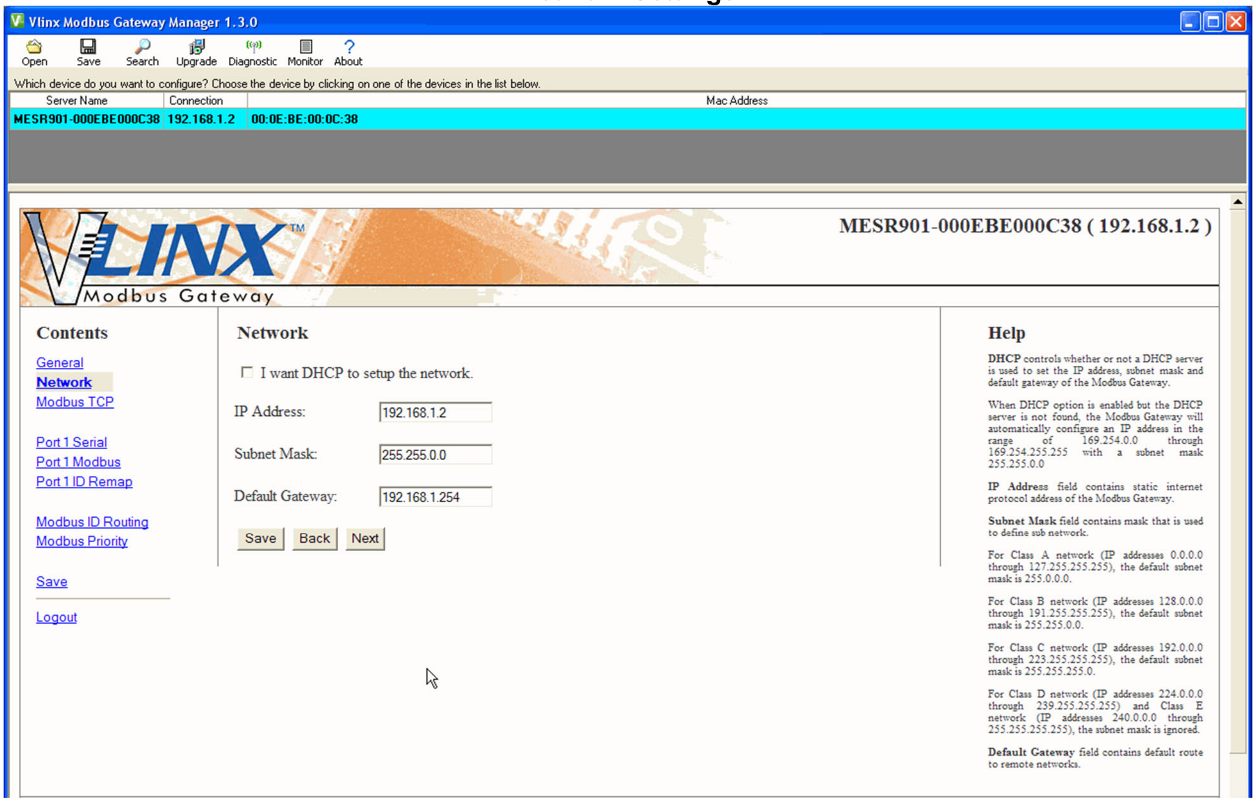
B&B Electronics – RS-485 Multi-drop Connection

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

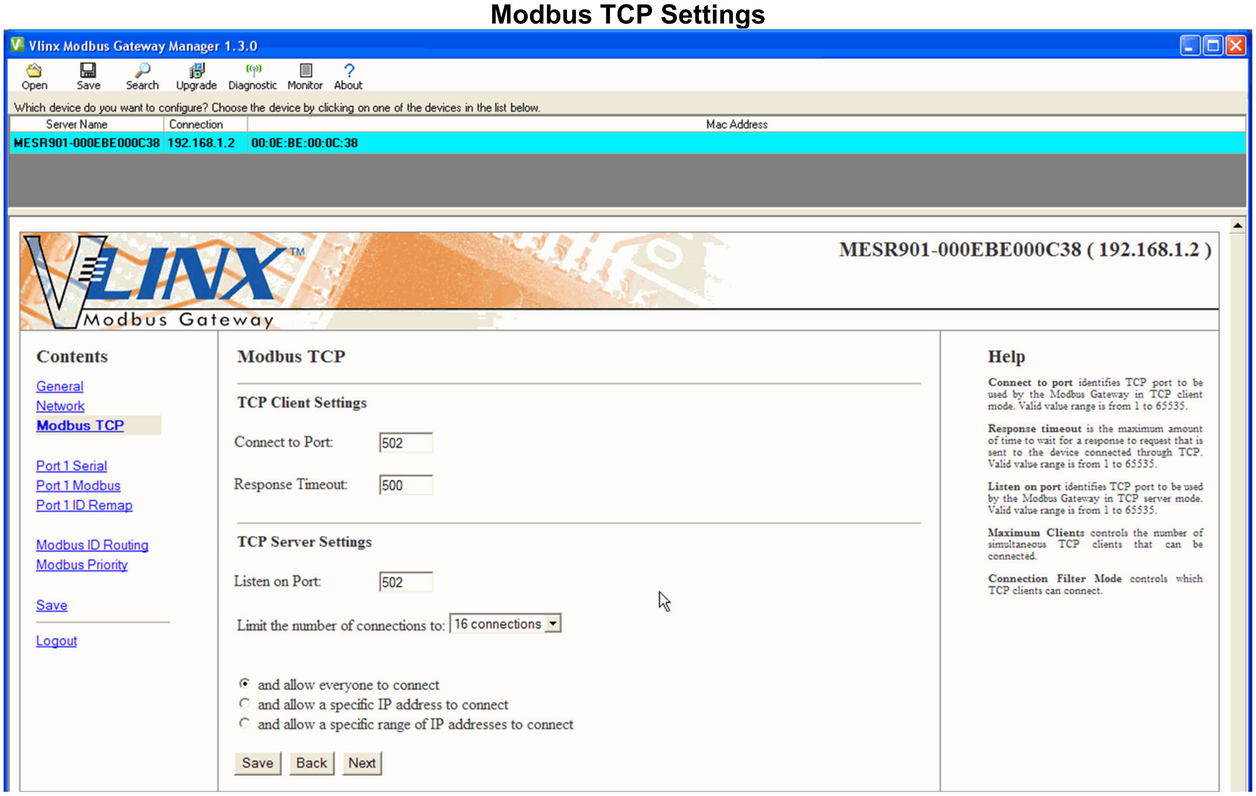
When configuring for RS-485, termination resistors (120 ς) are needed at each end of the network. Note the location of the resistor on the device. The MicroNet Safety Module has the termination resistor built into the module, jumpers are necessary between terminals 14 – 15 and 18 – 19 to activate the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

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

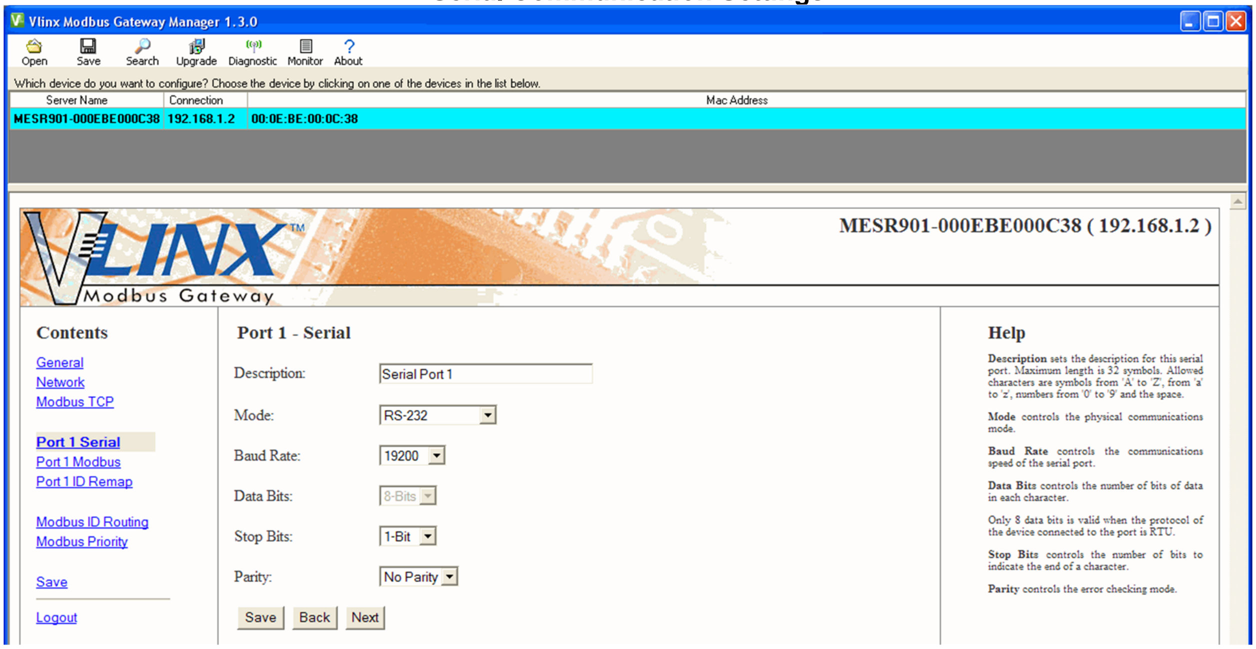
Network Settings



Modbus TCP Settings

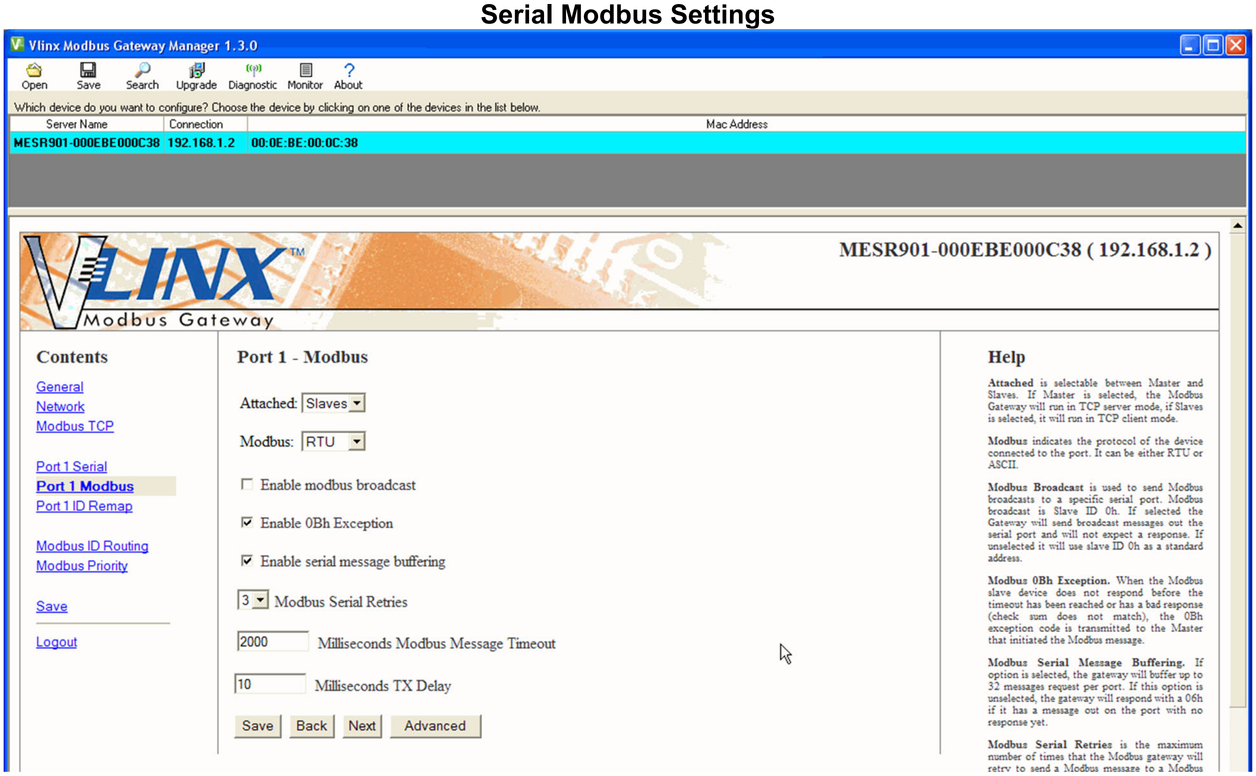


Serial Communication Settings



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

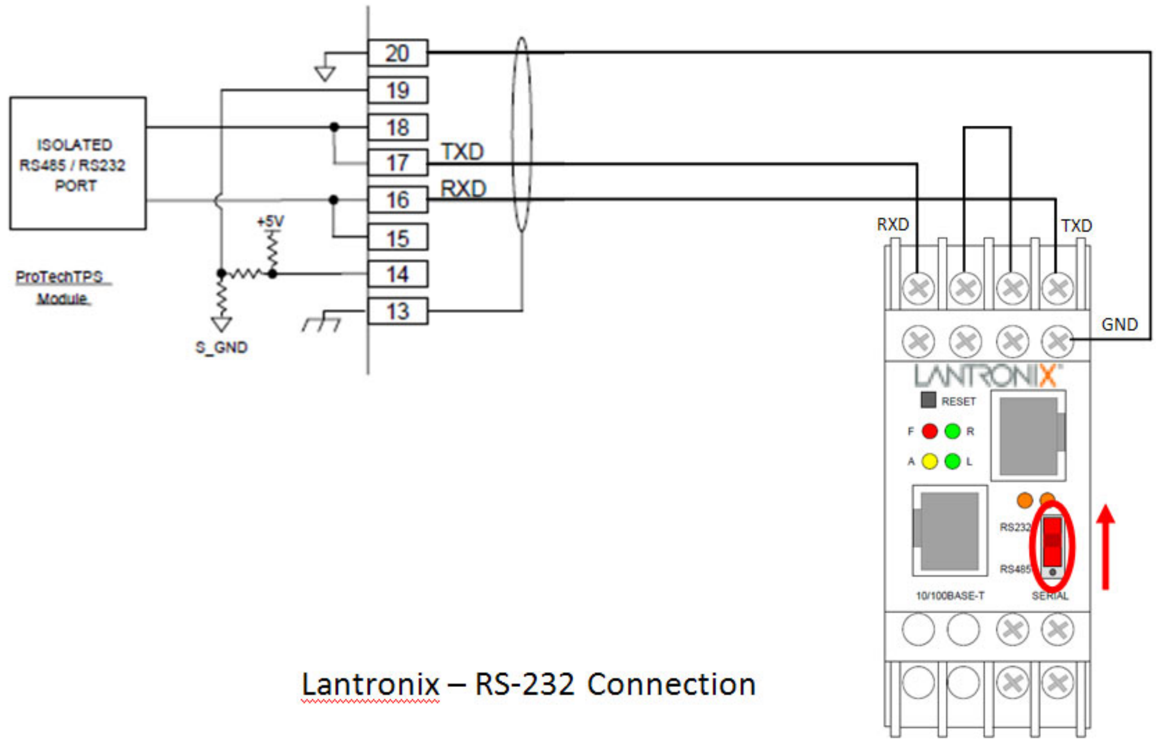


Lantronix Setup

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 MicroNet Safety Module. 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 MicroNet Safety Module.

Wiring

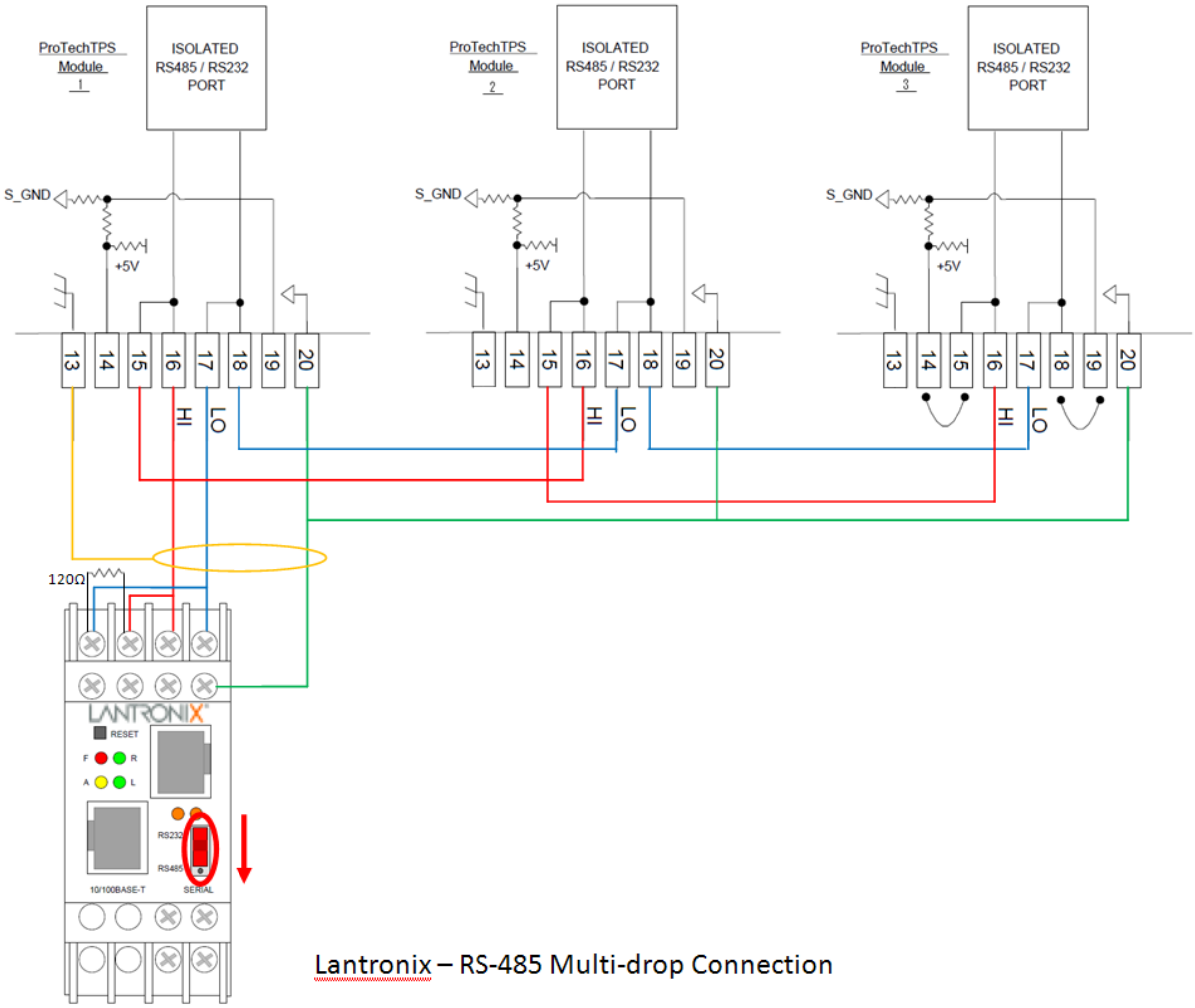
RS-232



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



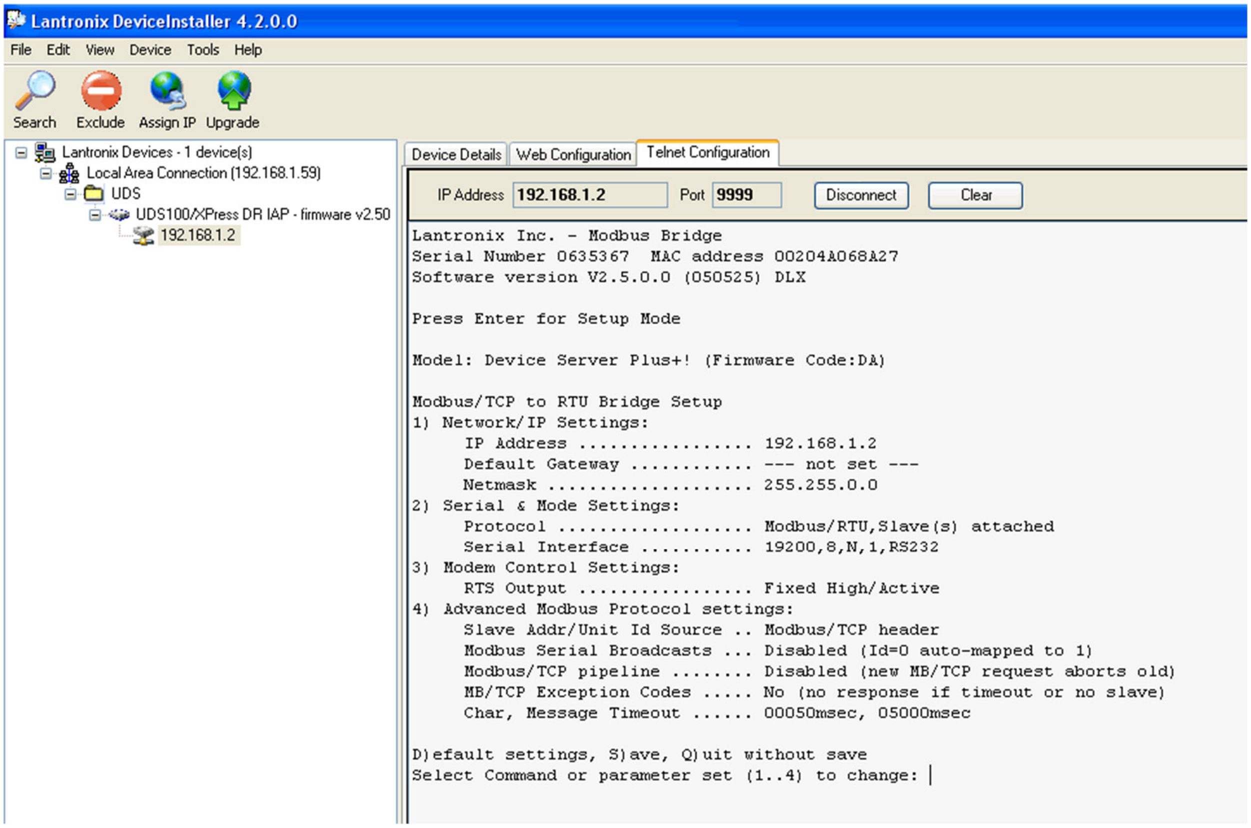
Lantronix – RS-485 Multi-drop Connection

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 MicroNet Safety Module has the termination resistor built into the module, jumpers are necessary between terminals 14 – 15 and 18 – 19 to activate the termination.

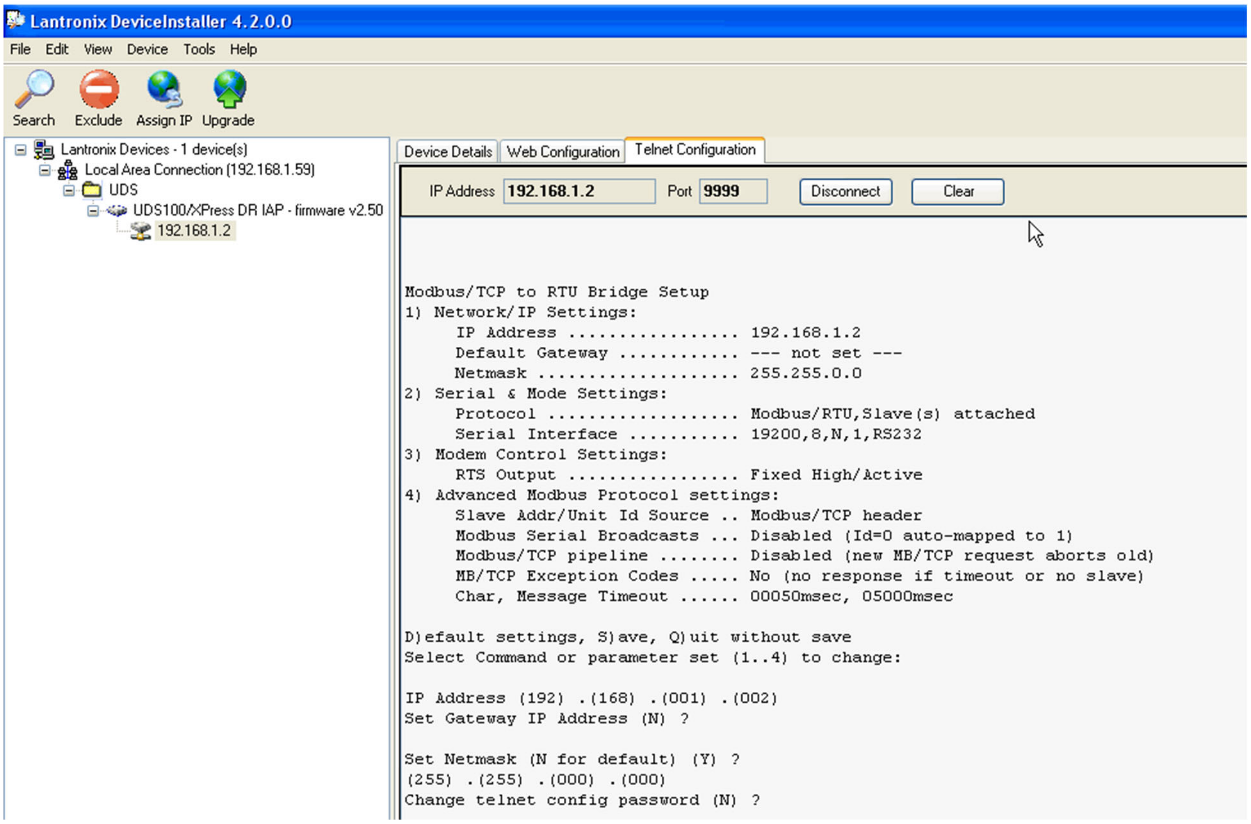
Configuration

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

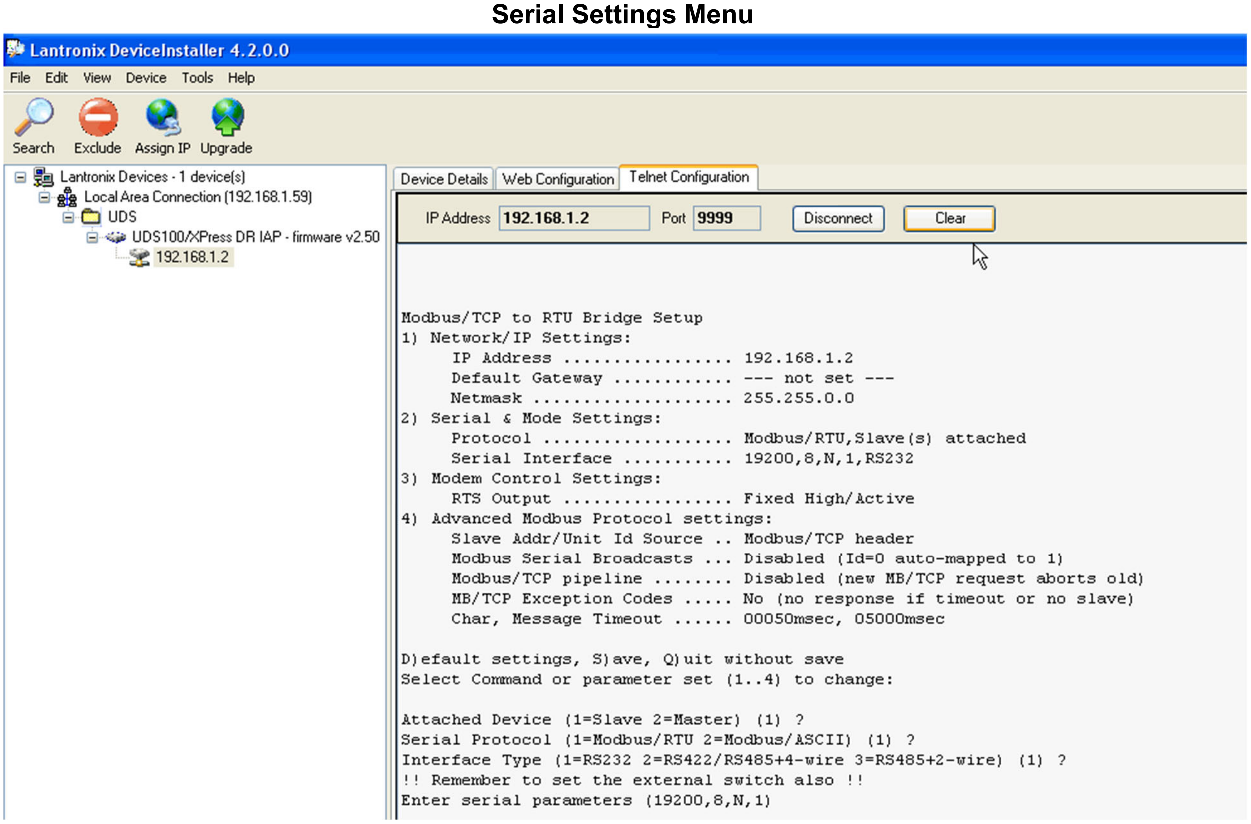
Overview



Network Menu

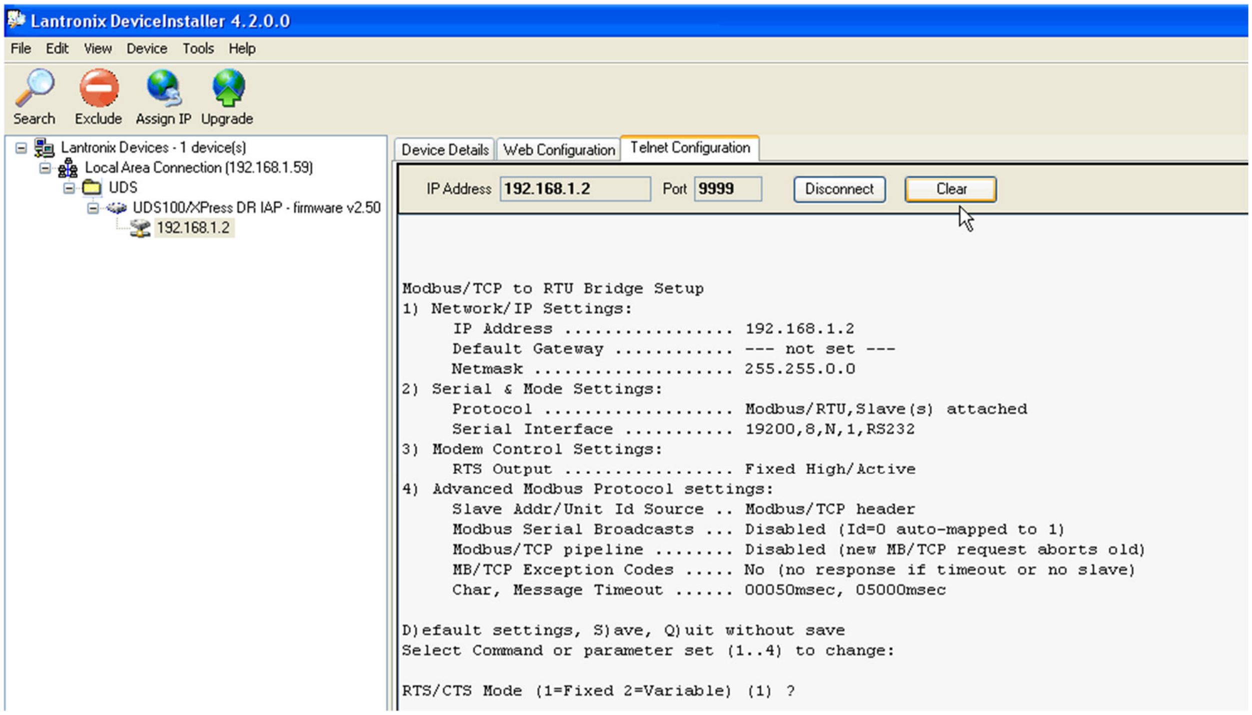


Serial Settings Menu

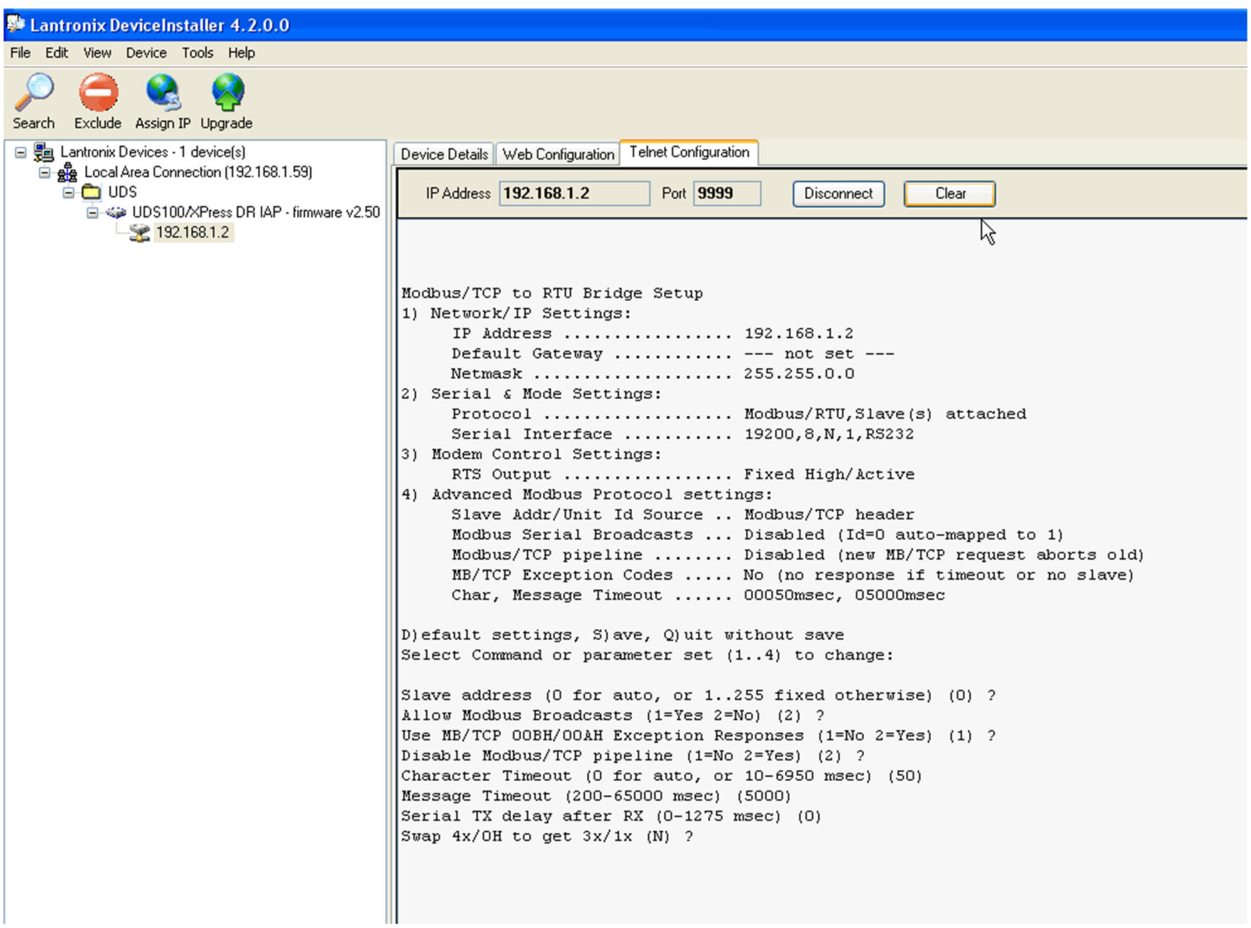


Note: For RS-485 communications, choose option 3 under interface type and don't forget to set the dip switch on the front of the device.

Modem Control Menu



Advanced Menu



Revision History

Changes in Revision G—
- Revised Regulatory Compliance section
- Revised Table 6-2
- Added Figures 6-1 and 6-2
- Removed Failure Rate Data section
- Replaced new EU DoC
- Added UK DoC

Changes in Revision F—
- Added Note to Serial Modbus Communications section in Chapter 2
- Added Warning boxes beneath Table 3-2 and beneath Figure 3-15
- Heavy edit to Speed Redundancy Manager section
- Added Acceleration Redundancy Manager
- Added (2-Wire Only) to the second row in Table 4-1
- Installed Configuration Guidance section in Chapter 5

Changes in Revision E—
- The following changes to the Regulatory Compliance section
    - Replaced EMC, Low Voltage, ATEX PED, RoHS Directives
    - Removed WEEE, EuP, C-Tick and GOST R Directives
    - Added Australia (& New Zealand) RCM Compliance
- Replaced Declaration

Changes in Revision D—
- Updated Figures 3-1, 3-2
- Added Figure 3-14

Changes in Revision C—
- Corrected title on Table 2-2

Changes in Revision B—
- Expanded/clarified Module Removal & Installation section (Chapter 2)

Changes in Revision A—
- Updated 3 entries in Table 4-5 (page 77)

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
Fort Collins, CO 80524 USA

Model Name(s)/Number(s): ProTech®-GII, ProTech® TPS, MicroNet® Safety Module, and ProTech MSM

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

Directive 2014/34/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 equipment and protective systems intended for use in potentially explosive atmospheres

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

Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits

Markings in addition to CE marking: Ex II 3 G Ex ec nC IIC T4 Gc

Applicable Standards:

EMC: EN 61000-6-4:2007,
EN 61000-6-4:2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments
EN 61000-6-2:2005,
EN 61000-6-2:2005/AC:2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

ATEX: EN 60079-0, 2018 : Explosive Atmospheres - Part 0: Equipment – General requirements
EN 60079-7:2015,
EN IEC 60079-7:2015/A1:2018 – Explosive Atmospheres – Part 7: Equipment protection by increased safety "e"
EN60079-15, 2010 : Explosive Atmospheres - Part 15: Equipment protection by type of protection "n

LVD: EN 61010-1:2010,
EN 61010-1-2010/A1:2019/AC:2019-04,
EN 61010-1:2010/A1:2019: Safety Requirements for Electrical Equipment for measurement, control and laboratory use – Part 1 : General Requirements

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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	(signed)
Full Name	**Annette Lynch**
Position	**Engineering Manager**
Place	**Woodward, Fort Collins, CO, USA**
Date	**August 1, 2022**

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UKCA DECLARATION OF CONFORMITY

UKCA DoC No.: 00396-EU-UKCA-02-01
Manufacturer's Name: WOODWARD INC.

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

Model Name(s)/Number(s): ProTech®-GII, ProTech® TPS, MicroNet® Safety Module, and ProTech MSM

Markings in addition to UKCA marking: Ex II 3 G Ex ec nC IIC T4 Gc

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The object of this Declaration is in full conformity with the following UK Statutory Instruments (and their amendments):

S.I. 2016 No. 1107	Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016
S.I. 2016 No. 1091	Electromagnetic Compatibility Regulations 2016
S.I. 2016 No. 1101	The Electrical Equipment (Safety) Regulations 2016

The Object of this Declaration is in conformity with the applicable requirements of the following designated standards and technical specifications.

EN 61000-6-4:2007, EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-6-2:2005, EN 61000-6-2:2005/AC:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN IEC 60079-0:2018	Explosive atmospheres - Part 0: Equipment - General requirements
EN 60079-7:2015, EN IEC 60079-7:2015/A1:2018	Explosive atmospheres - Part 7: Equipment protection by increased safety "e"
EN 60079-15:2010	Explosive atmospheres - Part 15: Equipment protection by type of protection "n
EN 61010-1:2010, EN 61010-1-2010/A1:2019/AC:2019-04, EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

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

MANUFACTURER

Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

11-August-2022
Date

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We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 26711V1.

B26711V1 : G

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