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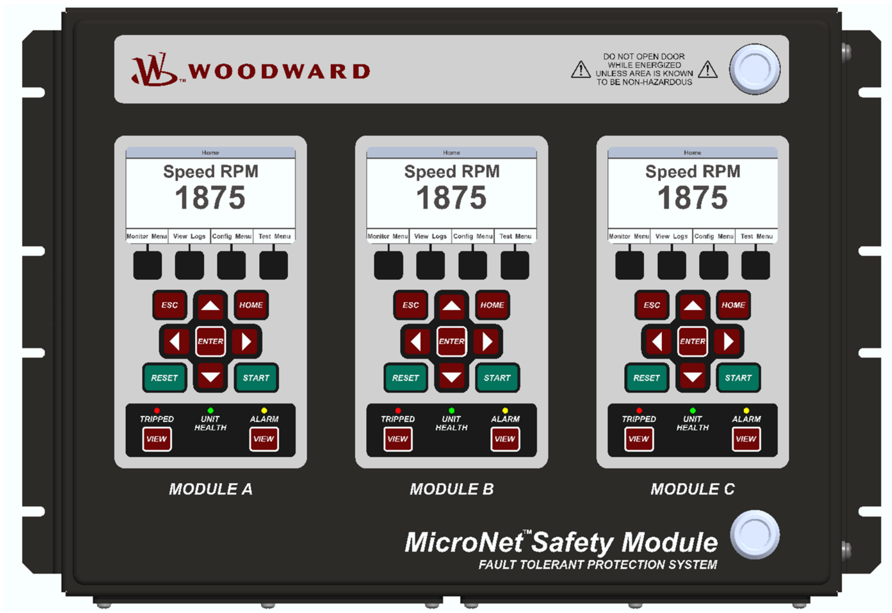
WOODWARD

Product Manual 35060V1
(Revision C, 12/2022)
Original Instructions



MicroNet™ Safety Module With Math Enhancements

Manual 35060 Consists of Two Volumes (35060V1 & 35060V2)

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.**

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

Contents

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Pentium (Intel Corporation)

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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.

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 necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

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

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
HSS	High Signal Select
LSS	Low Signal Select
Module	Functionality contained within one of the three identical sections
MPU	Magnetic Pick-up
MSM	MicroNet Safety Module
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
SFO	Speed Fail Override
Settings-File	A file that contains the configuration settings loaded with the MicroNet Safety Module Service Tool (.wset)

Chapter 1.
General Information

Purpose and Scope

The purpose of this manual is to provide the necessary background information for applying the MicroNet Safety Module. Topics covered include mechanical installation, electrical wiring, software programming, and troubleshooting. While this manual is primarily targeted at OEM customers, OEMs themselves may find it useful to copy some of the information from this manual into their application user manuals.

This manual does not contain instructions for the operation of the complete prime mover system. For prime mover or plant operating instructions, contact the plant-equipment manufacturer.

This version of the manual applies to all MicroNet Safety Module models with software 5418-7351. The software version can be identified on the front panel display at power-up or on the Module Information screen on the Monitor mode. It can also be found on the Identification tab of the Service Tool.

See the 'What's New' section at the end of this chapter for a listing of the changes in this software version.

How to Use This Manual

The following summarizes how to install a MicroNet Safety Module into a new or existing system:
- Unbox and inspect the hardware.
- Install, mount, and wire the hardware following the system installation procedures and recommendations in Chapter 2.
- Configure the device (Chapter 10) using one of the following options:
  - Service Tool (Chapter 13)
  - MicroNet Safety Module GAP tool (see manual 26712)
  - Front Panel (limited configurability provided, Chapter 10)
- Follow the safety and checkout procedures in Chapter 6.
- Troubleshooting guidelines are provided in Chapter 5.

Description

The MicroNet Safety Module (MSM) 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 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 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.

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
8237-2492	MSM, Bulkhead Mount, HV/LV, Indep Relay, Math Enh
8237-2493	MSM, Bulkhead Mount, HV/HV, Indep Relay, Math Enh
8237-2494	MSM, Bulkhead Mount, HV/LV, Voted Relay, Math Enh
8237-2495	MSM, Bulkhead Mount, HV/HV, Voted Relay, Math Enh
8237-2496	MSM, Panel Mount, HV/LV, Indep Relay, Math Enh
8237-2497	MSM, Panel Mount, HV/HV, Indep Relay, Math Enh
8237-2498	MSM, Panel Mount, HV/LV, Voted Relay, Math Enh
8237-2499	MSM, Panel Mount, HV/HV, Voted Relay, Math Enh
5437-2132	Spare Module for MSM models 8237-2494, -2498
5437-2133	Spare Module for MSM models 8237-2495, -2499
5437-2134	Spare Module for MSM models 8237-2492, -2496
5437-2135	Spare Module for MSM models 8237-2493, -2497

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 80 000 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 module provides three 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.

The MicroNet Safety Module is certified as a stand-alone IEC61508-based device or within an IEC61511-based plant safety system.

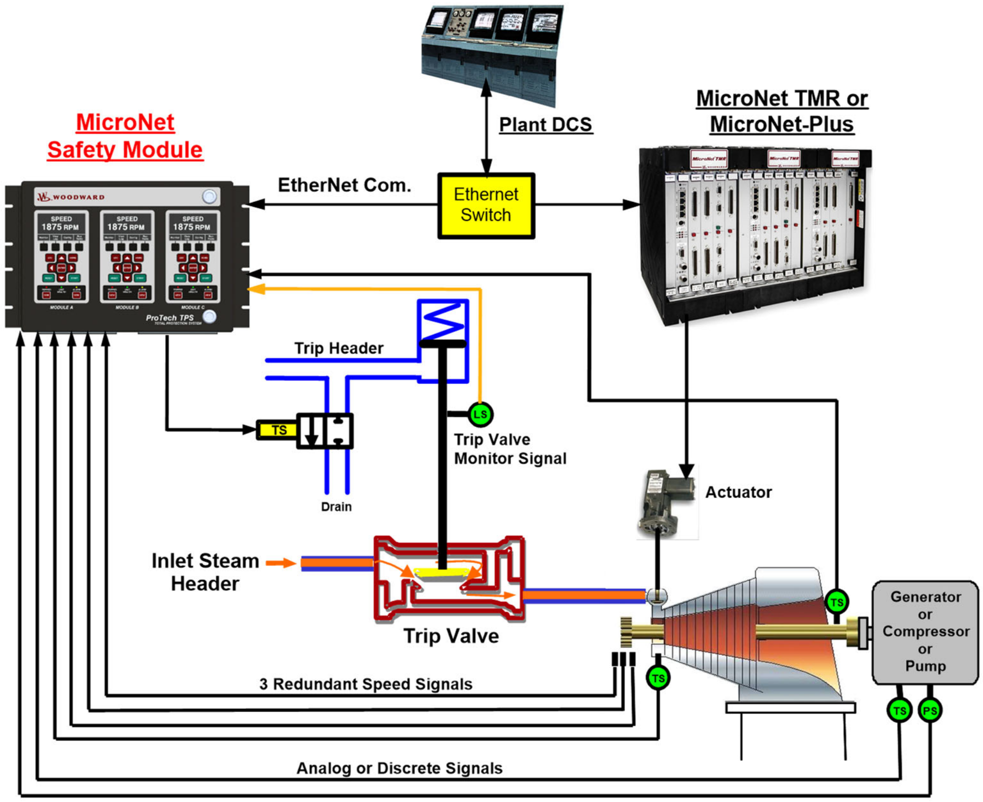


Figure 1-1. Typical MicroNet Safety Module Application (Voted Trip Relay Models)

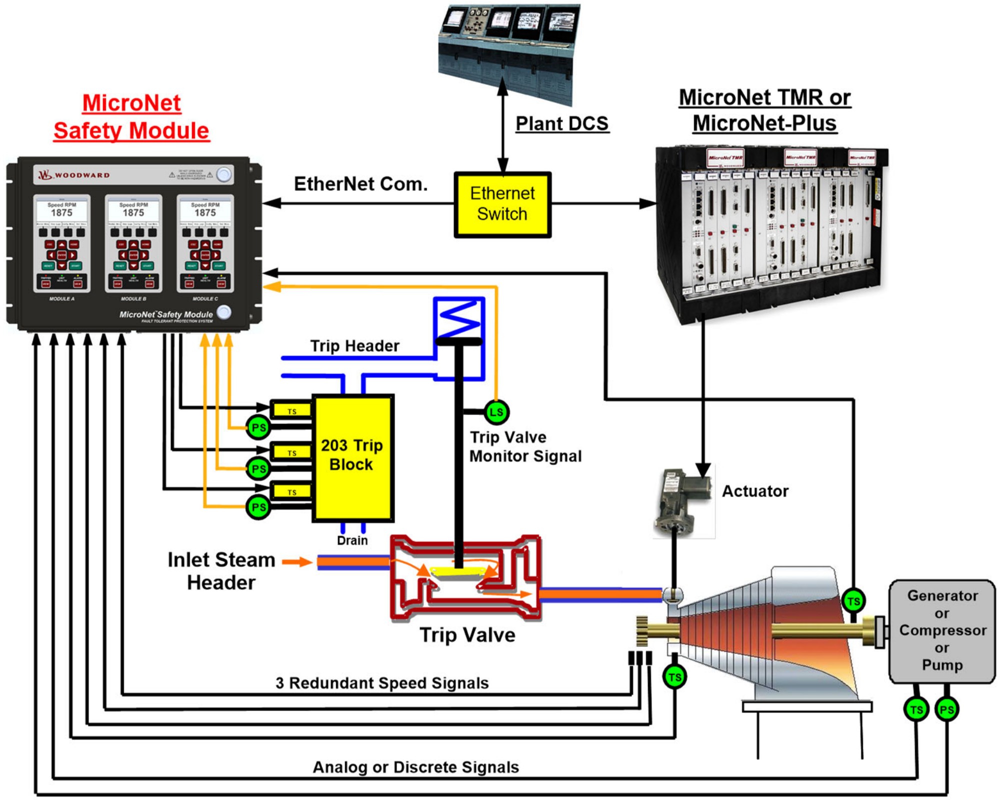


Figure 1-2. Typical MicroNet Safety Module Application (Independent Trip Relay Models)

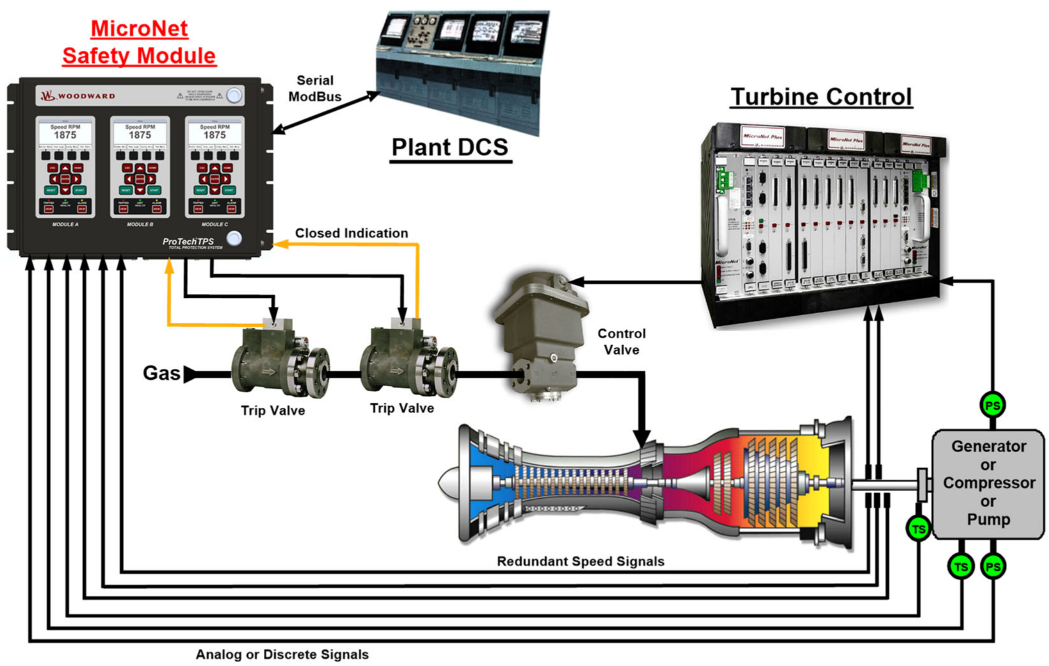


Figure 1-3. Typical Gas Turbine Application (Voted Trip Relay Models)

AMMONIA REFRIGERATION VENT HEADER APPLICATION

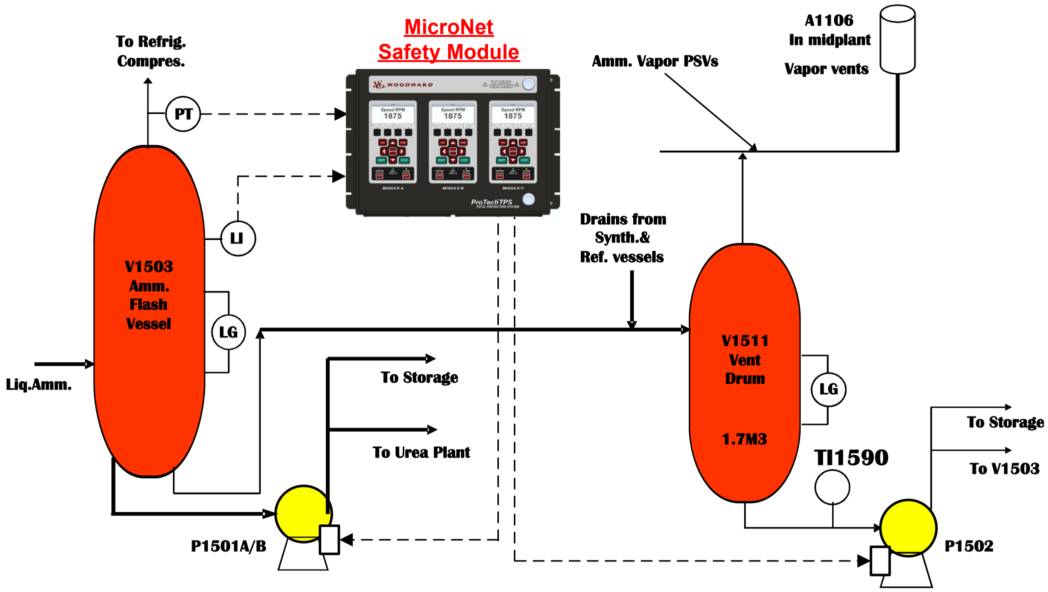


Figure 1-4. Typical Safety PLC Application (Voted Trip Relay Models)

What's New

The features described in this manual are software-version specific. The main feature change in this software provided enhanced math/computational functionality, adding over 100 analog-based logic blocks. The MicroNet Safety Module hardware is unchanged from previous releases, this is a software-only update. A listing of the changes is provided below.

The following new computational blocks were added:

- MULTIPLY block. Provides the product of all configured inputs. Up to 5 inputs per block. Can be connected to any other analog block. Quantity 5.
- DIVIDE block. Performs a divide function on the 2 inputs. Can be connected to any other analog block. Quantity 5.
- ADD block. Provides the sum of all configured inputs. Up to 5 inputs per block. Can be connected to any other analog block. Quantity 5.
- NEGATE block. Supports subtraction functionality by providing the negative value of the input. Each block has 1 input. Can be connected to any other analog block. Quantity 10.

The following new support blocks were added:

- CURVE block (polygon). A 2-dimensional lookup based on a single, configured analog input. Up to 6 breakpoints (coordinate pairs) can be defined. Values between breakpoints are interpolated. Values beyond table-defined min or max are limited - equal to first or last point, respectively. Can be connected to any other analog block. Quantity 2.
- SWITCH block. Outputs one of two analog Input values based on the status of the control input. Can be connected to any other analog block. Example usage: selecting a default value for a calculation if an analog input is failed. Quantity 10.
- CONSTANT block. Allows definition of a fixed analog value to be used in conjunction with the math/analog blocks. Quantity 40.
- ANALOG UNIT DELAY block. Loop breaking block for analog signals, to define execution order. Asserts a unit delay. Can be connected to any other analog block. Quantity 10.
- COUNTER block. Provides a count indication as well as a comparison output which indicates when a count threshold is exceeded. Quantity 10.
- PEAK HOLD block. Captures and holds both maximum and minimum signal values. Quantity 10.
- PULSE DETECT block. Monitors an analog signal and is used to detect a sudden rise in value followed by a drop. The output indicates a pulse was detected. Quantity 5.

- EVENT FILTER block. Provides an indication that an excessive number of events have occurred within the defined window of time. Typically used in conjunction with the PULSE DETECT. Quantity 5.

Changes to existing logic blocks/functions:

- Speed Loss (sudden speed loss): made the failure threshold configurable and expanded the action selection to include 'not used'.
- Analog Output: The source for the analog output was changed to be configurable, allowing it to be connected to analog logic blocks.
- Analog Redundancy Manager: A difference detection was added to the Analog Redundancy Manager blocks, providing a difference comparison between the 3 inputs. The difference indication is provided if the threshold is exceeded for the configured time delay.
- Configurable filter was added to the acceleration signal.
- Difference Detect: The block inputs were modified to allow connection to any of the internal analog logic signals (previously allowed connection to shared input signals only).
- Analog Inputs: The allowed range of the analog inputs was increased to +/- 999999.
- LAG blocks: A derivative (rate of change) output value was added to the LAG block for use in the configurable logic.
- Resettable Trip: The function input was modified to allow connection to any of the internal Boolean logic signals (previously allowed connection to discrete input 1-10 only).
- Auto Sequence Test: The displayed test result is for the entire sequence, not just the local module and the individual module test status was added. Removed Continue Input selection, allowing the Start Input to provide both functions. Added inter-module halt option.
- The analog comparator ON and OFF inputs were modified to allow connection to any of the internal analog logic signals (previously these were constant values).
- Change the User Defined Test set input to edge triggered so the test does not repeat if set is left true.
- Logic execution rate changes: The configurable logic runs at 8ms (previously 4ms). Note all speed, acceleration, trip, and output functions are unchanged.

Other Improvements and Additions:

- Chinese language support added as a configuration setting.
- Increased allowable ranges for speed settings from 32000 to 80000 rpm. The maximum speed frequency remains at 32kHz.
- Front Panel Display changes:
  - Speed display: The precision of the speed value on the front panel provides 1 decimal precision when below 100 rpm.
  - Front panel performance was improved, providing faster response to a key press.
  - Analog Input display: The front panel display of the analog input was expanded to show the level set points (e.g., Hi, Lo) as well as all the level status indications.
  - Trip button (front panel): Toggles display between the Trip Log and the Trip Latch.
  - Alarm button (front panel): Toggles display between the Alarm Log and the Alarm Latch.
  - Shared Reset Shared Start and Shared Speed Fail Override display screens were added.
  - Trip Latch inputs were rearranged to display more practical faults first (e.g., overspeed).
  - Filtering was added for the Home screen speed display.
- Modbus:
  - The outputs of all analog logic blocks have been included as Modbus analog/register reads.
  - The address numbering (Boolean and register) changed to be consecutive, removing huge gaps in numbering.
  - Twenty scalable analog reads have been added, allowing the user to select the source, and set the signal scaling (for very large or very small analog signals).
  - Spare Boolean read registers were added to prevent errors experienced by devices that queried in increments of 16.

Existing Control Upgrade

Customers who wish to have/utilize one or more of the above listed changes can purchase a conversion. The conversion includes installation of new firmware, 5418-7351 which operate with most existing MSM models. See table below for part numbers that can be upgraded. Revision D or newer of the MicroNet Safety Module Service Tool (9927-1838) is required for the new firmware and is compatible with all MSM models. Configuration files created for previous firmware revisions can be converted and loaded into the control with the latest firmware using the service tool. Configurations for the 5418-7351 are not compatible with the older firmware versions.

Table 1-2. MSM Conversion Compatibility

Description	Part Numbers that Can Be Converted	Preferred Part Number
MicroNet Safety Module – Bulkhead Mount, HV/LV, Ind. Relays	8237-1492	8237-2492
MicroNet Safety Module – Bulkhead Mount, HV/HV, Ind. Relays	8237-1493	8237-2493
MicroNet Safety Module – Bulkhead Mount, HV/LV, Voted Relays	8237-1494	8237-2494
MicroNet Safety Module – Bulkhead Mount, HV/HV, Voted Relays	8237-1495	8237-2495
MicroNet Safety Module – Panel Mount, HV/LV, Ind. Relays	8237-1496	8237-2496
MicroNet Safety Module – Panel Mount, HV/HV, Ind. Relays	8237-1497	8237-2497
MicroNet Safety Module – Panel Mount, HV/LV, Voted Relays	8237-1498	8237-2498
MicroNet Safety Module – Panel Mount, HV/HV, Voted Relays	8237-1499	8237-2499

How to Upgrade

The firmware of compatible MSM units can be field upgraded but requires use of specialized software tools and must be performed by authorized Woodward personnel. If you have any questions about this issue or wish to upgrade, please contact one of our Woodward facilities and refer to Application Note 06948.

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. Verify (and set, if needed) the module time and date.
6. If no special programming logic is used, skip to step 11.
7. If special programming logic is required, install the MicroNet Safety Module programming and configuration tool (PCT) from the provided PCT Installation CD to the desired computer and create a system application program.
8. 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.
9. From the respective module's front panel, copy the downloaded program to other modules.
10. From each module's front panel, verify that the correct program has been installed in each module by comparing unit CRC codes.
11. From each module's front panel, enter the configuration mode and verify that each of the overspeed and over-acceleration settings are correct.

12. Enter the configuration mode and configure all settings to the specific application's requirements.
13. Perform a full system checkout by verifying all system trips, alarms, and test routines function correctly before starting the machinery/system.
14. 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 faceplate & 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.

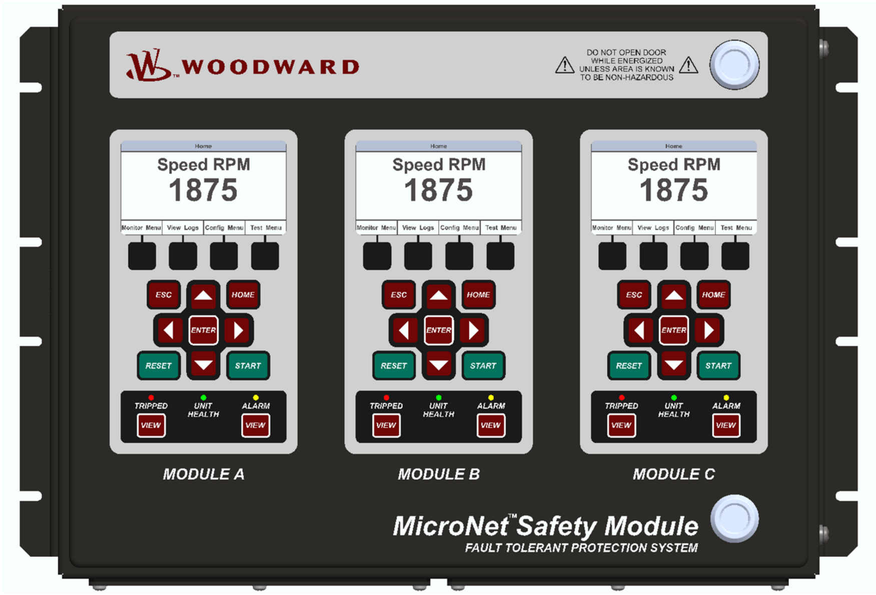


Figure 2-1. Typical MicroNet Safety Module Bulkhead Package—Front View

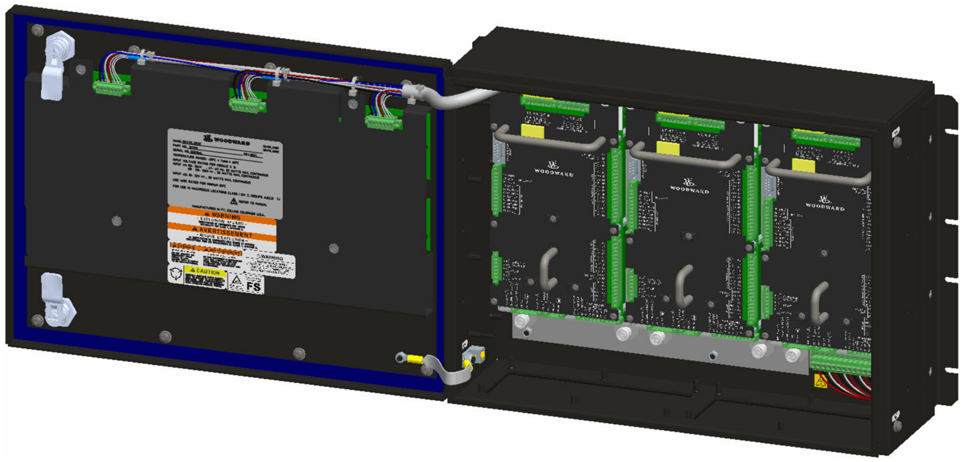


Figure 2-2a. Typical MicroNet Safety Module Bulkhead Package—Front Door Open

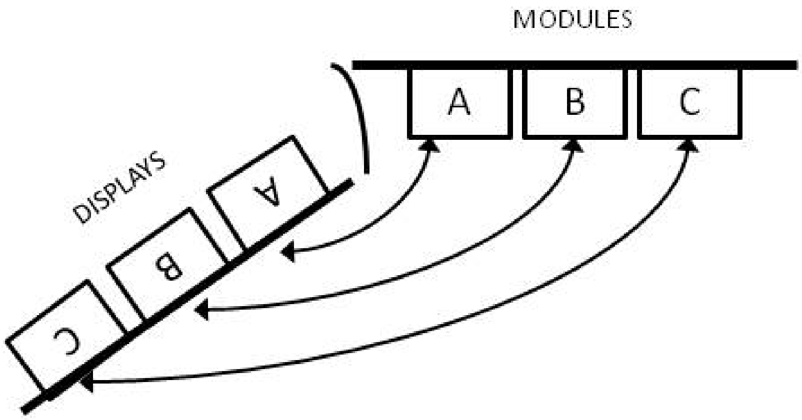


Figure 2-2b. Bulkhead Schematic Showing Front Panel A Connection to Module A and Front Panel C Connection to Module C—Top View

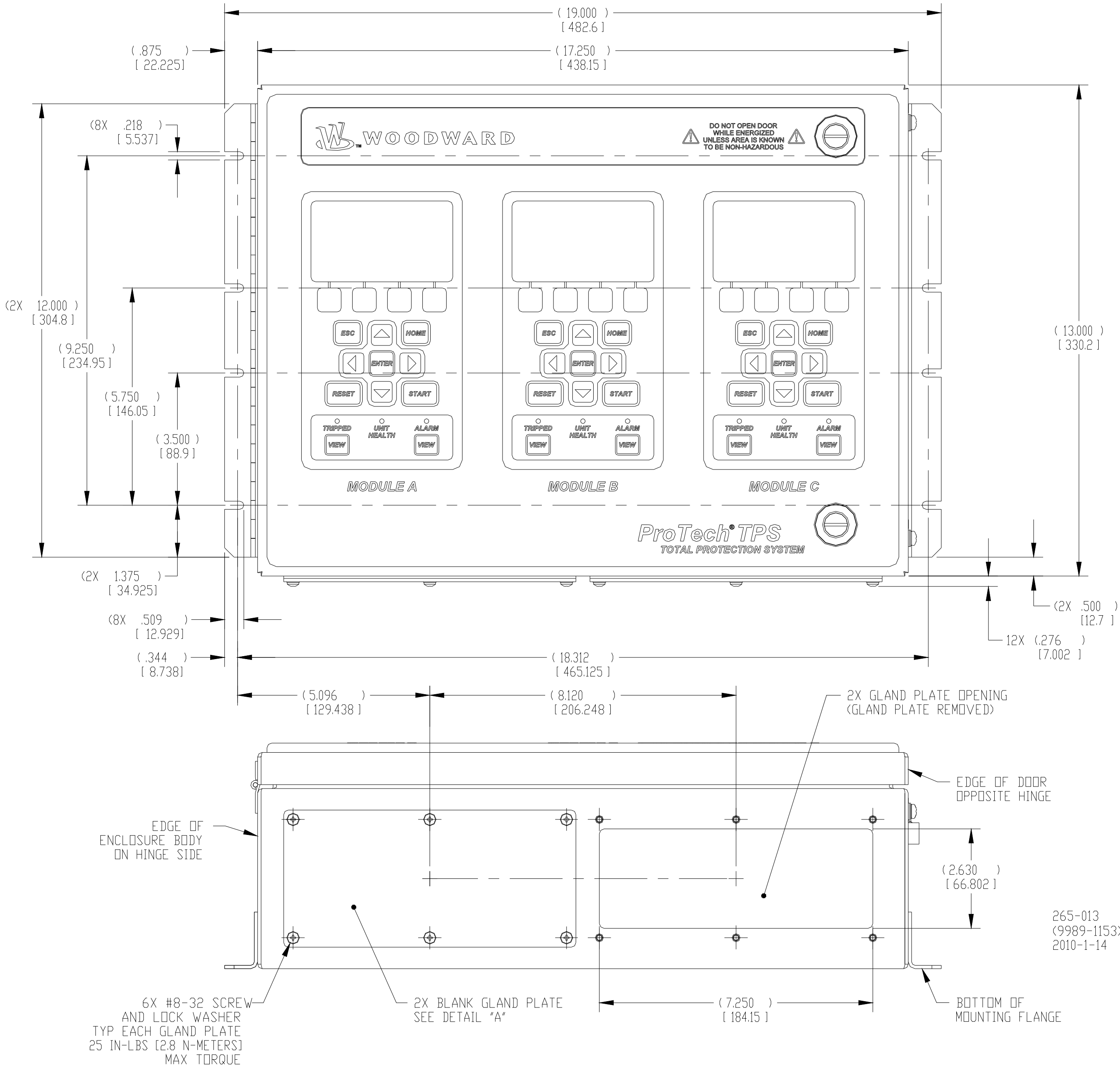


Figure 2-3. Mounting Outline Diagram for Bulkhead-Mounted Models

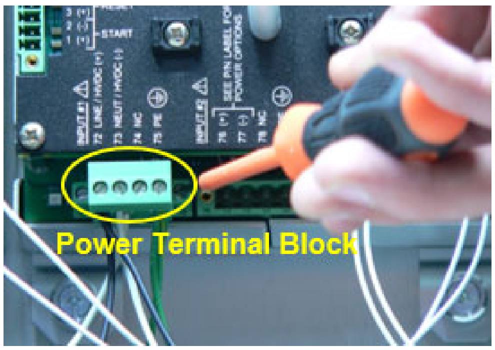
Module Removal and Installation—Bulkhead Mount Package

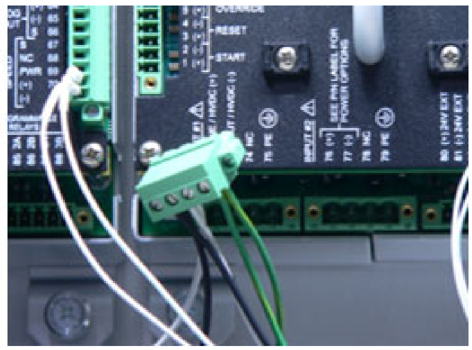
⚠WARNING	**Currently, display circuit boards are not replaceable. Users should not attempt to remove or install any display board. If a display board is unresponsive, contact Woodward for a recommendation regarding service options. DO NOT ATTEMPT TO REPAIR!**

Follow this procedure for module removal and installation:

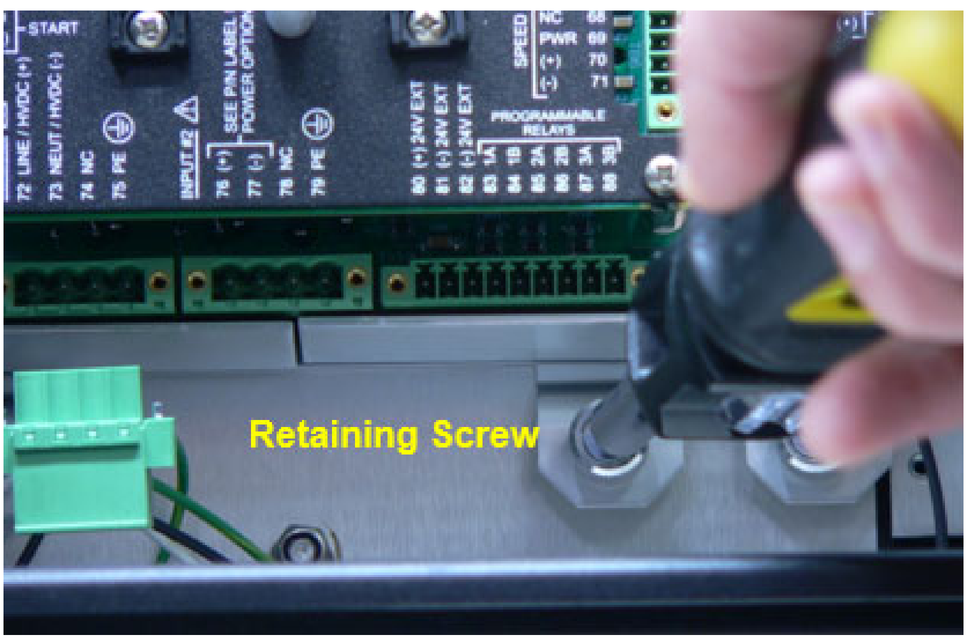
Removal:

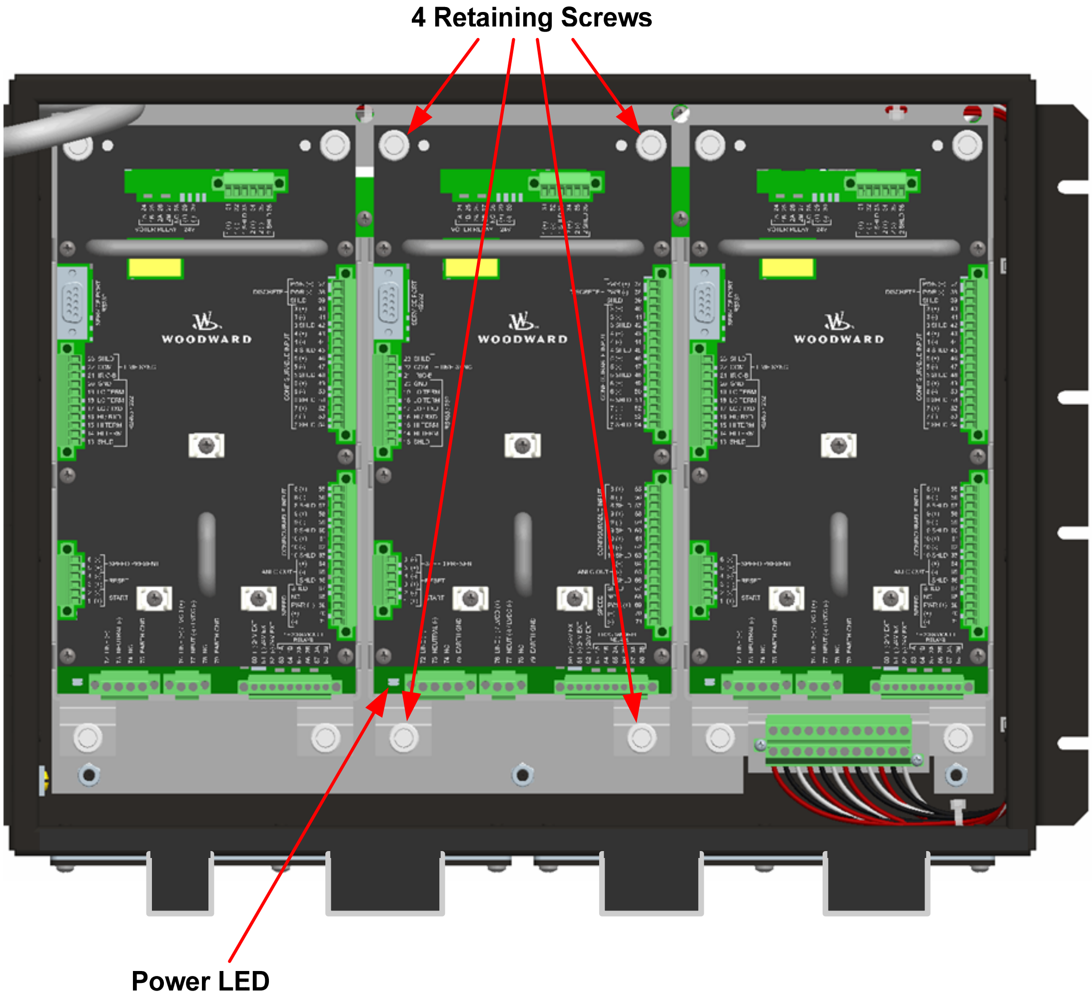
1. Disconnect power from the module to be removed.



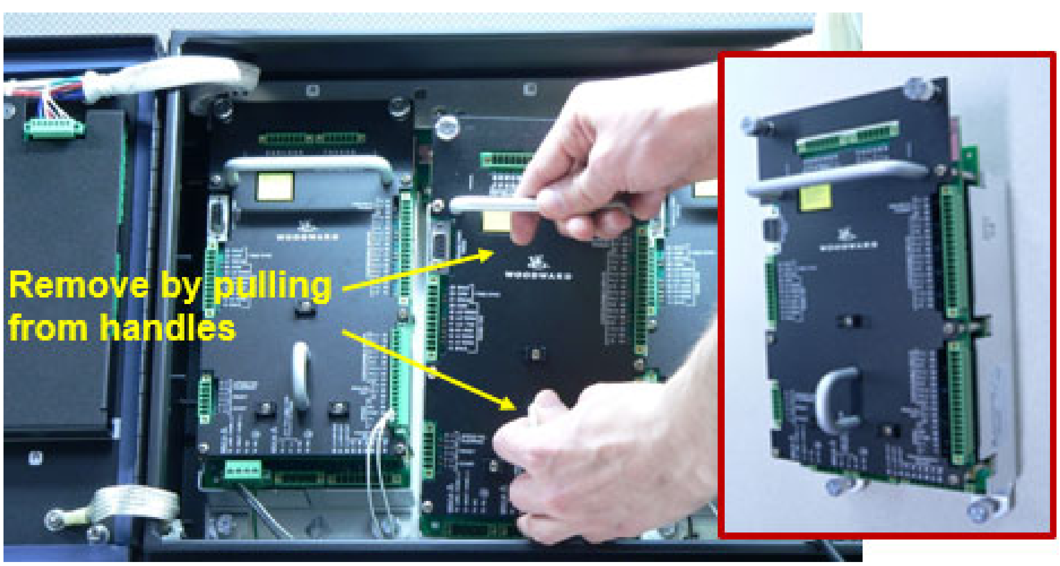


2. Verify power removed by observing power LED is OFF.
3. Remove terminal blocks from module terminals.
4. Loosen four module retention screws.

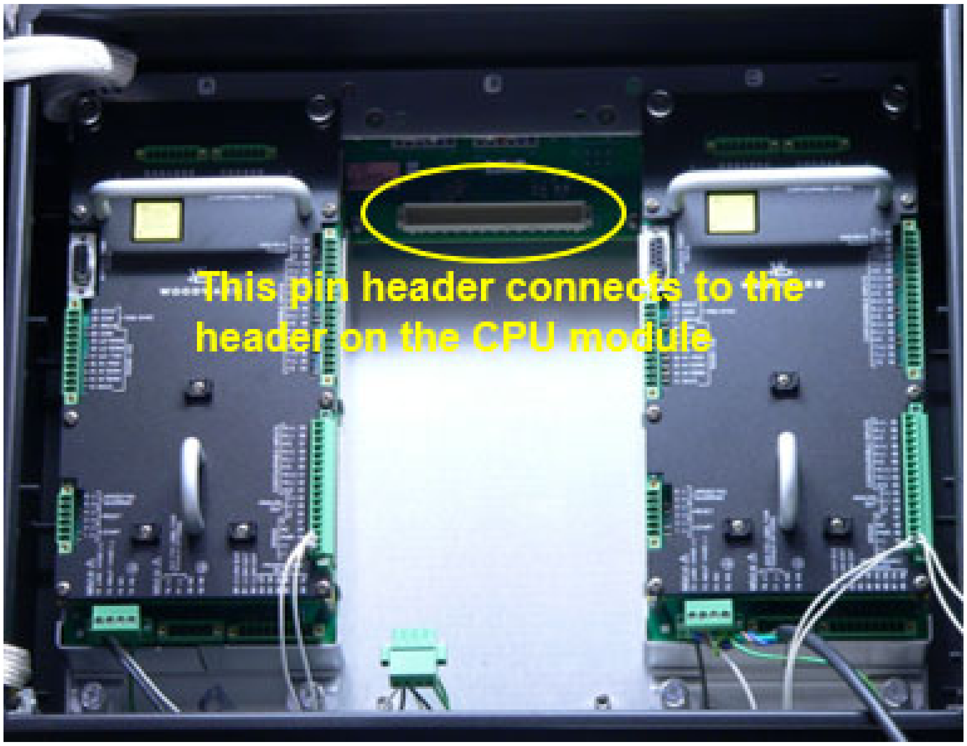


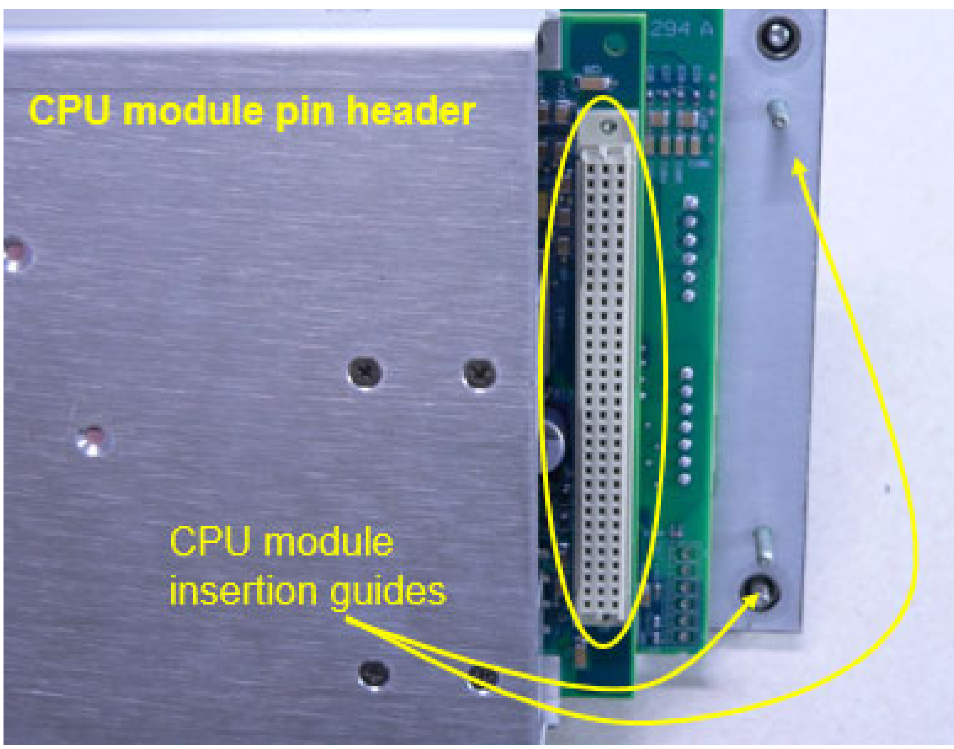


5. Remove module by pulling the two handles simultaneously.



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.

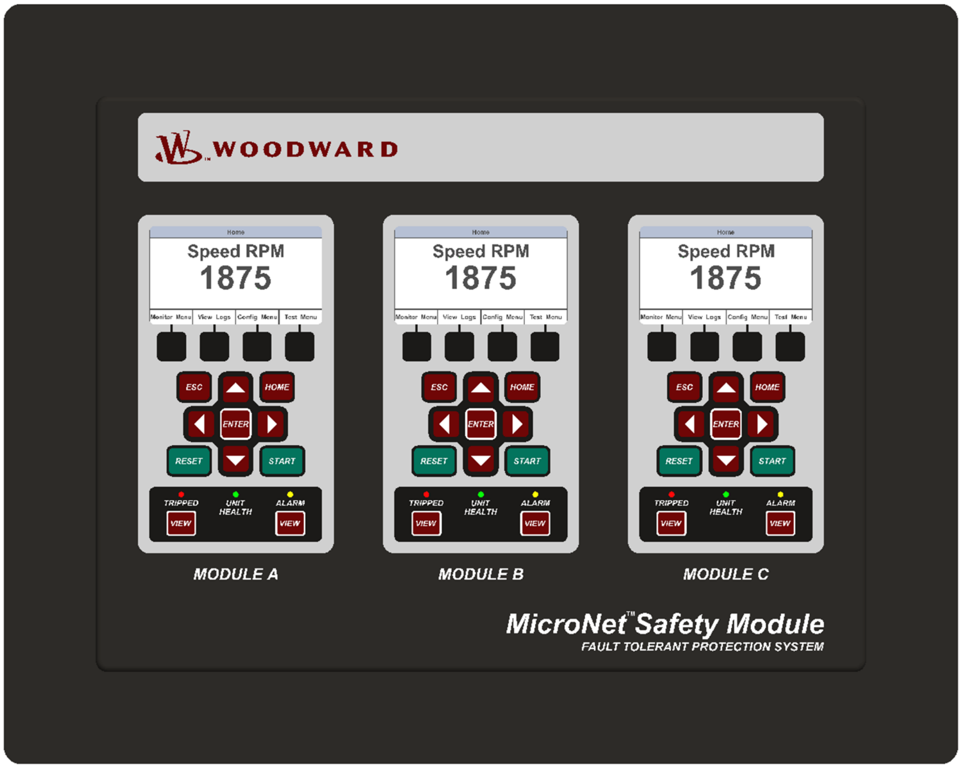


Figure 2-4a. Typical MicroNet Safety Module Panel Mount Package—Front View

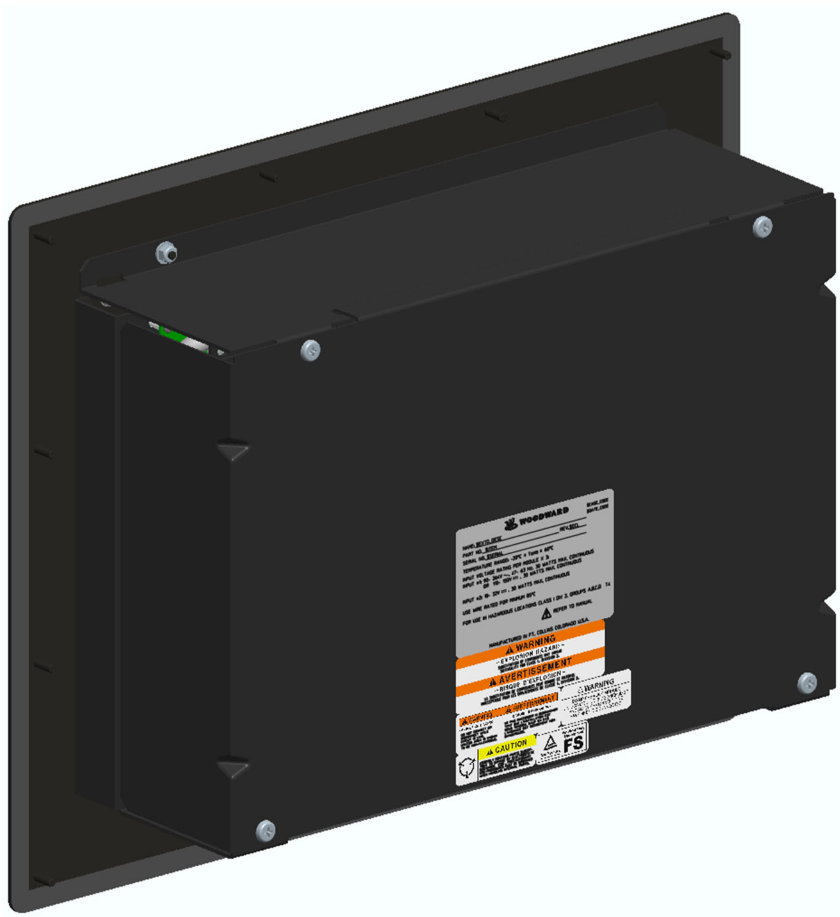


Figure 2-4b. Typical MicroNet Safety Module Panel Mount Package—Rear View with Cover

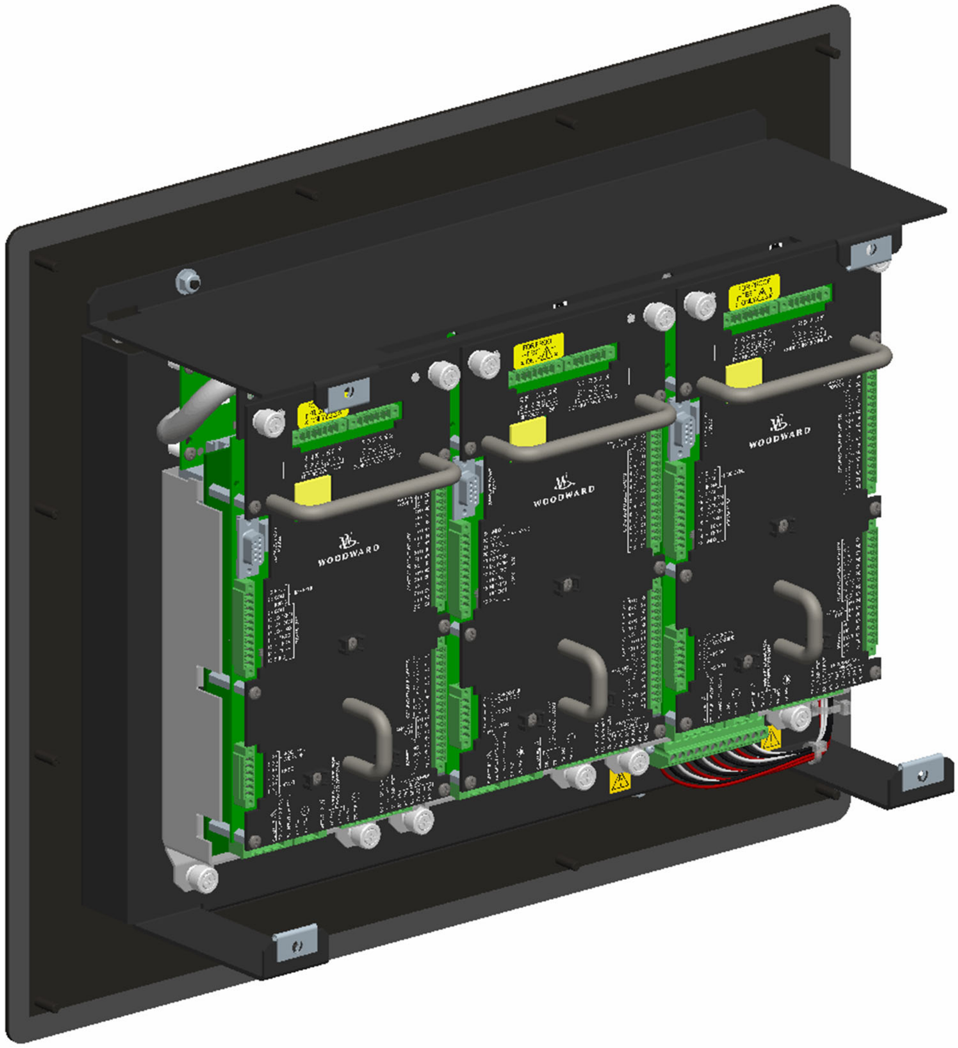


Figure 2-4c. Typical MicroNet Safety Module Panel Mount Package—Rear View without Cover

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.

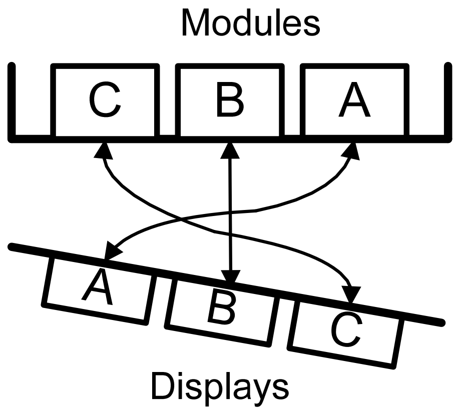


Figure 2-4d. Panel Mount Schematic Showing Front Panel A Connection to Module A and Front Panel C Connection to Module C—Top View

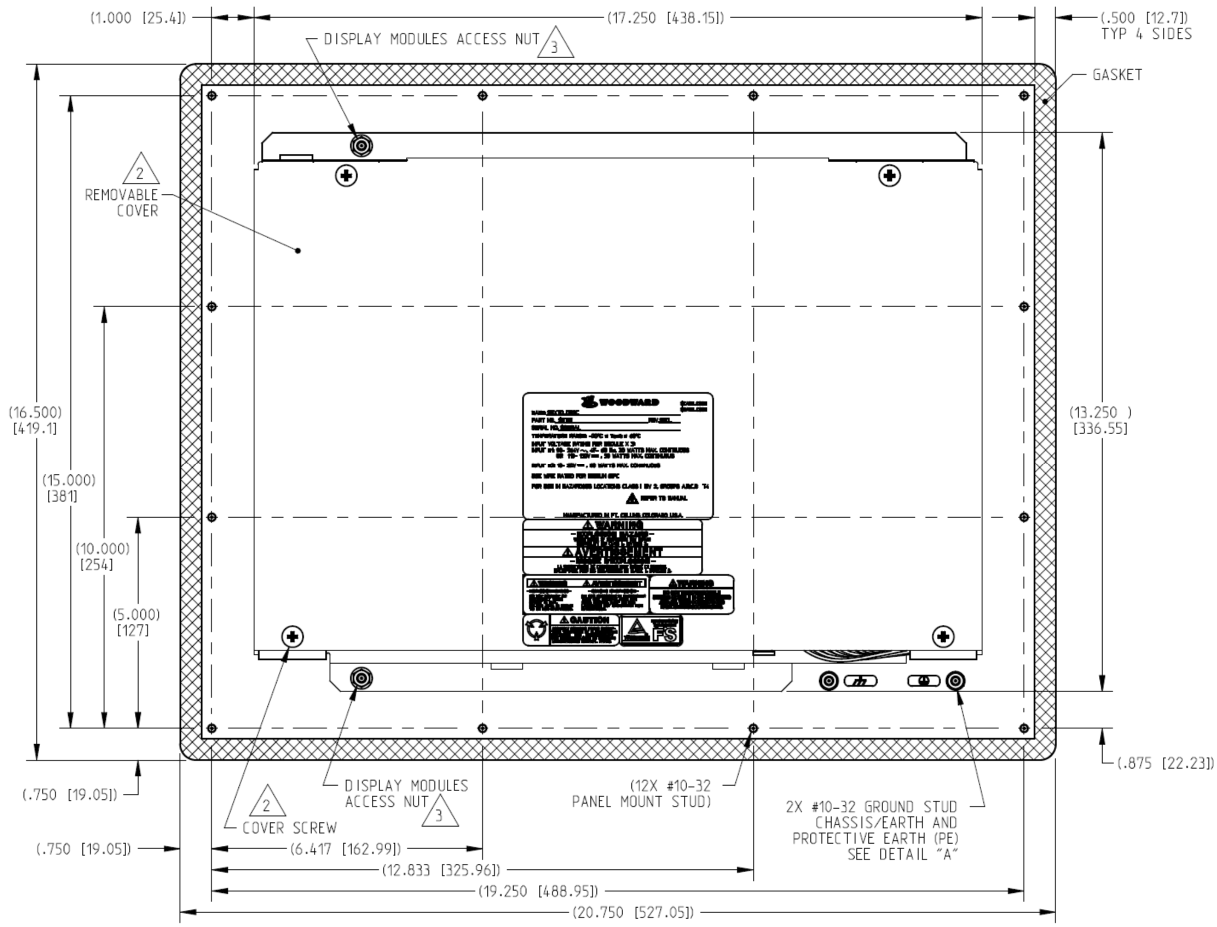


Figure 2-5a. Mounting Outline Diagram for Panel-Mount Models

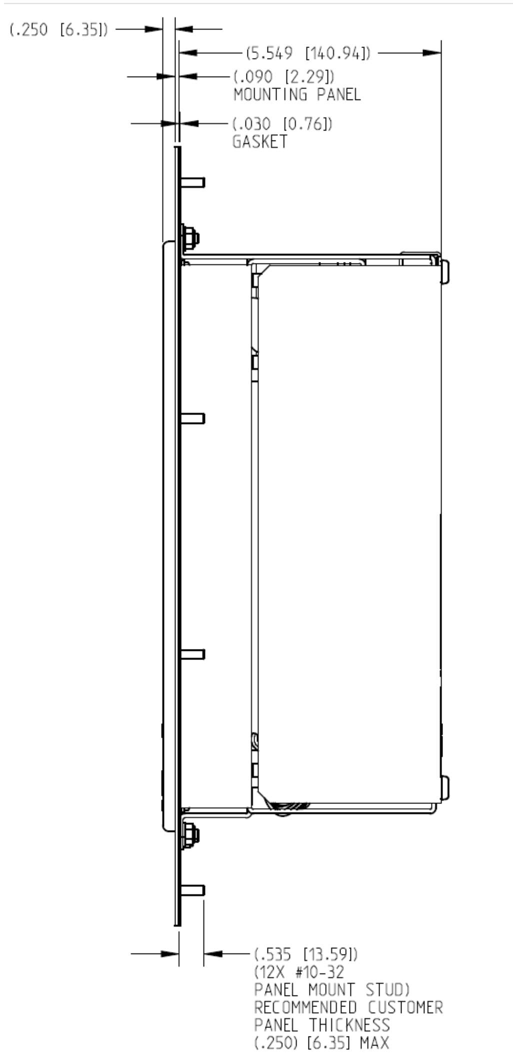


Figure 2-5b. Mounting Outline Diagram for Panel-Mount Models

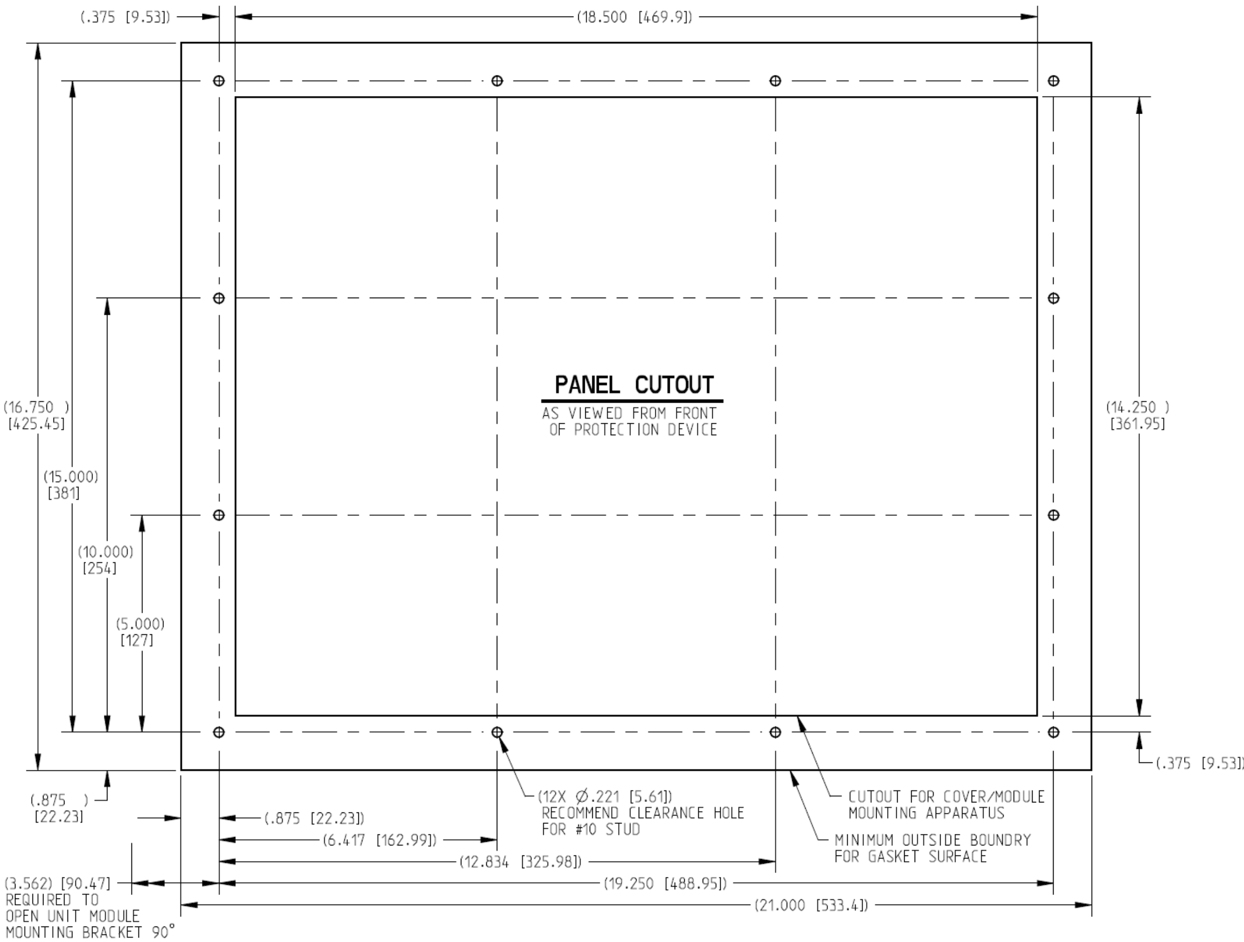


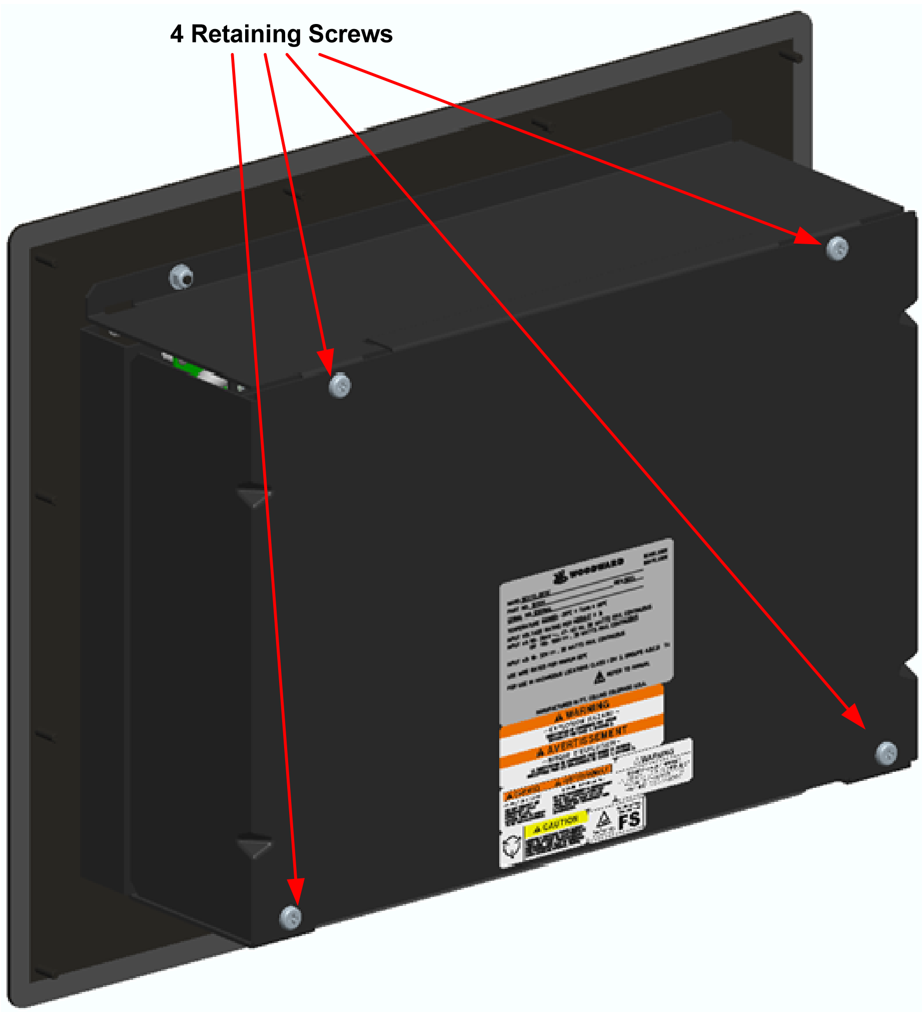
Figure 2-5c. Panel Cutout Diagram for Panel-Mount Models

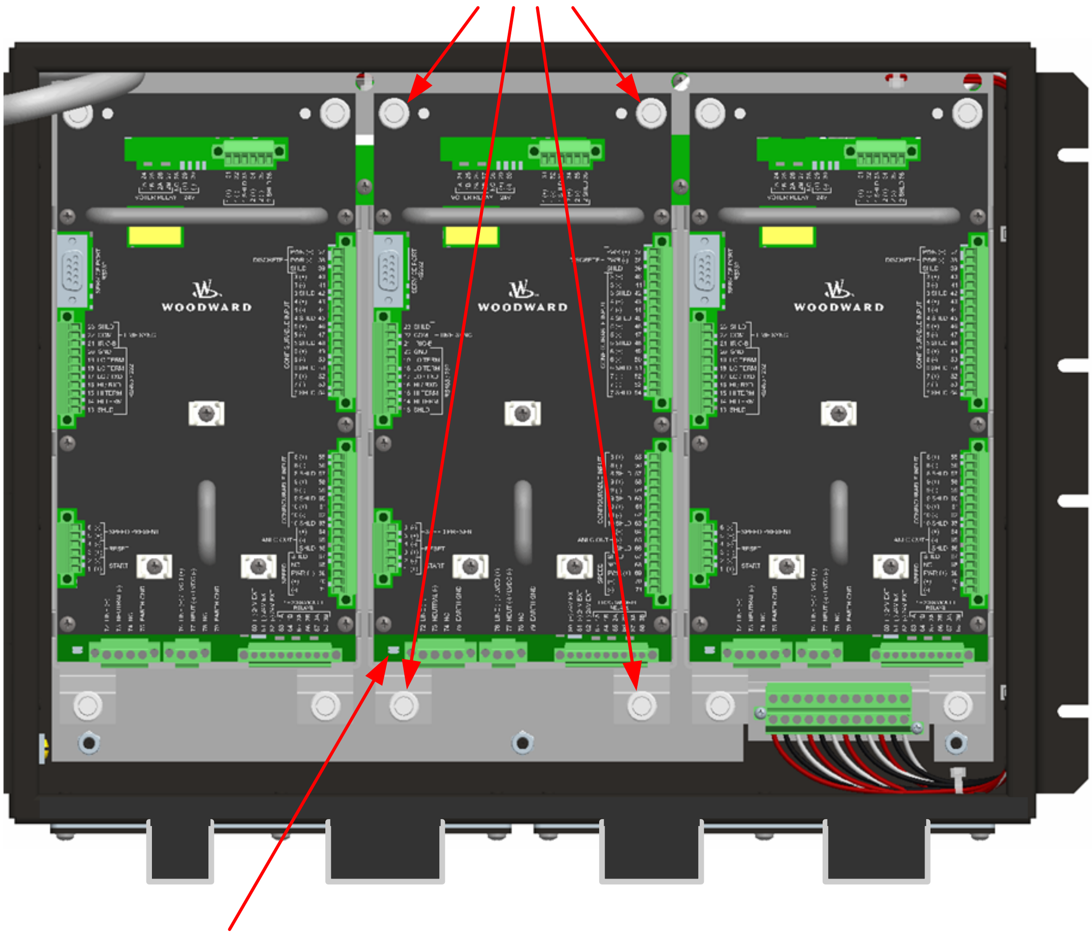
Module Removal and Installation—Panel Mount Package

Follow this procedure for module removal and installation:

Removal:

1. Disconnect power from the module to be removed.
2. Remove four 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 four module retaining screws.
7. Remove module by pulling the two handles simultaneously.





Installation:
1. Insert module into slot by pressing firmly on handles. The module has guides to assist in location.
2. Tighten 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 environment
- 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

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 26 lb. (12 kg)
Weight (Panel Mount Version):	Approximately 22 lb. (10 kg)
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.

Power Supply Specifications

Table 2-2. Input Specifications

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 2-3. High Voltage Input Specifications

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 2-4. Low Voltage Input Specifications

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 2-4. Configurable Input Power Supply Specifications

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 2-5. Relay Output Power Supply Specifications

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 enough 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 and 6 mm² (16 and 10 AWG) for power supply wiring and between 0.3 and 4 mm² (22 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 control'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 unit's 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.

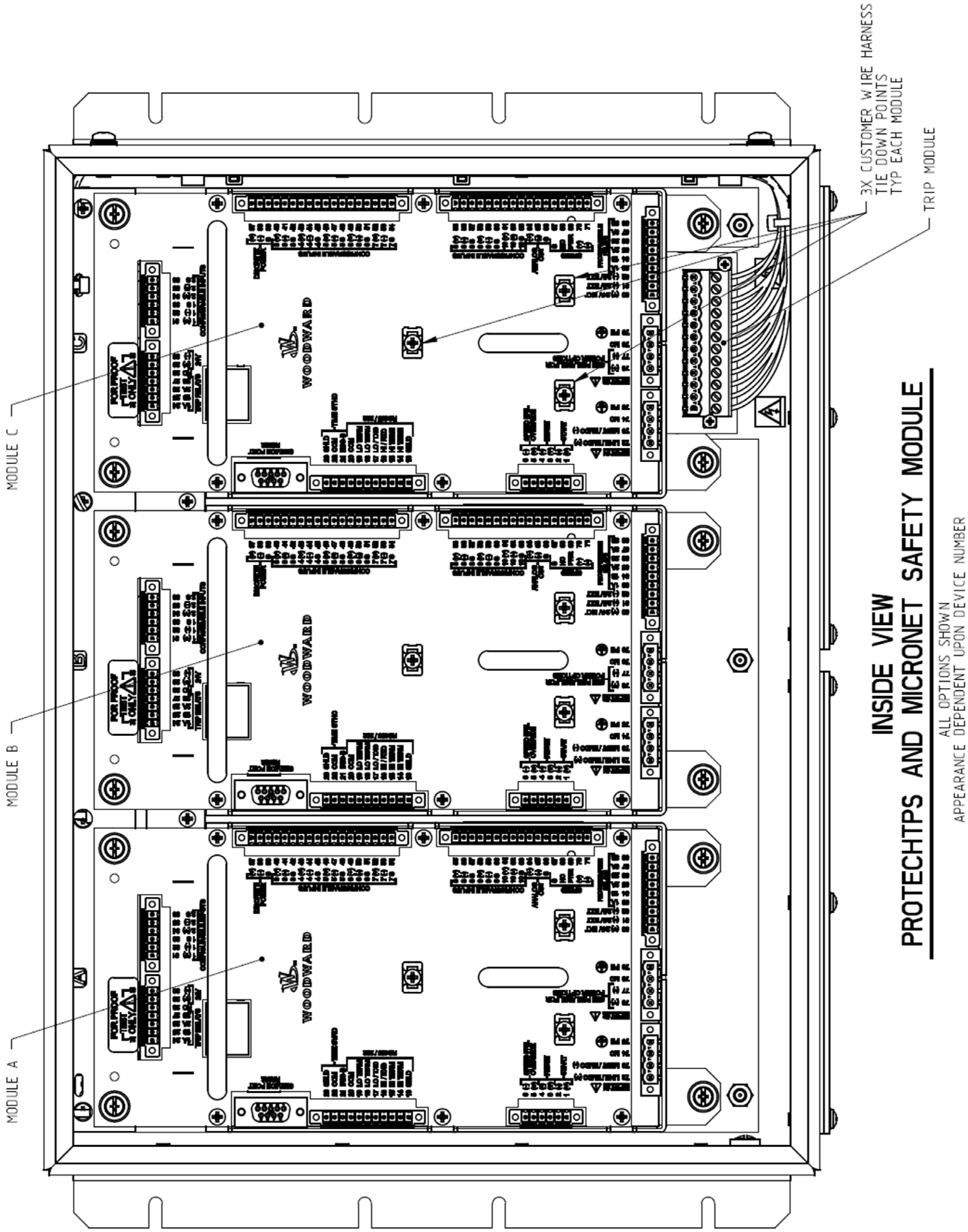


Figure 2-7. Inside View of MicroNet Safety Module

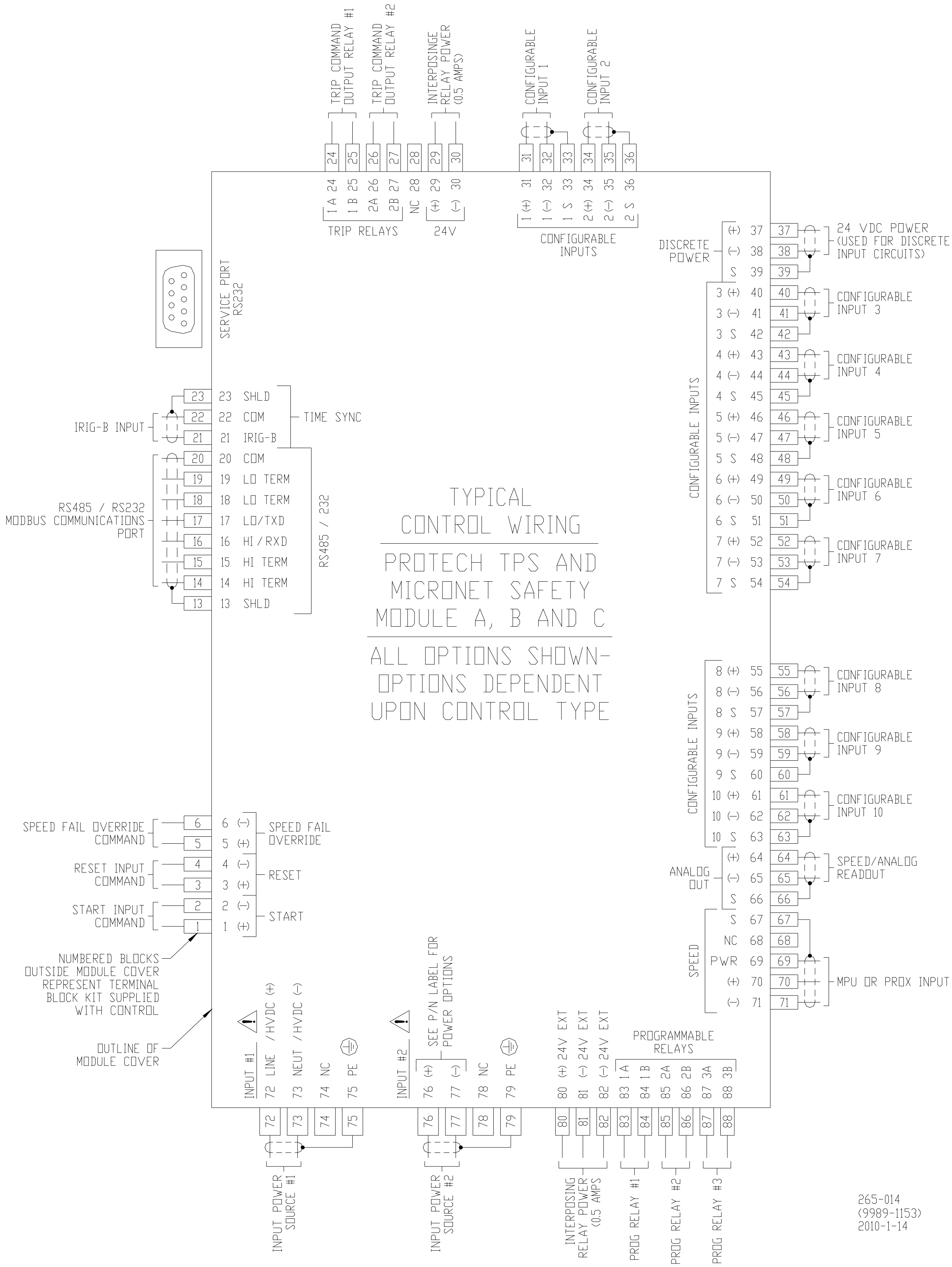


Figure 2-8. MicroNet Safety Module Control Wiring Diagram

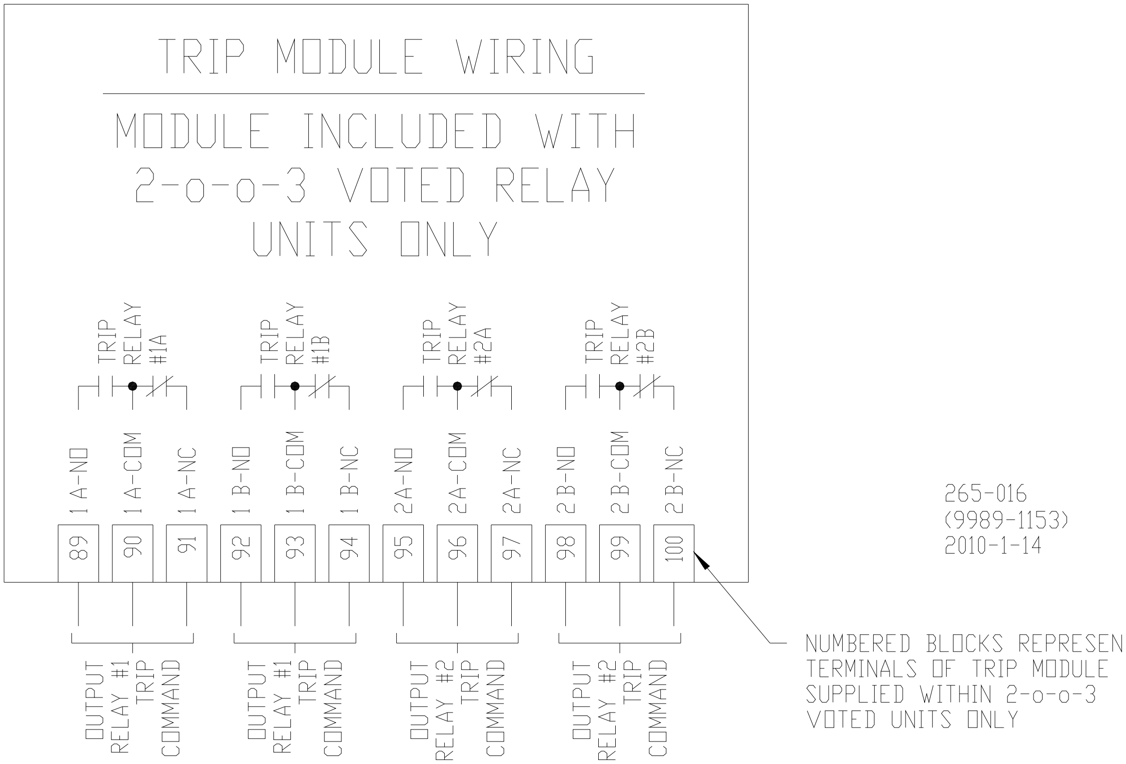


Figure 2-9. Trip Module – Included within Voted Trip Relay Units Only

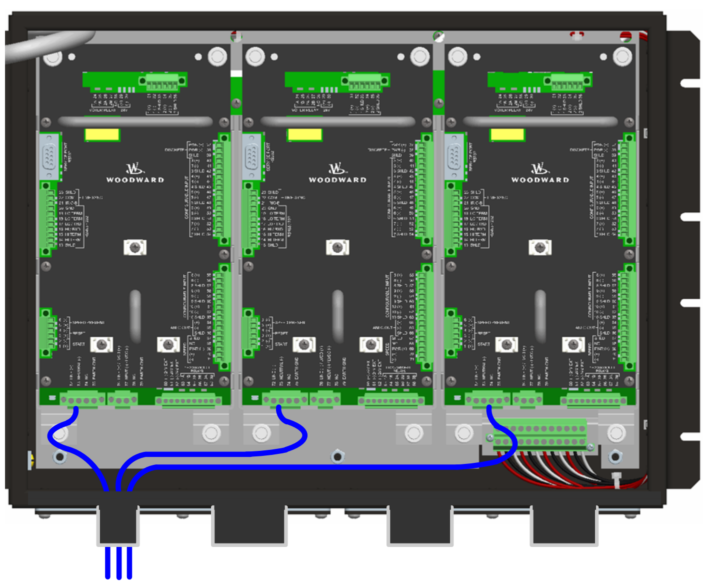


Figure 2-10a. Power Supply Field Wiring Routing & Stress Relief Diagram

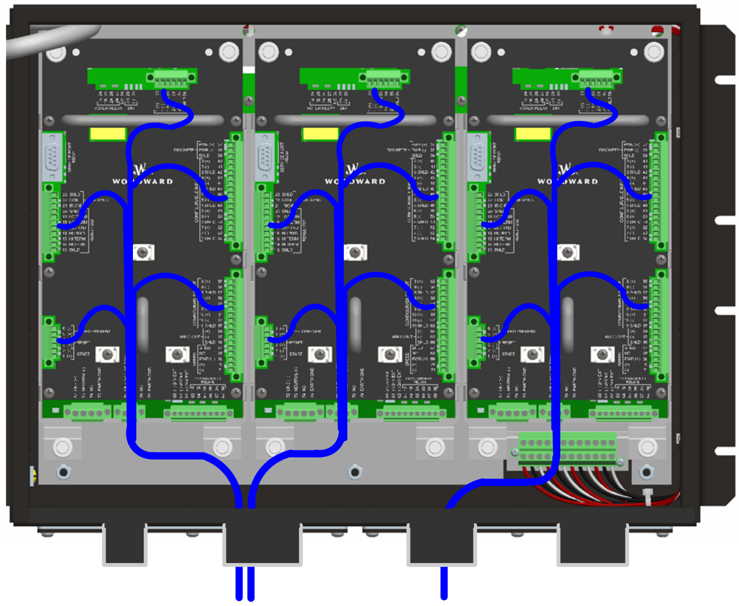


Figure 2-10b. Configurable I/O Wiring Routing & Stress Relief Diagram

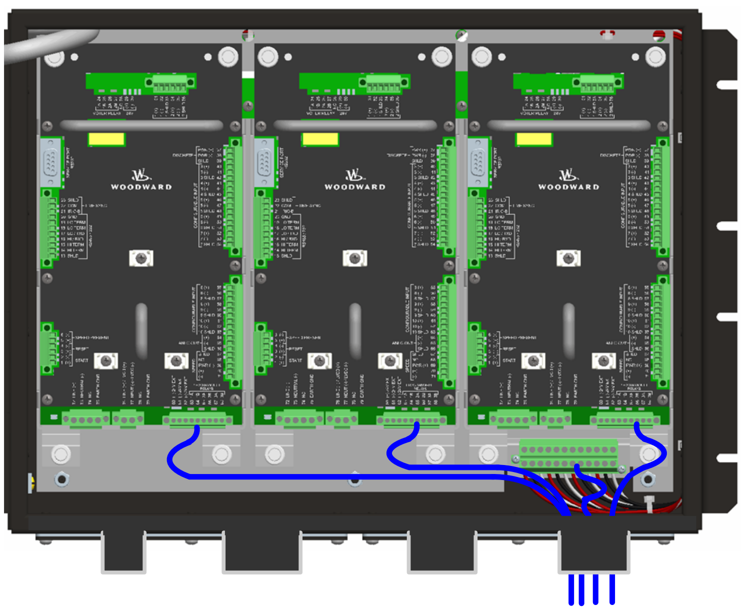


Figure 2-10c. Relay Output Field Wiring Routing & Stress Relief Diagram

Speed Sensor Inputs

To sense speed, each MicroNet Safety Module (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 Vrms 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 to 1.02 mm (0.010 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 and 28 Vdc, 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.

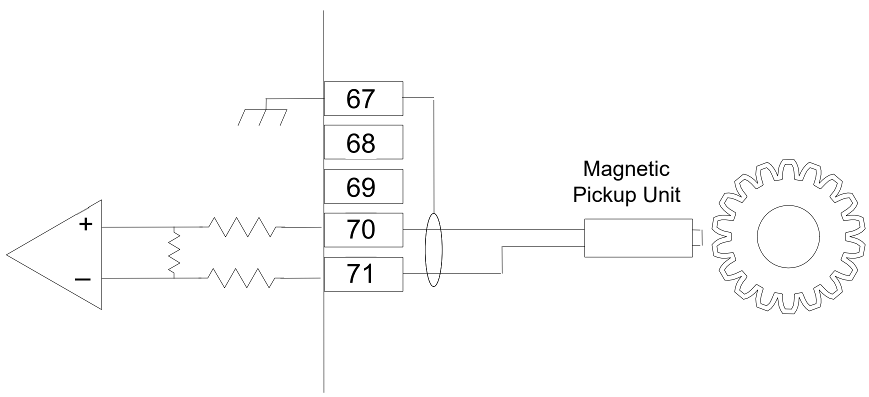


Figure 2-11a. Example MPU (Passive Magnetic Pickup Unit) Wiring

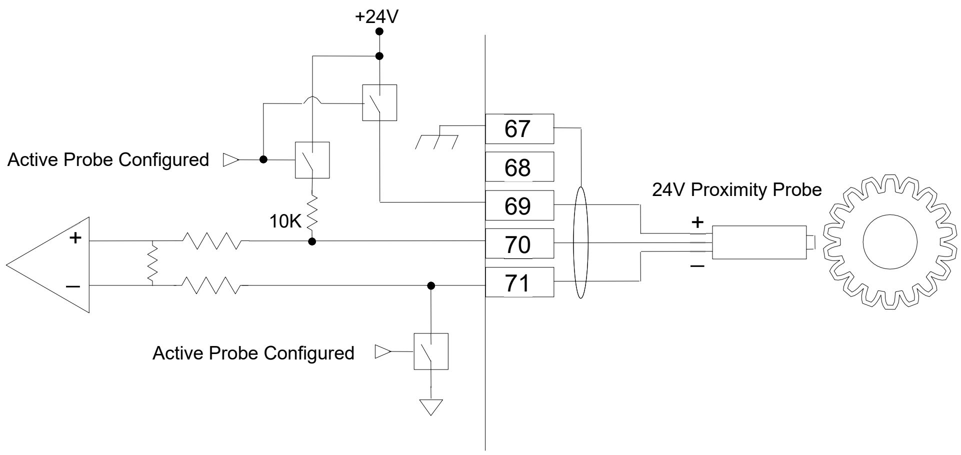


Figure 2-11b. Example Proximity Probe (Active Magnetic Pickup Unit) Wiring (Internal Power)

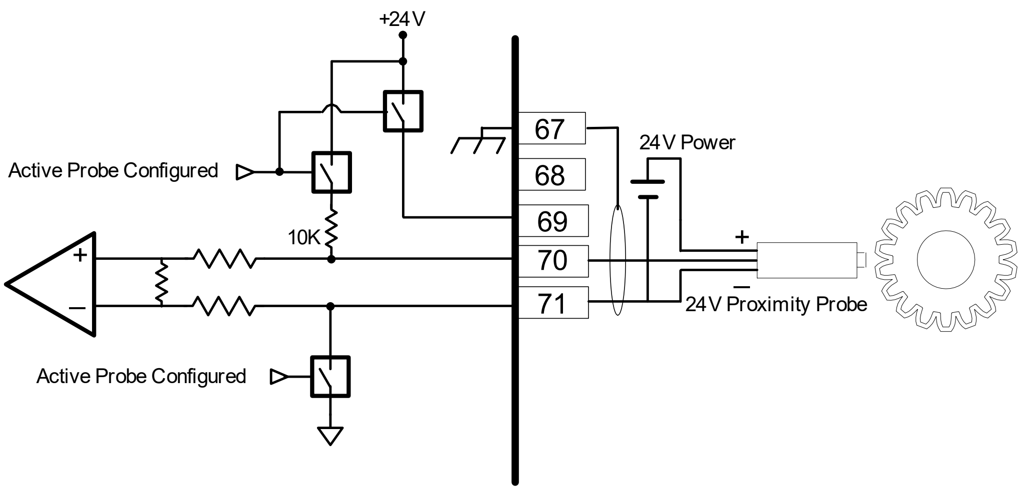


Figure 2-11c. Example Proximity Probe (Active Magnetic Pickup Unit) Wiring (External Power, Non-preferred)

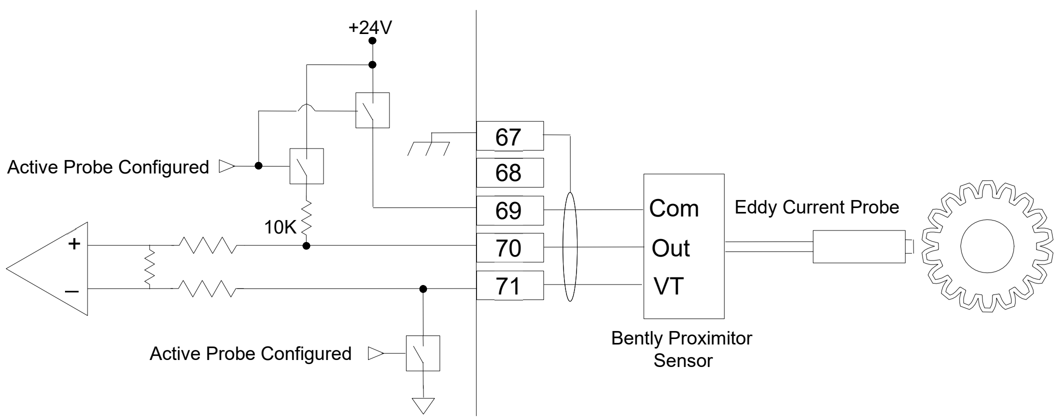


Figure 2-11d. Example Eddy Current Probe (Active Magnetic Pickup Unit) Wiring

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 Vdc 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 an MSM'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.

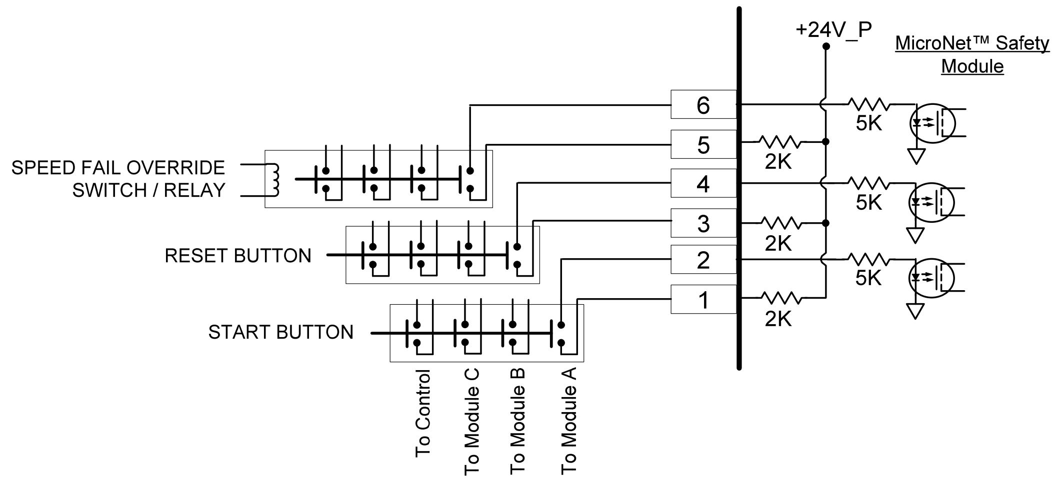


Figure 2-12a. Example Standard Discrete Input Wiring (Internal Power Option)

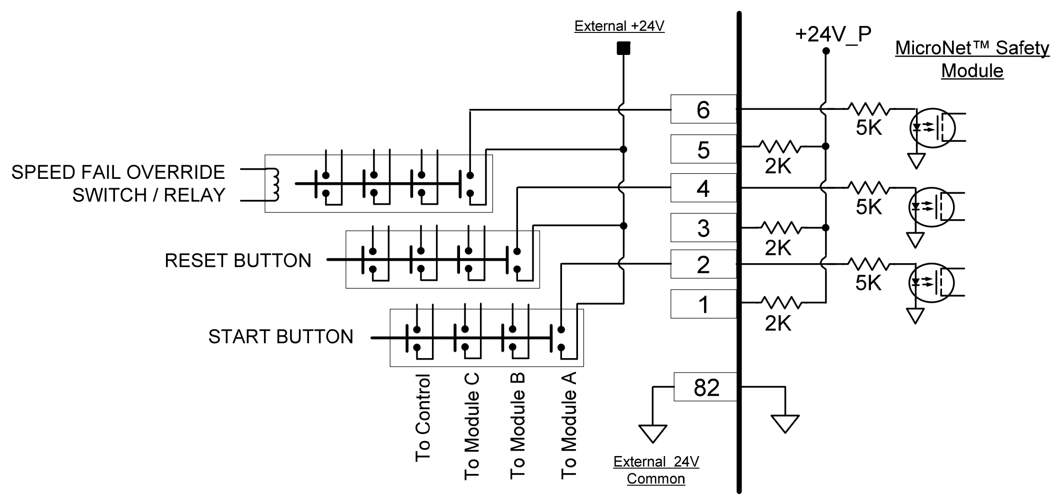


Figure 2-12b. Example Standard Discrete Input Wiring (External Power Option)

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 DIs. Shielded DI's may be grouped with multiple signals & one common/power wire in a single shield. In general, an input contact signal must change state for a minimum of 8 milliseconds for an MSM 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 18–26 Vdc power source can be used for the circuit-wetting voltage. In this case, terminal 38 (contact input common) must be connected to the external power source's common to establish a common reference point. Each contact input pulls 4.8 mA at 24 V when closed and requires at least 2.5 mA and 14 V to recognize a closure command. Refer to Figure 2-13b for wiring information.

IMPORTANT

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

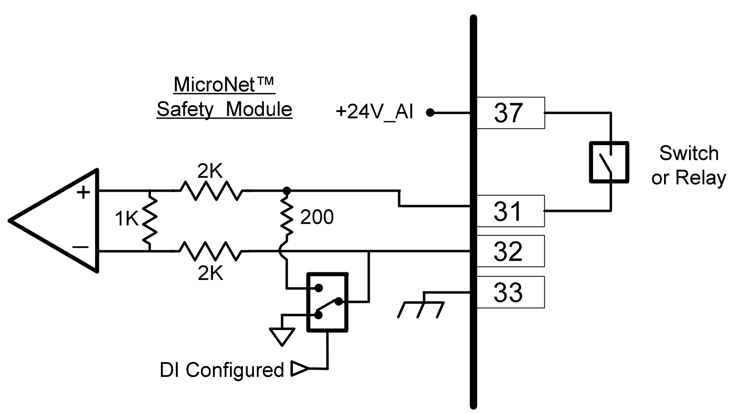


Figure 2-13a. Example Configurable Input Wiring—Discrete Input (Internal Power Option)

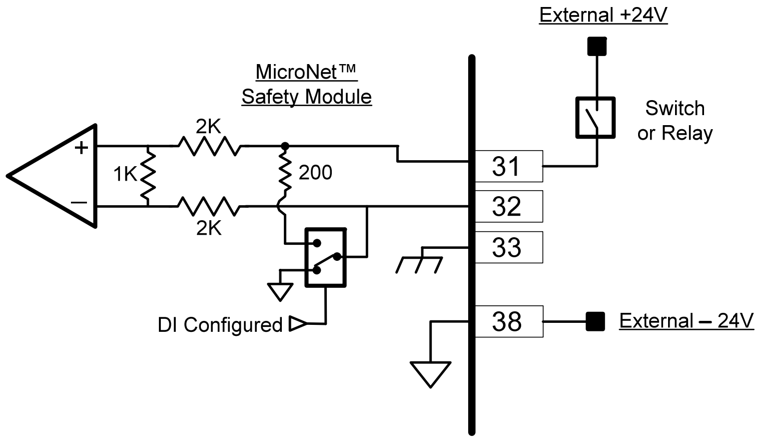


Figure 2-13b. Example Configurable Input Wiring—Discrete Input (External Power Option)

Configurable Discrete and Analog Inputs—Analog Input Wiring

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

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

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

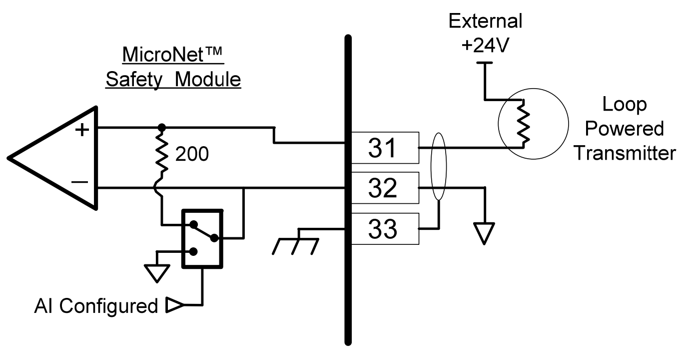


Figure 2-14. Example Configurable Input Wiring—Analog Input

Analog Output

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

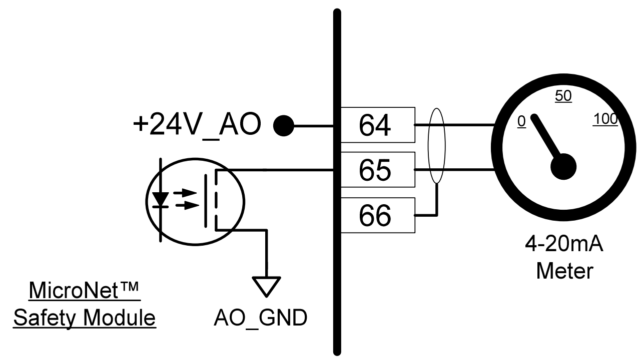


Figure 2-15. Example Analog Output Wiring

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.

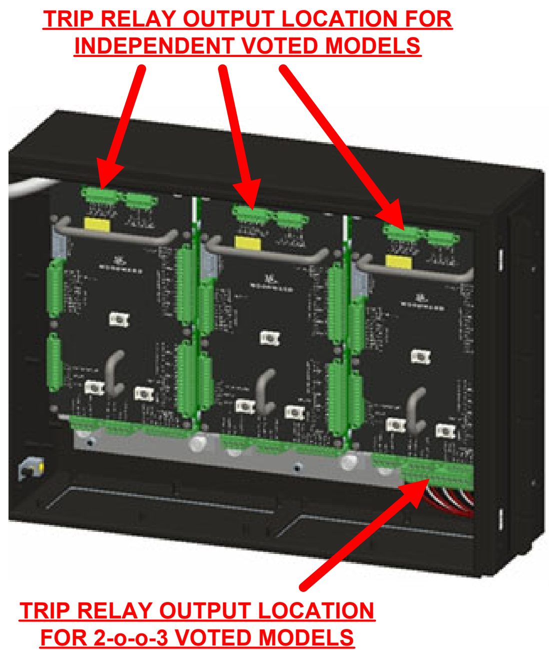


Figure 2-16a. Example Trip Relay Output Wiring

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 Vdc @ 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.

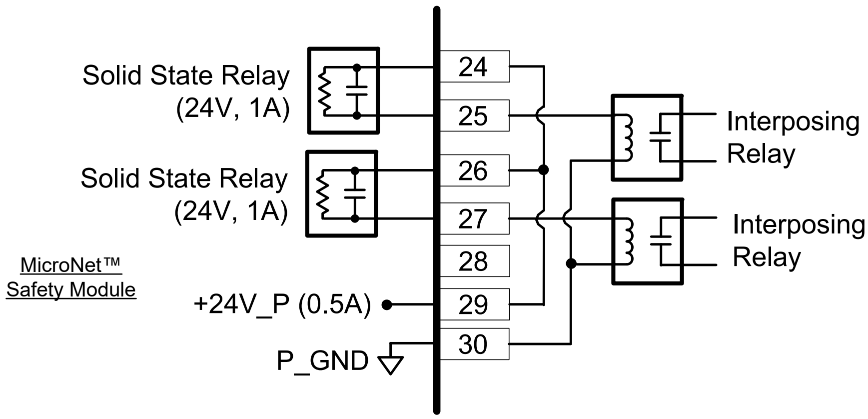


Figure 2-16b. Example Trip Relay Wiring (per Module) (Independent Trip Relay) (Internal Supply)

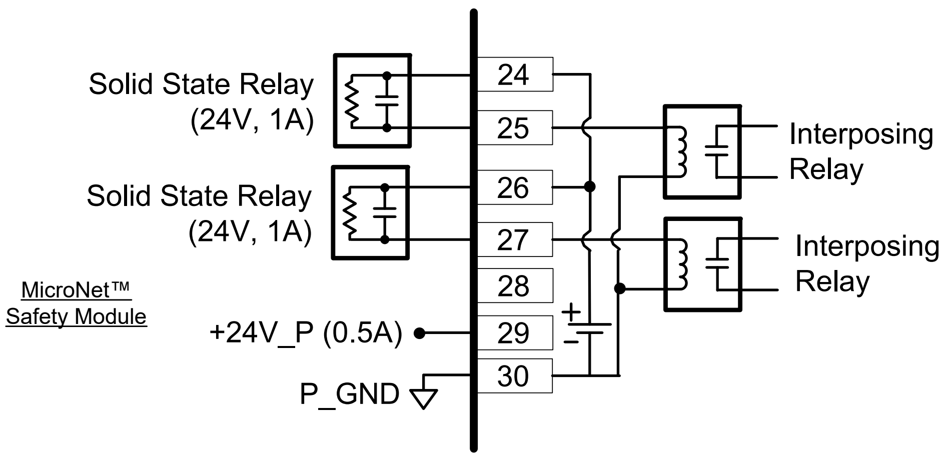


Figure 2-16c. Example Trip Relay Wiring (per Module) (Independent Trip Relay) (External Supply)

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 Vdc @ 1 A. Two of these relay outputs are dedicated as redundant trip signal outputs to drive the MicroNet Safety Module'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 Vac @ 8 A or 24 Vdc @ 8 A. Refer to Figure 2-16a for relay terminal location and Figure 2-16d for wiring information.

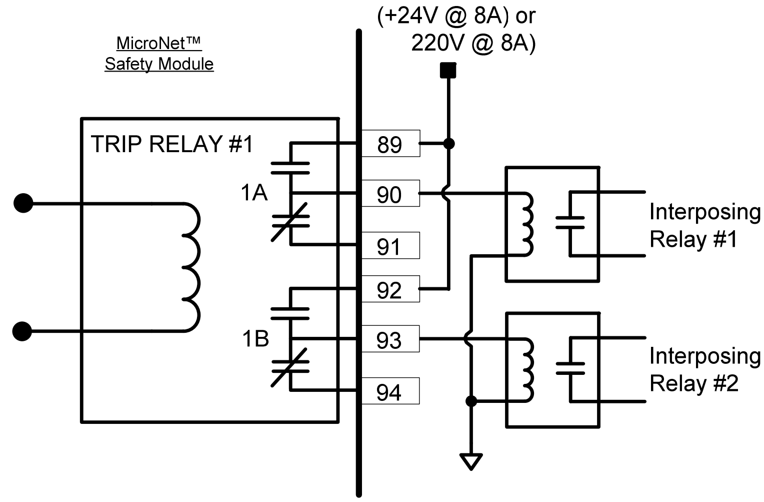


Figure 2-16d. Example Trip Relay Wiring (Voted Trip Relay Models)

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 Vdc @ 1 A. Refer to Figure 2-16e or f for wiring information.

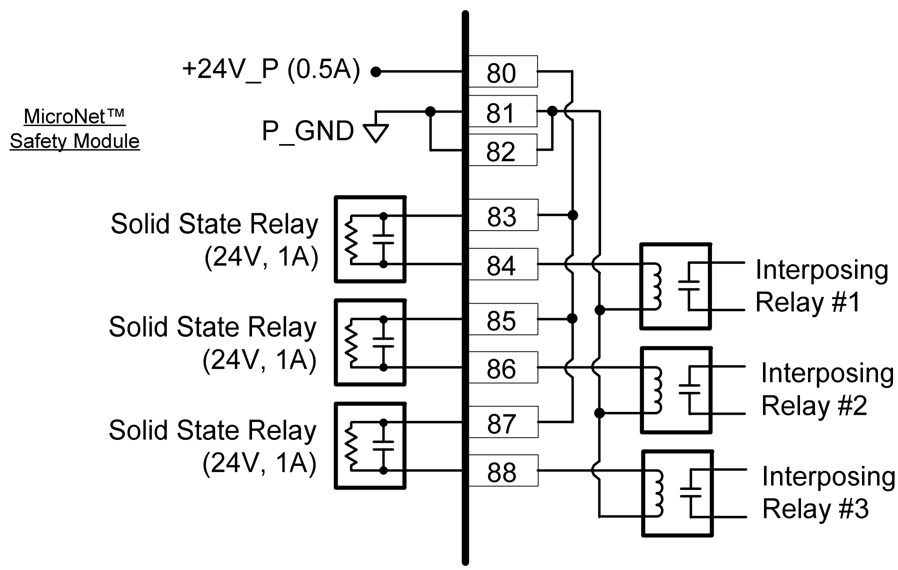


Figure 2-16e. Example Programmable Relay Wiring (Internal Supply)

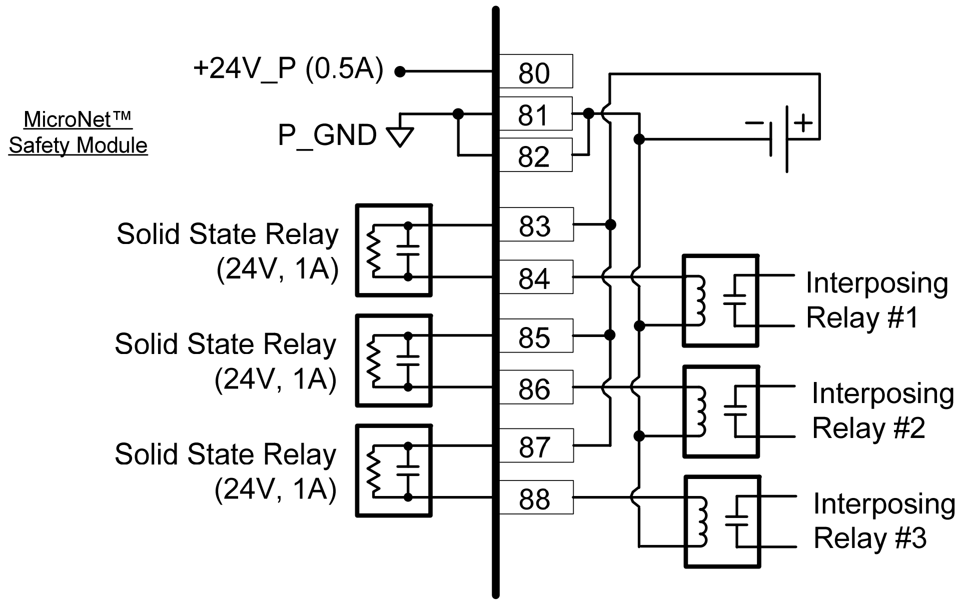


Figure 2-16f. Example Programmable Relay Wiring (External Supply)

Internal Power Supplies for Discrete Signals

Two internal 24 V power supplies are available within each MicroNet Safety Module 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 Vdc ±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 Vdc ±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 Vdc 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.

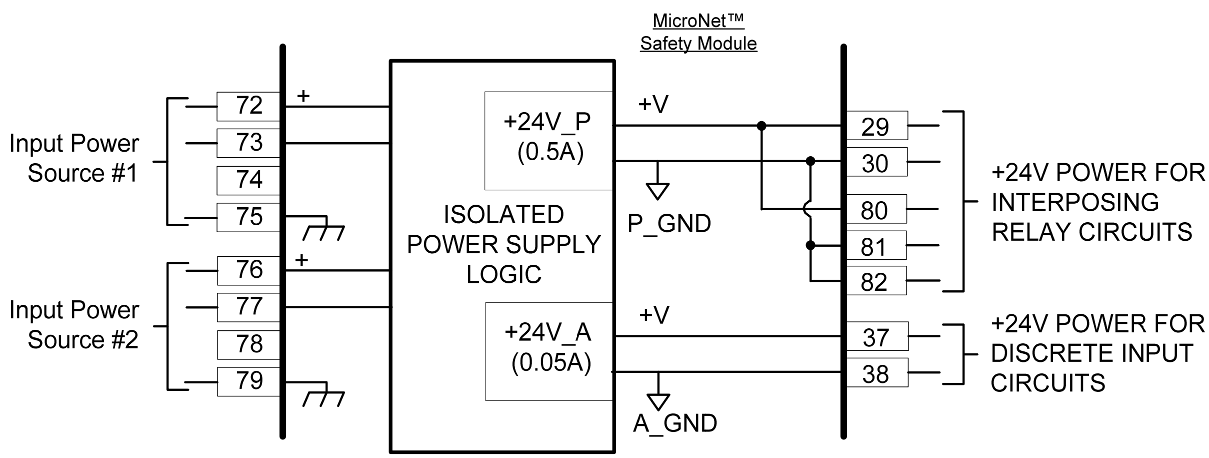


Figure 2-17. Power Supply Relationship Diagram

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.

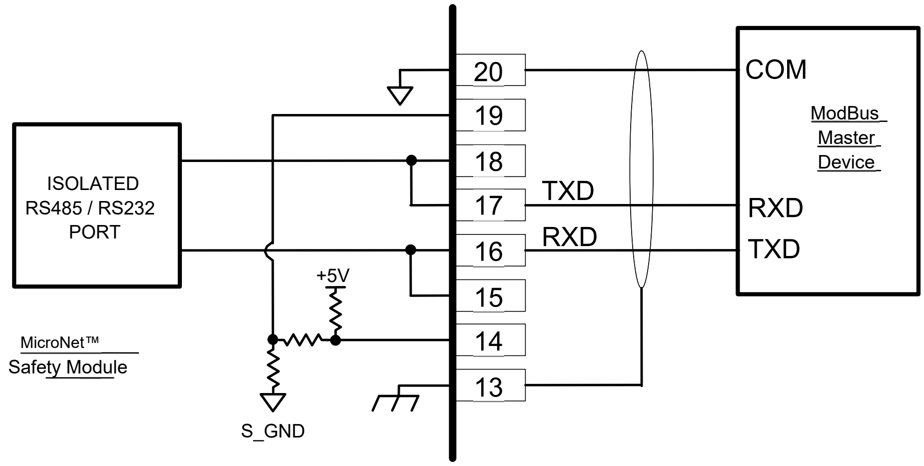


Figure 2-18a. Serial Port Interface Diagram—RS-232

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.

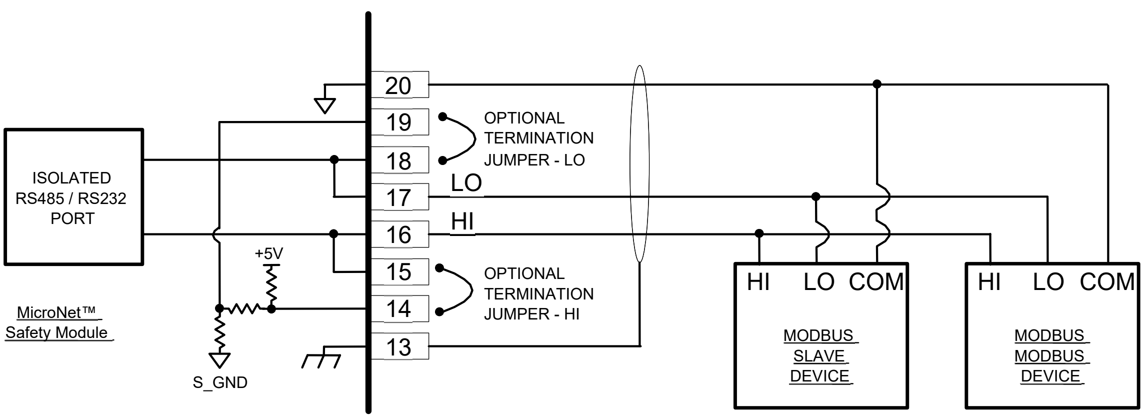


Figure 2-18b. Serial Com Port Interface Diagram—RS-485

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.

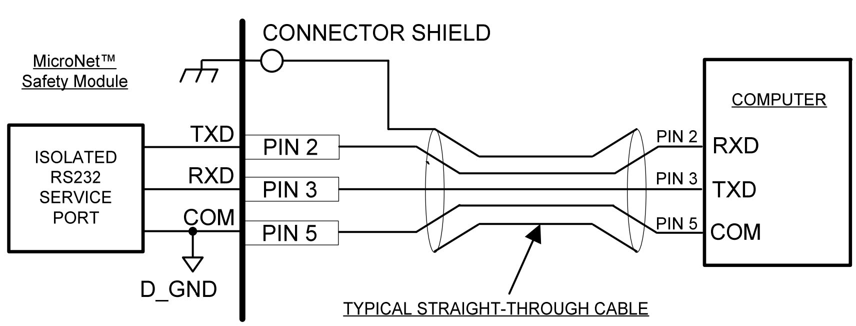


Figure 2-19. Service Tool Cable/Interface Diagram

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

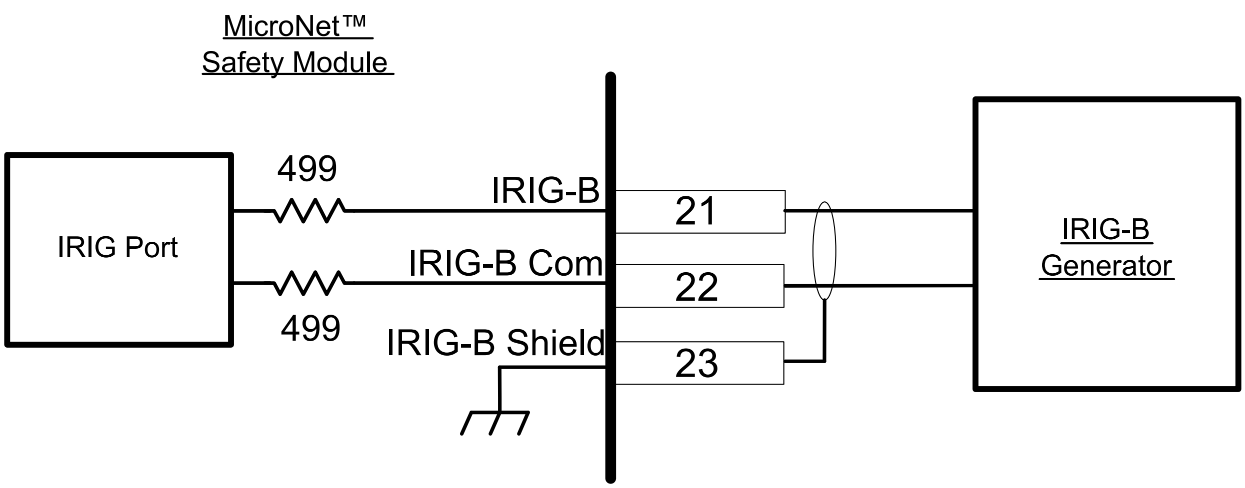


Figure 2-20. IRIG-B Interface Diagram

Chapter 3. Functionality

Introduction

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.

The MicroNet Safety Module includes all the functionality of the original MicroNet Safety Module 203 Overspeed Protection system, but adds additional inputs, outputs, protection features, and configurable software to allow the MicroNet Safety Module to meet the requirements of a Total Protection System.

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 configurable analog 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 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. Display options like Home Screen selection, Time Sync options 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.

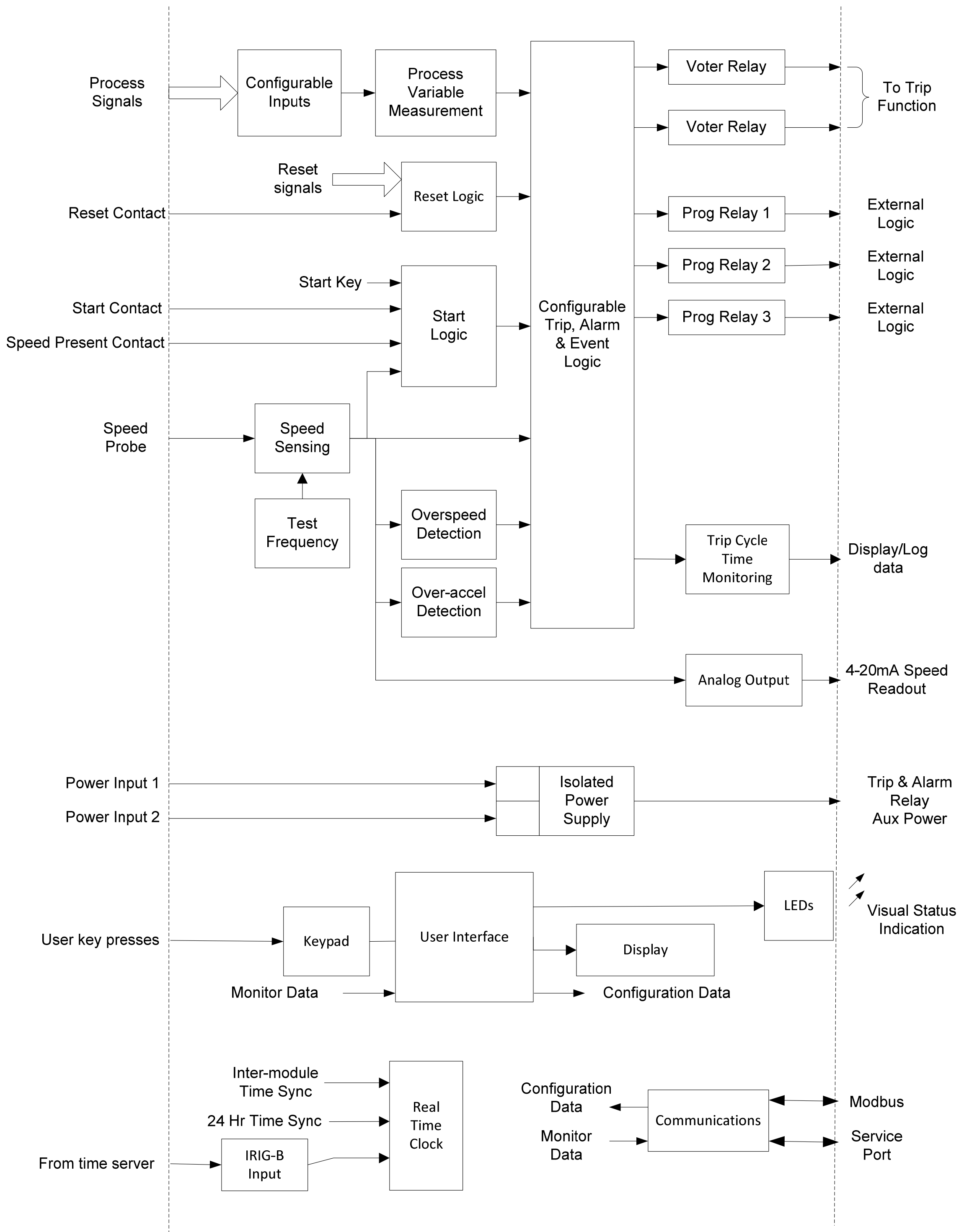


Figure 3-1. Basic Functional Overview

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 from a 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) if 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 10 and 12 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
- Copy the configuration to another module

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 the prime mover.**

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.

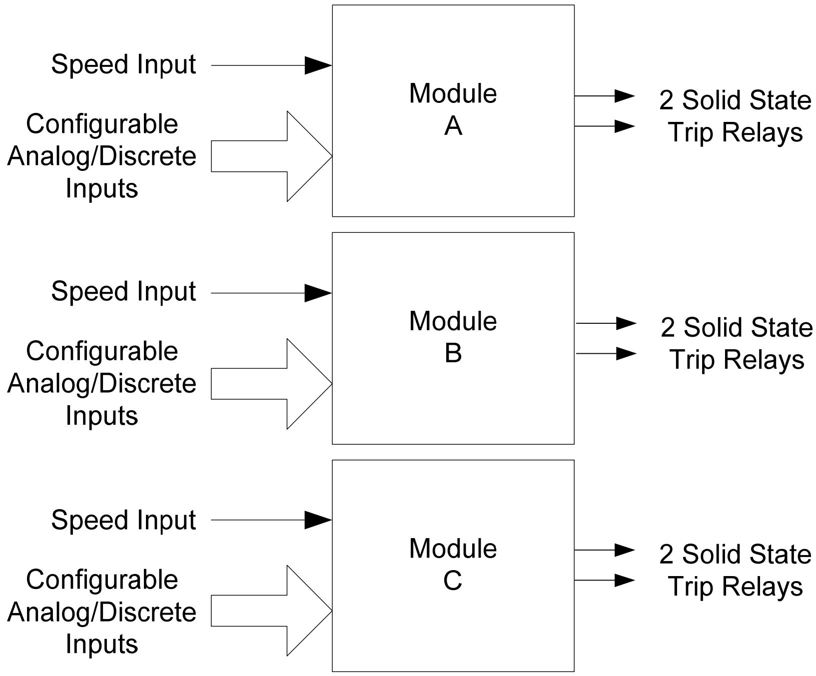


Figure 3-2. Basic Functional Overview of Independent Trip Relay Models

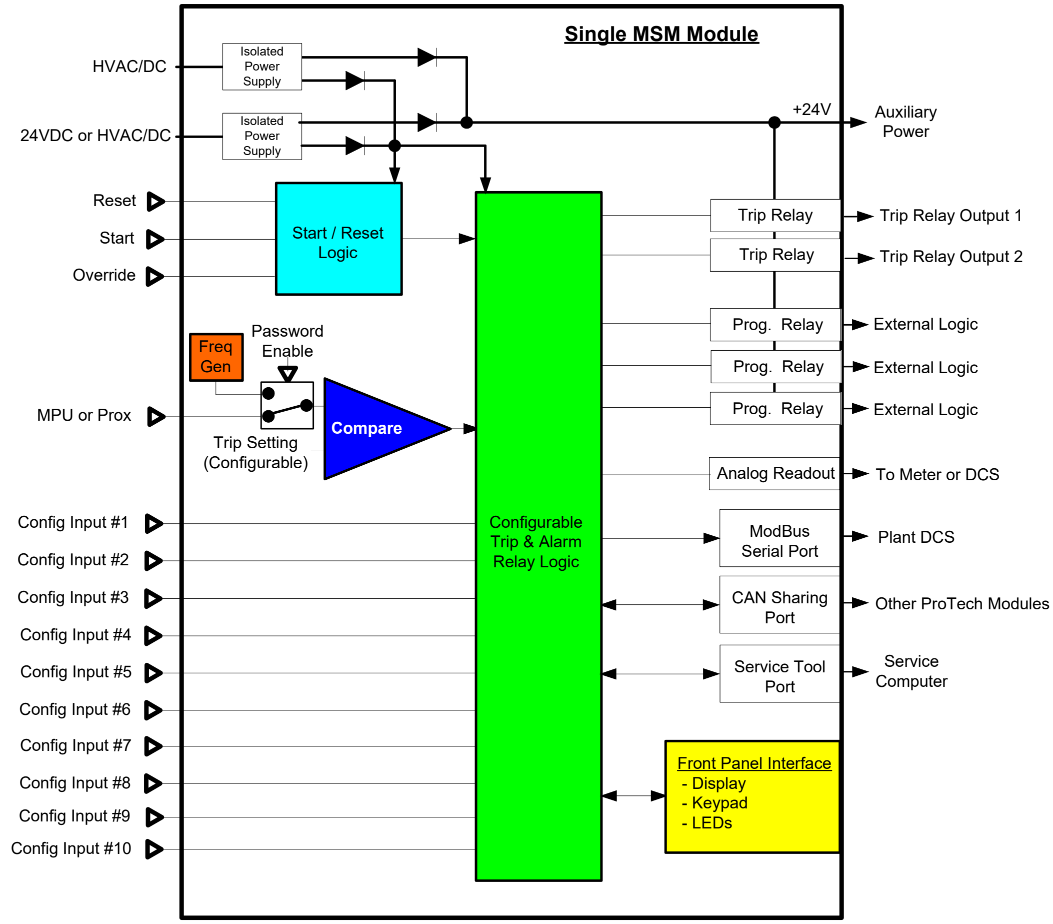


Figure 3-3. Functional Diagram of Single MicroNet Safety Module with Independent Trip Relay Outputs

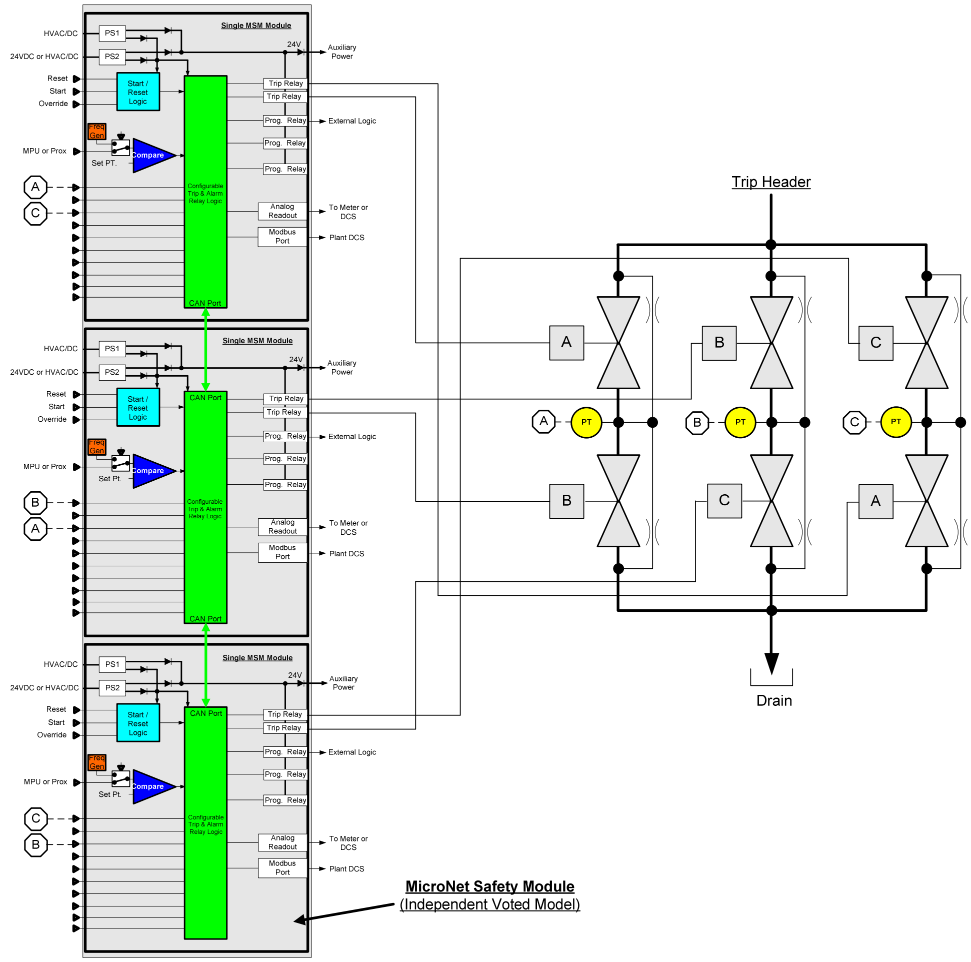


Figure 3-4. Example TMR Trip Block Assembly Interface

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 Vac from output to chassis and output to all other circuits
Signal Cable Length	Must be limited to 1000 ft / 305 m (low capacitance 16 AWG / 1.3 mm² pair)

MicroNet Safety Module 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.

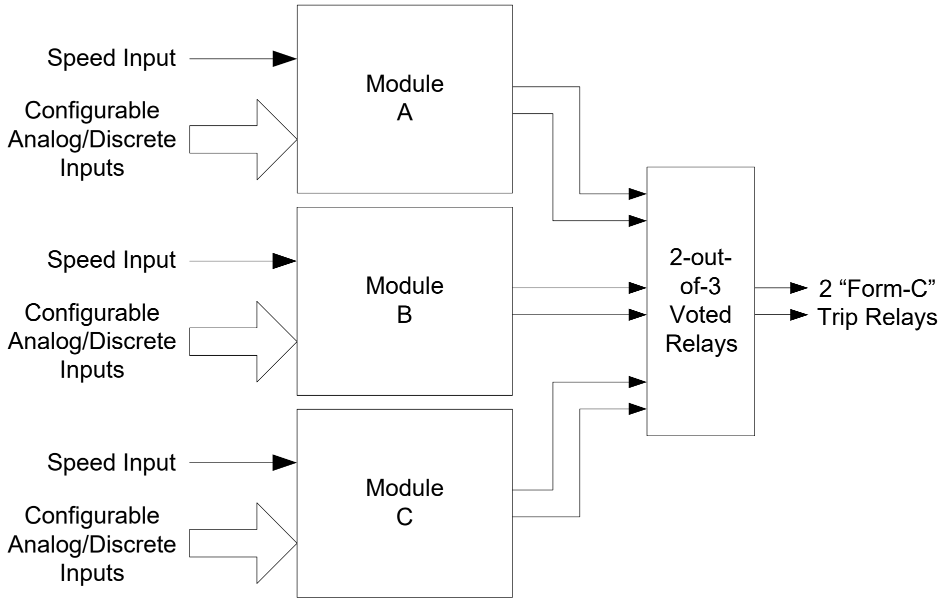


Figure 3-5. Basic Functional Overview of Voted Trip Relay Models

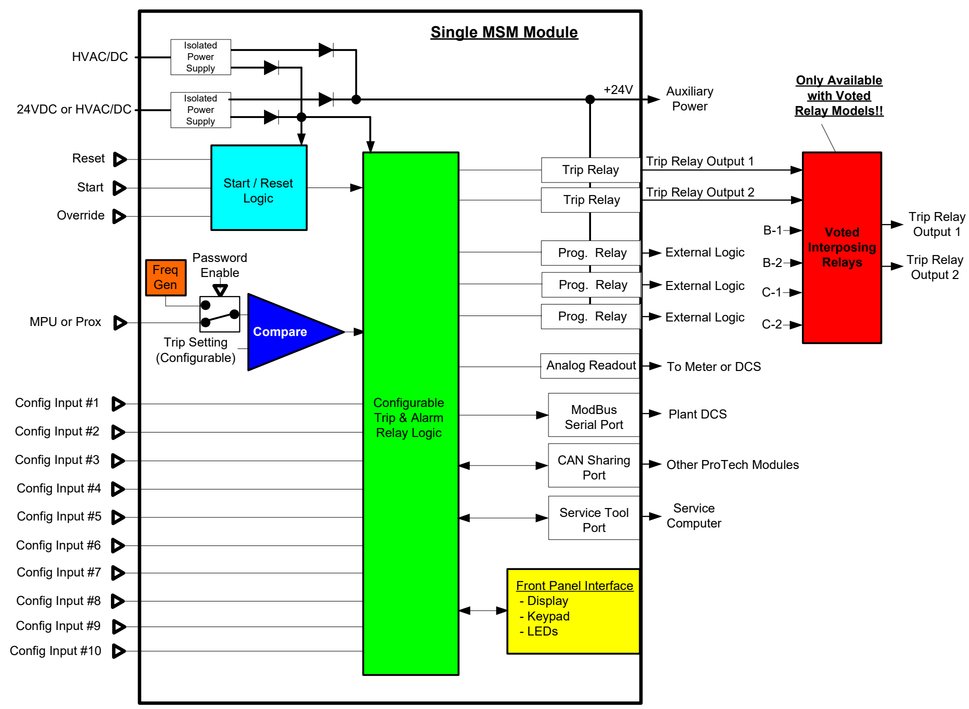


Figure 3-6. Functional Diagram of Single MicroNet Safety Module with Voted Trip Relay Outputs

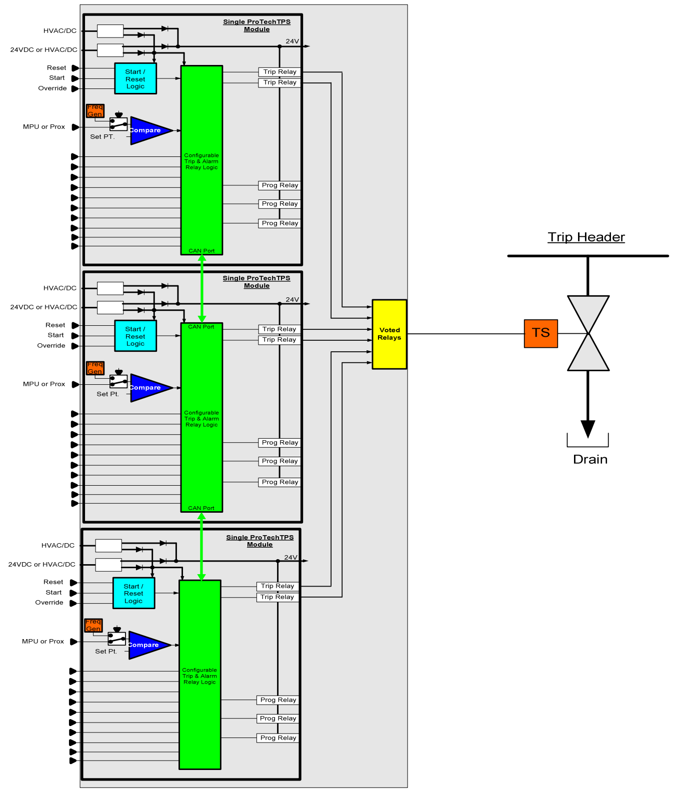


Figure 3-7. Simplex Trip Block Assembly

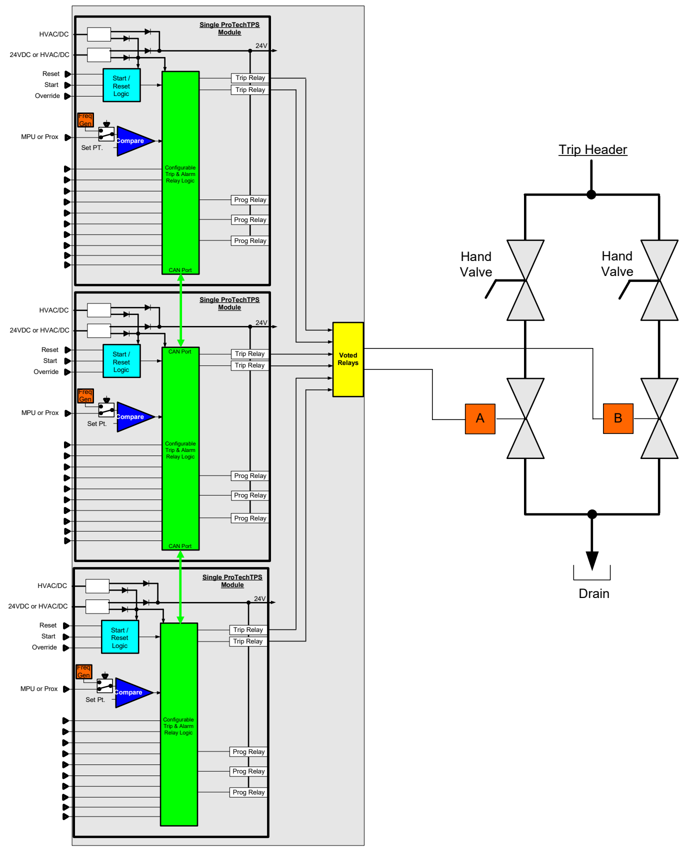


Figure 3-8. Dual Redundant Trip Block Assembly

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 Vac / 8 A @ 24 Vdc
Max. Switching Voltage	220 Vac / 150 Vdc
Max. Switching Power	2000 VA / 192 W
Isolation	1500 Vac 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.

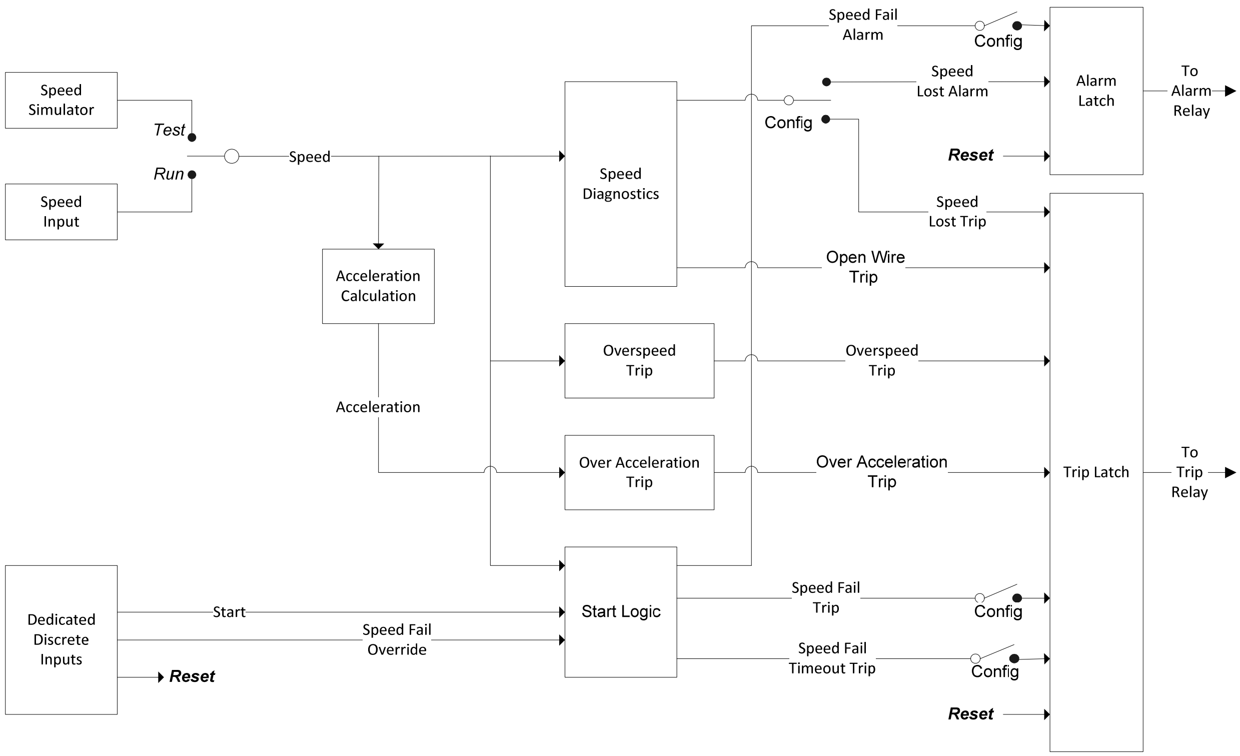


Figure 3-9a. Speed Overview Without Redundancy Configured

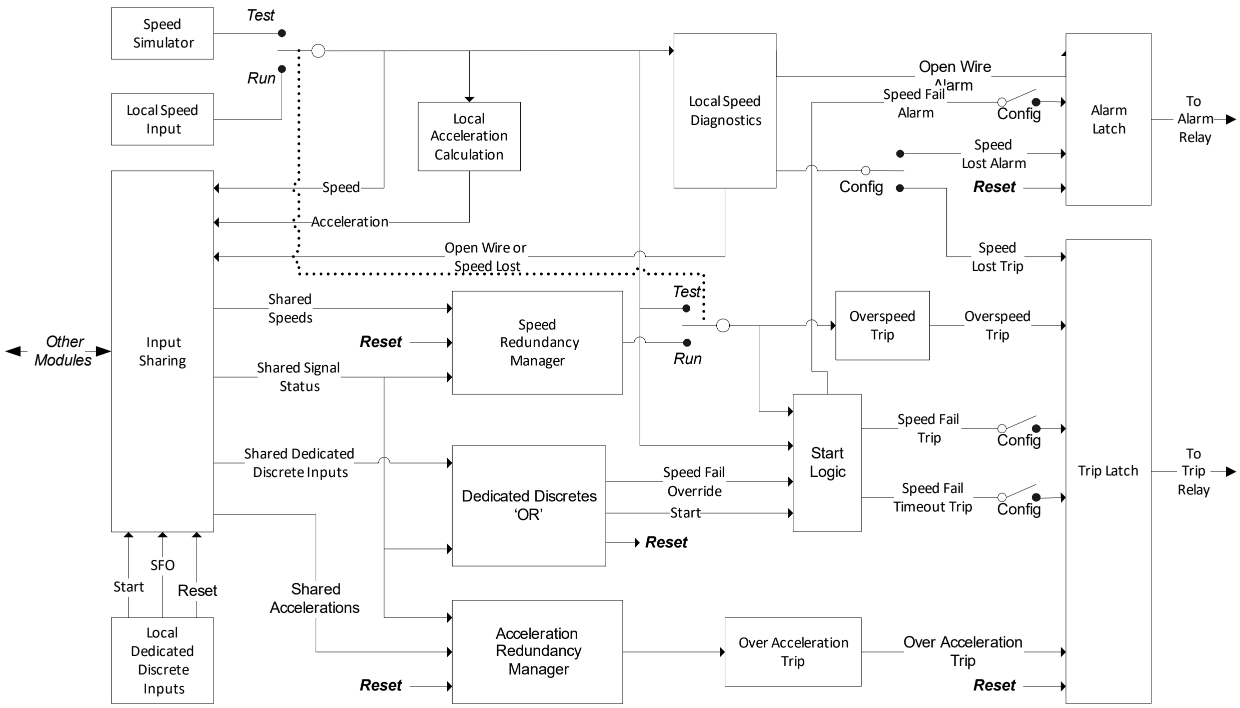


Figure 3-9b. Speed Overview With Redundancy Configured

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 Vrms.

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 that with 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 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 Detectable over-speed range: 0 to 80000 rpm
Acceleration Sensing Accuracy and Range	Accuracy: ±1% of current speed Detectable over-acceleration range: 0 to 25000 rpm/s
Signal Cable Length	Must be limited to 1500 ft /457 m (low capacitance 16 AWG / 1.3 mm²)
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 Vrms to 35 Vrms
Input Impedance	1.5 kΩ
Isolation	500 Vac 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 Vac 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 (SFO) contact overrides the Speed Fail Trip and Speed Fail Alarm. This is a level sensitive trigger so the contact must remain closed to prevent the Speed Fail Trip/Alarm 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 its 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 Vdc = "OFF"
	>= 16 Vdc = "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 Vac from output to chassis and output to all other circuits
I/O Execution Rate	4 ms

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 / 24 Vdc discrete input. NOTE: <6 Vdc = FALSE, >12 Vdc = TRUE. The Boolean output associated with the Discrete input can be used in the user configured software.

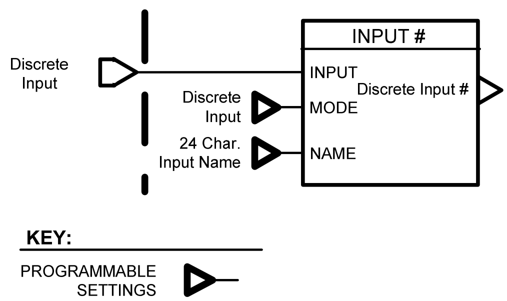


Figure 3-10. Discrete Input Example

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 and the analog input value 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.

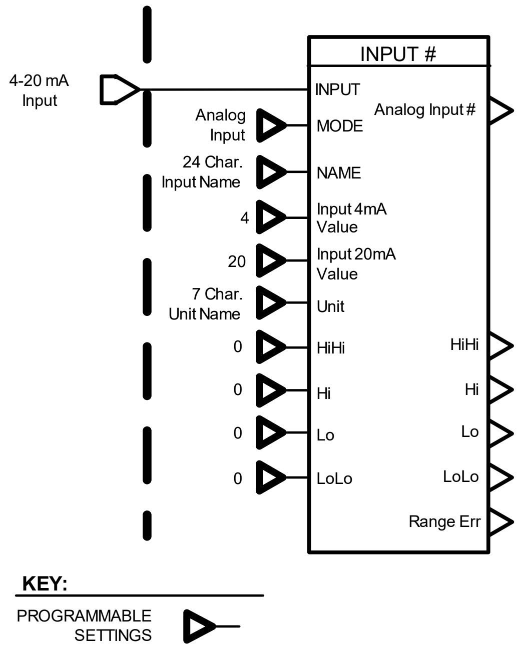


Figure 3-11. Analog Input Example

> ⚠**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 3-5. General Specifications

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

Table 3-6. Analog Input Mode

Input Current Range	0 to 25 mA
Common Mode Rejection	45 dB at 60 Hz
Input Common Mode Range	±40 V
Input Impedance	200 Ω ±1%
Resolution	12 bit
Accuracy	±0.25% of 25 mA at 25 °C, *(note 1)* ±0.5% of 25 mA over-temperature
I/O Execution Rate	8 ms
Analog Input Fail Thresholds	Fixed at 2 mA and 22 mA
Isolation	500 Vac 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 3-7. Discrete Input Mode

Input Thresholds	<= 6 Vdc = "OFF" >= 12 Vdc = "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.
I/O Execution Rate	1 ms
Max Input Voltage	32 V
Isolation	500 Vac 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.

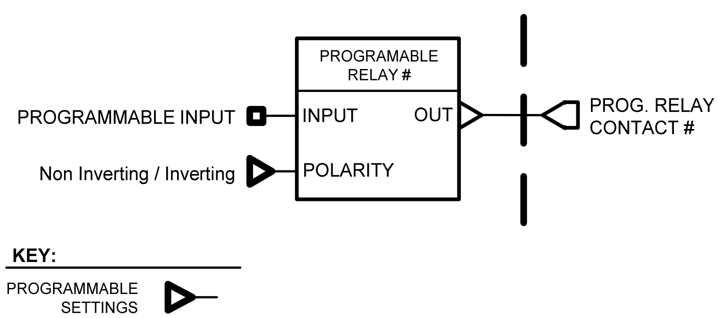


Figure 3-12. Programmable Relay Output Diagram

Table 3-8. 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 Vac from output to chassis and output to all other circuits
Signal Cable Length	Must be limited to 1000 ft / 305 m (low capacitance 16 AWG / 1.3 mm²)

Analog Output

A single 4–20 mA output is provided on each module as a readout to indicate the value sensed by that module. The output can be configured to reflect the speed, acceleration, or any analog value within the module. The scaling of the output signal is also configurable. 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 3-9. 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
I/O Execution Rate	4 ms
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 Vac from output to chassis and output to all other circuits
Signal Cable Length	Must be limited to 1000 ft / 305 m (low capacitance 16 AWG / 1.3 mm²)

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 overspeed trip setpoint is configurable from 0 to 80 000 RPM.

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).

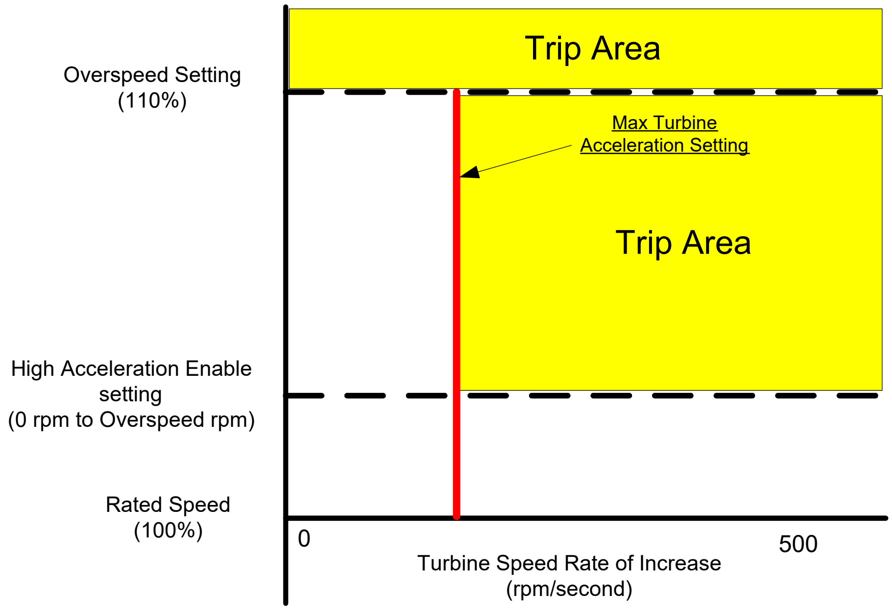


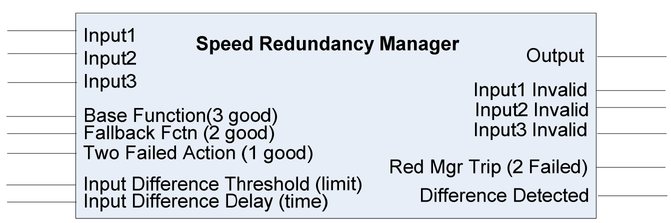
Figure 3-13. Over-Acceleration Enabling Diagram

Speed Redundancy Manager

The 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.

The configuration/use of the Speed Redundancy Manager is not required to use either the independent voted or 2-out-of-3 voted MicroNet Safety Module models. Independent voted and 2-out-of-3 voted logic is based on the MicroNet Safety Module's output voting architecture and not its inputs. If the 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.

Note: If a speed probe is not connected to a MicroNet Safety 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 (Base Function):
   a. Median signal (middle signal)
   b. Highest signal
   c. Lowest signal

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

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

   A trip is issued with no valid speed signal.

When the speed redundancy manager is used, the following internal functions use the voted speed signal: Overspeed trip, Speed Fail Trip and Speed Fail Timer. Local speed is always used for Open Wire, Speed Fail Alarm, and Speed Lost (i.e., sudden speed loss).

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

The front panel monitoring of this block displays the configured values, actual values, and the active signal selection mode (median, high signal select, low signal select). Actual data values can also be monitored over Modbus.

⚠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.**

Block Outputs

The speed redundancy manager provides the following outputs, which are automatically connected internally to the speed signal and alarm/trip logic but are also available for connection to other logic blocks.

- **Output:** Analog signal. Speed selection is based on the number of valid/good inputs and the configured action. An Active Mode is provided on the front panel to indicate the currently active signal selection criteria (MEDIAN, HSS, LSS).
- **Difference:** Boolean signal. Indicates the value of the difference detection output. True when valid inputs exceed the difference threshold for longer than the difference delay time. False when the difference is less than the threshold for 3x the delay time.
- **Input 1-3 Invalid:** Boolean signal (x3). Indicates the input is not valid and has been removed from the voting scheme. A reset is required to restore an invalid signal.
- **Speed RM Trip:** Boolean signal. Set true when the block issues a trip command. True with all inputs failed or with two inputs failed and configured to trip.

Speed or Accel Input Invalid Indications
An input becomes invalid if the shared signal is not available, which can be caused by a speed signal in test mode, by a changed configuration (speed input setting changed), by an improper configuration (speed not used), or by an inter-module communications issue. When an input is determined to be invalid, that input is not used by the redundancy manager (voted out). To restore an input that is no longer invalid, a reset is required. Note that the input 'invalid' Boolean signals are available to other logic blocks, however an alarm latch connection is automatically (internally) provided for any speed redundancy inputs.

NOTICE

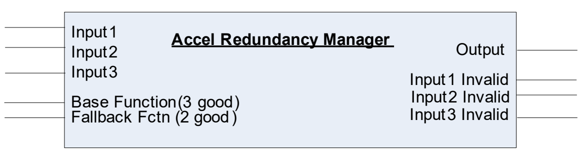
When the Speed Redundancy Manager is used, losing one of the speed signals will result in an alarm in all three modules. Once that speed signal is fixed, all three modules will need to be reset to clear the alarms (If the Reset inputs are shared, then one reset may reset multiple modules). Verify speed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

Acceleration Redundancy Manager

The configuration/use of the Acceleration Redundancy Manager is not required. If the 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 Redundancy Manager is configured for use, then each module can utilize acceleration from any input module combination (A, B, C) to select/vote the signal to use in its over-acceleration detection logic.

When configured, it automatically provides a voted scheme on up to three different signals. The output selection (voting) action is configurable, with predefined and selectable functionality for 3/2/1 signal outputs. 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.

With three good/valid signals the action can be configured to use the median value, highest value, or lowest value. Another selection is provided for the selection with two good signals (highest, lowest). When only one good signal is available, that remaining good signal is used.



Block Outputs

The acceleration redundancy manager provides a voted signal Output and a signal status indication (Input 1-3 Invalid). The Output is automatically used for the over-acceleration trip, when used. This Accel Redundancy Manager output, as well as the local module acceleration are available for connection to other logic blocks.

Note that the 'Accel RM Input x Invalid' indication is not automatically connected to the alarm latch and must be user-configured, if desired. When a speed redundancy manager is used, the 'Invalid' indications from that function block would typically provide failure indications (since acceleration is based on speed).

- **Output**: Acceleration signal used in over-acceleration detection logic. The signal selection is based on the number of valid/good inputs and the configured selection criteria.
- **Input 1-3 Invalid:** Boolean signal (x3). Indicates the input is not valid and has been removed from the voting scheme. A reset is required to restore an invalid signal. An input becomes invalid if the shared signal not available, which can be caused by a speed signal in test mode, by a changed configuration (speed input setting changed), by an improper configuration (speed not used), or by an inter-module communications issue.

The front panel monitoring of this block displays the configured values, actual values, and the active signal selection mode (median, high signal select, low signal select). Actual data values can also be monitored over Modbus.

Speed Diagnostics

The speed diagnostic logic provides the speed lost and speed probe open wire diagnostics. See figures 3-9a & 3-9b.

Speed Lost

Speed is monitored for a sudden loss of speed signal. The fault action for this diagnostic can be set to trip, alarm, or turned off (not used). This diagnostic is triggered when speed drops out (zero detected) while the previous (4ms) speed sample was above the user-configured threshold (default is 200rpm). Once detected, a speed lost condition will remain true until cleared by a reset or until speed is detected.

Open Wire

When the speed probe type is passive, then the local speed signal input is monitored for an open wire condition. The fault action (alarm vs trip) varies with the speed redundancy setup. When detected and speed redundancy is used, an Open Wire Alarm will be issued. If speed redundancy is not used, then a trip will be issued.

Start Logic

The start logic determines the speed fail alarm, speed fail trip and speed fail timeout trip diagnostics. See figure 3-14.

The 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 (i.e., passive) probes output a zero-rpm signal until the speed exceeds the probe's minimum frequency. Two different start logic functions are available for use within the MicroNet Safety Module to assist in starting a prime mover. One function is used to override the failed speed signal detection logic and the other is a timer that will cause a trip if the prime mover is not above the Speed Fail Setpoint before it expires. 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. Both start functions will override this alarm.

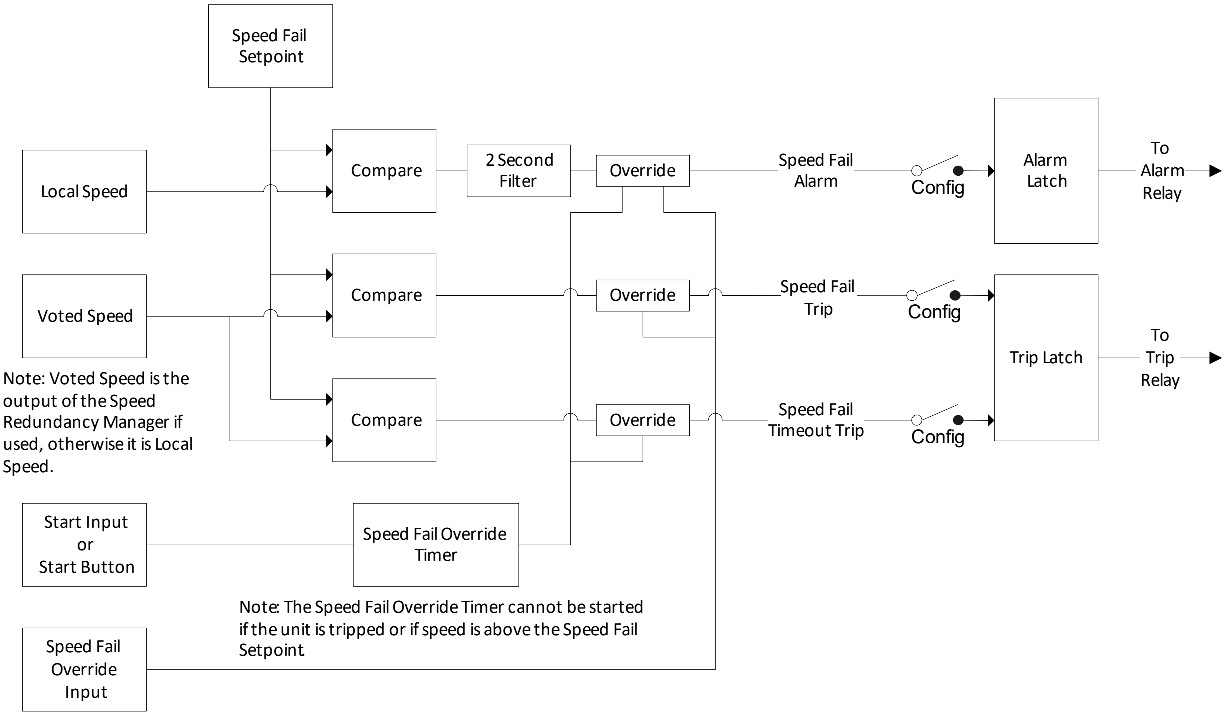


Figure 3-14. Start Logic Diagram

Speed Fail Override

The speed fail override (SFO) logic is provided to facilitate start-up prior to a valid sensed speed signal. The command is based on the Speed Fail Override contact input (see Dedicated Discrete Inputs). When the SFO discrete input is closed, the speed fail override function is active. When open, the override function is off, and the speed fail trip and speed fail alarm diagnostics are allowed. The function can also be configured to share inputs from other modules by enabling the SFO input sharing which provides a logical-OR on the selected inputs.

Speed Fail Alarm

This diagnostic is provided if the "Speed Fail Alarm" is configured as 'Used'. If the local speed signal is below the speed fail threshold and the fail override is not active, then this alarm will be issued. The alarm is inhibited if either the speed fail override or the speed fail timer is active.

Speed Fail Trip

If the "Speed Fail Trip" is configured as 'Used', the Speed-Fail-Override is used to override the speed fail trip logic. When the contact is open, the voted speed must exceed the Speed Fail Setpoint, otherwise a Speed Fail Trip occurs.

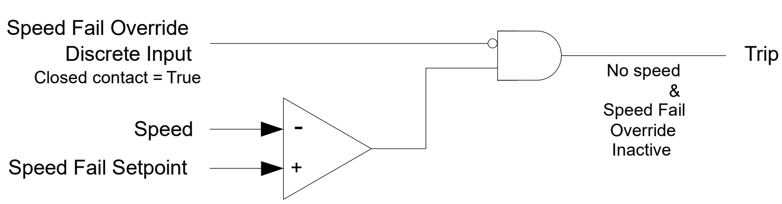


Figure 3-15. Speed Fail Trip Diagram

⚠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 configured as 'Used', the voted speed must exceed the Speed Fail Setpoint within the user-defined 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/restart the timer. The timer will not reset if the unit is tripped or if speed is above the speed fail setpoint threshold.

The start function can also be configured to share inputs from other modules by enabling the start input sharing which provides a logical-OR on the selected inputs. This is useful if only one or two discrete contacts are available from a specific circuit or application.

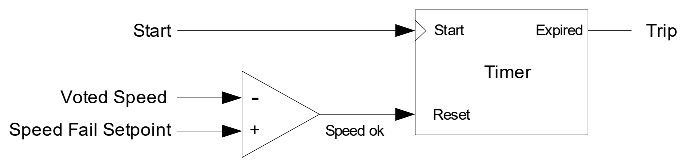


Figure 3-16. Speed Fail Timeout Trip Diagram

Start Example with Speed Fail Timeout Trip

First, clear any trips or alarms 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 prime-mover 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 setpoint 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 Timeout Trip is overridden because the Speed fail timer is cleared whenever speed exceeds the Speed fail setpoint. 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
- Counters
- Analog processing (addition, subtraction, multiplication, division)
- Pulse Detection (single and excessive)
- Polygon / Curve
- Derivative
- Signal selection (switch)
- Peak Value capture (min, max)

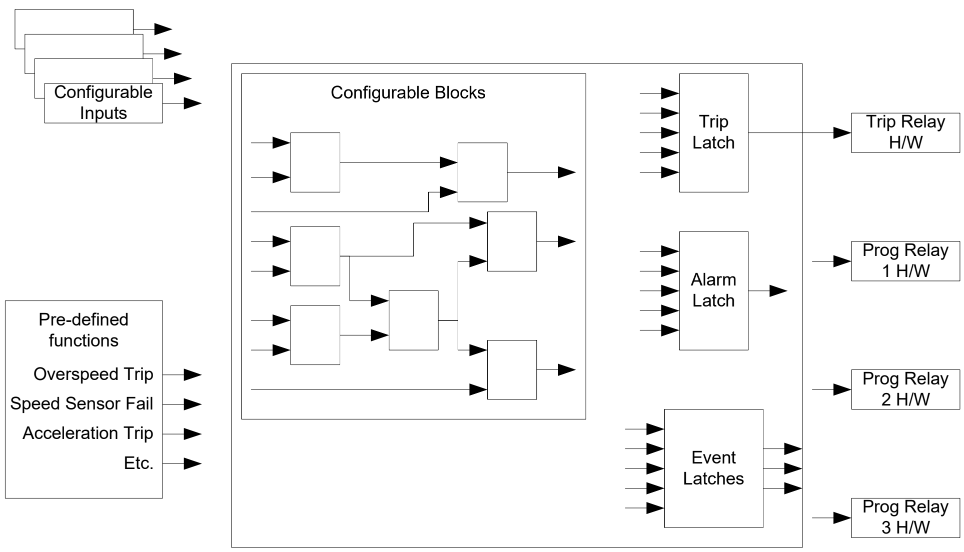


Figure 3-17. Overview of Configurable Logic

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) and/or GAP tool is correct.

Each of these logic blocks can be monitored using the front panel display of the MicroNet Safety Module (see Chapter 9). The outputs of each are also available for monitoring over Modbus (see Chapter 4).

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, Timers, Math etc. 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.

Configuration of Custom Logic

Custom logic can be built by combining logical functions like comparators, latches, gates, etc. The results of this logic can be used to cause a trip or alarm by using these results as inputs to the trip-latches, etc., or can be connected to one of the relay outputs.

Connecting outputs (results) from one function to inputs of other functions always must be defined by entering in the input fields of functions a reference to another function.

Before you start entering custom logic, Woodward recommends you make a logic diagram and keep this diagram in the documentation files. Woodward also recommends keeping the diagrams up to date after a modification in custom logic. Reconstruction of the logic interconnections from the configuration files after-the-fact is possible, but time consuming.

IMPORTANT	**The customer is responsible for fully testing their logic configuration. Custom logic shall be tested over the full range of possible input values.**

IMPORTANT	**The custom logic uses a non-latching 'one-shot' on the start and reset functions. If a condition needs to remain latched that is initiated by either start or reset function, a latch must be used.**

MicroNet Safety Module GAP Programming Tool

There is also a GAP Programming Tool available for configuring logic in the MicroNet Safety Module. Refer to manual 26712 for more information.

This tool provides the following:

- Graphical view of entire application.
- Completeness check to ensure the program will be accepted by the device.
- Documented feedback of the MicroNet Safety Module CRC codes to ensure program 'fingerprint' verifying laptop GAP program & installed MicroNet Safety Module settings.
- GAP Block help clarifying function and input/output fields of each block.
- Built-in simulation on the user PC to allow testing/debugging of logic.
- Simulation that allows manual entry (control) of Input signals.

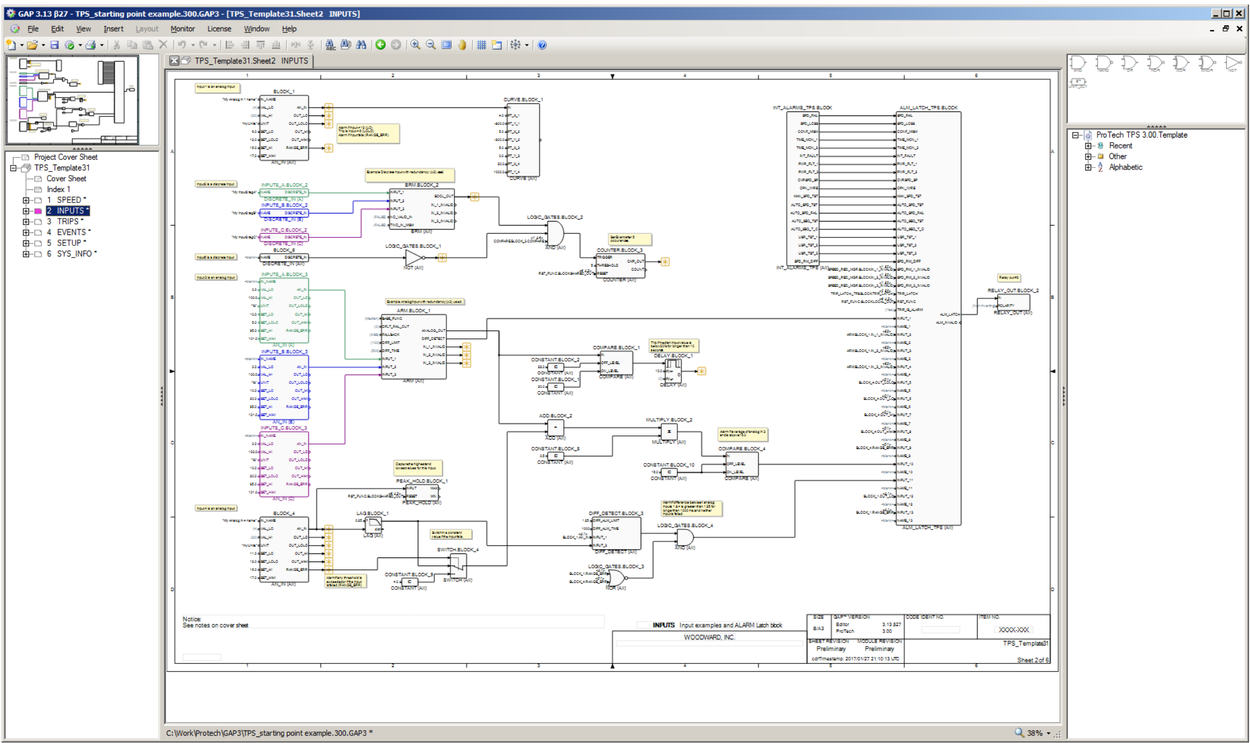


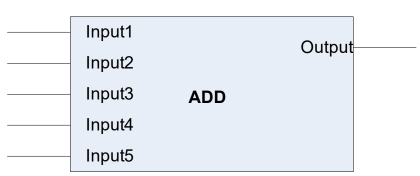
Figure 3-18. GAP Programming & Configuration

Configurable Logic Block Descriptions

The section below provides details of each of the logic block types.

Addition (ADD) Blocks

There are five Add blocks available for adding analog signals. The add block has up to five configurable inputs that can be connected to any analog logic signal. The output is the sum of the inputs.



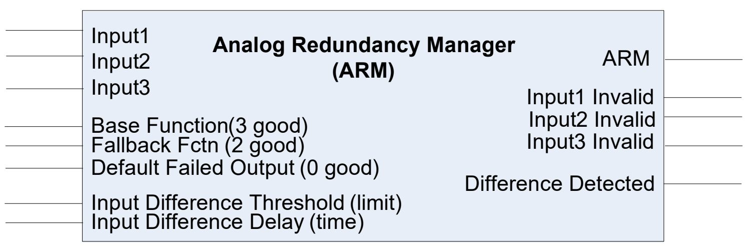
The block applies numeric limits of +/-1.844674E+19.

Analog Redundancy Managers

There are 15 analog redundancy manager blocks available, with each providing a voting scheme on up to three different shared signals. The output selection (voting) action is configurable, with predefined and selectable functionality for 3/2/1/0 signal outputs. For example, with three good/valid signals the action can be configured to use the median value, average value, highest value, or lowest value. Another selection is provided for the action with two good signals (highest, lowest, or average). When only one good signal is available, that signal is used. Lastly, with no good signals, the default failed output setting is used.

Each analog redundancy manager provides the following outputs, which are available for connection to other logic blocks. To use any of these signals, they must be connected to another logic block. Unlike speed and acceleration, no automatic internal connections are provided for these blocks. For example, if an alarm is desired, an Alarm Latch input must be configured (e.g., Analog RM 1 Input 1 Invalid).

- **Output:** Analog signal. Block output based on the number of valid/good inputs and the configured action. An Active Mode is provided on the front panel to indicate the currently active signal selection criteria.
- **Difference:** Boolean signal. Indicates the value of the difference detection output. True when valid inputs exceed the difference threshold for longer than the difference delay time. False when the difference is less than the threshold for 3x the delay time.
- **Input 1-3 Invalid:** Boolean signal (x3). Indicates the input is not valid and has been removed from the voting scheme. A reset is required to restore an invalid signal. This output is true if the referenced input signal is out of range (<2mA or >22mA), has an incorrect configuration (Not Used or Discrete In), if scaling of the input changed (4mA or 20mA values), or if communications to the module (inter-module) is lost.



The front panel monitoring of this block displays the configured values, actual values, and the active signal selection mode (e.g., Median).

Boolean Redundancy Managers

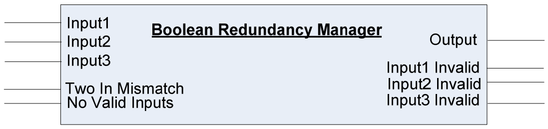
There are 15 Boolean redundancy manager blocks available, each provides a voting scheme on up to three different shared Boolean (true/false) signals. The voting action is dependent on the number of good/valid inputs and on the configuration settings.

Table 3-10. Valid Inputs and Block Outputs

Number of Valid Inputs	Block Output
3 good inputs	uses 2 out of 3 voting
2 good inputs (with same input value)	uses input value (2 out of 2 voting)
2 good inputs (with different input values)	uses the 'Two Input Mismatch Output' user setting
1 good input	uses the value of the good input
No good inputs	uses the 'Output with No Valid Inputs' user setting

Each Boolean redundancy manager provides the following outputs, which are available for connection to other logic blocks. To use any of these signals, they must be connected to another logic block. Unlike speed and acceleration, no automatic internal connections are provided for these blocks. For example, if an alarm is desired, an Alarm Latch input must be configured (e.g., Boolean RM 1 Input 1 Invalid).

- **Output:** Boolean signal. Block output based on the number of valid/good inputs and the configured action.
- **Input 1-3 Invalid:** Boolean signal (x3). Indicates the input is not valid and has been removed from the voting scheme. A reset is required to restore an invalid signal. This output is true if the referenced input signal has an incorrect configuration (Not Used or Analog In), or if communications to the module (inter-module) is lost.



Comparator Blocks

There are 15 comparators available that can be used to create an output available for trips, alarms, or any logical function.

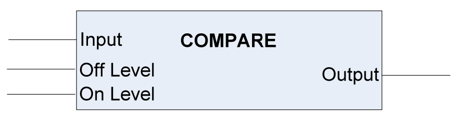
The block input is compared to on and off values. The on/off values have the same scaling as the connected analog input (e.g., speed is in rpm and acceleration is in rpm/s). The difference between ON-level and OFF-level can be used to create hysteresis.

If the ON-level is greater than the OFF-level, the output becomes TRUE when the input is higher than the ON-level and goes FALSE when the input becomes less than the OFF-level.

If the ON-level is less than the OFF-level, the output becomes TRUE when the input is less than the ON-level and goes FALSE when the input becomes higher than the OFF-level.

If the ON-level equals the OFF-level, there is no hysteresis, and the output becomes TRUE when the input is higher than the ON-level and goes FALSE when the input becomes less than the ON-level.

If the input is equal to the ON-level or OFF-level, the output does not change.



Below are two examples of comparator operation. In the first, the On level is greater than the Off level. In the second, the Off level is greater than the On level:

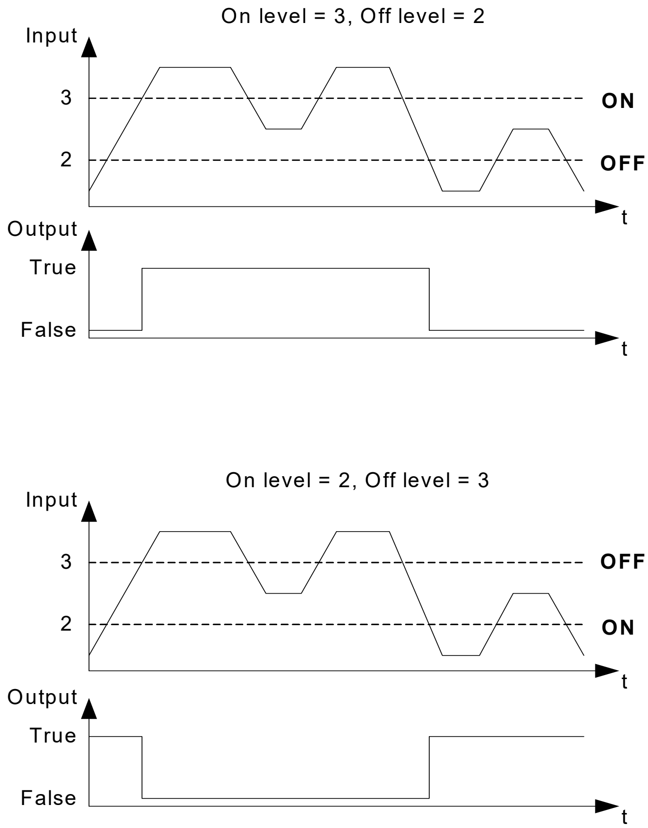


Figure 3-19. Counter Example

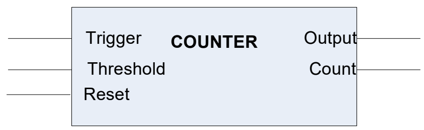
Constant Blocks

There are 40 Constant blocks available to provide a constant value to other analog logic blocks. Example usage: used to facilitate a divide by two or multiply by 100. Each Constant block has a configurable analog value.

Counter Blocks

There are 10 Counter blocks available for counting input events as well as comparing the number of events to a configured threshold value. This block has 3 configurable inputs (input, reset and threshold) and 2 outputs (count and count exceeded).

For each rising edge input, the output count increments. When the count output is equal to or above this threshold, the output goes true and stays true until the block reset is applied. Applying reset will clear the block outputs, setting the count value to zero and the threshold comparison to false.



The maximum count output value is 65535.

Curve / Polygon Blocks

There are two curve blocks that provide a 2-dimensional look-up (polynomial) function to an analog signal. Each curve has up to 6 configurable breakpoints. The curve output is based on the configured input. It uses the X & Y settings to determine the value. If the input is equal to an X-input breakpoint, the output will be the Y-breakpoint value. Between breakpoints the value is interpolated. At the endpoints the value is limited. Below the Breakpoint 1 X-value, the output is the Breakpoint 1 Y-value. Likewise, above the highest X-value the output is set to the highest Y-value. The number of breakpoints is configurable.

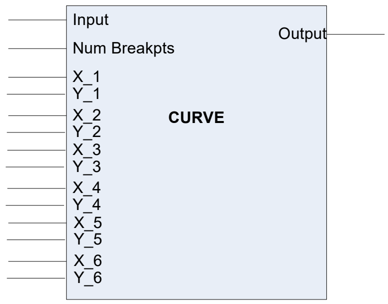
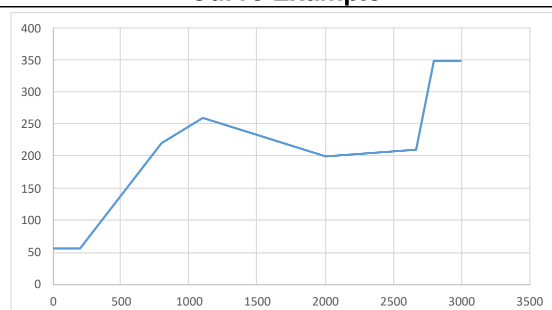


Table 3-11. Block Operation and Curve Examples

Example Block Operation | **Curve Example**

X	Y
200	55
800	220
1100	260
2000	200
2666	210
2800	350



Delay Blocks

There are 25 Delay functions (timers) available that can be used to create an output available for trips, alarms, or any logical function. Each delay function can have a pickup time (delay in switching from False to True) and a drop-off time (delay in switching from True to False).

The delay requires that the input be continuously true for a configurable True Delay Time before the output changes state to true, and that the input be continuously false for a configurable False Delay Time before the output changes state to false.

The input field for each delay can be any function result from another gate or from an analog input alarm setpoint, or a timer, etc. For this purpose, all functions like logic gates, timers, inputs, etc. are numbered. Referencing logic gate inputs to outputs from other functions is done by this numbering.

The False delay field defines the drop-off time (delay switching from True to false). The True delay field defines the pick-up time (delay switching from False to True).

Example of the delay block operation:

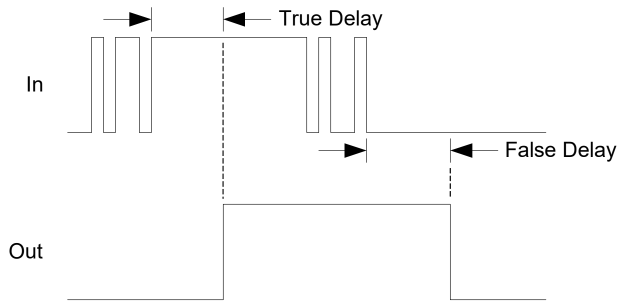
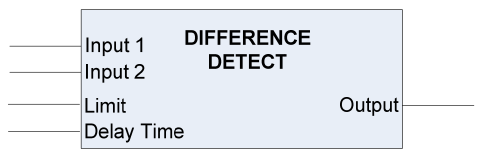


Figure 3-20. Delay Example

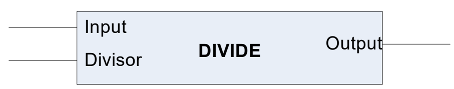
Difference Detection Blocks

There are 15 Difference Detection blocks available that can be used to create an output available for trips, alarms, or any logical function. Each Difference Detection function has a difference threshold and a time delay. The difference must be above the threshold for the time delay before the output goes true. The difference detection block output is set to FALSE when the difference between the inputs is smaller or equal than the user-configurable threshold for 3 times the user-configurable delay time.



Division Blocks

There are five Divide blocks available for dividing values of analog signals. Each block has a dividend input and a divisor input.



The block applies numeric limits of +/-1.844674E+19. An attempted divide by zero will output a value of 1.844674E+19.

Event Filter (Excessive Events) Blocks

There are five Event Filter blocks. These are used to provide an indication that an excessive number of events have occurred within the defined window of time. The time window is a sliding window (not fixed). Every event is time stamped, with the end of the window occurring at the most recent event. The difference between the most recent and oldest time stamps (based on the number of events used) is compared to the configured time window to determine if excessive events occurred.

The Output shall go true and latch true when the number of events detected is greater or equal to the specified "Number of Events" within the specified "Time Window". An event is defined as an Input transition from false to true. The Output is set to false and all-time stamps cleared if the Reset input is true.

Example of the event filter block operation:

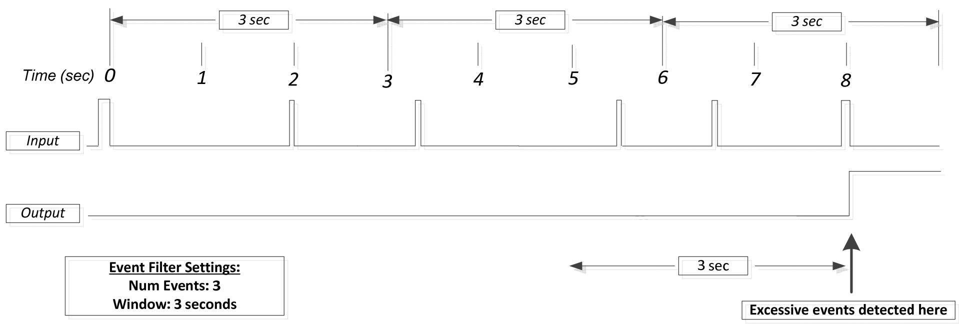


Figure 3-21. Event Filter Example

Lag / Derivative Blocks

There are 10 Lag blocks available for filtering analog signals. Each Lag function implements a single-pole filter and has a configurable time constant.

The lag block provides two outputs, the filtered output, and a derivative of the output. The derivative (d/dt) is the rate of change with respect to time, based on the filtered output. A lag tau setting of 4ms provides no filtering (output=input) if an unfiltered derivative value is desired.

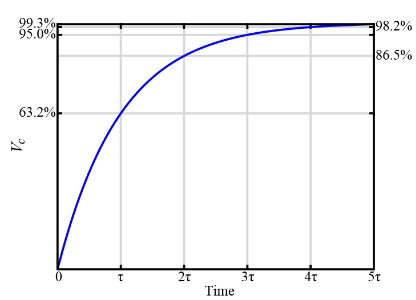


Figure 3-22. Lag Output

Latch Blocks

There are 10 latches (set/reset flip-flops) available that can be used to create an output available for trips, alarms, or any logical function. The latch output is set true by a rising edge on the set input. The latch is reset dominant, meaning the output is false if the reset input is true regardless of the set input.

Logic Gate Blocks (AND, OR, NOT, etc.)

There are 50 Logic gates available that can be used to create customized logic. These gates can each be custom defined by a selection from the following functions:

- AND
- NAND
- OR
- NOR
- XOR
- XNOR
- NOT

Each gate can have up to five inputs, depending on the selected function.

- AND, OR, NAND, and NOR gates can have up to five inputs.
- XOR, and XNOR gates have two inputs.
- NOT gates have one input.

In each input selection field, the origin of the signal can be entered. These inputs can be connected to any function output (e.g., another gate, an analog input alarm setpoint, a timer, etc.).

AND gate

Input A	Input B	Output
0	0	0
1	0	0
0	1	0
1	1	1

NAND gate

Input A	Input B	Output
0	0	1
1	0	1
0	1	1
1	1	0

OR gate

Input A	Input B	Output
0	0	0
1	0	1
0	1	1
1	1	1

NOR gate

Input A	Input B	Output
0	0	1
1	0	0
0	1	0
1	1	0

EX-OR gate

Input A	Input B	Output
0	0	0
1	0	1
0	1	1
1	1	0

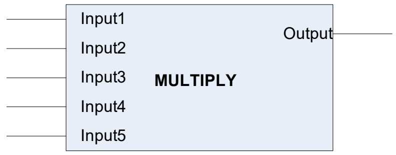
EX-NOR gate

Input A	Input B	Output
0	0	1
1	0	0
0	1	0
1	1	1

Figure 3-23. Logic Gate Tables

Multiplication Blocks

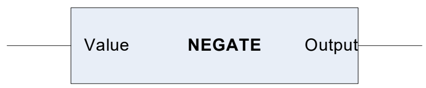
There are five Multiply blocks available for multiplying values of analog signals. Each block has up to 5 configurable inputs that can be connected to any analog logic signal. The output is the product of the inputs.



The block applies numeric limits of +/-1.844674E+19.

Negation Blocks

There are 10 Negate blocks available to facilitate a subtraction function. Each Negate block has a configurable input that can be connected to any analog logic signal. The output is the negative value of the input. Example: if Input = 3, Output = -3.



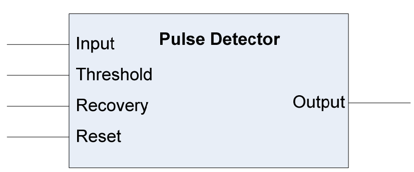
Peak Hold (min, max capture) Blocks

There are 10 Peak Hold blocks available for capturing and holding both maximum and minimum signal values. The input is monitored, and the outputs are held until a reset command is received. The reset will clear the outputs, setting them to the current input value.

Pulse Detection (Single and Excessive) Blocks

There are five Pulse Detection blocks. These can be used to monitor analog signals and is used to detect a rise in value followed by a drop. The output indicates a pulse was detected. This can be used in conjunction with a counter block (to monitor the number of pulses) or an event filter (to determine if an excessive number of events occurred within a specific sliding-window timeframe).

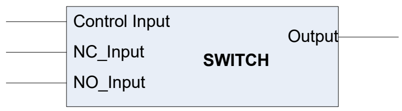
The Pulse Detector has a block Input and a Reset input as well as Threshold and Recovery settings. The block output goes TRUE when the input has gone above the Threshold and has dropped Recovery percent from its peak. The output stays true until the Reset input goes true. The Reset input is dominant and, while true, sets the output to false and clears the internally captured peak value.



Switch Blocks

There are 10 Switch blocks available for selecting between two analog signals. The switch outputs one of two analog Input values based on the status of the control input. Example usage: selecting a default value for a calculation if an analog input is failed.

The block has 3 inputs (Control, NC input, NO input) and one output. The output is equal to the normally closed (NC) input when the Control input is false. The output is equal to the normally open (NO) input when the Control input is true.

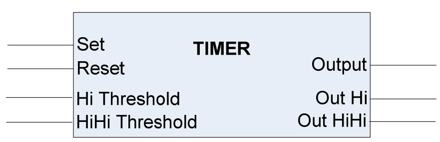


Timer Blocks

There are five timers available. Each timer has a start input, a reset input, an accumulated time output, a Hi setpoint reached output, and a HiHi setpoint reached output. Additionally, the settings for the Hi and HiHi thresholds are user configurable. The timer counts while the start input is true. This accumulated time is compared against the Hi and HiHi setpoints. When at or above the setpoint, the output is true.

The accumulated time output is reset to zero and the Boolean outputs (Hi and HiHi) set false when the reset input is true. The start input is ignored while the reset input is true. For example, if the reset input is set to true, and the start input is set to true, the timer remains reset. If the reset input changes to false with the start input still true, the timer will start.

The output value is displayed in milliseconds and can be viewed on the front panel or over Modbus as well as the status of the Hi and HiHi outputs.



Trip Cycle Timer Blocks

There are two trip cycle timers available. The trip cycle timer is a function that measures the time from a trip event until the trip is confirmed by an input (e.g., trip and throttle valve limit switch), or by any internally created logic function. An Alarm is indicated if the time is expired before the feedback confirmation is received. The trip cycle time is measured in milliseconds and shown in Monitor mode on the MicroNet Safety Module display.

Unit Delay Blocks

There are 10 analog unit delay blocks, and 10 Boolean unit delay blocks available to break loops detected in the configurable logic by forcing a specific execution order. This is also referred to as a 'Z^{-1}'. The output of the unit delay equals the input of the block the last time it was executed.

If any block input is connected to its output or if a loop is detected, the Configuration Check Error Log will show an error and uploading of the configuration file will not be possible. Properly inserting a unit delay block in the loop will enforce program execution and satisfy the loop check algorithm.

User Implementation Examples

The predefined building blocks can be used to create functions required in an application. A couple of simple examples are included below.

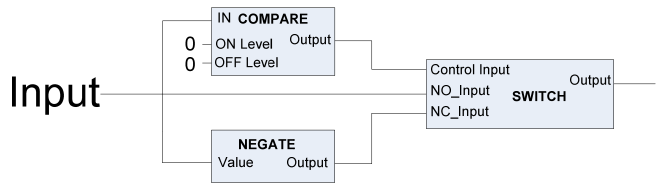


Figure 3-24. Absolute Value Example

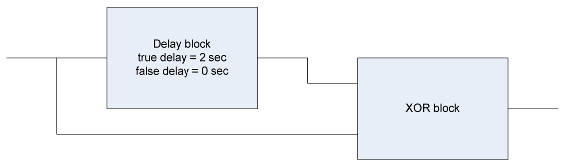


Figure 3-25. One Shot Example Using a Delay Block

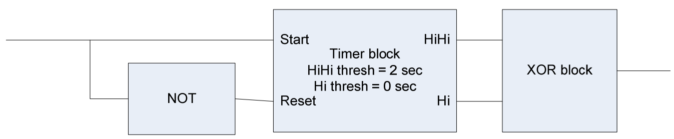


Figure 3-26. One Shot Example Using a Timer Block

Logic Connections and Selection Options

Analog Logic Configuration

The Analog Logic Configuration screen provides sub-screens for configuration of the logic blocks that handle analog signals. For most configured analog input selections, the options available include the output of every logic block that is of type analog. The values are shown below.

Table 3-12. Analog Function Input Selections

Not Connected	Add 1-5	Lag d/dt 1-10
Speed	Negate 1-10	Switch 1-10
Speed RM	Multiply 1-5	Analog Unit Delay 1-10
Acceleration	Divide 1-5	Peak Hold Min 1-10
Acceleration RM Analog Input 1-10	Curve 1-2	Peak Hold Max 1-10
Analog RM 1-15	Lag 1-10	Counter 1-10
Constant 1-20		

Boolean Logic Selection Options

For most configured Boolean input selections, the options available include the output of every logic block or function output that is of type Boolean. The values are shown below.

Table 3-13. Boolean Function Input Selections

Not Connected	Auto-Sequence Test Active	Analog RM 1-5 Diff Detected
Always FALSE	Auto-Seq Continue Timeout	Analog RM 1-15 Input 1-3 Invalid
Always TRUE	User Defined Test 1-3	Boolean RM 1-15
Start Function	Configuration Mismatch	Boolean RM 1-15 Input 1-3 Invalid
Start Function (shared)	Speed Fail Alarm	Difference Detection 1-15
Reset Function	Trip	Counter 1-10
Reset Function (shared)	Alarm	Event Filter 1-5
Speed Fail Override	Event Latch	Pulse Detector 1-5
Speed Fail Override (shared)	Analog Input 1-10 HiHi	Speed RM Input 1-3 Invalid
Overspeed Trip	Analog Input 1-10 Hi	Speed RM Difference
Over-acceleration Trip	Analog Input 1-10 Lo	Speed RM Trip
Speed Fail Trip	Analog Input 1-10 LoLo	Acceleration RM Input 1-3 Invalid
Speed Fail Timeout	Analog In 1-10 Range Err	Trip Time Monitor 1-2
Speed Lost Alarm	Discrete Input 1-10	Power Up Trip
Speed Lost Trip	Analog Comparator 1-15	Internal Fault Trip
Speed Probe Open Wire Trip	Logic Gate 1-50	Internal Fault Alarm
Speed Probe Open Wire Alarm	Latch 1-10	Configuration Trip
Temporary Ovrspd Setpoint On	Delay 1-25	Resettable Trip Input
Manual Sim Speed Active	Timer 1-5 HiHi	Power Supply 1-2 Fault
Auto Sim Speed Active	Timer 1-5 Hi	Parameter Error
Auto Sim Speed Failed	Unit Delay 1-10	Shared Data Rx Error 1-

A description of each of the Boolean function logic connections is provided below. In general, the function must be configured for the indication to go true. An attempted connection to an un-used function will result in a configuration error when loading settings to the device.

Table 3-14. Boolean Function Logic Connections

Selection Identifier	Description of Selection
Not Connected	This is the setting to be selected for an input that is not used.
Always FALSE	Sets the value of the input to a fixed setting of FALSE. Provided for inputs where a constant 'FALSE' is desired.
Always TRUE	Sets the value of the input to a fixed setting of TRUE. Provided for inputs where a constant 'TRUE' is desired.
Start Function	Start function output. Momentarily (516 ms) true on the rising edge of a start command (front panel or discrete input). Can be triggered by the Start discrete input or by the front panel Start pushbutton.
Start Function (shared)	Shared start function output. Function is rising edge triggered and provides a 516 ms pulse when triggered.
Reset Function	Connection to the local reset function output. Function is rising edge triggered and provides a 500 ms pulse when triggered. Can be triggered by reset discrete input, by Modbus command, by front panel Reset or by the configurable reset source.
Reset Function (shared)	Connection to the shared reset function output. Function is rising edge triggered and provides a 500 ms pulse when triggered.
Speed Fail Override	Local Speed Fail Override discrete input status indication. True when the input is high and false when low.
Speed Fail Override (shared)	Shared Speed Fail Override function output. True when any input is high and false when all are low.

Selection Identifier	Description of Selection
Overspeed Trip	Overspeed indication. True when speed is above the overspeed setpoint and false otherwise (true when active, non-latched).
Over-acceleration Trip	Over-acceleration indication. True when acceleration is above the acceleration trip setpoint, and speed is above the acceleration trip enabled speed and false otherwise.
Speed Fail Alarm	Speed Fail Alarm indication. True when speed is not above the threshold and false otherwise (true when active, non-latched). Overridden if Speed fail Override is active or the Speed Fail Timer is running.
Speed Fail Trip	Speed Fail Trip indication. True when speed is not above the threshold and false otherwise (true when active, non-latched). Overridden if Speed fail Override is active.
Speed Fail Timeout	Speed Fail Timeout indication. After the Speed Fail Timer expires, true when speed is not above the threshold and false otherwise.
Speed Lost Alarm	Speed Lost Alarm indication. True when a speed lost condition is detected. Remains true until cleared by a reset or until speed is detected.
Speed Lost Trip	Speed Lost Trip indication. True when a speed lost condition is detected. Remains true until cleared by a reset or until speed is detected.
Speed Probe Open Wire Alarm	Speed Probe Open Wire Alarm indication. True while an open wire is detected, and speed redundancy is used. Speed probe type must be passive.
Speed Probe Open Wire Trip	Speed Probe Open Wire Trip indication. True while an open wire is detected, and speed redundancy is not used. Speed probe type must be passive.
Temporary Ovrspd Setpoint On	Temporary Overspeed Setpoint On indication. True while the test is in the Active state.
Manual Simulated Speed Test Active	Manual Simulated Speed Test Active indication. True while the test is in the active state.
Auto Simulated Speed Test Active	Auto Simulated Speed Test Active indication. True while the test is in the active state.
Auto Simulated Speed Test Failed	Auto Simulated Speed Test Failed indication. Momentarily true if the module did not trip during the test.
Auto-Sequence Test Active	Auto-Sequence Test Active indication. True while the test is in the Active state.
Auto-Sequence Test Continue Timeout	Auto-Sequence Test Continue Timeout indication. Momentarily true if the Start/Continue signal did not occur before the timer timed out.
User Defined Test 1-3	User Defined Test 1, 2, or 3 active indication. True while the specified User Defined Test is in the Active state.
Configuration Mismatch	Configuration Mismatch indication as determined by the module-to-module configuration compare function. True if there is a mismatch and false otherwise.
Trip	Trip Latch output. True if any trip is detected. Remains true until cleared by a reset if configured as Latching.
Alarm	Alarm Latch output. True if any alarm is detected. Remains true until cleared by a reset.
Event Latch	Event Latch output. True if any event is detected. Remains true until cleared by a reset.
Analog Input 1-10 HiHi	Analog Input HiHi output. This output is true when the analog input's HiHi threshold exceeded output and false when at or below.
Analog Input 1-10 Hi	Analog Input Hi output. This output is true when the analog input is above the Hi threshold and false when at or below.
Analog Input 1-10 Lo	Analog Input Lo output. This output is true when the input current is below the Lo threshold setting and false when at or above.
Analog Input 1-10 LoLo	Analog Input LoLo output. This output is true when the input current is below the LoLo threshold setting and false when at or above.

Selection Identifier	Description of Selection
Analog In 1-10 Range Err	Analog Input Range Error output. This output is true when the input current is at or above 22 mA or at or below 2 mA and false otherwise.
Discrete Input 1-10	Discrete input status indication. True when the input is above the guaranteed-on value of 12 volts. False when the input is below the guaranteed off value of 6 volts.
Analog Comparator 1-15	Comparator block output. True when the input is above the threshold and false otherwise.
Logic Gate 1-50	Logic Gate output. True/False depends on logic gate type (AND, NAND, OR, NOR, XOR, XNOR, NOT) and block inputs.
Latch 1-10	Latch output. Set to True by a rising edge of the set input. False if the reset input is true regardless of the set input.
Delay 1-25	Delay output. The delay requires that the input be continuously true for a configurable True Delay Time before the output changes state to true, and that the input be continuously false for a configurable False Delay Time before the output changes state to false.
Timer 1-5 HiHi	Timer HiHi output. True if the accumulated time is at or greater than the HiHi threshold and false when less than threshold or when the reset input is true.
Timer 1-5 Hi	Timer Hi output. True if the accumulated time is at or greater than the Hi threshold and false when less than threshold or when the reset input is true.
Unit Delay 1-10	Unit Delay output. Out is equal to the input delayed by one execution cycle.
Analog RM 1-15 Diff Detect	Analog Redundancy Manager (ARM) difference detected output. True when valid inputs exceed the difference threshold for longer than the difference delay time. False when the difference is less than the threshold for 3x the delay time.
Analog RM 1-15 Input 1-3 Invalid	Analog Redundancy Manager (ARM) invalid input indication. ARM connection indicating the corresponding block's input is not valid and, as such, that input is not included in the block output. Remains true until cleared by a reset. Output is true if the referenced input signal is out of range (<2mA or >22mA), has an incorrect configuration (Not Used or Discrete In), if scaling of the input changed (4 or 20ma values), or if communications to the module (inter-module) is lost.
Boolean RM 1-15	Boolean Redundancy Manager (BRM) output.
Boolean RM 1-15 Input 1-3 Invalid	Boolean Redundancy Manager invalid input indication. BRM connection indicating the selected block's input is not valid and, as such, that input is not included in the block output. True if the corresponding input is invalid. Remains true until cleared by a reset. Output is true if the referenced input signal has an incorrect configuration (Not Used or Analog In), or if communications to the module (inter-module) is lost.
Difference Detection 1-15	Difference Detection block output. True indicates difference exceeded for longer than the delay time.
Counter 1-10	Counter block output value. True indicates at or above threshold. False when below threshold or when reset is true.
Event Filter 1-5	Event Filter block output.
Pulse Detector 1-5	Pulse Detector block output.
Speed RM Input 1-3 Invalid	Speed Redundancy Manager output connection indicating the selected speed input is not valid and, as such, that input is not included in the block output. True if the corresponding input is invalid. Remains true until cleared by a reset. Output is true if the referenced speed signal is failed or in test mode, has an incorrect configuration (Not Used), if scaling of the input changed (type, gear teeth, or gear ratio), or if communications to the module (inter-module) is lost.

Selection Identifier	Description of Selection
Speed RM Difference	Connection to the difference detected output on the speed redundancy manager block. True if the difference between any two inputs is greater than the Diff Threshold for Diff Time and false otherwise.
Speed RM Trip	Speed redundancy manager trip output indication provided when two inputs fail (and configured for use). True if all used inputs have failed or if "Two Inputs Failed Action" is set to TRIP and two of the three used inputs have failed and false otherwise.
Acceleration RM Input 1-3 Invalid	Acceleration Redundancy Manager output connection indicating the selected acceleration/speed input is not valid and, as such, that input is not included in the block output True if the corresponding input is invalid. Remains true until cleared by a reset. Output is true if the referenced speed/accel signal is failed or in test mode, has an incorrect configuration (Not Used), if scaling of the input changed (type, gear teeth, or gear ratio), or if communications to the module (inter-module) is lost.
Trip Time Mon 1-2 Alarm	Trip Cycle Time Monitor output. True if the trip cycle time was greater than the threshold. Remains true until cleared by a reset.
Power Up Trip	Power up trip indication. This trip is issued during power-up when the trip latch is configured for de-energize to trip. Remains true until cleared by a reset. The trip output must be configured as 'de-energize to trip' to use this indication.
Internal Fault Trip	Indicates an internal fault trip condition was detected. When this is true, the Unit Health is red, and the product remains in a tripped state. A power cycle is required to clear this error.
Internal Fault Alarm	Indicates an internal fault alarm condition was detected. When this is true, the MicroNet Safety Module remains in an alarm state. Remains true until cleared by a reset.
Configuration Trip	Indicates the product is tripped as a result of changing configuration settings. This indication is true while loading a new configuration or if a trip was issued to enter configuration mode.
Resettable Trip Input	Output from the Resettable Trip function.
Power Supply 1 Fault	Output from the power supply fault detection. True when Power Supply 1 is bad and false otherwise.
Power Supply 2 Fault	Output from the power supply fault detection. True when Power Supply 2 is bad and false otherwise.
Parameter Error	Indicates a parameter error was detected, meaning there was a problem reading the settings out of the EEPROM. When this is true, the MicroNet Safety Module remains in a tripped state. This is a fault provided after firmware is loaded into the device that indicates a parameter structure change (i.e., a new parameter has been added or removed) requiring an initialization. For safety purposes, the device will not function until all parameter values have been properly initialized. A power cycle is required to clear this error.
IRIG Signal Lost	Indicates the IRIG-B time signal is not being received.
Shared Data Rx Error 1	True if data from another module is bad and false otherwise. The conditions for true are: Signal on A is true when data from B is bad. Signal on B is true when data from A is bad. Signal on C is true when data from A is bad.

Selection Identifier	Description of Selection
Shared Data Rx Error 2	Indicates an internal communication issue between control modules. True if data from another module is bad and false otherwise. The conditions for true are: Signal on A is true when data from C is bad. Signal on B is true when data from C is bad. Signal on C is true when data from B is bad.

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 provided to facilitate clearing of latched functions. 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".

The reset function can also be configured to share inputs from other modules by enabling the reset input sharing which provides a logical-OR on the selected inputs. This is useful if only one or two discrete contacts are available from a specific circuit or application.

The shared reset function is automatically internally connected to numerous functions including the alarm latch, trip latch, and redundancy managers.

Resettable Trip Function

It is possible to configure logic (typically a 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 (e.g., a trip string). The resettable trip feature facilitates connection of the MicroNet Safety Module into a trip string as an input and output. Use of this pre-defined function prevents a lock-up issue where a trip input is preventing the clearing of the trip output.

When configured, this provides a special pre-defined trip function. While this trip input is active (commanding a trip; typically, an open discrete input), the MicroNet Safety Module trip output shall be resettable (via the shared 'Reset' function).

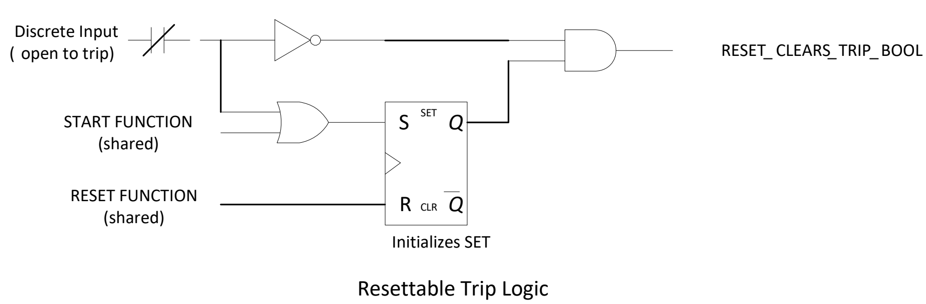


Figure 3-27. Resettable Trip Logic

Alarm Latch

An "alarm" refers to an action of the MicroNet Safety 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)
- 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 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:
- 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)
- Internal Fault Trip
- Power Up Trip (if configured for De-energize to trip)
- Configuration Trip
- Parameter Error Trip
- 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.

Test Routines

Each MicroNet Safety Module provides a variety of test routines to support common test requirements.

- **Temporary Overspeed Setpoint** – permits module overspeed testing using actual speed by temporarily replacing the overspeed trip setpoint.
- **Simulated Speed Test** – permits module overspeed testing using an internally generated speed signal. Manual and auto options are provided.
- **Auto Sequence Test** – provides an automated sequential simulated overspeed speed test of all three modules, one at a time.
- **User-Defined Test** – provides the User or OEM the ability to create their own customized test. Three user-defined tests are available.

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.**

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 tripped or in a test; or 'None'—for no permissive. Selecting 'None' means that tests can be run on any module regardless of the alarm/trip status 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. If a test is not permitted, or aborted, messages displayed on the front panel explain the cause.

Temporary Overspeed Setpoint

This feature temporarily replaces the Overspeed Trip setpoint with a different value for testing, while still using the speed signal from the rotating machine. 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.

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.

⚠WARNING	**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.**

This test is started and stopped from the front panel. 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 and 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.

The Temporary Overspeed test cannot be started if *this* module is already tripped or in another test mode. The test will alert the user when *another* module is already tripped, but this does not prevent starting the test. Also note the configured Test Mode Permissive does not apply to this test.

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. These are the Manual Simulated Speed Test, the Auto Simulated Speed Test and the Auto Sequence Test. 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 and 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 setpoint. 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.

An alarm is issued to indicate the test is active. The test can be reset/ended from the front panel, via Modbus, or if the inter-module test mode permissive is lost. For example, if the permissive is configured as 'Module Not Alarm' and another module detects an alarm (or trip), then the test will be aborted.

When the overspeed trip occurs, it is logged in the module's trip log and noted as a test. If the test fails, an 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 like 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 one 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, sequentially. First, the auto simulated speed 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 start/continue 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 Auto Sequence Test is always initiated on Module A. The test is not allowed when any module is tripped, in test, or in alarm. The test is aborted upon detection of any trip, alarm or test mode not related to the auto sequence test.

An alarm is indicated on each module while the test is active. When the overspeed trip occurs, it is logged in the module's trip log and noted as a test. If the test fails due to a timeout, an alarm is generated and logged in the module's alarm log.

The front panel displays the status of the last test (e.g., Passed, Not Completed) and the test status of each module. Module A also displays the time remaining until the next scheduled test.

During certain maintenance procedures it may be desirable to lock out this test. An option is available to temporarily disable this test function from being performed either periodically (timer) or programmatically (logic commands). See 'Operator Can Disable Test' in chapters 10 or 13. If this feature is selected, the operator can disable (and re-enable) the Auto Sequence test from the front panel of the module.

When the Auto Sequence test is set to the disabled mode, 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 one 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.

Periodic test interval and disable mode functions are configured only on Module A, however the inter-module halt and test start/continue selections are configured on each module.

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 test mode permissive is not met. The test mode permissive can be configured to prevent the test if any other module is tripped or in alarm. Regardless of the test mode permissive configuration, the User-defined tests cannot be initiated if the module is already tripped or if any other test routine is active.

User-defined tests can be initiated from the front panel (with password), via Modbus (with confirmation), or through configurable logic (which allows connection to any Boolean value including Discrete Inputs). Initiating from Modbus requires two commands, an initiate, and a confirmation. A rising-edge input sets the test mode latch which stays true until the reset input goes true, the timeout expires, or an abort condition occurs. The output of the User-defined test must be connected to other logic blocks to perform a function. An alarm is associated with each test to indicate the test is active. The test can be reset/ended from configurable logic, the front panel, or via Modbus.

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 zero 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.

An active test will be aborted if the inter-module test mode permissive is lost. For example, if the permissive is configured as 'Not In Alarm' and another module detects an alarm (or trip), then the test will be aborted.

To initiate the User-Defined Test via Modbus, the appropriate Initiate Used-Def Test command (Modbus address 0:0202, 0:0302, or 0:0402) must be followed by the corresponding Confirm User-Def Test command (Modbus address 0: 0201, 0:0301, or 0:0401) within 10 seconds. The intent of the confirmation is to prevent an erroneous signal from initiating a test. The test can be aborted from Modbus using the appropriate address (0: 0203, 0:0303, or 0:0403).

Lamp Test

Each module provides a lamp test which cycles through all the color options of each front panel LED. When initiated, the test turns all LEDs off, then turns on color option 1 (Tripped=red, Unit Health=red, Alarm=amber), then color option 2 (Tripped=red, Unit Health=green, Alarm=amber), and concludes the test by turning the LEDs off. After the test is completed, the LEDs return to displaying the current status. Note that only the Unit Health LED has a 2nd color option. The Lamp Test can be applied to any module at any time without a password.

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.

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 8 ms for any Boolean in the Configurable Logic.

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 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 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

Figures 28 and 29 are based on Sensed Frequency Level for Independent Trip Relay Models.

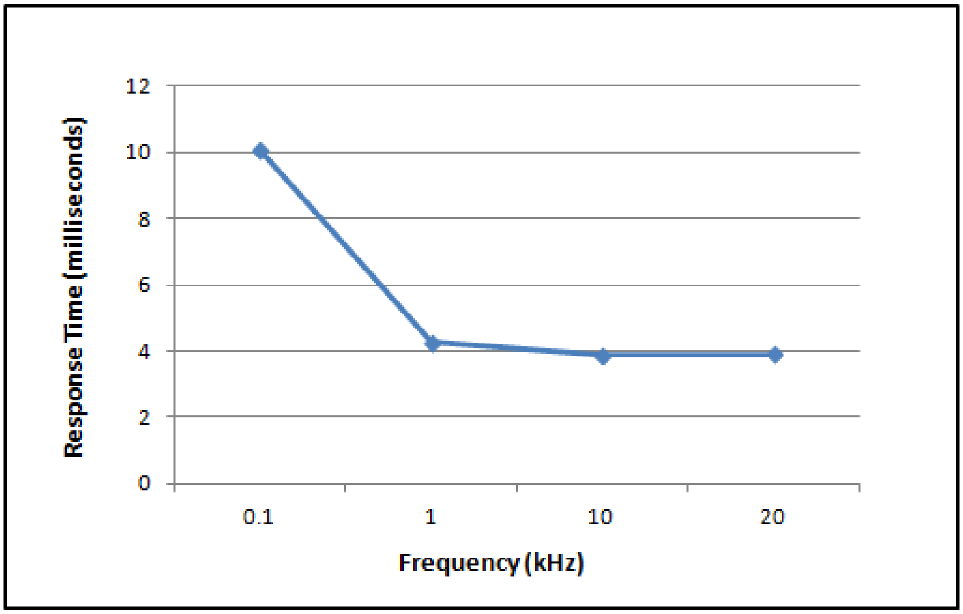


Figure 3-28. Total System Response Time When Speed Redundancy Manager Function is Not Configured

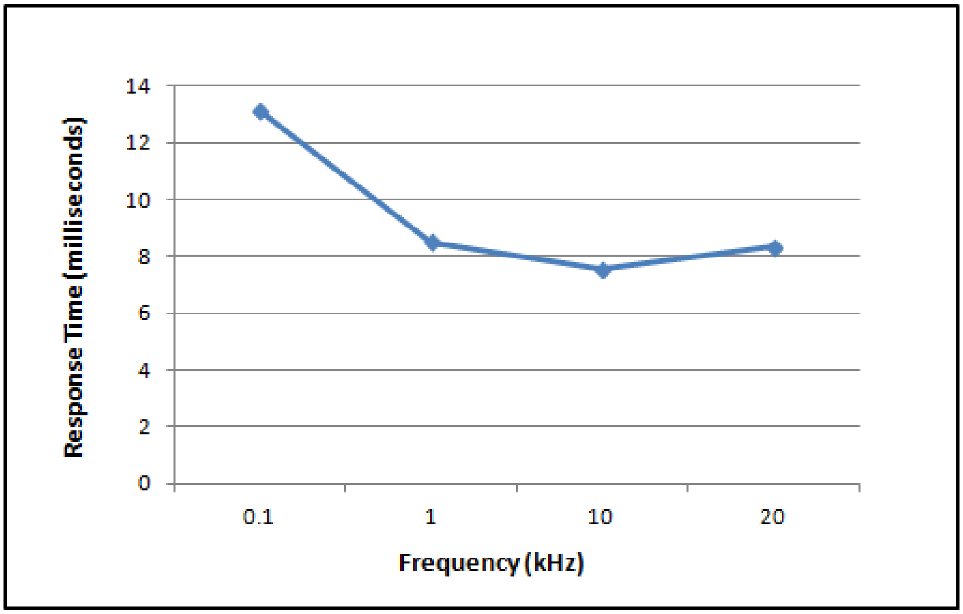


Figure 3-29. Total System Response Time When Speed Redundancy Manager Function is Configured

Voted Trip Relay Models—Response Graphs

Figures 30 and 31 are based on Sensed Frequency Level for 2oo3 Voted Trip Relay Models.

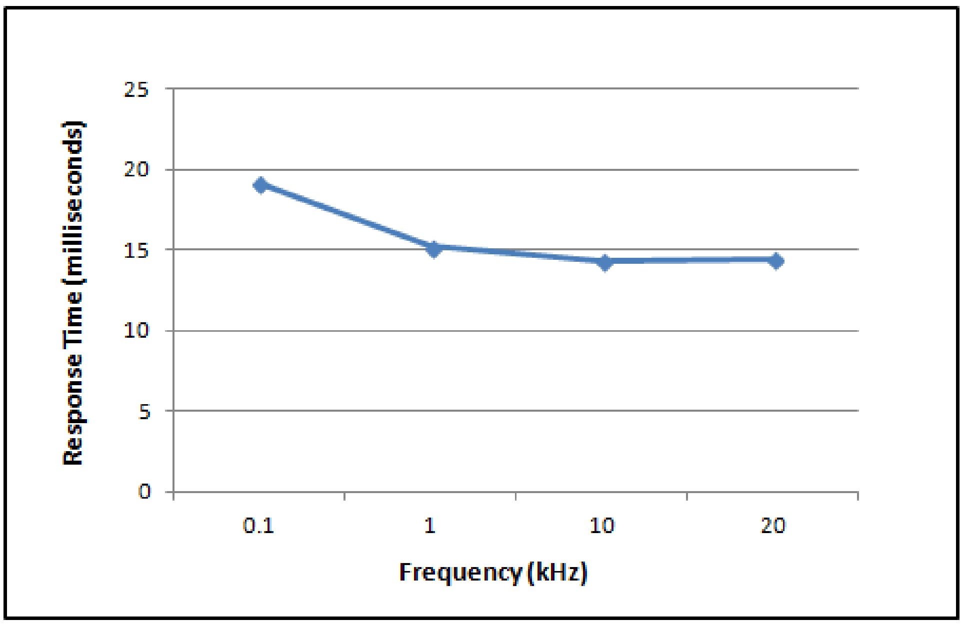


Figure 3-30. Total System Response Time When Speed Redundancy Manager Function is Not Configured

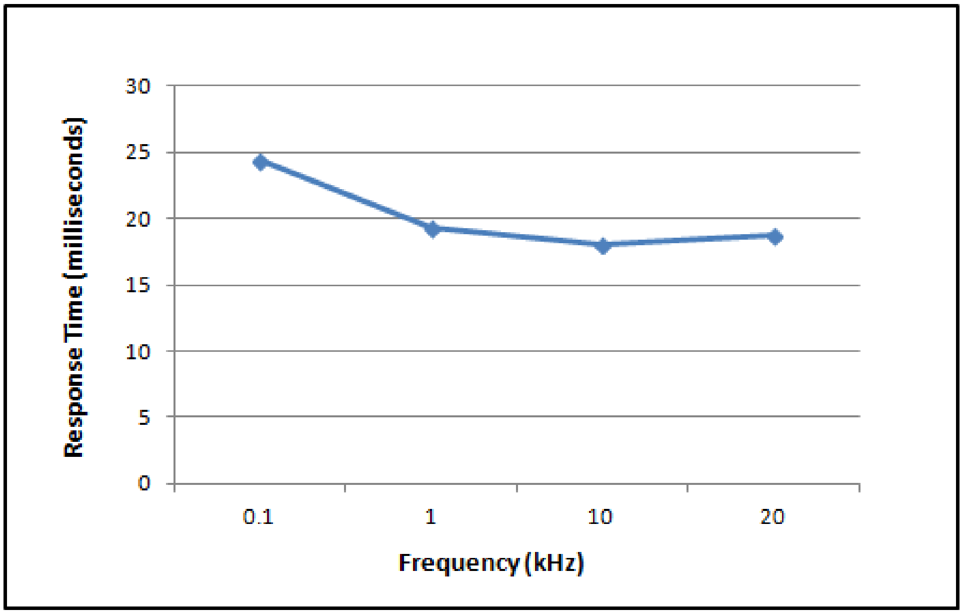


Figure 3-31. Total System Response Time When Speed Redundancy Manager Function is Configured

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

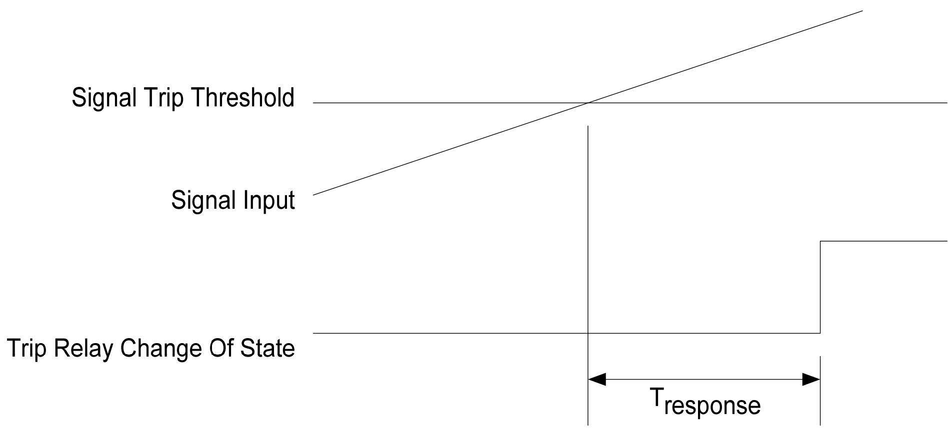


Figure 3-32. Response Time Definition

Analog Output

The response time of the analog output varies with the function source configured, see table below. When configured as a speed readout, the response time is less than 12 ms measured from a change in speed to a change in the output current. If configured for any non-voted logic function, response time is less than 20 ms. Worst case response time is less than 24 ms. This is for logic functions using inter-module signal sharing (e.g., Analog Redundancy Manager). Since the Redundancy Manager functions require the sharing of signals between all modules, the total throughput response time is longer.

Table 3-15. Output Source and Maximum Response Time

Output Source	Max Response Time
Speed (local, >1kHz)	12 ms
Speed (voted/shared signal, >1kHz)	24 ms
Logic function (non-voted)	20 ms
Logic function (voted/shared signal)	24 ms

Chapter 4. Modbus Communications

Modbus Communications

The MicroNet Safety Module can communicate with plant distributed control systems and/or 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.

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

Number of Ports	1
Comm Type	RS-232/RS-485, user selectable (2-Wire Only)
Termination Resistor	RS-485 on board, terminal block selectable
Isolation	500 Vac from output to chassis and output to all other circuits
Signal Cable Length	Must be limited to 1500 ft / 305 m RS-485 (low capacitance 16 AWG / 1.3 mm²), 50 ft / 15 m RS-232

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 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) (Reset and Test Initiate Commands)	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 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 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, twenty addresses with user-selectable scaling have been provided. See Analog Modbus Scaled Values (3:0001 to 0020).

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 4-4.

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 zero before starting the initiate-confirm sequence.

If an Abort command is set to one, 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 signals (hardware inputs, logic blocks, hardware outputs, etc.). A Boolean read register will have the value one if the status of the monitored signal is true and a zero if false. The available Boolean read registers are listed in Table 4-5.

Heartbeat indication (1:0284)

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

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 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 –32768 to +32767 (if signed) or 0 to 65535 (if unsigned). MicroNet Safety Module analog settings can have a range of +/- 999999 and computed values can be much larger (e.g., MULTIPLY result). The value of the register reads is clamped at max or min when limits are exceeded. Some values, like the Timer values, are sent using more than one register. The available Analog read registers, units, and range are listed in Table 4-6.

Analog Modbus Scaled Values (3:0001 to 0020)

The MicroNet Safety Module provides 20 registers to custom scale 20 different analog signals. These are used to either allow transmission of decimal place data (e.g., x100) or allow values beyond numeric limits (e.g., x 0.01).

The Analog Modbus Scaled Values (3:0001 to 0020) have user-selected factors ranging from (0.001 to 1000). The value in the specified register will be the signal multiplied by the selected Scale Factor. On the receiving end, the signal will need to be divided by the scale factor. The scale factor values for these registers are individually selected as 0.001, 0.01, 0.1, 1.0, 10, 100 or 1000. Refer also to the Modbus section in the service tool configuration (Chapter 13) for settings information.

Last Trip time and date indication (3:0086 - 0092)

Last Trip Date/Time represents the Date/Time of the most recent first out trip. The Last Trip time and date indication registers (3:0086 to 0092) 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 (1:0038 to 0074) changing to a true state. When one of those registers change to a true state, then the Last Trip time and date indication registers (3:0086 to 0092) will indicate the sensed date and time of the event. This Date/Time will remain locked in these registers until the next trip condition occurs.

Unit Health indication (3:0093)

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 (3:0094)

This register indicates the state of the Auto Sequence Test as follows:
0 = Not Started
1 = Running
2 = Passed
3 = Failed
4 = Not Completed

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

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

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

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:0001	Over Speed Trip	1:0107 to 0181	User Configurable Alarms 1 to 75
1:0002	Over Accel Trip	1:0182 to 0189	Spare (ok to read)
1:0003	Speed Redundancy Manager Trip	1:0190 to 0214	Event Latched Inputs 1 to 25
1:0004	Speed Probe Open Wire Trip	1:0215 to 0239	Event Latch First Outs 1 to 25
1:0005	Speed Lost Trip	1:0240 to 0247	Spare (ok to read)
1:0006	Speed Fail Trip	1:0248 to 0257	Module A Discrete Input 1 to 10
1:0007	Speed Fail Timeout Trip	1:0258 to 0267	Module B Discrete Input 1 to 10
1:0008	Resettable Trip Input Trip	1:0268 to 0277	Module C Discrete Input 1 to 10
1:0009	Internal Fault Trip	1:0278	Module A Trip Latch Out
1:0010	Power Up Trip	1:0279	Module A Alarm Latch Out
1:0011	Configuration Trip	1:0280	Module B Trip Latch Out
1:0012	Parameter Error Trip	1:0281	Module B Alarm Latch Out
1:0013 to 0037	User Configurable Trips 1 to 25	1:0282	Module C Trip Latch Out
1:0038	Over Speed Trip First Out	1:0283	Module C Alarm Latch Out
1:0039	Over Accel Trip First Out	1:0284	Heartbeat
1:0040	Speed Redundancy Manager Trip First Out	1:0285 to 0292	Spare (ok to read)
1:0041	Speed Probe Open Wire Trip First Out	1:0293	Speed Fail Override
1:0042	Speed Lost Trip First Out	1:0294	Overspeed
1:0043	Speed Fail Trip First Out	1:0295	Over-acceleration
1:0044	Speed Fail Timeout Trip First Out	1:0296	Speed Fail Trip Non-Latched
1:0045	Resettable Trip Input Trip First Out	1:0297	Speed Fail Timeout
1:0046	Internal Fault Trip First Out	1:0298	Speed Lost Alarm Non-Latched
1:0047	Power Up Trip First Out	1:0299	Speed Lost Trip Non-Latched
1:0048	Configuration Trip First Out	1:0300	Speed Probe Open Wire Trip Non-Latched
1:0049	Parameter Error Trip First Out	1:0301	Tmp Ovrspd Setpoint On
1:0050 to 0074	User Configurable Trip First Outs 1 to 25	1:0302	Simulated Speed Active
1:0075 to 0082	Reserved (ok to read)	1:0303	Auto Speed Test Active
1:0083	Internal Fault Alarm	1:0304	Auto Speed Test Failed
1:0084	Module Config Mismatch Alarm	1:0305	Auto Sequence Test Active
1:0085	Power Supply 1 Fault Alarm	1:0306	Auto Sequence Continue Timeout
1:0086	Power Supply 2 Fault Alarm	1:0307	User Defined Test 1
1:0087	Speed Fail Alarm	1:0308	User Defined Test 2
1:0088	Speed Lost Alarm	1:0309	User Defined Test 3
1:0089	Speed Probe Open Wire Alarm	1:0310	Configuration Mismatch
1:0090	Speed Red Mgr Input Difference Alarm	1:0311	Speed Fail Alarm Non-Latched
1:0091	Speed Red Mgr Input 1 Invalid Alarm	1:0312	Trip Latch Output
1:0092	Speed Red Mgr Input 2 Invalid Alarm	1:0313	Alarm Latch Output
1:0093	Speed Red Mgr Input 3 Invalid Alarm	1:0314	Event Latch Output
1:0094	Temp Overspeed SP is Active Alarm	1:0315 to 0324	Discrete Input 1 to 10
1:0095	Simulated Speed Test in Progress Alarm	1:0325 to 0334	Analog Input 1 to 10 Hi
1:0096	Auto Speed Test Active Alarm	1:0335 to 0344	Analog Input 1 to 10 HiHi
1:0097	Auto Speed Test Failed Alarm	1:0345 to 0354	Analog Input 1 to 10 Lo
1:0098	Auto Sequence Test Active Alarm	1:0355 to 0364	Analog Input 1 to 10 LoLo
1:0099	Auto Sequence Continue Timeout Alarm	1:0365 to 0374	Analog Input 1 to 10 Range Error
1:0100	User Test 1 Active Alarm	1:0375 to 0389	Analog Comparator 1 to 15
1:0101	User Test 2 Active Alarm	1:0390 to 4039	Logic Gate 1 to 50

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:0102	User Test 3 Active Alarm	1:0440 to 0449	Latch 1 to 10
1:0103	Trip Cycle Time Mon 1 Alarm	1:0450 to 0474	Delay 1 to 25
1:0104	Trip Cycle Time Mon 2 Alarm	1:0475	Timer 1 HiHi
1:0105	Irig Signal Lost Alarm	1:0476	Timer 1 Hi
1:0106	Trip Latch Output Alarm	1:0477	Timer 2 HiHi

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

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:0478	Timer 2 Hi	1:0547	Analog Red Mgr 9 Input 3 Invalid
1:0479	Timer 3 HiHi	1:0548	Analog Red Mgr 10 Input 1 Invalid
1:0480	Timer 3 Hi	1:0549	Analog Red Mgr 10 Input 2 Invalid
1:0481	Timer 4 HiHi	1:0550	Analog Red Mgr 10 Input 3 Invalid
1:0482	Timer 4 Hi	1:0551	Analog Red Mgr 11 Input 1 Invalid
1:0483	Timer 5 HiHi	1:0552	Analog Red Mgr 11 Input 2 Invalid
1:0484	Timer 5 Hi	1:0553	Analog Red Mgr 11 Input 3 Invalid
1:0485 to 0494	Unit Delay 1 to 10	1:0554	Analog Red Mgr 12 Input 1 Invalid
1:0495 to 0497	Reserved (ok to read)	1:0555	Analog Red Mgr 12 Input 2 Invalid
1:0498	Internal Fault Trip Non-Latched	1:0556	Analog Red Mgr 12 Input 3 Invalid
1:0499	Internal Fault Alarm Non-Latched	1:0557	Analog Red Mgr 13 Input 1 Invalid
1:0500	Configuration Trip	1:0558	Analog Red Mgr 13 Input 2 Invalid
1:0501	Resettable Trip Input	1:0559	Analog Red Mgr 13 Input 3 Invalid
1:0502	Power Supply 1 Fault	1:0560	Analog Red Mgr 14 Input 1 Invalid
1:0503	Power Supply 2 Fault	1:0561	Analog Red Mgr 14 Input 2 Invalid
1:0504	Parameter Error	1:0562	Analog Red Mgr 14 Input 3 Invalid
1:0505	Irig Signal Lost	1:0563	Analog Red Mgr 15 Input 1 Invalid
1:0506 to 0520	Analog Red Mgr 1 - 15 Difference Detected	1:0564	Analog Red Mgr 15 Input 2 Invalid
1:0521	Analog Red Mgr 1 Input 1 Invalid	1:0565	Analog Red Mgr 15 Input 3 Invalid
1:0522	Analog Red Mgr 1 Input 2 Invalid	1:0566 to 0580	Bool Red Mgr Output 1 to 15
1:0523	Analog Red Mgr 1 Input 3 Invalid	1:0581	Bool Red Mgr 1 Input 1 Invalid
1:0524	Analog Red Mgr 2 Input 1 Invalid	1:0582	Bool Red Mgr 1 Input 2 Invalid
1:0525	Analog Red Mgr 2 Input 2 Invalid	1:0583	Bool Red Mgr 1 Input 3 Invalid
1:0526	Analog Red Mgr 2 Input 3 Invalid	1:0584	Bool Red Mgr 2 Input 1 Invalid
1:0527	Analog Red Mgr 3 Input 1 Invalid	1:0585	Bool Red Mgr 2 Input 2 Invalid
1:0528	Analog Red Mgr 3 Input 2 Invalid	1:0586	Bool Red Mgr 2 Input 3 Invalid
1:0529	Analog Red Mgr 3 Input 3 Invalid	1:0587	Bool Red Mgr 3 Input 1 Invalid
1:0530	Analog Red Mgr 4 Input 1 Invalid	1:0588	Bool Red Mgr 3 Input 2 Invalid
1:0531	Analog Red Mgr 4 Input 2 Invalid	1:0547	Bool Red Mgr 3 Input 3 Invalid
1:0532	Analog Red Mgr 4 Input 3 Invalid	1:0548	Bool Red Mgr 4 Input 1 Invalid
1:0533	Analog Red Mgr 5 Input 1 Invalid	1:0549	Bool Red Mgr 4 Input 2 Invalid
1:0534	Analog Red Mgr 5 Input 2 Invalid	1:0550	Bool Red Mgr 4 Input 3 Invalid
1:0535	Analog Red Mgr 5 Input 3 Invalid	1:0551	Analog Red Mgr 9 Input 3 Invalid
1:0536	Analog Red Mgr 6 Input 1 Invalid	1:0552	Analog Red Mgr 10 Input 1 Invalid
1:0537	Analog Red Mgr 6 Input 2 Invalid	1:0553	Analog Red Mgr 10 Input 2 Invalid
1:0538	Analog Red Mgr 6 Input 3 Invalid	1:0554	Analog Red Mgr 10 Input 3 Invalid
1:0539	Analog Red Mgr 7 Input 1 Invalid	1:0555	Analog Red Mgr 11 Input 1 Invalid
1:0540	Analog Red Mgr 7 Input 2 Invalid	1:0556	Analog Red Mgr 11 Input 2 Invalid
1:0541	Analog Red Mgr 7 Input 3 Invalid	1:0557	Analog Red Mgr 11 Input 3 Invalid
1:0542	Analog Red Mgr 8 Input 1 Invalid	1:0558	Analog Red Mgr 12 Input 1 Invalid
1:0543	Analog Red Mgr 8 Input 2 Invalid	1:0589	Analog Red Mgr 12 Input 2 Invalid
1:0544	Analog Red Mgr 8 Input 3 Invalid	1:0590	Analog Red Mgr 12 Input 3 Invalid
1:0545	Analog Red Mgr 9 Input 1 Invalid	1:0591	Analog Red Mgr 13 Input 1 Invalid
1:0546	Analog Red Mgr 9 Input 2 Invalid	1:0592	Analog Red Mgr 13 Input 2 Invalid
1:0593	Bool Red Mgr 5 Input 1 Invalid	1:0618	Bool Red Mgr 13 Input 2 Invalid
1:0594	Bool Red Mgr 5 Input 2 Invalid	1:0619	Bool Red Mgr 13 Input 3 Invalid
1:0595	Bool Red Mgr 5 Input 3 Invalid	1:0620	Bool Red Mgr 14 Input 1 Invalid
1:0596	Bool Red Mgr 6 Input 1 Invalid	1:0621	Bool Red Mgr 14 Input 2 Invalid
1:0597	Bool Red Mgr 6 Input 2 Invalid	1:0622	Bool Red Mgr 14 Input 3 Invalid
1:0598	Bool Red Mgr 6 Input 3 Invalid	1:0623	Bool Red Mgr 15 Input 1 Invalid
1:0599	Bool Red Mgr 7 Input 1 Invalid	1:0624	Bool Red Mgr 15 Input 2 Invalid
1:0600	Bool Red Mgr 7 Input 2 Invalid	1:0625	Bool Red Mgr 15 Input 3 Invalid

ADDRESS	DESCRIPTION	ADDRESS	DESCRIPTION
1:0601	Bool Red Mgr 7 Input 3 Invalid	1:0626 to 0640	Difference Detection 1 to 15
1:0602	Bool Red Mgr 8 Input 1 Invalid	1:0641 to 0650	Counter 1 to 10
1:0603	Bool Red Mgr 8 Input 2 Invalid	1:0651 to 0655	Event Filter 1 to 5
1:0604	Bool Red Mgr 8 Input 3 Invalid	1:0656 to 0660	Pulse Detector 1 to 5
1:0605	Bool Red Mgr 9 Input 1 Invalid	1:0661	Speed Red Mgr Input 1 Invalid
1:0606	Bool Red Mgr 9 Input 2 Invalid	1:0662	Speed Red Mgr Input 2 Invalid
1:0607	Bool Red Mgr 9 Input 3 Invalid	1:0663	Speed Red Mgr Input 3 Invalid
1:0608	Bool Red Mgr 10 Input 1 Invalid	1:0664	Speed Red Mgr Input Difference
1:0609	Bool Red Mgr 10 Input 2 Invalid	1:0665	Accel Red Mgr Input 1 Invalid
1:0610	Bool Red Mgr 10 Input 3 Invalid	1:0666	Accel Red Mgr Input 2 Invalid
1:0611	Bool Red Mgr 11 Input 1 Invalid	1:0667	Accel Red Mgr Input 3 Invalid
1:0612	Bool Red Mgr 11 Input 2 Invalid	1:0668	Speed Probe Open Wire Alarm Non-Latched
1:0613	Bool Red Mgr 11 Input 3 Invalid	1:0669	Speed Red Mgr Trip Non-Latched
1:0614	Bool Red Mgr 12 Input 1 Invalid	1:0670	Shared Reset
1:0615	Bool Red Mgr 12 Input 2 Invalid	1:0671	Shared Start
1:0616	Bool Red Mgr 12 Input 3 Invalid	1:0672	Shared Speed Fail Override
1:0617	Bool Red Mgr 13 Input 1 Invalid	1:0673 to 0691	Spare (ok to read)

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

ADDRESS	DESCRIPTION	UNITS	RANGE
3:0001 to 0020	Analog Modbus Scaled Values 1 to 20	User Units	-32768 to 32767
3:0021	Speed (after Speed Red Mgr, if used)	RPM	0 to 32500
3:0022	Acceleration (after Accel Red Mgr, if used)	RPM/s	-32500 to 32500
3:0023	Module A Speed	RPM	0 to 32500
3:0024	Module A Acceleration	RPM/s	-32500 to 32500
3:0025	Module B Speed	RPM	0 to 32500
3:0026	Module B Acceleration	RPM/s	-32500 to 32500
3:0027	Module C Speed	RPM	0 to 32500
3:0028	Module C Acceleration	RPM/s	-32500 to 32500
3:0029	Overspeed SetPoint (Local)	RPM	0 to 32500
3:0030 to 0039	Analog Inputs (Local) 1 to 10	User Units	-32500 to 32500
3:0040 to 0049	Module A Analog Inputs 1 to 10	User Units	-32500 to 32500
3:0050 to 0059	Module B Analog Inputs 1 to 10	User Units	-32500 to 32500
3:0060 to 0069	Module C Analog Inputs 1 to 10	User Units	-32500 to 32500
3:0070	Trip Cycle Time 1	ms	0 to 65535
3:0071	Trip Cycle Time 2	ms	0 to 65535
3:0072	Test Mode Time Remaining	s	0 to 65535
3:0073	Speed Fail Time Remaining	s	0 to 65535
3:0074	Timer 1 Seconds	s	0 to 65535
3:0075	Timer 1 Milliseconds	ms	0 to 999
3:0076	Timer 2 Seconds	s	0 to 65535
3:0077	Timer 2 Milliseconds	ms	0 to 999
3:0078	Timer 3 Seconds	s	0 to 65535
3:0079	Timer 3 Milliseconds	ms	0 to 999
3:0080	Timer 4 Seconds	s	0 to 65535
3:0081	Timer 4 Milliseconds	ms	0 to 999
3:0082	Timer 5 Seconds	s	0 to 65535

ADDRESS	DESCRIPTION	UNITS	RANGE
3:0083	Timer 5 Milliseconds	ms	0 to 999
3:0084	Temp Overspeed SetPoint	RPM	0 to 65535
3:0085	Simulated Speed RPM	RPM	0 to 65535
3:0086	Last Trip Month	Months	1 to 12
3:0087	Last Trip Day	Days	1 to 31
3:0088	Last Trip Year	Years	2000 to 2099
3:0089	Last Trip Hour	Hours	0 to 23
3:0090	Last Trip Minute	Minutes	0 to 59
3:0091	Last Trip Second	Sec	0 to 59
3:0092	Last Trip Milli-Second	ms	0 to 999
3:0093	Unit Health Status	Enum	0 to 2
3:0094	Auto-Sequence Test Status	Enum	0 to 3
3:0095 to 0109	Analog Redundancy Manager blocks 1 to 15	User Units	-32768 to 32767
3:0110 to 0149	Constant Block outputs 1 to 40	User Units	-32768 to 32767
3:0150 to 0154	Add block outputs 1 to 5	User Units	-32768 to 32767
3:0155 to 0164	Negate block outputs 1 to 10	User Units	-32768 to 32767
3:0165 to 0169	Multiply block outputs 1 to 5	User Units	-32768 to 32767
3:0170 to 0174	Divide block outputs 1 to 5	User Units	-32768 to 32767
3:0175 to 0176	Curve block outputs 1 to 2	User Units	-32768 to 32767
3:0177	Lag block 1 lag output	User Units	-32768 to 32767
3:0178	Lag block 1 derivative output	User Units	-32768 to 32767
3:0179	Lag block 2 lag output	User Units	-32768 to 32767
3:0180	Lag block 2 derivative output	User Units	-32768 to 32767
3:0181	Lag block 3 lag output	User Units	-32768 to 32767
3:0182	Lag block 3 derivative output	User Units	-32768 to 32767
3:0183	Lag block 4 lag output	User Units	-32768 to 32767
3:0184	Lag block 4 derivative output	User Units	-32768 to 32767
3:0185	Lag block 5 lag output	User Units	-32768 to 32767
3:0186	Lag block 5 derivative output	User Units	-32768 to 32767
3:0187	Lag block 6 lag output	User Units	-32768 to 32767
3:0188	Lag block 6 derivative output	User Units	-32768 to 32767
3:0189	Lag block 7 lag output	User Units	-32768 to 32767
3:0190	Lag block 7 derivative output	User Units	-32768 to 32767
3:0191	Lag block 8 lag output	User Units	-32768 to 32767
3:0192	Lag block 8 derivative output	User Units	-32768 to 32767
3:0193	Lag block 9 lag output	User Units	-32768 to 32767
3:0194	Lag block 9 derivative output	User Units	-32768 to 32767
3:0195	Lag block 10 lag output	User Units	-32768 to 32767
3:0196	Lag block 10 derivative output	User Units	-32768 to 32767
3:0197 to 0206	Switch block outputs 1 to 10	User Units	-32768 to 32767
3:0207 to 0216	Analog Unit Delay block outputs 1 to 10	User Units	-32768 to 32767
3:0217	Peak Hold 1 Max output	User Units	-32768 to 32767
3:0218	Peak Hold 1 Min output	User Units	-32768 to 32767
3:0219	Peak Hold 2 Max output	User Units	-32768 to 32767

ADDRESS	DESCRIPTION	UNITS	RANGE
3:0220	Peak Hold 2 Min output	User Units	-32768 to 32767
3:0221	Peak Hold 3 Max output	User Units	-32768 to 32767
3:0222	Peak Hold 3 Min output	User Units	-32768 to 32767
3:0223	Peak Hold 4 Max output	User Units	-32768 to 32767
3:0224	Peak Hold 4 Min output	User Units	-32768 to 32767
3:0225	Peak Hold 5 Max output	User Units	-32768 to 32767
3:0226	Peak Hold 5 Min output	User Units	-32768 to 32767
3:0227	Peak Hold 6 Max output	User Units	-32768 to 32767
3:0228	Peak Hold 6 Min output	User Units	-32768 to 32767
3:0229	Peak Hold 7 Max output	User Units	-32768 to 32767
3:0230	Peak Hold 7 Min output	User Units	-32768 to 32767
3:0231	Peak Hold 8 Max output	User Units	-32768 to 32767
3:0232	Peak Hold 8 Min output	User Units	-32768 to 32767
3:0233	Peak Hold 9 Max output	User Units	-32768 to 32767
3:0234	Peak Hold 9 Min output	User Units	-32768 to 32767
3:0235	Peak Hold 10 Max output	User Units	-32768 to 32767
3:0236	Peak Hold 10 Min output	User Units	-32768 to 32767
3:0237 to 0246	Counter block outputs 1 to 10	User Units	0 to 65535

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 control.

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.

Front Panel Indications

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.

Green – Unit OK and functioning properly.
Red – Safety Functionality is not running/internal fault trip is present.
Unlit (off) – Status unknown because of a communication fault with the front panel or the module is not powered.

TRIPPED LED

The TRIPPED LED indicates the state of the trip latch.

Unlit (off) – Unit not tripped, or the module is not powered.
Red – Unit tripped, press VIEW button below the LED to toggle between the trip log and trip latch to see the active status on each trip input.

ALARM LED

The ALARM LED indicates the state of the alarm latch.

Unlit (off) – No alarms or the module is not powered.
Yellow – Active alarms, press VIEW button below LED to toggle between the alarm log and alarm latch to see the active status on each alarm input.

Module Incompatibility

Module and software versions are continuously monitored for correct versions. If an incompatibility is detected, the signals and commands from the incompatible module are ignored. The redundancy manager blocks with display these as ‘Invalid’ inputs. Additionally, internal fault alarms will be indicated for both software version mismatch and heartbeat error, due to loss of inter-module communications.

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.) A reset command may be required to clear failed signals.
	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.

Problem or Diagnostic Indication	Possible Cause	Suggested Actions
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.
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.

Problem or Diagnostic Indication	Possible Cause	Suggested Actions
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 output selection and scaling are correct.

Problem or Diagnostic Indication	Possible Cause	Suggested Actions
MODBUS not working	Wiring fault, terminal block loose.	Verify the wiring and terminal block connections. 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 termination 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 (PCT) not working	Wiring and connection.	Verify the cable plugged into the DB9 port is not a crossover. A straight-through cable is required. Check that power is applied to the MicroNet Safety Module and the service tool is connected.
	COM Port.	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
Overspeed Trip (if speed redundancy or the speed probe is used)	The module tripped on an overspeed event or a test mode overspeed.	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.
		Test mode overspeed.	Using the PCT or front panel, check the trip log for a trip with a test mode indication.
		Configuration.	Using the PCT or front panel, verify the correct settings are selected.
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.	Check trip system prior to operating turbine or equipment, 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. Acceleration filtering may need to be configured.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
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.
Resettable Trip Input	Trip was issued by the Resettable Trip function.	Logic issue or wiring fault. Incorrect setting.	Use PCT or front panel to verify function configuration settings and monitor the input values. If input state is incorrect, check wiring continuity. Use PCT or front panel to verify proper configuration settings.
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 Trip 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.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
Incompatible Modules (displayed on front panel interface)	Module incompatibility was detected.	Incompatible software version in either the display module or the control module.	Replace module with an appropriate compatible module. Contact Woodward to verify appropriate part numbers.
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.

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 Module Faults 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 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.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
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. Incorrect speed loss threshold setting.	Check wiring continuity and probe integrity. Use PCT or front panel to verify proper configuration settings.
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 Input 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.
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 another 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 another 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 another 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.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
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.
Auto Sequence Test Timeout	Indicates the test did not continue to the next module because it timed out waiting for a Start/Continue signal.	Wiring fault. Timeout set too short.	Check configurable input connections. Connect PCT and verify settings.
User Defined Test 1	Indicates the User Defined Test 1 has been activated.	User enabled the User Defined Test, or the configured Set Input was true.	Connect PCT and verify settings. Check the set and reset functions are correct. Note specifically the effect of the timeout setting.
User Defined Test 2	Indicates the User Defined Test 2 has been activated.	User enabled the User Defined Test, or the configured Set Input was true.	Connect PCT and verify settings. Check the set and reset functions are correct. Note specifically the effect of the timeout setting.
User Defined Test 3	Indicates the User Defined Test 3 has been activated.	User enabled the User Defined Test, or the configured Set Input was true.	Connect PCT and verify settings. Check the set and reset functions are correct. Note specifically the effect of the timeout setting.
Trip Cycle Time Mon 1 Alarm	Indicates the Trip Cycle Monitor Time 1 Alarm has been set.	Trip Cycle Monitor Time 1 Alarm is set when the maximum cycle time has been exceeded during a trip cycle time test. Configuration Wiring Fault or Configuration	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.

Problem or Diagnostic Indication	Description	Possible Cause	Suggested Actions
Trip Cycle Time Mon 2 Alarm	Indicates the Trip Cycle Monitor Time 2 Alarm has been set.	Trip Cycle Monitor Time 2 Alarm is set when the maximum cycle time has been exceeded during a trip cycle time test.	Check the Trip Cycle Time Monitor Menu and note the trip cycle time to see if the cycle time indicator signal is reaching the MicroNet Safety Module.
		Configuration	Connect PCT and verify settings. Verify the trip indicator input is from the correct source and the max cycle time setting is correct.
		Wiring Fault or Configuration	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.

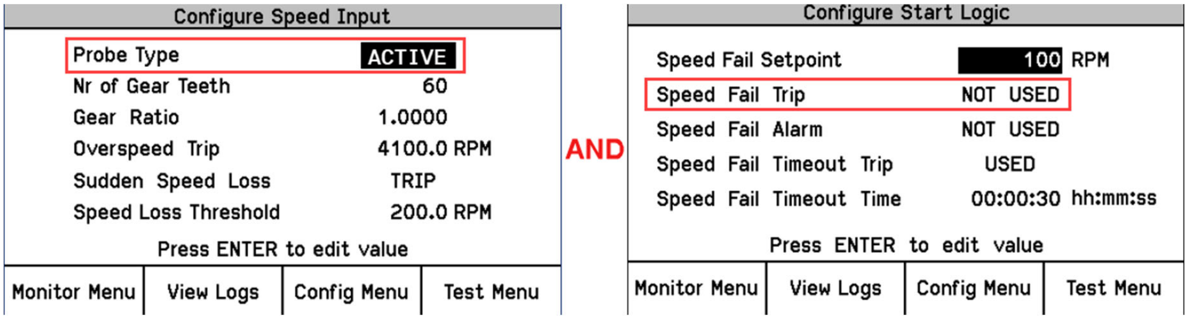


Figure 5-1. Configuration Guide - Front Panel Interface with Active Probe

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:

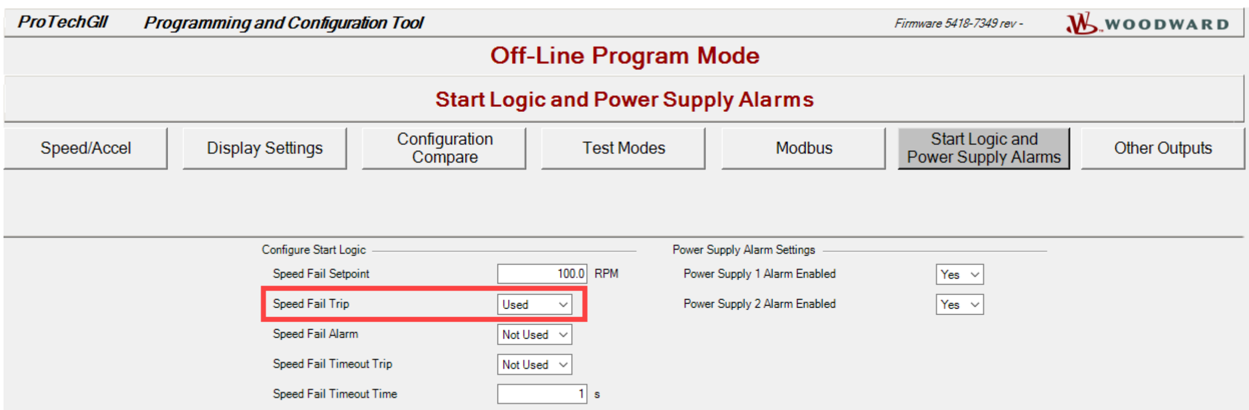
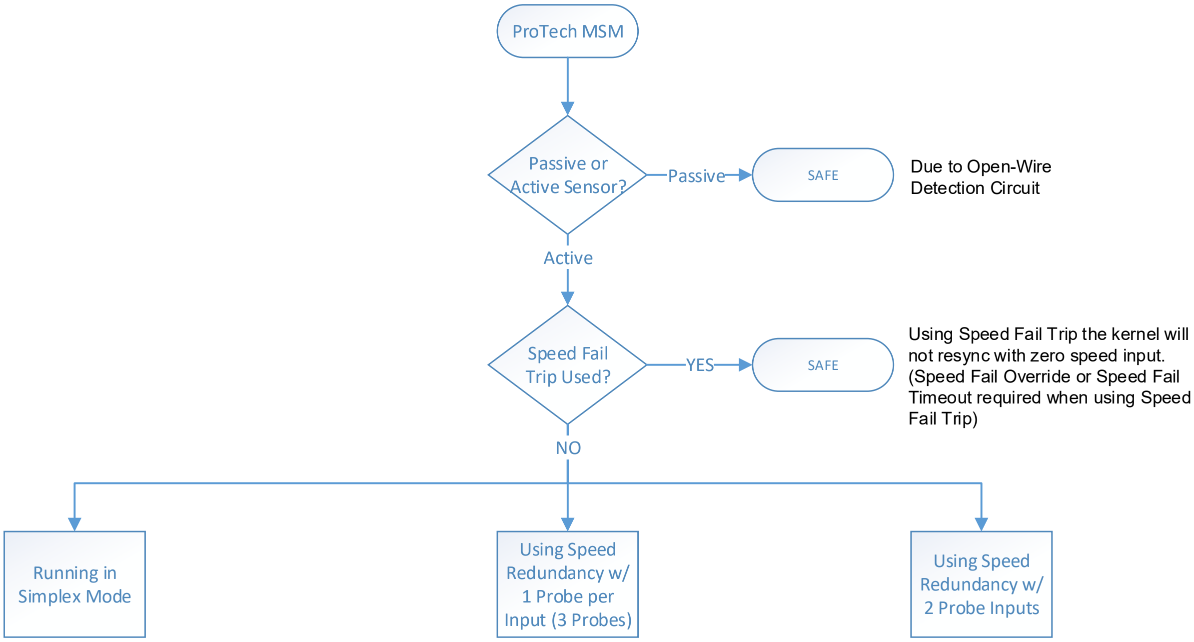


Figure 5-2. Speed Fail Trip Using PCT

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:



Running in Simplex Mode:

- 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.

Using Speed Redundancy w/ 1 Probe per Input (3 Probes):

- 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.

Using Speed Redundancy w/ 2 Probe Inputs:

- 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. Applications requiring certification up to SIL3 must use the 'de-energize to trip' configuration. The energize-to-trip mode does not meet SIL3 safety requirements.

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.

IMPORTANT **Applications requiring certification up to SIL3 must use the 'de-energize to trip' configuration option.**

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 is present.

SIL Specifications

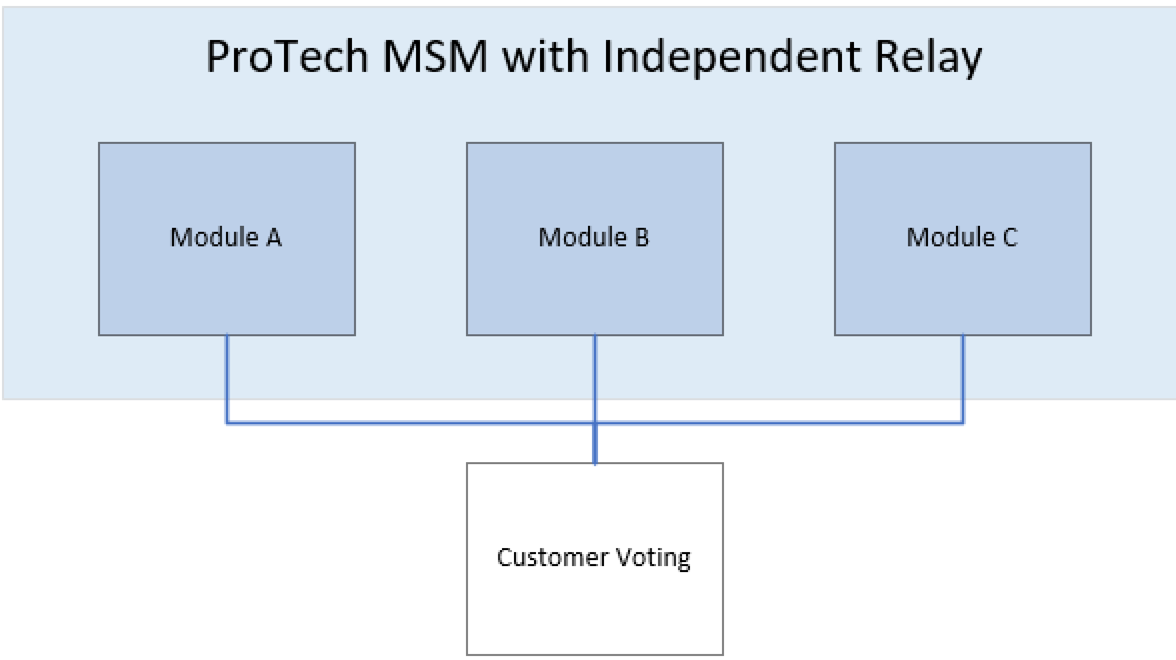
PFD = Probability of Failure to perform a safety function on Demand
PFH = Probability of a dangerous Failure per Hour (High Demand or Continuous mode of operation)
PFD and PFH calculations have been performed on the MicroNet Safety Module according IEC61508.
For SIL3, IEC states the following requirements.

Table 6-2. SIL Specifications

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

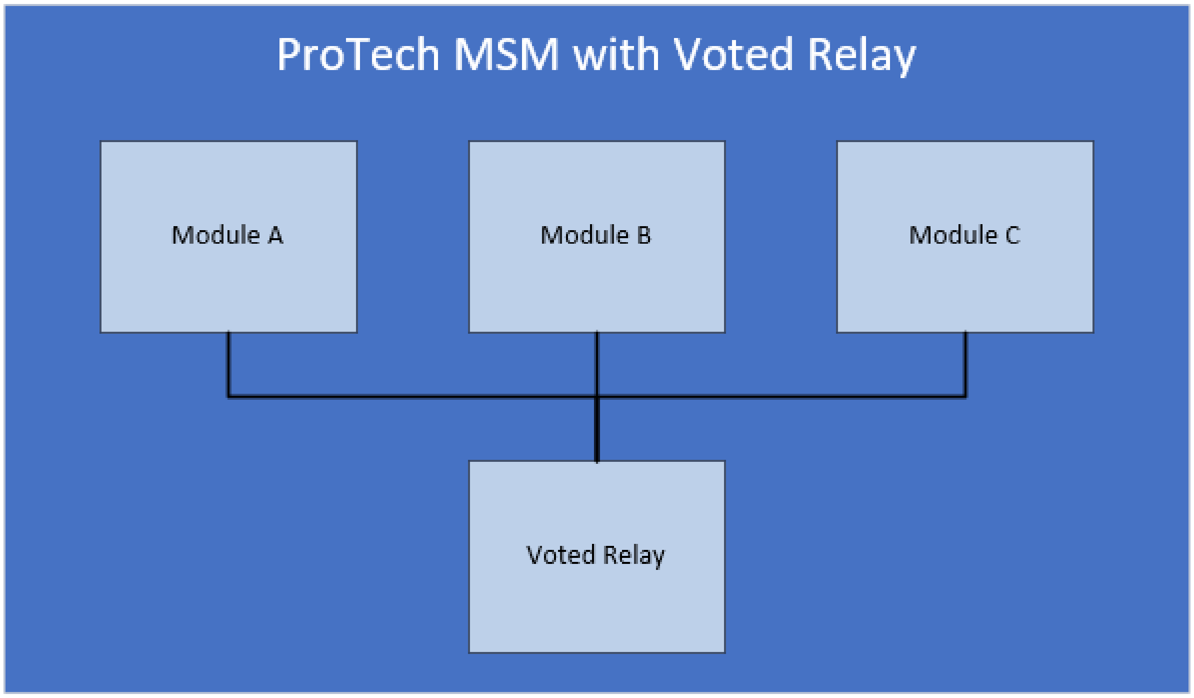
PFD	
PFD	**Proof Test Interval**
3.2E-5	6 months
5.2E-5	9 months
7.5E-5	1 year

PFH
7.8E-8 1/h
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 ±1 V).
4. Verify proper Discrete Input voltage (terminals 37 – 38; 23 ±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 ±1 V).
6. Test Speed input by using one of the internal speed test modes in the Test Menu. Resistance measurement of each of the voter outputs is required. Verify as follows:
   a. With module not tripped, resistance measurement from 1A – 1B, or 2A – 2B must be less than 100 Ω.
   b. With module tripped, resistance measurement from 1A – 1B, or 2A – 2B must be greater than 1 MΩ.
7. Test any configurable inputs that are set to analog mode to make sure that all inputs are operational. The analog signal must be varied from a steady state value. Verify the proper signal by monitoring the respective input on the Monitor Menu\Configurable Input page of the front panel.
8. Test any configurable inputs that are set to discrete mode to make sure that all inputs are operational and not stuck in the ON or OFF state. Inputs must be cycled from ON to OFF and OFF to ON. Verify the proper signal by monitoring the respective input on the Monitor Menu\Configurable Input page of the front panel.
9. Test Programmable Outputs if used as part of the safety system.
10. Cycle dedicated inputs and verify the proper signal by monitoring the respective input on the Monitor Menu/Dedicated Discrete Input page of the front panel.
11. If possible, compare external speed with measured speed-reading on the MicroNet Safety Module display.
12. If used as part of the safety system, verify the analog output. Measure this output by performing an automated overspeed trip test as described in step 6.

13. Chassis isolation checks using resistance measurement. Measure from terminals 39, 66, 67 to a point on the MicroNet Safety Module chassis (the grounding braid is a good place for this measurement): < 1 Ω.
14. Perform a lamp test from front panel Test Menu.

Chapter 7.
Asset Management

Product Storage Recommendations

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

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

Refurbishment Period Recommendation

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

⚠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 **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

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 needs 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 many 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 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

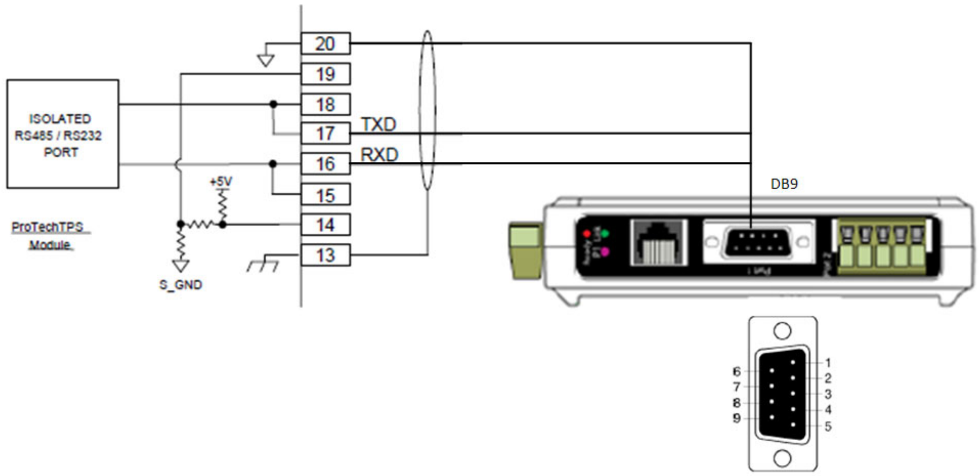
   Lantronix
   15353 Barranca Parkway
   Irvine, CA 92618
   USA

   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

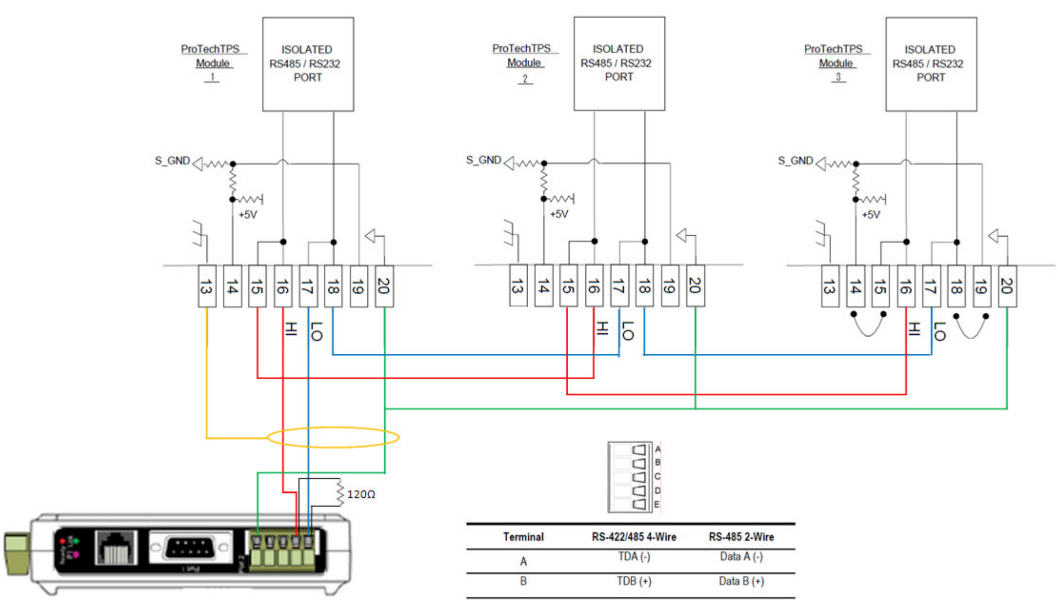


DB9 M Pin	Direction	RS-232
1	Input	DCD
2	Input	RXD
3	Output	TXD
4	Output	DTR
5	—	GND
6	Input	DSR
7	Output	RTS
8	Input	CTS
9	Input	RI

B&B Electronics – RS-232

Figure A-1. RS-232

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



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

Figure A-2. RS-485 2-Wire

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.

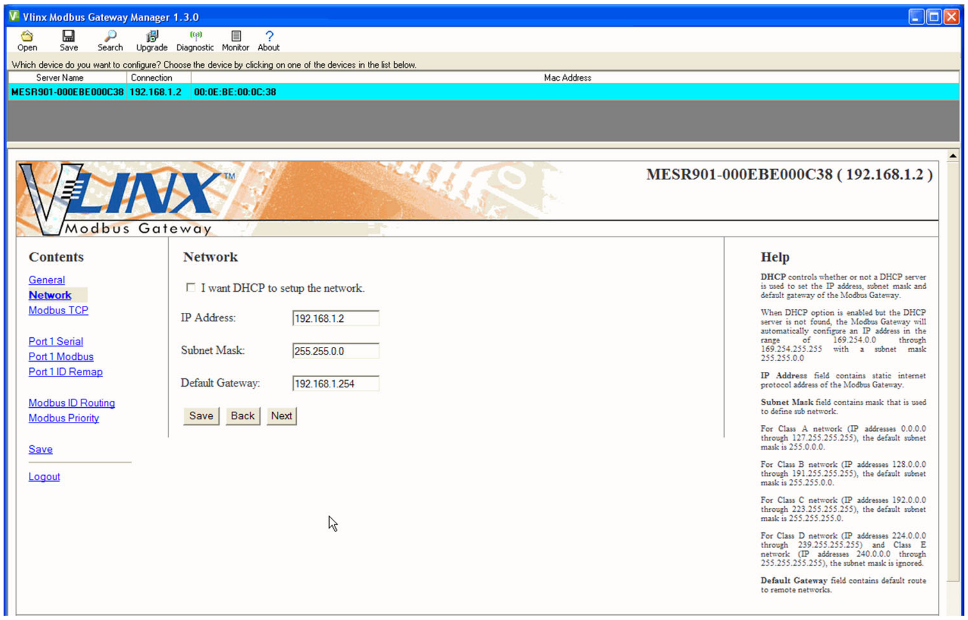


Figure A-3. Network Settings

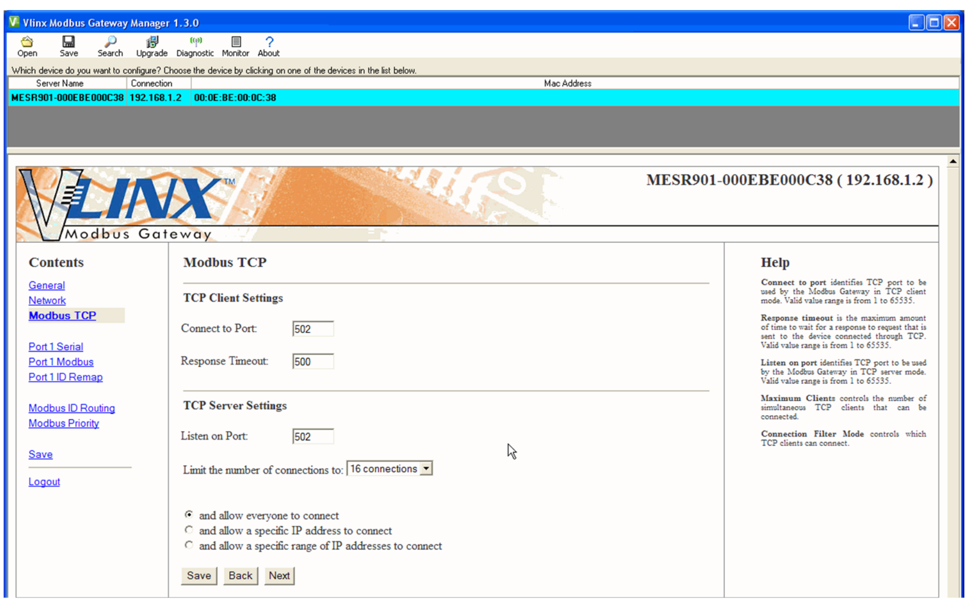


Figure A-4. Modbus TCP Settings

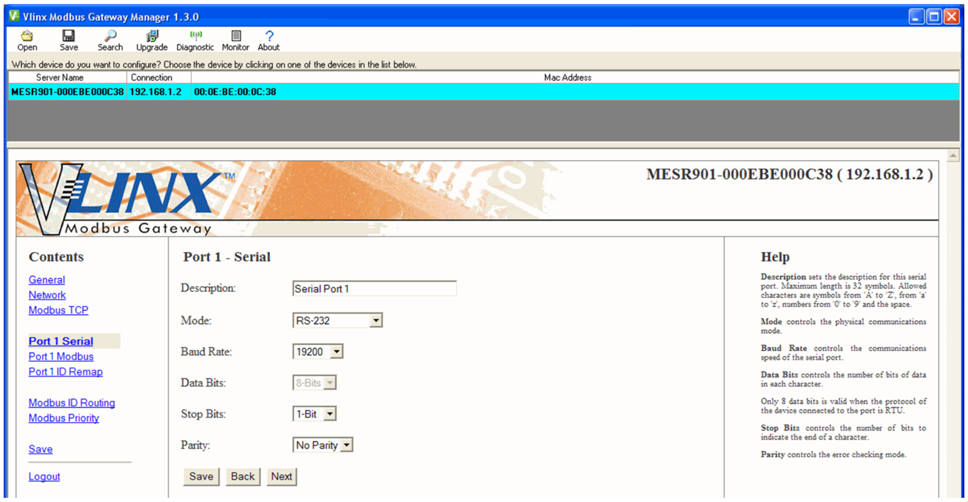


Figure A-5. Serial Communication Settings

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.

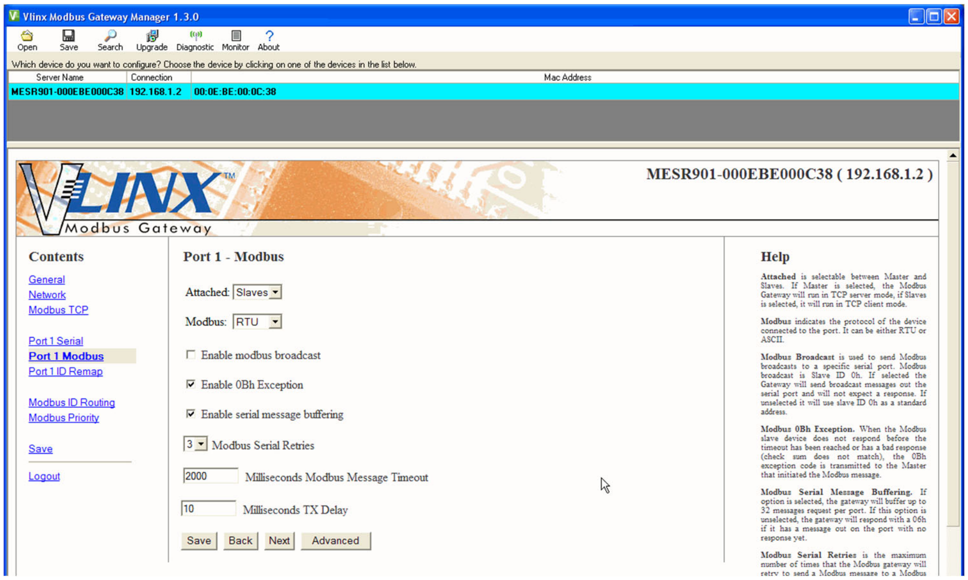


Figure A-6. Serial Modbus Settings

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

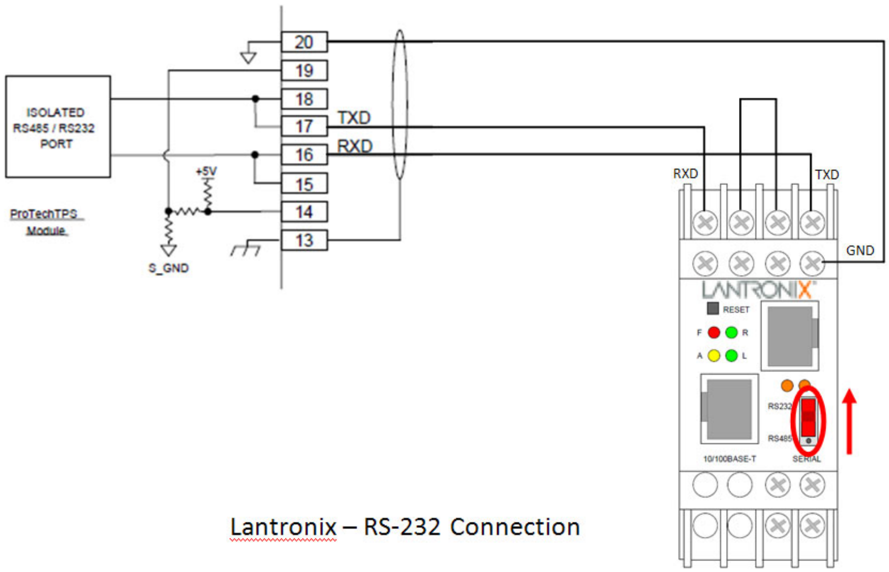


Figure A-7. Lantronix RS-232 Connection

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

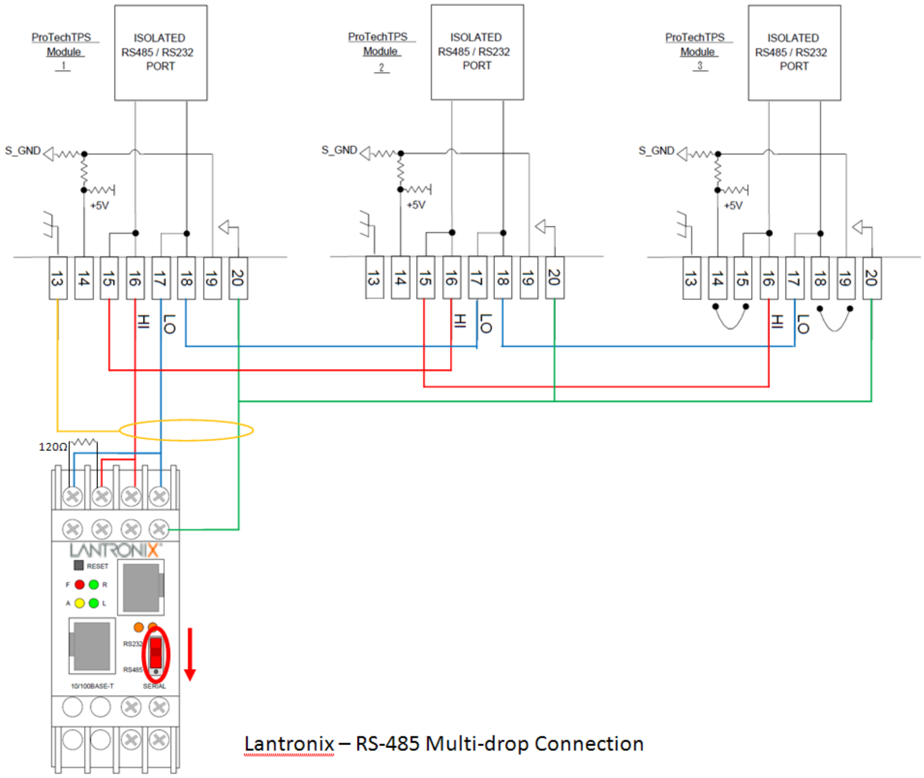


Figure A-8. Lantronix – RS-485 Multi-Drop Connection

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.

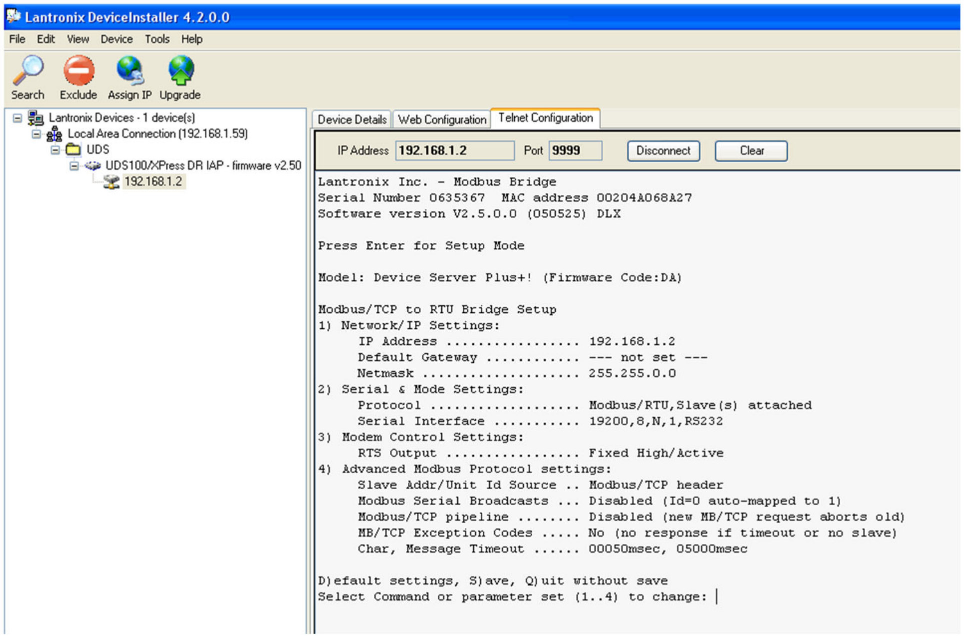


Figure A-9. Configuration Overview

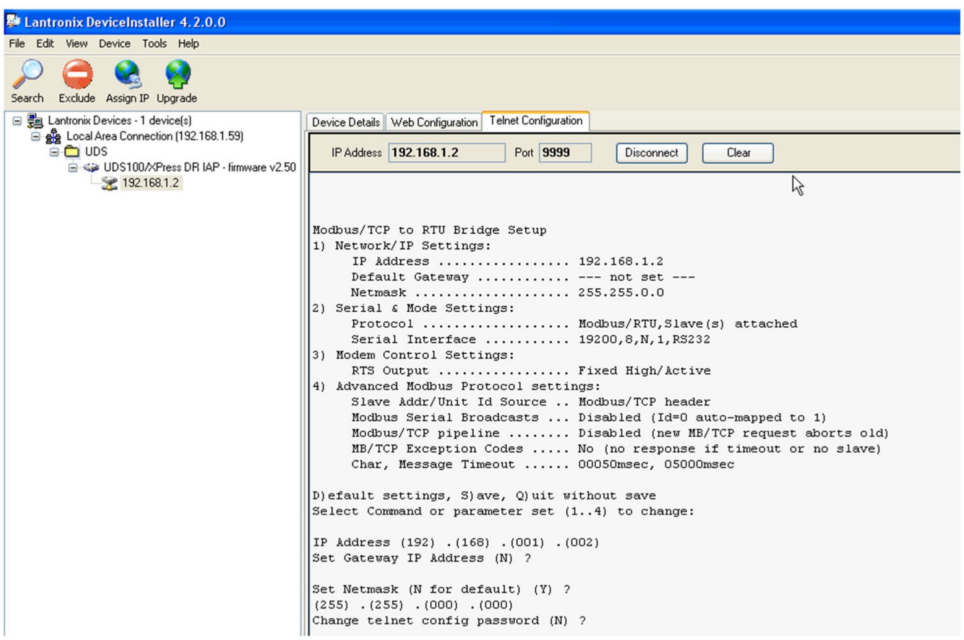


Figure A-10. Network Menu

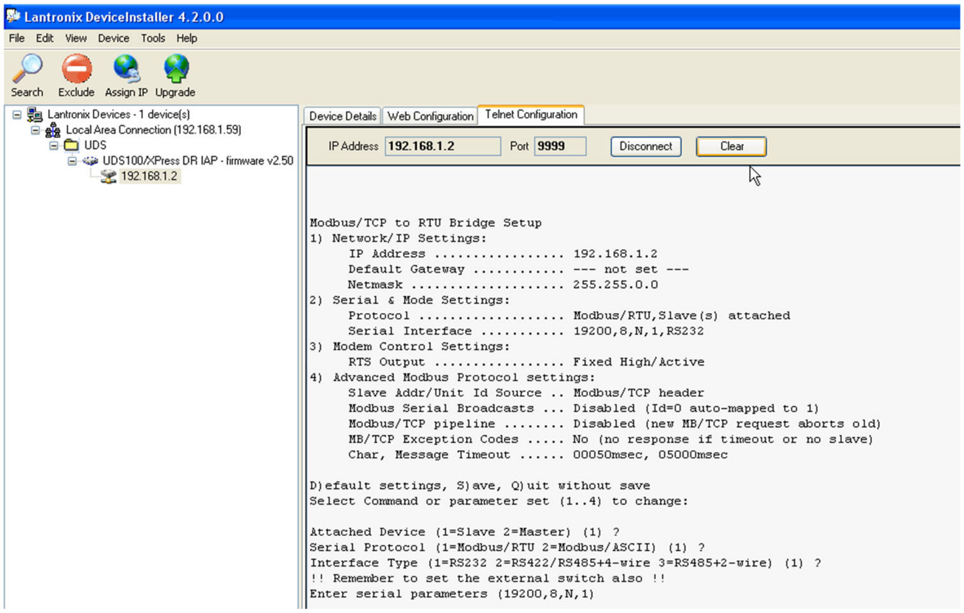


Figure A-11. Serial Settings Menu

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.

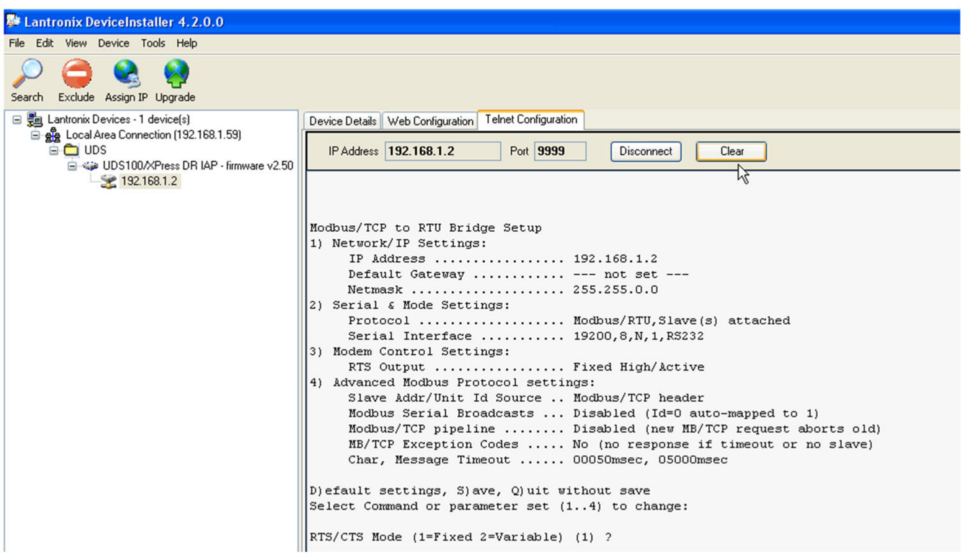


Figure A-12. Modem Control Menu

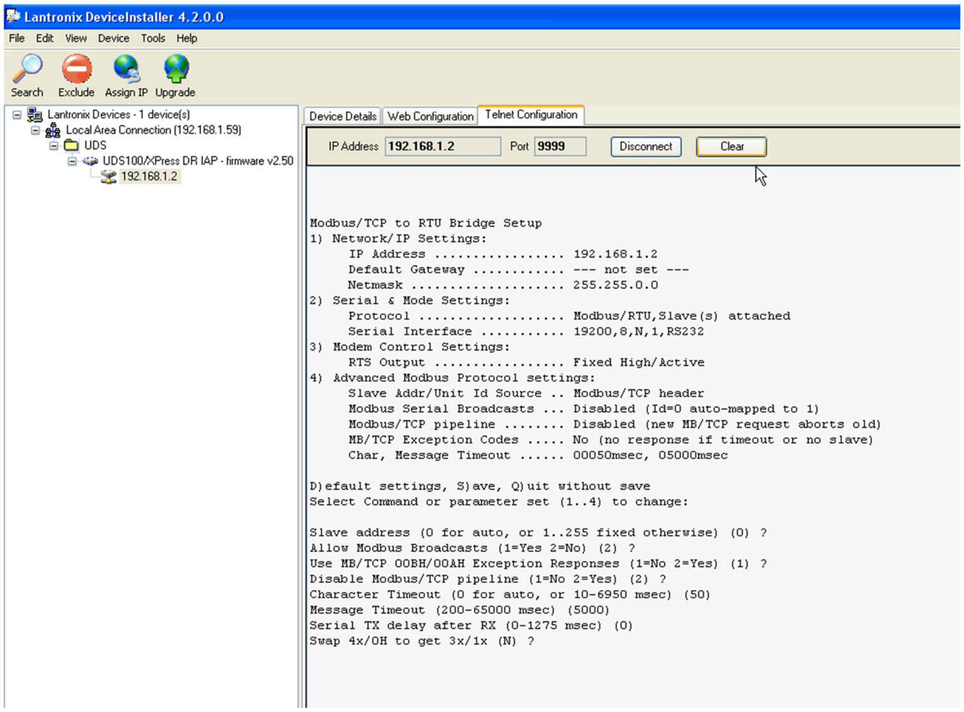


Figure A-13. Advanced Menu

Revision History

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

Revision B—
- Added note to Serial Modbus Communications section in Chapter 2
- Added three Warning boxes to Chapter 3
- Added content to the Notice box in the Block Outputs section in Chapter 3
- Added content to the Comm Type specification in Table 4-1
- Added headings to Chapter 5 Troubleshooting tables.
- Installed Configuration Guidance section in Chapter 5

Revision A—
- New content in ATEX PED and RoHS Directives in Regulatory Compliance section
- Removed WEEE, EuP, and C-Tick Directives from the Regulatory Compliance section
- Added Australia (& New Zealand) RCM Compliance to the Regulatory Compliance section

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	Annette Lynch
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

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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Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 35060V1.

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