MSR57P Guardmaster Speed Monitoring Safety Relay

Catalog Number 440R-S845AER-NNL

Allen-Bradley
by ROCKWELL AUTOMATION

Guardmaster®

User Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

These labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

Chapter 4

Speed Monitoring I/O Signals

Chapter 5

General Safety Relay and Feedback Monitoring Configuration

Chapter 6

Safe Stop and Safe Stop with Door Monitoring Modes

Chapter 7

Safely-limited Speed (SLS) Modes

Chapter 8

Secondary Modes for Multi-axis Cascaded Systems

Chapter 9

Safe Maximum Speed and Direction Monitoring

Chapter 10

Safety Configuration and Verification

Chapter 11

Configuration Examples

Application Examples

Appendix E

About This Publication

This manual explains how the Guardmaster® MSR57P Speed Monitoring Safety Relay can be used in Safety Integrity Level (SIL) 3, Performance Level (PLe), or Category (CAT) 4 applications. It describes the safety requirements, including PFD and PFH values and application verification information, and provides information on how to install, configure, and troubleshoot the safety relay.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Updated Certifications	152

Who Should Use This Manual

Use this manual if you are responsible for the design, installation, configuration, or troubleshooting of safety applications that use the MSR57P speed monitoring safety relay.

You must have a basic understanding of electrical circuitry and familiarity with relay logic. You must also be trained and experienced in the creation, operation, and maintenance of safety systems.

Conventions

This manual lists configuration parameters by number, followed by the name in brackets. For example, P24 [OverSpd Response].

Terminology

The following table defines the terms that this manual uses.

Abbreviation	Full Term	Definition
1oo2	One out of Two	Refers to the behavioral design of a dual-channel safety system.
CAT	Category	—
DC	Door control	—
DM	Door monitoring	—
EN	European norm	The official European Standard.
ESM	Enabling switch monitoring	—
ESPE	Electro-sensitive Protective Equipment	An assembly of devices and/or components working together for protective tripping or presence-sensing purposes and comprise as a minimum: • Sensing device • Controlling/monitoring devices • Output signal-switching devices (OSSD).
FMEA	Failure mode and effects analysis	Analysis of potential failure modes to determine the effect upon the system and identify ways to mitigate those effects.
IEC	International Electrotechnical Commission	—
IGBT	Insulated gate bipolar transistor	—
HFT	Hardware fault tolerance	The HFT equals *n*, where *n*+1 faults could cause the loss of the safety function. An HFT of 1 means that two faults are required before safety is lost.
HIM	Human interface module	A module used to configure a device.
LM	Lock monitoring	—
MP	Motion power	—
OSSD	Output signal switching device	The component of the electro-sensitive protective equipment (ESPE) connected to the control system of a machine, which, when the sensing device is actuated during normal operation, responds by going to the off state.
PC	Personal computer	Computer used to interface with and program your safety system.
PFD	Probability of a dangerous failure on demand	The average probability of a system to fail to perform its design function on demand.
PFH	Average frequency of a dangerous failure per hour (probability of failure per hour)	The probability of a system to have a dangerous failure occur per hour.
PL	Performance Level	ISO 13849-1 safety rating
RL	Reset loop	—
SDM	Safe direction monitoring	—
SFF	Safe failure fraction	The sum of safe failures plus the sum of dangerous detected failures that are divided by the sum of all failures.
SIL	Safety integrity level	A measure of a products ability to lower the risk that a dangerous failure could occur.
SLS	Safely-limited Speed	—
SMA	Safe Maximum Acceleration	—
SMS	Safe Maximum Speed	—
SS	Safe stop	—
STO	State torque off	—

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Guardmaster MSR57P Speed Monitoring Safety Relay Installation Instructions, publication 440R-IN016	Provides information on installation of the MSR57P safety relay.
HIM Quick Reference, publication 20HIM-QR001	A quick reference for using the HIM keypad.
PowerFlex 1203-USB Converter User Manual, publication DRIVES-UM001	Provides detailed information on installation, configuration, and troubleshooting the 1203-USB converter.
PowerFlex Smart Self-powered Serial Converter User Manual, publication 20COMM-UM001	Provides detailed information on installation, configuration, and troubleshooting the 1203-SSS Series B serial converter.
PowerFlex 700S High Performance AC Drive - Phase II Control Programming Manual, publication 20D-PM001	Provides the information to start-up, program and troubleshoot PowerFlex® 700S Phase II AdjustableFrequency AC drives.
PowerFlex 700 AC Drives – Series A, Frames 0...6 User Manual, publication 20B-UM001	Provides detailed information on installation, wiring, programming, and troubleshooting PowerFlex 700 Series A drives.
PowerFlex 700 AC Drives – Frames 0...10 User Manual, publication 20B-UM002	Provides detailed information on installation, wiring, programming, and troubleshooting PowerFlex 700 Series B drives.
PowerFlex 70 Adjustable Frequency AC Drives User Manual, publication 20A-UM001	Provides detailed information on installation, wiring, programming, and troubleshooting PowerFlex 70 drives.
PowerFlex 70/700 Adjustable Frequency AC Drives Reference Manual, publication PFLEX-RM001	Provides specifications and dimensions, and detailed information about drive operation.
DriveGuard Safe Torque Off Option (Series B) for PowerFlex 40P and PowerFlex 70 User Manual, publication PFLEX-UM003	Provides detailed information installation, wiring, and operating PowerFlex 70 AC drives with the Safe Torque Off option. The manual also includes certification information for the Safe-Off option.
Kinetix 6000 Multi-axis Servo Drive User Manual, publication 2094-UM001	Provides detailed information on installation, connection, configuration, and troubleshooting a Kinetix® 6000 drive. The manual also includes specifications and dimensions.
Kinetix Safe Torque-off Feature Reference Manual, publication GMC-RM002	Provides detailed information on the safety requirements, and connector and wiring diagrams for the Safe Torque Off feature.
Kinetix Motion Control Selection Guide, publication GMC-SG001	Provides features, specifications, and dimensions for selecting Kinetix Motion Control servo drives, motors, actuators, and accessory components.
Ultra3000 Digital Servo Drives Installation Manual, publication 2098-IN003	Provides information on installation and wiring for the Ultra™ 3000 Digital Servo Drives.
Ultra3000 Digital Servo Drives Integration Manual, publication 2098-IN005	Provides power-up procedures, system integration, and troubleshooting tables for the Ultra 3000 Digital Servo Drives.
EtherNet/IP Network Devices User Manual, publication ENET-UM006	Describes how to configure and use EtherNet/IP™ devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, publication ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, publication SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
UL Standards Listing for Industrial Control Products, publication CMPNTS-SR002	Assists original equipment manufacturers (OEMs) with construction of panels, to help confirm that they conform to the requirements of Underwriters Laboratories.
American Standards, Configurations, and Ratings: Introduction to Motor Circuit Design, publication IC-AT001	Provides an overview of American motor circuit design that is based on methods that are outlined in the NEC.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley® industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies that incorporate solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Notes:

Safety Concept

Introduction

This chapter describes the safety Performance Level concept and how the MSR57P speed monitoring safety relay can meet the requirements for SIL CL 3, PLe, or CAT 4 applications.

Safety Certification

The MSR57P speed monitoring safety relay is certified for use in safety applications up to and including SIL CL 3 according to IEC 61508 and EN 62061, Performance Level PLe, and CAT 4 according to ISO 13849-1. Safety requirements are based on the standards current at the time of certification.

The TÜV Rheinland group has approved the MSR57P speed monitoring safety relay for use in safety-related applications where the de-energized state is considered to be the safe state. All examples related to I/O included in this manual are based on achieving de-energization as the safe state for typical Machine Safety and Emergency Shutdown (ESD) systems.

Important Safety Considerations

As a user, you must:

- Set-up, rate for safety, and validate any sensors or actuators that are connected to the system.
- Complete a system-level risk assessment and reassess the system anytime a change is made.
- Certify the system to the desired safety Performance Level.
- Project management and proof tests.
- Program the application software and the device configurations in accordance with the information in this manual.
- Access control to the system, including handling passwords. Analyze all configuration settings and choose the proper setting to achieve the required safety rating.

IMPORTANT When applying functional safety, restrict access to qualified, authorized personnel who are trained and experienced.

ATTENTION: When designing your system, consider how personnel exit the machine if the door locks while they are in the machine. Additional safeguard devices can be required for your specific application.

ATTENTION: An HIM can be used to configure and monitor the MSR57P speed monitoring safety relay. However, the stop button on the HIM does not have safety integrity and must not be used to execute a Safe Stop.
The stop button setting is not maintained through a power cycle. Do not use the stop button with an automatic reset configuration. Unintended motion could result.

Safety Category 4 Performance Definition

To achieve Safety Category 4 according to ISO 13849-1:2015, the safety-related parts must be designed such that:

- The safety-related parts of machine control systems and/or their protective equipment, and their components, must be designed, constructed, selected, assembled, and combined in accordance with relevant standards so that they can withstand expected conditions.
- You must apply basic safety principles.
- A fault in any of its parts does not lead to a loss of safety function.
- A fault is detected at or before the next demand of the safety function, or, if this detection is not possible, then an accumulation of faults must not lead to a loss of the safety function.
- The average diagnostic coverage of the safety-related parts of the control system must be high, including the accumulation of faults.
- The mean time to dangerous failure of each of the redundant channels must be high.
- You must apply measures against common cause failure.

Stop Category Definitions

You must perform a risk assessment to determine the selection of a stop category for each stop function.

- Stop Category 0 is achieved with immediate removal of power to the actuator, which results in an uncontrolled coast-to-stop. Safe Torque Off accomplishes a Stop Category 0 stop.
- Stop Category 1 is achieved with power available to the machine actuators to achieve the stop. Power is removed from the actuators when the stop is achieved.
- Stop Category 2 is a controlled stop with power available to the machine actuators. The stop is followed by a holding position under power.

IMPORTANT When you design the machine application, you must consider the timing and distance for a coast-to-stop (Stop Category 0 or Safe Torque Off). For more information regarding stop categories, refer to EN 60204-1.

Performance Level and Safety Integrity Level (SIL) 3

For safety-related control systems, PL, according to ISO 13849-1, and SIL levels, according to IEC 61508 and EN 62061, include a rating of the system's ability to perform its safety functions. You must include all safety-related components of the control system in both a risk assessment and the determination of the achieved levels.

See the ISO 13849-1, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

See Safety Configuration and Verification on page 121, for more information on the requirements for the configuration and verification of a safety-related system that contains the MSR57P speed monitoring safety relay.

Functional Proof Tests

The functional safety standards require that you perform functional proof tests on the equipment that is used in the system. Proof tests are performed at user-defined intervals and are dependent upon PFD and PFH values.

IMPORTANT Your specific application determines the time frame for the proof test interval.

PFD and PFH Definitions

Safety-related systems can be classified as operating in either a Low Demand mode, or in a High Demand/Continuous mode.

- Low Demand mode: The frequency of demands for operation that are made on a safety-related system is no greater than one per year or no greater than twice the proof test frequency.
- High Demand/Continuous mode: The frequency of demands for operation that are made on a safety-related system is greater than once per year or greater than twice the proof test interval.

The SIL value for a low demand safety-related system is directly related to the order-of-magnitude ranges of average probability of failure to perform its safety function on demand. This value is also called average PFD. The SIL value for a High Demand/Continuous mode safety-related system is directly related to the probability of a PFH.

PFD and PFH Data

These PFD and PFH calculations are based on the equations from Part6 of EN 61508 and show worst-case values.

The following table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

PFD and PFH for 20-year Proof Test Interval

Attribute	Pulse Test ON		Pulse Test OFF (1)
	Single Encoder	Dual Encoder	
PFD	1.23E - 04	5.93E-04	25.9E-04
PFH	7.04E-09	3.38E-09	14.8E-09
SFF	99.3%	99.2%	97.9%

(1) The following parameters are used to configure pulse tests for outputs: P71 [MP Out Mode], P72 [SS Out Mode], P73 [SLS Out Mode], P74 [Door Out Mode]. If you disable pulse tests on any of these outputs, the achievable SIL, Category, and PL ratings of your entire MSR57P safety relay system are reduced. See Outputs on page 47.

Safe State

The safe state encompasses all operation that occurs outside of the other monitoring and stopping behavior that is defined as part of the speed monitoring safety relay. In addition, configuration takes place in the safe state. While the safety relay is in the safe state, all safety control outputs, except the Door Control (DC_Out) output, are in their safe state (de-energized). The DC_Out output is in either the locked state or in the de-energized state, depending upon the condition that resulted in the safe state.

The diagnostic Fault_Status output can be on in the safe state.

When you cycle power, the safety relay enters the safe state for self-testing. If the self-tests pass and there is a valid configuration, the safety relay remains in the safe state until a successful request for safe speed monitoring occurs.

If a Safe State fault is detected, the safety relay goes to the safe state. This state includes faults that are related to integrity of hardware or firmware.

For more information on faults, see Troubleshoot the MSR57P Safety Relay on page 143.

Safety Reaction Time

The safety reaction time is the amount of time from when the system receives a safety-related event input to when the system is in the safe state.

The safety reaction time is 20 ms (max) from an input signal condition that triggers a Safe Stop, to the initiation of the configured Safe Stop type.

The safety reaction time from an overspeed event that triggers a Safe Stop, to the actual initiation of the configured Safe Stop type, is equal to the value of the P24 [OverSpd Response] parameter.

For more information on overspeed response time, see Overspeed Response Time on page 56.

Considerations for Safety Ratings

The achievable safety rating of an application that uses the MSR57 safety relay is dependent upon many factors, including the encoder setup, drive options, output pulse tests, and the type of motor.

When you use two independent encoders to monitor motion, and when installed in a manner to avoid any common cause dangerous failure, the MSR57P safety relay can be used in applications up to and including SIL CL 3, PLe, and CAT 4.

When you use a drive with the STO option and one external contactor, or two external contactors, the MSR57P safety relay can be used in applications up to and including SIL CL 3, PLe, and CAT 4.

IMPORTANT Some of the diagnostics that are performed on the encoder signals require motion to detect faults. You must verify that motion occurs at least once every 6 months.

Output Pulse Test Considerations

If the pulse test of any safety output is disabled, the maximum safety rating is up to and including SIL CL 2, PLd, and CAT 3 for any safety chain that incorporates any input or output of the MSR57P safety relay.

IMPORTANT If you set any of the P71 [MP_Out Mode], P72 [SS_Out Mode], P73 [SLS_Out Mode], or P74 [DC_Out Mode] parameters to 1 = No Pulse Test, it disables internal diagnostics and external diagnostics that are required to achieve higher safety ratings.

You must exercise the SS_In input at least once every 6 months.

You can disable pulse tests if the connected device does not support OSSD inputs. See the product documentation for your connected device.

Considerations for Single-encoder Applications

When configured correctly, the MSR57P safety relay performs these diagnostics on the encoder:

- $Sin^2 + Cos^2$ diagnostic.
- Detection of open or short-circuit.
- Encoder supply voltage monitoring.
- Detection of illegal quadrature transitions of the sine and cosine signals.

A safety rating up to and including SIL CL 3, PLe, and CAT 4 can be achieved in a single-encoder application with these requirements:

- The motor is a Permanent Magnet (PM) brushless AC motor.
- The motor controller must be configured as a closed-loop application with field-oriented control that uses the single-encoder for commutation.
- The motor-to-encoder coupling is designed to exclude shaft slippage as a dangerous failure mechanism.
- The MSR57P safety relay is configured for Sin/Cos encoder type.

  The encoder is of the Sin/Cos type and is suitable for the desired safety rating of the application.

  An encoder that is suitable for SIL CL 3 applications must:

  - Use independent Sine/Cosine signals.
  - Be incapable of producing simulated signals when under an error condition.
  - Use simple or discreet circuitry with no complex or programmable internal devices.
- The controller is not configured for auto transition to encoderless commutation if there is an encoder failure.
- The motor controller must use the same encoder signals as the MSR57P safety relay.
- Encoder voltage monitoring in the MSR57P safety relay must be enabled.
- The system design of the motor/encoder-to-load coupling excludes shaft slippage and breakage as a dangerous failure mechanism.

Single-encoder with Kinetix Drive

A safety rating up to and including SIL CL 3, PLe, and CAT 4 can be achieved in an MSR57P safety relay single-encoder application when the safety relay is used with a properly configured Kinetix® Servo Drive with STO and any motor/encoder combination that meets the single-encoder application requirements that are listed in Considerations for Single-encoder Applications.

Single-encoder with PowerFlex Drive

A safety rating up to and including SIL CL 3, PLe, and CAT 4 can be achieved in an MSR57P safety relay single-encoder application when the safety relay is used with a properly configured PowerFlex® 700S or PowerFlex 755 drive and any motor/encoder combination that meets the single-encoder application requirements that are listed in Considerations for Single-encoder Applications.

For example, to configure a PowerFlex 700S drive properly to meet the single-encoder application requirements listed in Considerations for Single-encoder Applications on page 17, make these parameter settings.

Parameter Number	Parameter Name	Required Drive Parameter Setting	Addresses Single-encoder Requirement
P485	Motor Ctrl Mode	2 = Pmag Motor	The motor controller must be configured as a closed-loop application with field-oriented control that uses the single-encoder for commutation.
P222	Mtr Fdbk Sel Pri	5 = FB Opt Port0	
P153, bit 16	Control options	OFF = Auto Tach Sw	The controller is not configured for auto transition to encoderless commutation if there is an encoder failure.

You must verify that a Sin/Cos feedback option is installed in the drive. The drive must be commissioned according to the normal startup procedure for proper operation in your system.

The MSR57P safety relay is suitable for SIL CL 3, Cat 4 applications when connected to drives that also support Cat 4 applications. Some applications can require an external contactor to meet Cat 4 requirements. See your drive manual for details on safety requirements.

See publication 20D-PM001 for detailed information on installation, configuration, and operation of a PowerFlex 700S drive.

Commutation

Permanent Magnet (PM), brushless AC motors, like those listed previously, are a class of synchronous motor that depends on the electronic brushless commutation to generate torque and motion. In PM brushless motors, the permanent magnets on the rotor create an electromagnetic field. A number of electromagnets that are commutated electronically with IGBTs at the right speed, order, and times, create a rotating magnetic field. Switching the currents in the coils of the stator winding creates movement of the electromagnetic field. This process is called commutation. Interaction of the two electromagnetic fields produces magnetic force or torque.

Excessive noise, broken encoder wires, and loss of the encoder power supply are factors that can affect commutation while the motor is running. To help prevent the motor from spinning, the drive can detect these conditions with the use of safety monitoring circuits.

Contact Information if Device Failure Occurs

If you experience a failure with any safety-certified device, contact your local Allen-Bradley product distributor or Rockwell Automation sales office. With this contact, you can:

- Return the device to Rockwell Automation so the failure is appropriately logged for the affected catalog number and a record is made of the failure.
- Request a failure analysis (if necessary) to determine the probable cause of the failure.

About the MSR57P Speed Monitoring Safety Relay

Introduction

This chapter describes the features of the MSR57P speed monitoring safety relay.

Safety Functions

The MSR57P speed monitoring safety relay features five inputs, three sets of safety outputs, and one bipolar safety output. Each of the inputs supports a specific safety function.

- Safe Stop (SS)
- Safely-limited Speed Monitoring (SLS)
- Door Monitoring (DM)
- Enabling Switch Monitoring (ESM)
- Lock Monitoring (LM)

An additional reset input provides for reset and monitoring of the safety circuit.

The safety relay can be used in single-axis or multi-axis applications, and the safety relay is configurable as a primary or secondary depending on its location in the system.

Safety Modes

The safety relay can be configured to operate in one of 11 user-selectable Safety modes, which are based on combinations of the safety functions listed previously. The safety relay monitors motion for Safe Stop in every mode except Disabled.

Safety Mode	Page
Disabled – All safety functions are disabled.	20
Safe Stop – The safety relay activates the configured Safe Stop type upon deactivation of the Safe Stop input or the occurrence of a Stop Category fault.	67
Safe Stop with Door Monitoring – The safety relay monitors for Safe Stop and the status of the door.	76
Safely-limited Speed – The safety relay monitors for Safe Stop and the feedback velocity. The safety relay compares the feedback velocity to a configurable safe speed limit. If the velocity exceeds the limit, the safety relay initiates the configured Safe Stop type.	79
Safely-limited Speed with Door Monitoring – The safety relay monitors for Safe Stop, Safely-limited Speed, and the status of the door.	82
Safely-limited Speed with Enabling Switch Control – The safety relay monitors for Safe Stop, Safely-limited Speed, and the status of the enabling switch input.	84
Safely-limited Speed with Door Monitor and Enabling Switch – The safety relay monitors for Safe Stop, Safely-limited Speed, the status of the door, and the status of the enabling switch input.	86
Safely-limited Speed (status only) – The safety relay monitors for Safe Stop and the feedback velocity. The safety relay compares the feedback velocity to a configurable safe speed limit. If the velocity exceeds the limit, the system status is made available as a safe output, which is intended for a safety programmable logic controller. No stopping action takes place.	90

Safety Mode	Page
Secondary, Safe Stop – The safety relay performs the same functions as Safe Stop mode. However, the safety relay regards the door monitor input as a door control output from an upstream axis, and performs a logical AND with its internal door control signal to form the cascaded door control output.	95
Secondary, Safely-limited Speed – The safety relay performs the same functions as Safely-limited Speed mode. However, the safety relay regards the door monitor input as a door control output from an upstream axis, and performs a logical AND with its internal door control signal to form the cascaded door control output.	100
Secondary, Safely-limited Speed (status only) – The safety relay performs the same functions as Safely-limited Speed Status Only mode. However, the safety relay regards the door monitor input as a door control output from an upstream axis, and performs a logical AND with its internal door control signal to form the cascaded door control output.	102

Disabled Mode

In Disabled mode, all safety functions are disabled. Input, output, or speed monitoring diagnostics do not take place and all outputs are in their safe state.

Lock Monitoring

Lock monitoring helps prevent access to the hazard during motion. In many applications, it is not sufficient for the machine to initiate a stop command once the door is opened because a high inertia machine can take a long time to stop. The safest condition is to prevent access to the hazard until a safe speed is detected. The lock monitoring feature is used to verify the operation of the door lock mechanism.

Lock monitoring can be enabled on single units or on the first unit in a multi-axis system. If the Lock Monitor input (LM_In) indicates that the door is unlocked when the Door Control output (DC_Out) is in the locked state, or if the lock monitor input indicates locked when the Door Monitor input (DM_In) transitions from closed to open, the configured Safe Stop type is initiated.

Safe Maximum Speed, Safe Maximum Acceleration, and Safe Direction Monitoring

Three additional safety functions, Safe Maximum Speed (SMS), Safe Maximum Acceleration (SMA) and Safe Direction Monitoring (SDM), operate independent of the other modes and rely on the Safe Stop function. When you configure the safety relay for Safe Maximum Speed, the feedback velocity is monitored and compared against a user-configurable limit. If the measured velocity is greater than or equal to the limit, the configured Safe Stop type is executed.

When Safe Acceleration Monitoring is enabled, the safety relay monitors the acceleration rate and compares it to a configured Safe Maximum Acceleration Limit. If acceleration is detected as greater than or equal to the Safe Maximum Acceleration Limit, an Acceleration fault occurs. If an Acceleration fault is detected while the safety relay is actively monitoring motion, the configured Safe Stop type is initiated.

Safe Direction Monitoring is also activated via device configuration. The safety relay monitors the feedback direction and executes the configured Safe Stop type when motion in the illegal direction is detected.

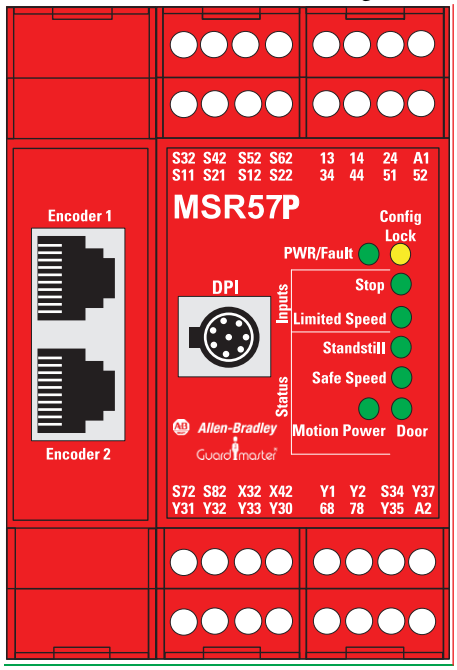
See Safe Maximum Speed and Direction Monitoring on page 113, for detailed information on these functions.

Hardware Features

The MSR57P safety relay features five dual-channel inputs, three sets of sourcing safety outputs, and one bipolar safety output. You can configure dual-channel inputs to accept contact devices with two normally closed contacts, or one normally closed and one normally open contact. They can also be configured for single channel operation.

IMPORTANT Single-channel operation does not meet SIL CL 3, PLe, Cat 4 safety integrity.

These inputs also support output signal switching devices (OSSD). Each output has integral pulse-test-checking circuitry. Two RJ45 connectors support the encoder inputs. The MSR57P safety relay features status indicators and status data for troubleshooting.



Configuration

Configure the MSR57P safety relay, use a HIM (catalog number 20-HIM-A3) to set the configuration parameters. You can also use DriveExplorer™ software, version 5.02 or later, or DriveExecutive™ software [(a)], version 4.01 or later. With all of these configuration tools, you save the configuration and download it to another MSR57P safety relay. You can edit the configuration offline only with DriveExecutive software.

When the safety relay configuration is complete, it can be safety-locked to help prevent unauthorized changes to the safety configuration. If you set a password to protect the safety configuration, you must enter the password before you can lock or unlock the configuration.

If you are using a HIM to configure the safety relay, see Appendix C on page 163 for information on how to connect a HIM and set parameters with the keypad. If you use software to configure the safety relay, see Appendix D on page 165 for information on how to connect to a personal computer and use the software.

(a) RSLinx® software, version 2.50.00 or later, is required for DriveExecutive software.

Notes:

Installation and Wiring

Introduction

This chapter provides details on device connections and how to wire the MSR57P safety relay.

ATTENTION: This device is intended to be part of the safety-related control system of a machine. You must perform a risk assessment before installation to determine whether the specifications of this device are suitable for all foreseeable operational and environmental characteristics for the system to which it is to be installed.

General Safety Information

ATTENTION: Use this product for its intended applications
This equipment must not be used for unintended applications, nor in ways that do not conform to appropriate safety standards and good practices. The safety functions cannot operate properly, or at all, if this equipment is not used for the intended purposes.

Use within specified operating limits.

This product and the equipment on which it is installed, persons handling the product and the equipment, and/or the immediate environment can be harmed if this equipment is operated outside the specified limits of any of its technical specifications.

Qualified technical personnel must install and operate the equipment.

This equipment is to be installed, started up, and operated only by technical personnel who have been trained and understand:

- The products covered by this publication.
- Directives, regulations, and good practices that relate to machine safety.
- Instrumentation and automation components, equipment, and systems.
- Industrial electrical practices.

Up-to-date user documentation must be readily accessible by technical personnel.

The latest version of user documentation that includes instructions for installation, operation, and maintenance of this product must be readily available to personnel involved in any of these tasks.

Identify hazardous areas and dangerous operating modes before using the product.

Machine safety applications make it necessary for hazardous areas and dangerous operating modes to be carefully identified, and adequate measures must be taken to confirm that failure or tampering does not allow automated equipment to be of risk to personnel.

Observe electrical safety regulations and good practices.

Electrical safety regulations stipulated by the appropriate technical authorities must be observed.

Do not use the product if it is damaged or diminished in any way.

Carefully inspect the product before it is installed, or reinstalled. If, at any time, the condition of the product is observed to be diminished in any way so that there is even the slightest possibility of incorrect functioning, you must assume that safe operation is no longer possible, and the equipment must be removed from the system immediately so that unintentional operation is impossible. Examples of such conditions are:

- Visible damage to the equipment.
- Loss of electrical functions.
- Exposure to temperatures higher than the specified operating limit.
- Visible indication of burning.
- Physical damage due to impact or excessive mechanical shock.

Observe all electrical safety regulations stipulated by the appropriate technical authorities.

ATTENTION: Verify that the electrical power supply to the MSR57P safety relay is switched off before making or removing any electrical connections.

Environment and Enclosure

IMPORTANT This product must be installed inside protected control panels or cabinets that are appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet must be IP54 or higher.

See Appendix A on page 151.

Considerations for Reducing Noise

To reduce the effects of Electromagnetic Interference (EMI), follow these guidelines when connecting your system:

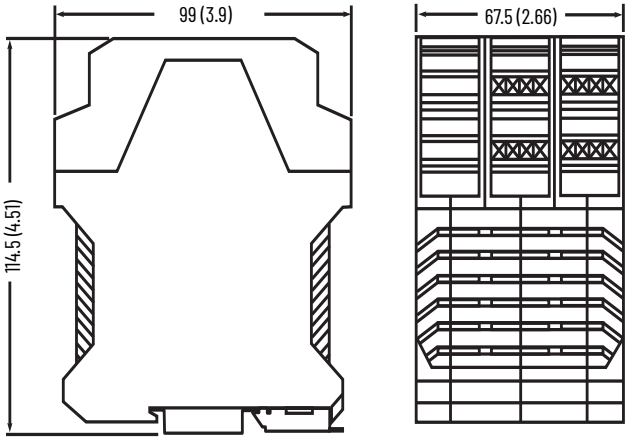
- Keep wire lengths as short as possible.
- Route signal cables away from motor and power wiring.
- Ground all equipment, following the manufacturers instructions.

Additional noise reduction techniques can be necessary.

See publication GMC-RM001 for more information.

Approximate Dimensions

Dimensions [mm (in.)]



Space Requirements

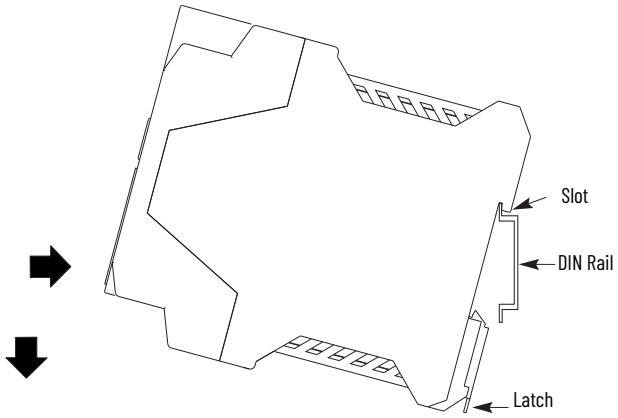
You must provide adequate air space around the system (module cluster). Minimum recommended clearances:

- 15 mm (0.6 in.) above.
- 15 mm (0.6 in.) below.
- 2...3 mm (0.08...0.12 in.) between modules at ambient temperatures higher than 40 °C (104 °F).

Mount the MSR57P Safety Relay

To mount the MSR57P safety relay to an EN50022 -35 x 7.5 DIN rail:

1. Hook the top slot over the DIN rail.
2. Snap the bottom of the safety relay into position while pressing the safety relay down against the top of the rail.



3. Attach end plates on each end of the DIN rail.

To remove the safety relay from the DIN rail, use a screwdriver to pull down the latch and lift the safety relay from the rail.

Power Supply Requirements

The external power supply must conform to the Directive 2006/95/EC Low Voltage, by applying the requirements of EN61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests and one of the following:

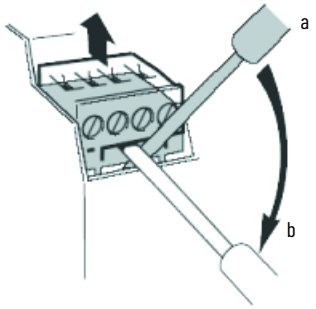
- EN IEC 62368-1- SELV (Safety Extra Low Voltage)
- EN60204 - PELV (Protective Extra Low Voltage)
- UL 508 Limited Voltage Circuit

To meet EN60204 - PELV, 24V DC + 10...20% must be supplied by a power supply that complies with IEC/EN60204 and IEC/EN 61558-1. Such a power supply meets the electrical safety requirements and maintains minimum power of 19.2V DC during 20 ms, even if the voltage dips.

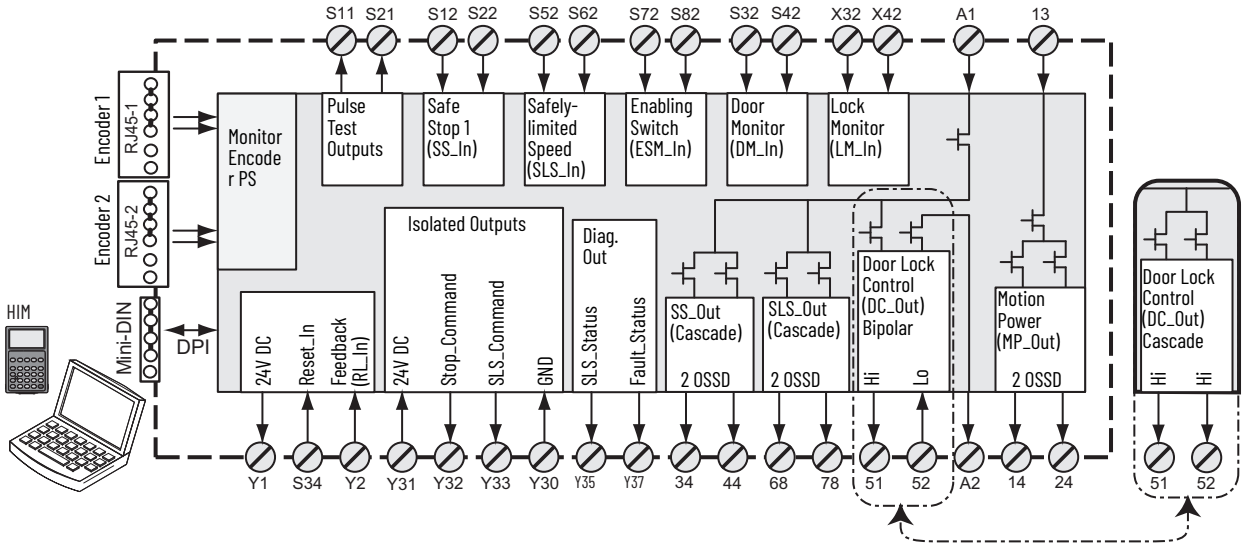
For planning information, see publication 1770-4.1.

Removable Terminal Blocks

To remove an upper terminal block, insert a screwdriver into the slot (a) as shown and push down (b) to disconnect the terminal block. For the lower terminal blocks, reverse the direction of the action.



Circuit Diagram



Terminal Connections

Tighten all terminal screws firmly and recheck them after all connections are made. Recommended terminal screw torque is 0.6...0.8 N•m (5...7 lb•in).

Terminal	Function
A1	+24V DC, user supply (1)
A2	Common, user supply
S11, S21	Test_Out_0, Test_Out_1, pulse test output for Safe Stop (SS), Safely-limited Speed (SLS), Enabling Switch Monitor (ESM), Door Monitor (DM), and Lock Monitor (LM)
S12, S22	SS_In_Ch0, SS_In_Ch1, Safe Stop (SS) dual-channel input
S72, S82	ESM_In_Ch0, ESM_In_Ch1, Enabling Switch Monitoring (ESM) dual-channel input
S52, S62	SLS_In_Ch0, SLS_In_Ch1, Safely-limited Speed (SLS) dual-channel input
S32, S42	DM_In_Ch0, DM_In_Ch1, Door Monitoring (DM) dual-channel input
X32, X42	LM_In_Ch0, LM_In_Ch1, Lock Monitor (LM) dual-channel input, solenoid position
Y1	24V DC output; RL Feed for reset (S34) and for feedback (Y2)
S34	Reset_In
Y2	RL_In, feedback input
Y35	SLS_Status output
Y37	Fault_Status output
13	Supply power for SS safety output 14 and Motion Power (MP) safety output 24
14, 24	MP_Out_Ch0, MP_Out_Ch1, Motion Power (MP) outputs
68, 78	SLS_Out_Ch0, SLS_Out_Ch1, Safely-limited Speed (SLS) outputs
51	DC_Out_Ch0 (High Side), Door Control output (door switch solenoid, bipolar or 2 Channel Source)
52	DC_Out_Ch1 (Low Side), Door Control output (door switch solenoid, bipolar or 2 Channel Source)
34, 44	SS_Out_Ch0, SS_Out_Ch1, Safe Stop (SS) outputs
Y31	24V DC power for isolated outputs
Y32	Stop_Command, isolated output
Y33	SLS_Command, isolated output
Y30	GND for isolated outputs

(1) The MSR57P safety relay can be powered when 24V power is removed from terminal A1 and a sourcing safety output is shorted to 24V. If A1 power must be removed, also remove any power that could be shorted to a safety sourcing output.

Compatible Encoders

These feedback devices are supported.

Supported Feedback Devices

Description	Cat. No.	Additional Resources
Sin/Cos Encoders (1)	842HR-x*J*xxx15FWY*x*	See publication 842HR-IN001, for more information on these encoders.
Incremental Encoders (1)	845T-*xx*12*xxx*-*x* and 845T-*xx*13*xxx*-*x* 845T-*xx*42*xxx* and 845T-*xx*43*xxx*-*x* 845T-*xx*52*xxx* and 845T-*xx*53*xxx*-*x*	See publication 845T-IN003 more information about Bulletin 845T incremental encoders.
	845H-SJ*xxx*4*xx*Y*xx*	See publication 842H-IN003 more information about Bulletin 845H incremental encoders.
Rotary Motors	1326AB-B*xxxx*-M2L/-S2L	See publication GMC-SG001, for more information on these motors.
	Kinetix® HPK Asynchronous Servo Motor	
	Kinetix MP Motors with embedded Sin/Cos or incremental encoders	
	Kinetix TL (TLY-A*xxxxx*-H) Motors with incremental encoders	
	Any motor with SHS-170 Stegmann encoder	See the product documentation for your specific motor to determine the encoder type.
	Any motor with SCS-60 Stegmann encoder	
	Any motor with SRS-60 Stegmann encoder	
	Any motor with SRM-60 Stegmann encoder	
	Any motor with SCS-Kit 101 Stegmann encoder	
	Any motor with SRS660 Stegmann encoder	
Linear Actuators	Kinetix MP Integrated Linear Stages	See publication GMC-SG001, for more information on these actuators.

(1) Maximum cable length for encoders is 90 m (295 ft).

Connect an Encoder

Use twisted-pair, individually shielded cable to connect encoders and drives. See your encoder or drive manual for proper cable type and maximum length.

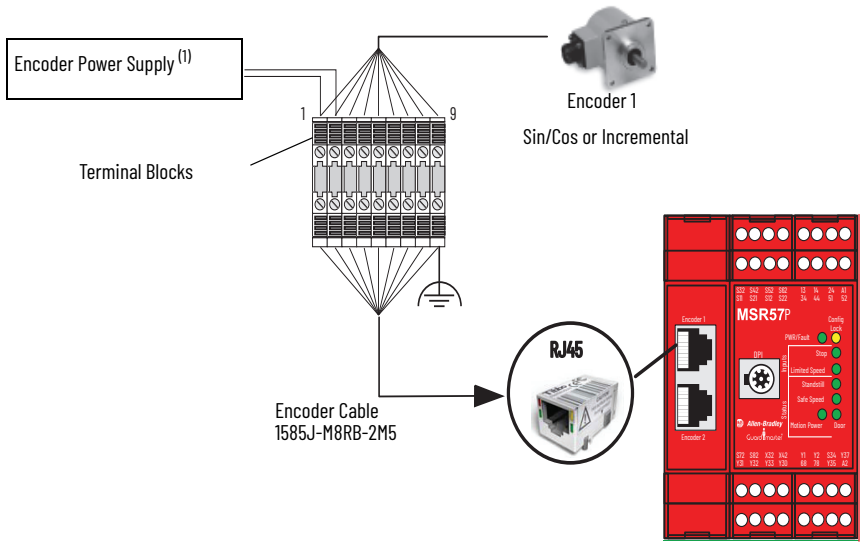
IMPORTANT The drive or encoder and the MSR57P safety relay power supply reference must be the same.

IMPORTANT The MSR57P safety relay has an internal resistance of 600 W on each of the encoder signals to achieve an equivalent load resistance of 100 W if used with a drive that has 120 W internal ending resistors. Your encoder can require that the equivalent load resistance is 100 W or greater. See your encoder user manual to verify that the equivalent termination resistance does not exceed the encoder signal load specification.

ATTENTION: Do not use external ending resistors with PowerFlex® or Kinetix drives. Doing so can permanently damage the drive.

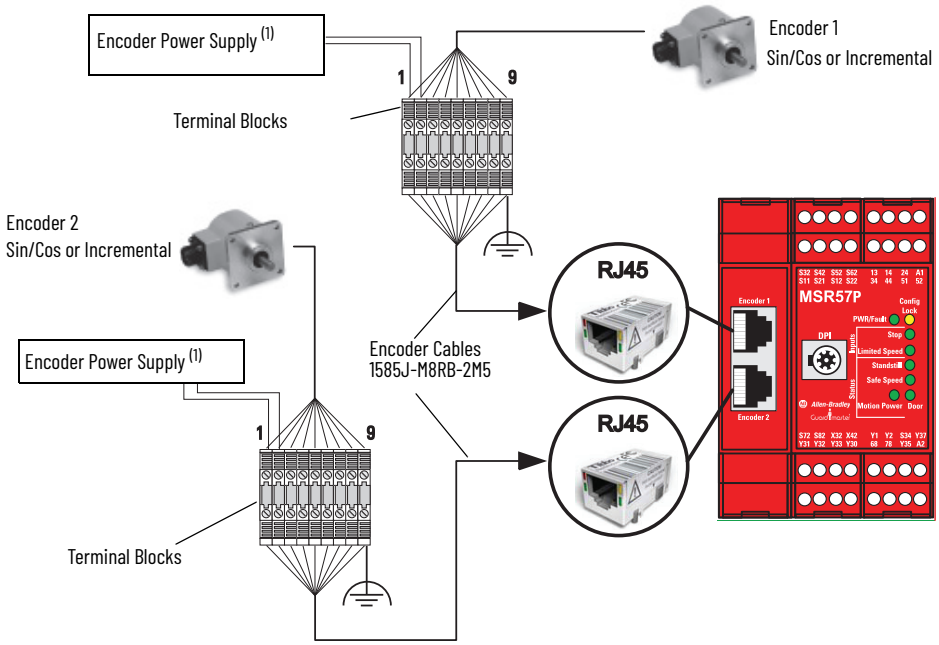
Figure 1 on page 28...Figure 7 on page 32 show examples of how to connect an MSR57P safety relay with an encoder, with or without a drive.

Figure 1 - Single Encoder without a Drive



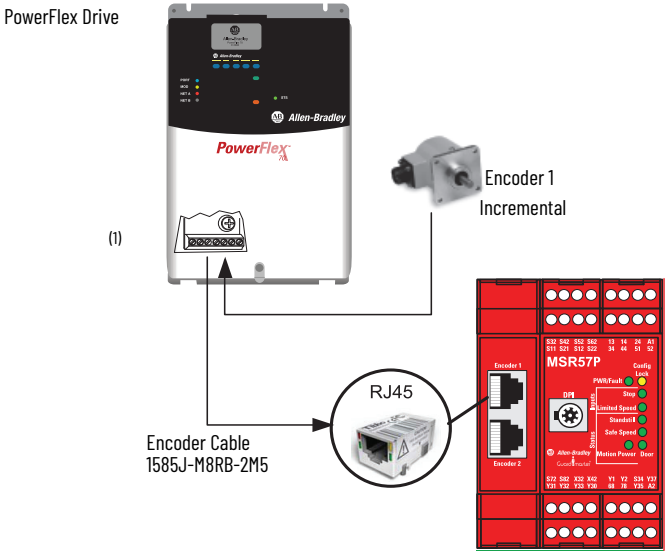
(1) Refer to your encoder specifications to determine power supply requirements (5V, 9V, 12V, or 24V).11

Figure 2 - Two Encoders without a Drive



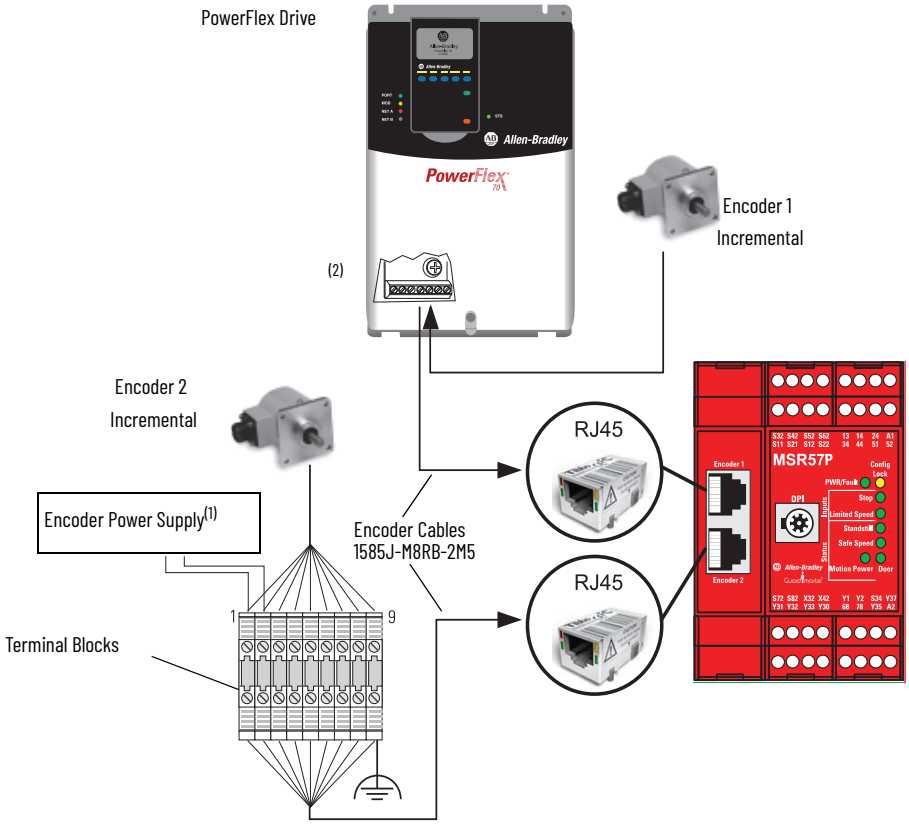
(1) Refer to your encoder specifications to determine power supply requirements (5V, 9V, 12V, or 24V).

Figure 3 - Single Encoder with PowerFlex Drive



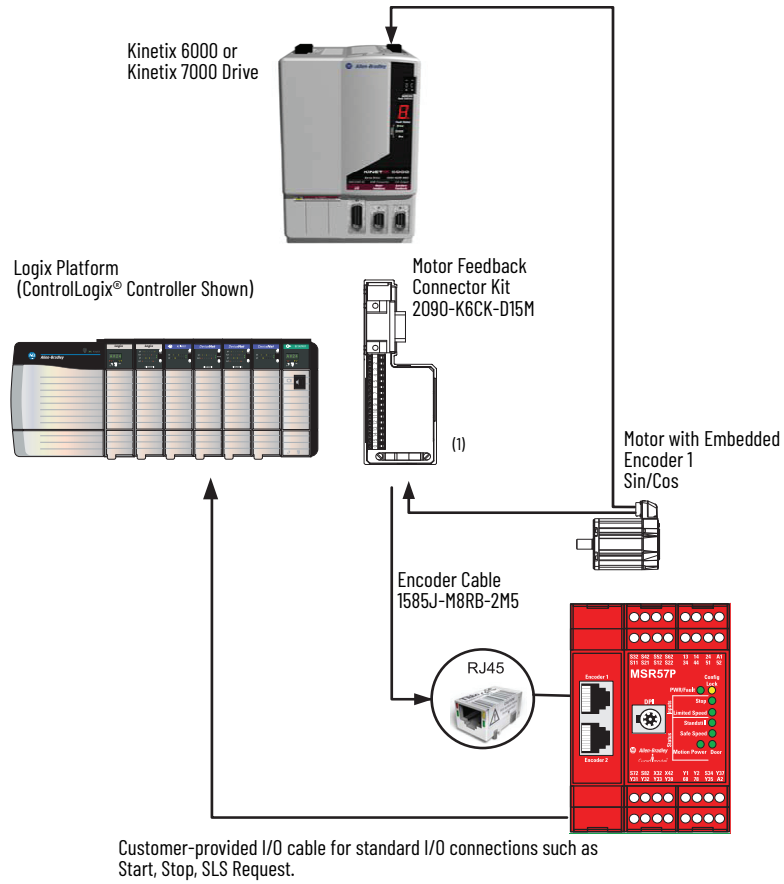
(1) End the shield to functional earth at the drive end. See Encoder Interface Terminal Block (Enhanced Control Only) on page 40.
Encoder power (5V or 12V) sourced from the drive.

Figure 4 - Two Encoders with PowerFlex Drive



(1) Refer to your encoder specifications to determine power supply requirements (5V, 9V, 12V, or 24V).
(2) End the shield to functional earth at the drive end. See Encoder Interface Terminal Block (Enhanced Control Only) on page 40.
Encoder power (5V or 12V) sourced from the drive.

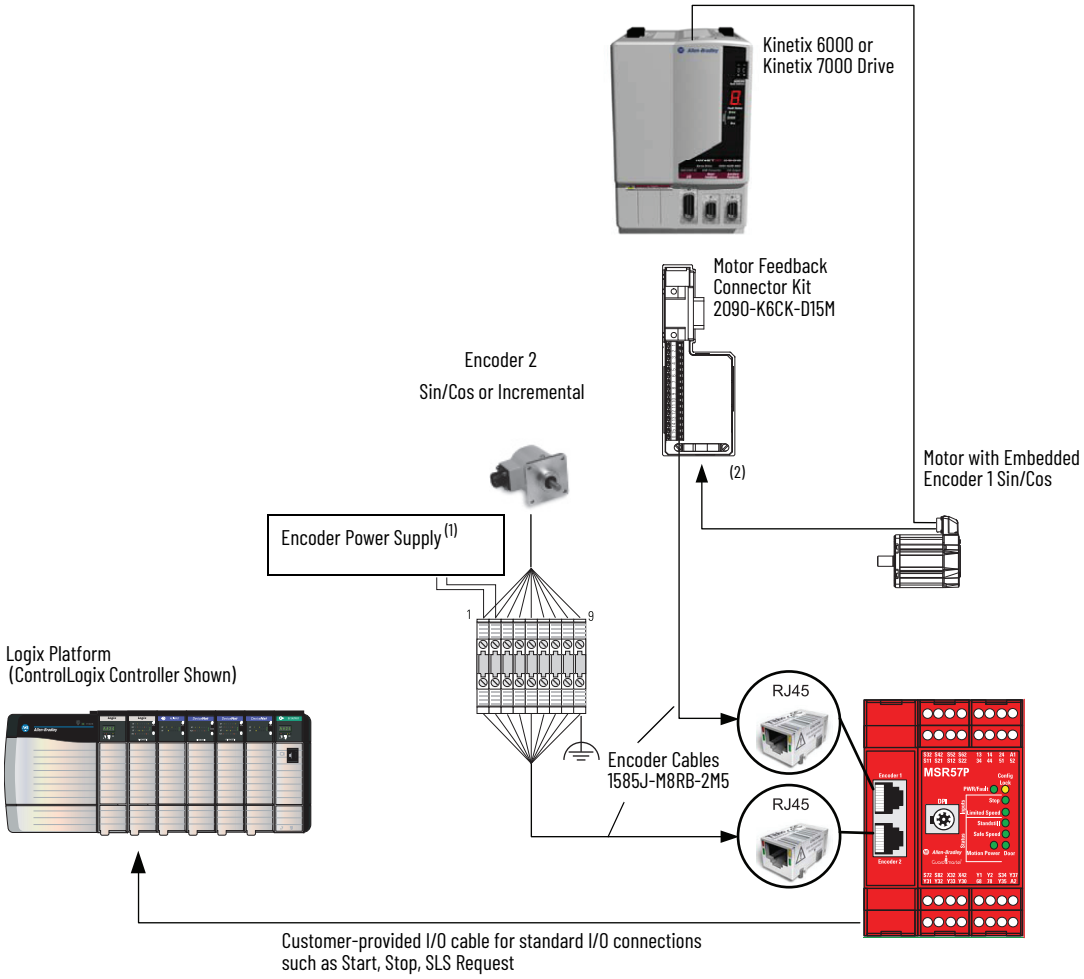
Figure 5 - Single Encoder with a Kinetix 6000 or Kinetix 7000 Drive



(1) End the shield to the functional earth at the drive end. See Figure 8 on page 39.

In Figure 6, the drive only monitors feedback from Encoder 1.

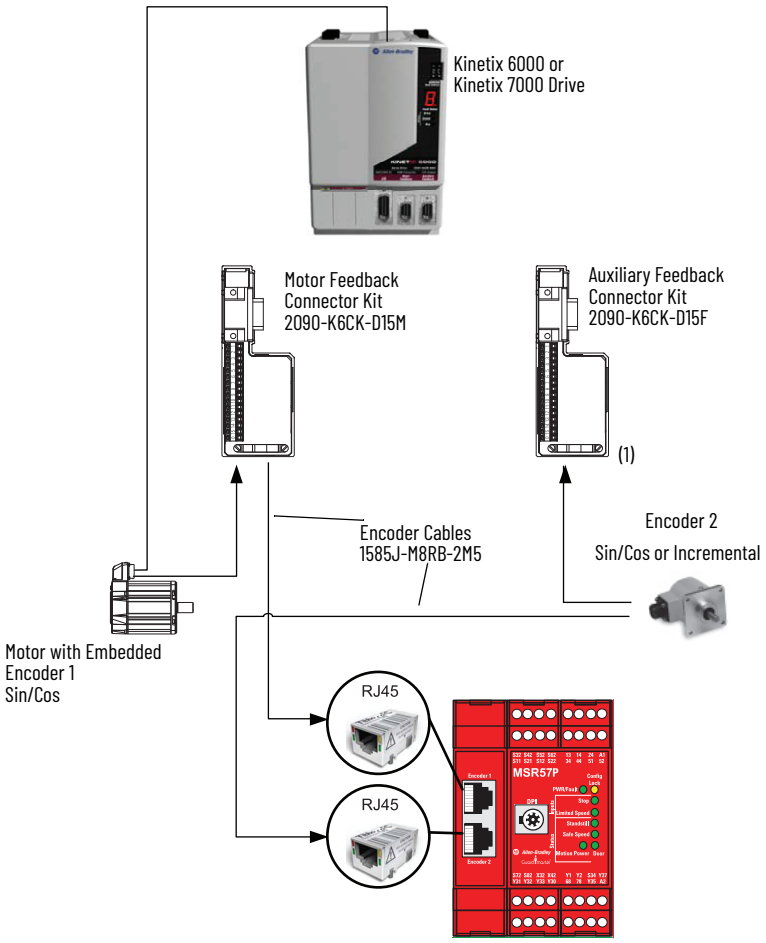
Figure 6 - Two Encoders with a Kinetix 6000 or Kinetix 7000 Drive



(1) Refer to your encoder specifications to determine power supply requirements (5V or 9V).
(2) End the shield to the functional earth at the drive end. See Figure 8 on page 39.

In Figure 7, the drive monitors feedback from both encoders.

Figure 7 - Monitoring Feedback from Two Encoders with a Kinetix 6000 or Kinetix 7000 Drive

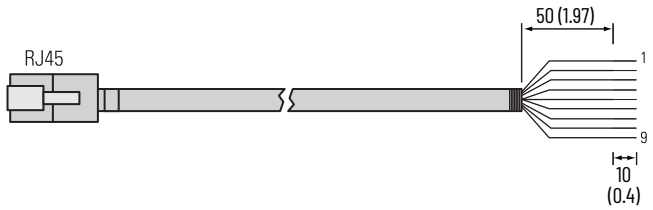


(1) End the shield to functional earth at the drive end. See Figure 8 on page 39.

Encoder Cable Specifications

To connect the MSR57P safety relay, use a catalog number 1585J-M8RB-2M5 cable.

1585J-M8RB-2M5 Cable [mm (in.)]



2.5 m (8.2 ft) Cable Cat. No.	Connection to MSR57P Safety Relay	Connection to Encoder	Connection to Drive or Power Supply
1585J-M8RB-2M5	RJ45	Flying leads	Flying leads

1585J-M8RB-2M5 Flying Lead Wires

Pin Number	Wire Color	Signal
1	White/Orange	GND
2	Orange	VCC
3	White/Blue	A1-/SIN1-REF
4	Blue	A1+/SIN1+
5	Green	NC
6	White/Brown	B1-/COS1-REF
7	White/Green	NC
8	Brown	B1+/COS1+
9	Bare	Shield (case) (1)

(1) End the encoder shield to functional earth at the drive.

Feedback Cable Connections for Motion Control Applications

To connect your MSR57P safety relay to a Kinetix 2000, Kinetix 6000, Kinetix 7000 or Ultra™ 3000 drive, review the connector options and compatible cable and motor types that are listed in the following tables.

Connector Options for Connecting Motor and Auxiliary Feedback

Connection Option	Connector Kit Cat. No.	Description	Using this Type of Cable
Low-profile connectors for Kinetix 6000 and Kinetix 7000 Drives	2090-K6CK-D15M	Motor feedback connector kit	See Table 1 on page 34.
	2090-UXBK-D15*xx*	15-pin panel-mounted breakout board kit	
	2090-K6CK-D15F	Auxiliary feedback connector kit	User-supplied flying lead cable.
Low-profile connectors for Kinetix 2000 Drives	2090-K2CK-D15M	Motor feedback connector kit	See Table 1 on page 34.
	2090-K2CK-COMBO	Motor, auxiliary, and I/O feedback connector kit	
	2090-UXBK-D15*xx*	15-pin panel-mounted breakout board kit	
Flying lead cable at the Ultra3000 drive end with one of these three kits.	2090-UXBB-DM15	15-pin drive-mounted breakout board	
	2090-UXBK-D15*xx*	15-pin panel-mounted breakout board kit	
	2090-UXCK-D15	15-pin (high-density D-shell) drive connector kit	

Table 1 - Motor Feedback Cables for Specific Motor/Feedback Combinations

Compatible Drives (1)				Motor Series	Feedback Type	Flying Lead Feedback Cable	Pinout
Ultra3000	Kinetix 2000	Kinetix 6000	Kinetix 7000				
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A*xxxx*-M/S	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XX*x*FMP-S*xx* (2) (3) or 2090-XXNFMF-S*xx* (non-flex) (4) or 2090-CFBM4DF-CDAF*xx* (continuous-flex) (4)	Motors Using the 2090-XXxFMP-Sxx Feedback Cable on page 35
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B*xxxx*-M/S			
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	1326AB-B*xxxx*-M2L 1326AB-B*xxxx*-S2L			
—	—	—	2099-BM*xx*-S	MPL-B5*xxx*-M/S, MPL-B6*xxx*-M/S, MPL-B8*xxx*-M/S, MPL-B9*xxx*-M/S			
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A3*xxx*-H MPL-A4*xxx*-H MPL-A45*xxx*-H	Incremental encoder		
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A*xxxx*-V/E MPF-A*xxxx*-M/S MPS-A*xxxx*-M/S	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XXNFMF-S*xx* (non-flex) (4) or 2090-CFBMxDF-CDAF*xx* (continuous-flex) (4)	Motors Using 2090-XXNFMF-Sxx or 2090-CFBM4DF-CDAFxx Feedback Cable on page 36 and Table 7 on page 37
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B*xxxx*-V/E MPF-B*xxxx*-M/S MPS-B*xxxx*-M/S			
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A15*xxx*-H MPL-A2*xxx*-H	Incremental encoder		
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B15*xxx*-H MPL-B2*xxx*-H			
—	—	—	2099-BM*xx*-S	Kinetix HPK	High-resolution encoder		
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	TLY-A*xxxx*-H	Incremental encoder	2090-CFBM6DF-CBAA*xx*	Motors Using 2090-CFBM6DF-CBAAxx Cables on page 38
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPAS-A*xxxx*-V/A	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XXNFMF-S*xx* (non-flex) (4) or 2090-CFBM4DF-CDAF*xx* (continuous-flex) (4)	Motors Using 2090-XXNFMF-Sxx or 2090-CFBM4DF-CDAFxx Feedback Cable on page 36 and Table 7 on page 37
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPAS-B*xxxx*-V/A			
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A*xxxx*-M/S	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XX*x*FMP-S*xx* (5) (6) or 2090-XXNFMF-S*xx* (non-flex) (7) or 2090-CFBM4DF-CDAF*xx* (continuous-flex) (4)	Motors Using the 2090-XXxFMP-Sxx Feedback Cable on page 35
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B*xxxx*-M/S			
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	1326AB-B*xxxx*-M2L 1326AB-B*xxxx*-S2L			

(1) See publication GMC-SG001 for detailed information on the compatibility of specific drive and motor combinations.
(2) For Kinetix MPL motors equipped with bayonet-style connectors.
(3) These cables are available as non-flex (catalog number 2090-XXNFMP-S*xx*) and continuous-flex (catalog number 2090-XXTFMP-S*xx*).
(4) For Kinetix MPL motors equipped with DIN-style connectors.
(5) For Kinetix MPL motors equipped with bayonet-style connectors.
(6) These cables are available as non-flex (catalog number 2090-XXNFMP-S*xx*) and continuous-flex (catalog number 2090-XXTFMP-S*xx*).
(7) For Kinetix MPL motors equipped with DIN-style connectors.

Flying Lead Feedback Cable Pinouts

Motors Using the 2090-XXxFMP-Sxx Feedback Cable

Table 2 - MPL-Bxxx-M/-S, MPL-A5xxx-M/-S, and 1326AB-Bxxx-M2L/-S2L Motors

Drive Side					MSR57P Safety Relay Side		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
A	Black	Sine+	1	–>	4	Blue	A1+/SIN1+
B	White/Black	Sine-	2	–>	3	White/Blue	A1-/SIN1-REF
C	Red	Cos+	3	–>	8	Brown	B1+/COS1+
D	White/Red	Cos-	4	–>	6	White/Brown	B1-/COS1-REF
E	Green	Data+	5		NC		
F	White/Green	Data-	10		NC		
K	Gray	EPWR_5V	14		NC		
L	White/Gray	ECOM	6	–>	1	White/Orange	GND
N	Orange	EPWR_9V	7	–>	2	Orange	VCC
R		TS+	11		NC		
T		S1	12		NC		
U		S2	13		NC		
V		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) Bayonet-style connector.
(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Table 3 - MPL-A3*xxx*-M/-S, MPL-A4*xxx*-M/-S, and MPL-A45*xxx*-M/-S Motors

Drive Side					MSR57P Safety Relay Side		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
A	Black	Sine+	1	–>	4	Blue	A1+/SIN1+
B	White/Black	Sine-	2	–>	3	White/Blue	A1-/SIN1-REF
C	Red	Cos+	3	–>	8	Brown	B1+/COS1+
D	White/Red	Cos-	4	–>	6	White/Brown	B1-/COS1-REF
E	Green	Data+	5		NC		
F	White/Green	Data-	10		NC		
K	Gray	EPWR_5V	14	–>	2	Orange	VCC
L	White/Gray	ECOM	6	–>	1	White/Orange	GND
N	Orange	EPWR_9V	7		NC		
R		TS+	11		NC		
T		S1	12		NC		
U		S2	13		NC		
V		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g (2)	Bare	Shield (case)

(1) Bayonet-style connector.
(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Table 4 - MPL-A3*xxx*-H, MPL-A4*xxx*-H, and MPL-A45*xxx*-H Motors

Drive Side					MSR57P Safety Relay Side		
					1585J-M8RB-2M5 Cable		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		Pin	Wire Color	Signal
A	Black	AM+	1	–>	4	Blue	A1+/SIN1+
B	White/Black	AM-	2	–>	3	White/Blue	A1-/SIN1-REF
C	Red	BM+	3	–>	8	Brown	B1+/COS1+
D	White/Red	BM-	4	–>	6	White/Brown	B1-/COS1-REF
E	Green	IM+	5		NC		
F	White/Green	IM-	10		NC		
K	Gray	EPWR_5V	14	–>	2	Orange	VCC
L	White/Gray	ECOM	6	–>	1	White/Orange	GND
N	Orange	EPWR_9V	7		NC		
R		TS+	11		NC		
T		S1	12		NC		
U		S2	13		NC		
V		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) Bayonet-style connector.
(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Motors Using 2090-XXNFMF-Sxx or 2090-CFBM4DF-CDAFxx Feedback Cable

Table 5 - MPL-B15*xxx*-V/-E, MPL-B2*xxx*-V/-E, MPF/MPS-B*xxx*-M/-S, MPF-A5*xx*-M/-S Motors, and MPAS-B*xxxx*-V*xx*S*x*A Linear Stages

Drive Side					MSR57P Safety Relay Side		
					1585J-M8RB-2M5 Cable		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		Pin	Wire Color	Signal
1	Black	Sine+	1	–>	4	Blue	A1+/SIN1+
2	White/Black	Sine-	2	–>	3	White/Blue	A1-/SIN1-REF
3	Red	Cos+	3	–>	8	Brown	B1+/COS1+
4	White/Red	Cos-	4	–>	6	White/Brown	B1-/COS1-REF
5	Green	Data+	5		NC		
6	White/Green	Data-	10		NC		
9	Gray	EPWR_5V	14		NC		
10	White/Gray	ECOM	6	–>	1	White/Orange	GND
11	Orange	EPWR_9V	7	–>	2	Orange	VCC
13		TS+	11		NC		
15		S1	12		NC		
16		S2	13		NC		
17		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) DIN connector.
(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Table 6 - MPL-A15*xxx*-V/-E, MPL-A2*xxx*-V/-E, MPF/MPS-A3*xx*-M/-S, MPF/MPS-A4*xx*-M/-S, MPF/MPS-A45*xx*-M/-S, MPS-A5*xx*-M/-S Motors, and MPAS-A*xxxx*-V*xx*S*x*A Linear Stages

Drive Side					MSR57P Safety Relay Side		
					1585J-M8RB-2M5 Cable		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		Pin	Wire Color	Signal
1	Black	Sine+	1	–>	4	Blue	A1+/SIN1+
2	White/Black	Sine-	2	–>	3	White/Blue	A1-/SIN1-REF
3	Red	Cos+	3	–>	8	Brown	B1+/COS1+
4	White/Red	Cos-	4	–>	6	White/Brown	B1-/COS1-REF
5	Green	Data+	5		NC		
6	White/Green	Data-	10		NC		
9	Gray	EPWR_5V	14	–>	2	Orange	VCC
10	White/Gray	ECOM	6	–>	1	White/Orange	GND
11	Orange	EPWR_9V	7		NC		
13		TS+	11		NC		
15		S1	12		NC		
16		S2	13		NC		
17		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) DIN connector.
(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Table 7 - MPL-A15*xxx*-H, MPL-A2*xxx*-H, MPL-B15*xxx*-H, MPL-B2*xxx*-H Motors, and MPAS-A/B*xxxx*-ALM*x*2C Linear Stages

Drive Side					MSR57P Safety Relay Side		
					1585J-M8RB-2M5 Cable		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		Pin	Wire Color	Signal
1	Black	AM+	1	–>	4	Blue	A1+/SIN1+
2	White/Black	AM-	2	–>	3	White/Blue	A1-/SIN1-REF
3	Red	BM+	3	–>	8	Brown	B1+/COS1+
4	White/Red	BM-	4	–>	6	White/Brown	B1-/COS1-REF
5	Green	IM+	5		NC		
6	White/Green	IM-	10		NC		
9	Gray	EPWR_5V	14	–>	2	Orange	VCC
10	White/Gray	ECOM	6	–>	1	White/Orange	GND
11	Orange	EPWR_9V	7		NC		
13		TS+	11		NC		
15		S1	12		NC		
16		S2	13		NC		
17		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) DIN connector.
(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Motors Using 2090-CFBM6DF-CBAAxx Cables

Table 8 - TLY-A*xxxx*-H Motors

Drive Side					MSR57P Safety Relay Side		
Motor Connector Pin		Signal	Drive CN2 Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
9	Black	AM+	1	–>	4	Blue	A1+/SIN1+
10	White/Black	AM-	2	–>	3	White/Blue	A1-/SIN1-REF
11	Red	BM+	3	–>	8	Brown	B1+/COS1+
12	White/Red	BM-	4	–>	6	White/Brown	B1-/COS1-REF
13	Green	IM+	5		NC		
14	White/Green	IM-	10		NC		
22	Gray	EPWR_5V	14	–>	2	Orange	VCC
23	White/Gray	ECOM	6	–>	1	White/Orange	GND
15		S1	12		NC		
17		S2	13		NC		
19		S3	8		NC		
24		Shield		–>	1	White/Orange	GND
					NC		
					NC		
					NC		
					5	Green	NC
					7	White/Green	NC
					g(1)	Bare	Shield (case)

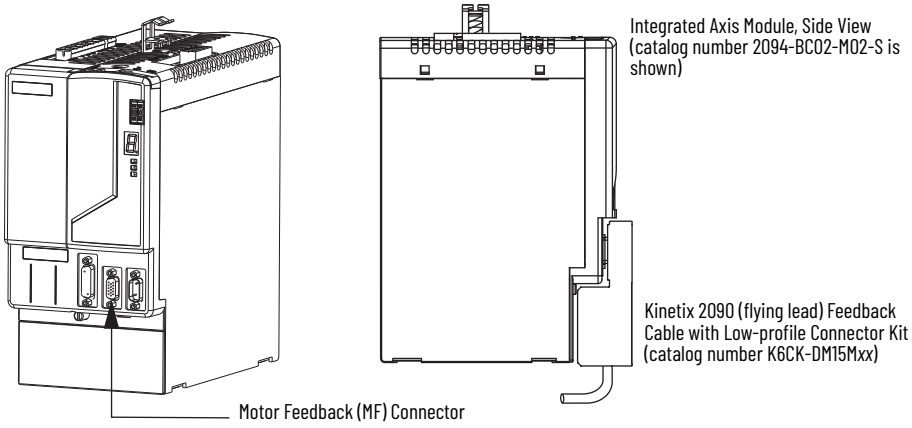
(1) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See Figure 8 on page 39.

Wiring Low-profile Connector Kits

Low-profile connector kits (catalog number 2090-K6CK-D*xxx*) are suitable for motor feedback (MF), auxiliary feedback (AF), and I/O (IOD) connections on any Kinetix 6000 IAM or AM module or on a Kinetix 7000 drive when used with an MSR57P safety relay.

Use the low-profile connector kit (catalog number 2090-K2CK-D15M or 2090-K2CK-COMBO) for Kinetix 2000 drives.

Kinetix 6000 Integrated Axis Module/Axis Module (MF connector) Example

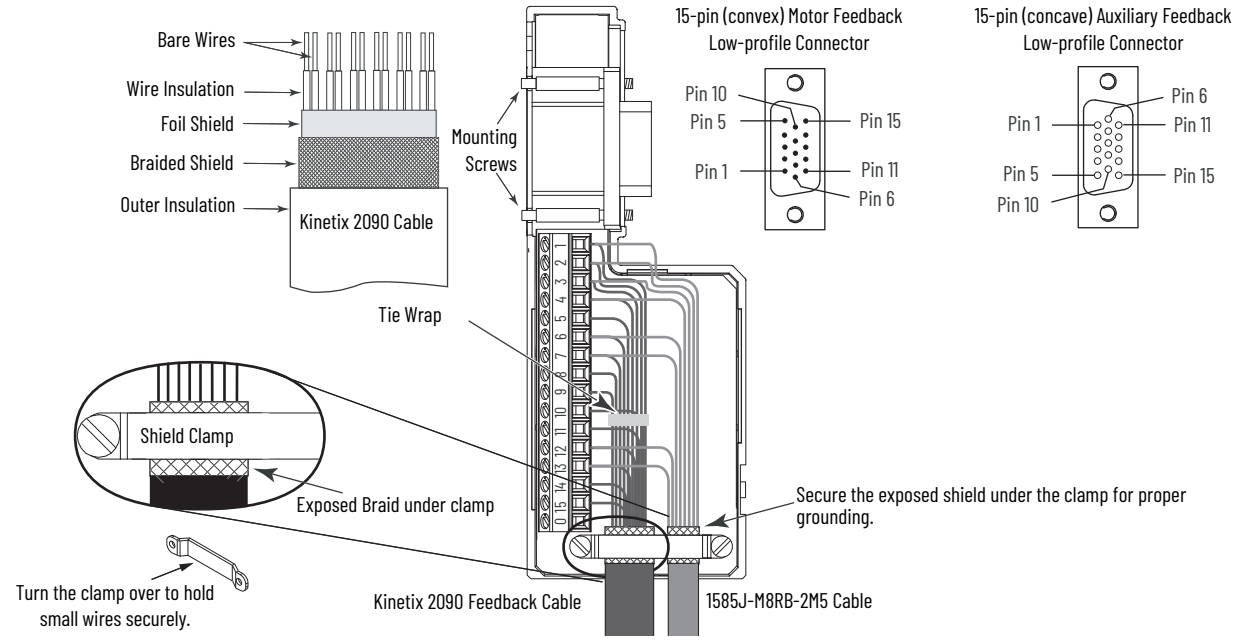


IMPORTANT It is essential to tighten the mounting screws to confirm that the shield integrity of the low-profile connector covers with the drive feedback connector D-shells. Use 0.4 N•m (3.5 lb•in) torque.

For detailed information on connections and important wiring requirements regarding Kinetix 2000, Kinetix 6000, Kinetix 7000, and Ultra3000 drives, see the following publications:

- 2093-UM001
- 2094-UM001
- 2099-UM001
- 2098-IN005
- 2098-IN003
- GMC-RM001

Figure 8 - Wiring (15-pin) Flying Lead Feedback Cable Connections

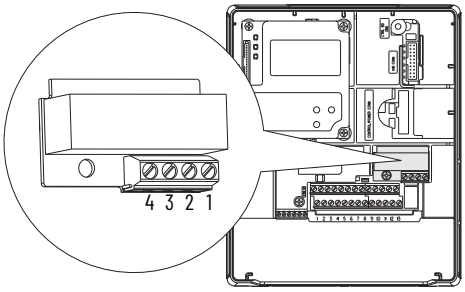


Feedback Connections for PowerFlex 70 Drives

IMPORTANT For detailed information in the installation and connection of PowerFlex 70 drives, including important wiring requirements, see publications:

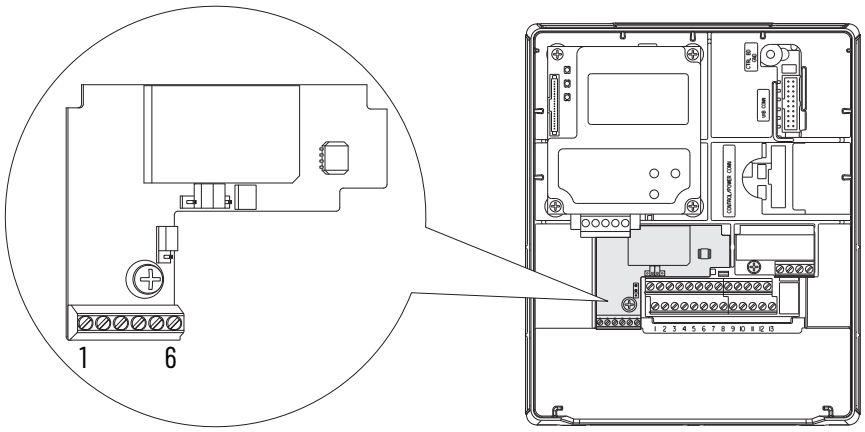
- 20A-UM001
- PFLEX-UM003
- DRIVES-IN001

Safe Torque Off Terminal Block (Enhanced Control Only)



No.	Signal	Description
1	Monitor - N.C.	Normally closed contacts for monitoring safety relay status. Maximum resistive load: 250V AC / 30V DC / 50VA / 60 W Maximum inductive load: 250V AC / 30V DC / 25VA / 30 W
2	Common - N.C.	
3	+24V DC	Connections for user supplied power to energize coil.
4	24V Common	

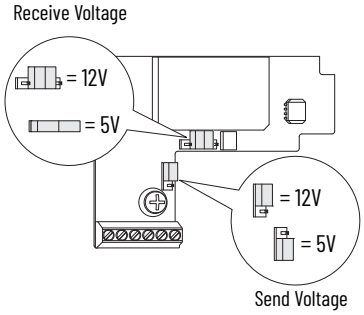
Encoder Interface Terminal Block (Enhanced Control Only)



PowerFlex 70 Side			MSR57P Safety Relay Side		
Terminal	Signal		Pin	Color	Signal
1	5-12V Power (1)	–>	2	Orange	VCC
2	Power Return	–>	1	White/Orange	GND
3	Encoder B (NOT)	–>	6	White/Brown	B1-/COS1-
4	Encoder B	–>	8	Brown	B1+/COS1+
5	Encoder A (NOT)	–>	3	White/Blue	A1-/SIN1-
6	Encoder A	–>	4	Blue	A1+/SIN1+
CASE	Shield	–>	9	Bare	Shield

(1) Jumper selectable +5/12V is available on 20A-ENC-1 encoder boards.

Jumper Settings



Set the jumper according to your encoder specifications.

Encoder Wiring Examples

Figure 9 and Figure 10 show examples of how to connect encoder power and encoder signals.

Figure 9 - Encoder Power

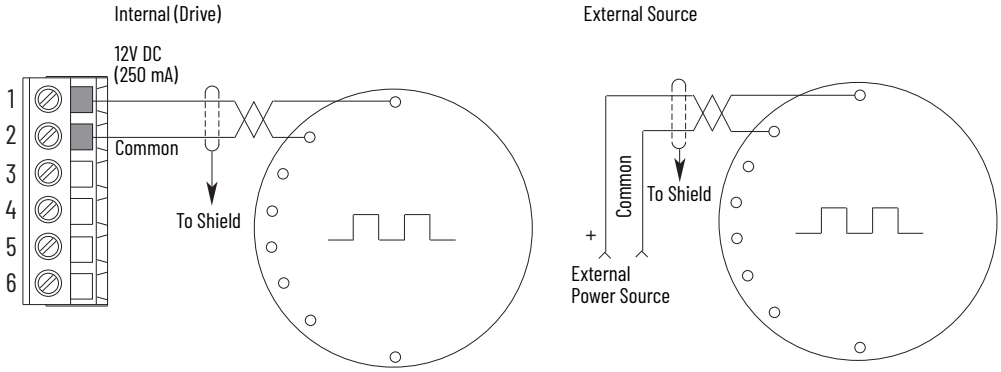
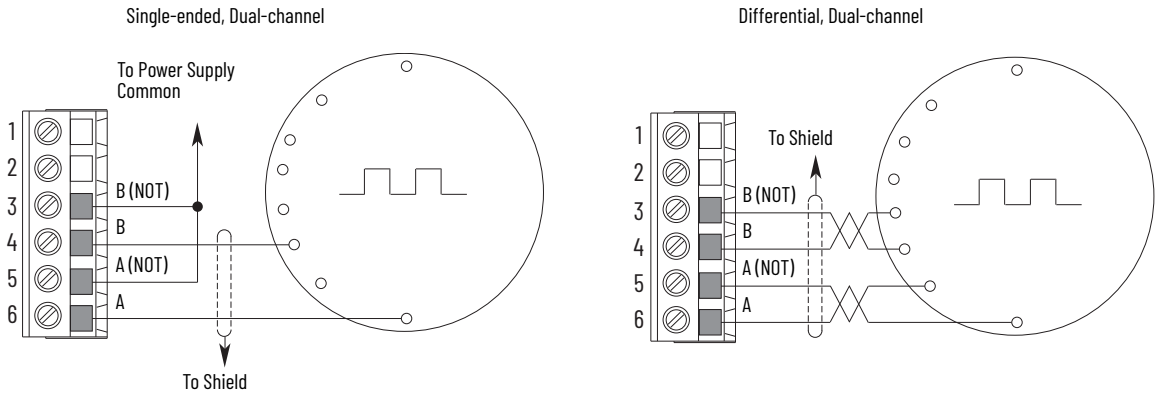


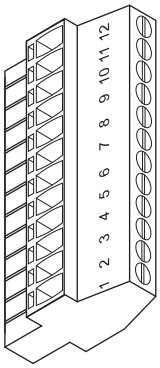
Figure 10 - Encoder Signal



Feedback Connections for PowerFlex 700S Drives

Use the terminal connection information in Table 9 on page 42 to connect the MSR57P safety relay to a PowerFlex 700S drive.

Table 9 - Terminal Connections

PowerFlex 700S Side				MSR57P Safety Relay Side		
	Terminal	**Signal**		**Pin**	**Color**	**Signal**
	12	Power Common	–>	1	White/Orange	GND
	11	POWER	–>	2	Orange	VCC
	10	REFSIN	–>	3	White/Blue	A1-/SIN1-
	9	+SIN	–>	4	Blue	A1+/SIN1+
	8	REFCOS	–>	6	White/Brown	B1-/COS1-
	7	+COS	–>	8	Brown	B1+/COS1+
	6	Shield	–>	9	Bare	Shield
	5	Shield				
	4	NC		NC		
	3	NC		NC		
	2	DATA+ (RS-485)		NC		
	1	DATA- (RS-485)		NC		

IMPORTANT For detailed information in the installation and connection of PowerFlex 700S drives, including important wiring requirements, see publication 20D-PM001.

Connect a Configuration Device

If you are using a HIM to configure the safety relay, see Appendix C on page 163 for information on how to connect a HIM and set parameters with the keypad.

If you are using software to configure the safety relay, see Appendix D on page 165 for information on how to connect to a personal computer and use the software.

Speed Monitoring I/O Signals

Introduction

This chapter describes the input and output signals of the speed monitoring safety relay.

Inputs

The MSR57P safety relay has five inputs capable of safety-certified dual-channel support. Each dual-channel input supports a specific safety function of the MSR57P safety relay: Safe Stop, Safely-limited Speed, Door Monitoring, Enabling Switch Monitoring, and Lock Monitoring.

All five inputs are electrically identical and rely on the same pair of pulse test outputs [Test_Out_0 (S11) and Test_Out_1 (S21)], when not using the OSSD configuration.

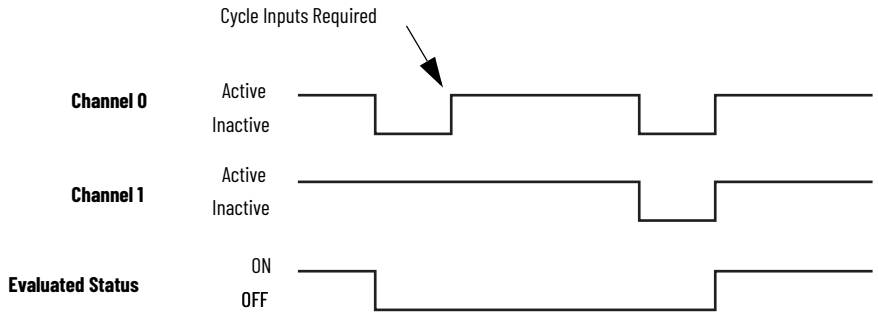
You can configure the inputs for one of the following settings:

- 0 = Not used
- 1 = Dual-channel equivalent (2NC)
- 2 = Dual-channel equivalent 3 s (2NC 3 s)
- 3 = Dual-channel complementary (1NC + 1NO)
- 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s)
- 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s)
- 6 = Single channel (1NC).

IMPORTANT Single-channel configuration (1NC) is not SIL CL 3, PLe, Cat 4.

The consistency between the two channels is evaluated when inputs are configured for dual-channel operation. For dual-channel equivalent configurations, the active state for both channel 0 and channel 1 is on. For dual-channel complementary configurations, the active state for channel 0 is on and the active state for channel 1 is off. The input pair is evaluated as off anytime both channels are not active.

When both channels are active, if one channel's input terminal transitions from active to inactive and back to active, while the other channel's input terminal remains active, both channels must go inactive simultaneously before the evaluated status returns to on. This condition is called cycle inputs required.



If you configure inputs with the following dual-channel settings, an Input fault occurs if there is an input discrepancy for longer than 3 seconds, or if any cycle inputs required condition exists for longer than 3 seconds.

- 2 = Dual-channel equivalent 3 s (2NC 3 s)
- 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s)
- 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s)

If you configure inputs with one of the following dual-channel settings, which have no inputs discrepancy time limit, an Input fault does not occur for any discrepant condition or for any cycle inputs required condition.

- 1 = Dual-channel equivalent (2NC)
- 3 = Dual-channel complementary (1NC + 1NO)

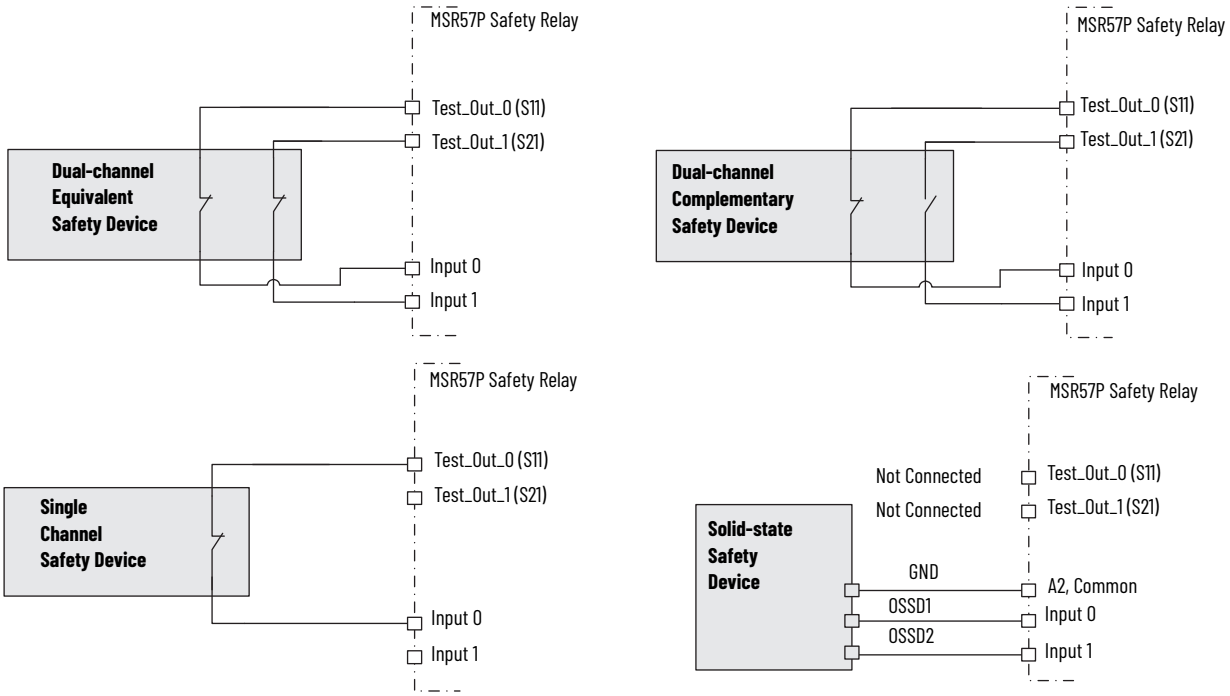
For all input settings except dual-channel SS equivalent 3 s (2 OSSD 3 s), a fault occurs if one or two channels are connected to a 24V DC source other than terminals S11 and S21.

I/O faults are Stop Category faults, which initiate the configured Safe Stop type. I/O faults are latched until the safety relay is successfully reset.

For more information on I/O faults, see Troubleshoot the MSR57P Safety Relay on page 143.

When using a dual-channel complementary (1NC + 1NO) device, you must connect the normally open input to the second input, see Figure 11. For example, if the door is open when the input is on, the normally open contact must be the second input (Input 1).

Figure 11 - Safety Input Wiring Examples



IMPORTANT Do not cross-wire the test outputs to inputs. For example, do not connect Test_Out_0 to Input 1 or Test_Out_1 to Input 0.

Function	Terminals				
	Safe Stop (SS_In)	Safely-limited Speed (SLS_In)	Door Monitoring (DM_In)	Enabling Switch Monitoring (ESM_In)	Lock Monitoring (LM_In)
Input 0 = Channel 0	S12	S52	S32	S72	X32
Input 1 = Channel 1	S22	S62	S42	S82	X42

The unit detects short-circuits of the input loop to ground or 24V. The unit also detects cross loops for dual-channel inputs.

Safe Stop Input (SS_In)

The SS_In input is intended for connection to an E-stop device.

The SS_In input must be active to initiate Safe Stop monitoring. If the SS_In input is monitored, the unit uses a transition from on to off (closed to open) to request the configured Safe Stop type.

In a cascaded configuration, the SS_In input is connected to the Safe Stop (SS_Out) output of an upstream MSR57P safety relay.

Safely-limited Speed Input (SLS_In)

The SLS_In input is used to connect to a switch in which the off state requests Safely-limited Speed monitoring.

If Safely-limited Speed monitoring is configured, the unit monitors the SLS_In input from the time of a successful Safe Stop reset or Safely-limited Speed reset, until the time that the configured Safe Stop type initiates or the safe state is entered.

If the SLS_In input is being monitored, the off state is used to request the Safely-limited Speed monitoring functionality of the safety relay.

In a cascaded configuration, the SLS_In input is connected to the Safe Stop (SS_Out) output of an upstream MSR57P safety relay.

Door Monitor Input (DM_In)

This input monitors the status of the door to indicate if it is open or closed. The DM_In input can be connected to a non-guardlocking switch if the door does not need to be locked. The first unit in multi-axis systems monitors the door status.

The DM_In input is intended for connection to a guard locking switch when the speed monitoring safety relay is configured as a primary device with door monitoring. When the MSR57P safety relay is configured as a secondary in a cascaded system, the DM_In input is connected to the door control output (DC_Out) of the upstream MSR57P safety relay.

Enabling Switch Monitor Input (ESM_In)

The ESM_In input is intended to be connected to an enabling switch. The speed monitoring safety relay uses the ESM_In input as a safety enable only, not for control. The first unit in multi-axis systems performs the ESM_In inputs function and monitoring.

The ESM_In input on state is used to enable motion under mode-specific conditions in the Safely-limited Speed with Enabling Switch (Lim Speed ES) and Safely-limited Speed with Door Monitoring and Enabling Switch Monitoring (LimSpd DM ES) modes.

See SLS with Enabling Switch Monitoring Mode on page 84 and SLS with Door Monitoring and Enabling Switch Monitoring Mode on page 86 for the conditions that must be true to start monitoring the ESM_In input.

If the ESM_In input is off while it is monitored, an ESM Monitoring fault (Stop Category fault) occurs and the safety relay initiates the configured Safe Stop type.

See Troubleshoot the MSR57P Safety Relay on page 143 for information on faults and recovery.

Lock Monitor Input (LM_In)

The LM_In input verifies that the guard locking solenoid switch is locked. The input is intended to confirm the door control function.

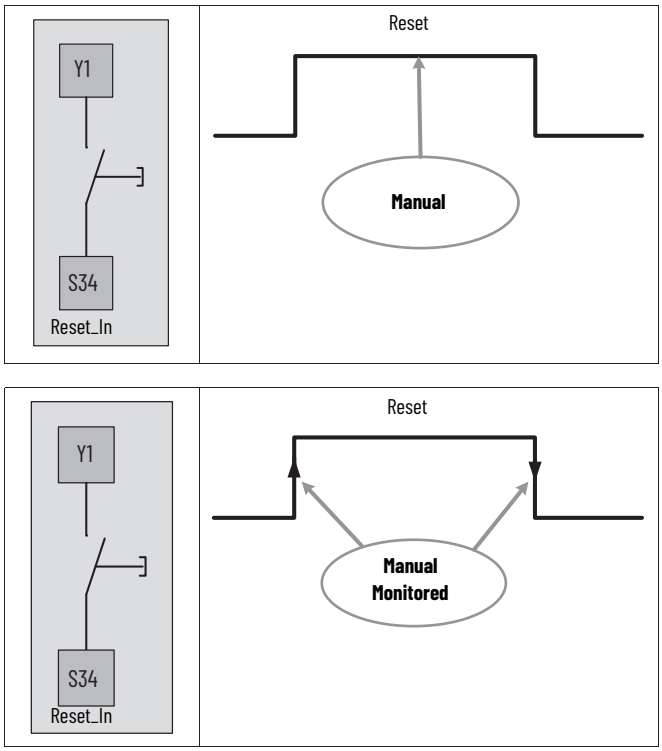
The first unit in multi-axis systems monitors the LM_In input.

Reset Input (Reset_In)

The reset input is for reset and monitoring of the safety circuit. You can configure the reset input for automatic, manual, or manual monitored reset types.

Wire the S34 reset input terminal to the 24V DC output terminal, Y1, depending on the configured reset type, see Figure 12 on page 47.

Figure 12 - S34 to Y1 Connection

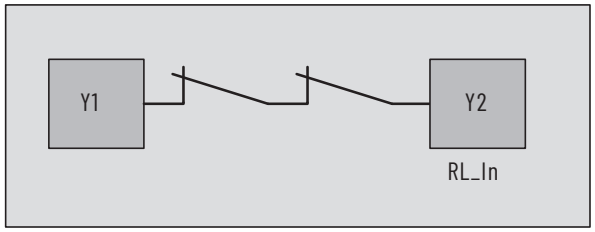


IMPORTANT If you configure the safety relay for automatic reset, wiring of the S34 reset input terminal is not required.

Reset Loop Input (RL_In)

The RL_In input is used to monitor either the normally closed contacts of the contactors, which are used to remove power, or the feedback contacts from a drive Safe Torque Off circuit. The signal level of the RL_In can be used to qualify a successful reset of the speed monitoring safety relay. For feedback loop or external device monitoring and reset qualification, wire the reset loop input, Y2 to the 24V DC output terminal Y1, see Figure 13.

Figure 13 - Y2 to Y1 Connection



Outputs

The MSR57P safety relay has four safety control outputs and four diagnostic outputs. The outputs have various output current capabilities, depending on function.

See Specifications on page 151 to verify your power requirements.

Safety Control Outputs

Safe Stop Output (SS_Out)

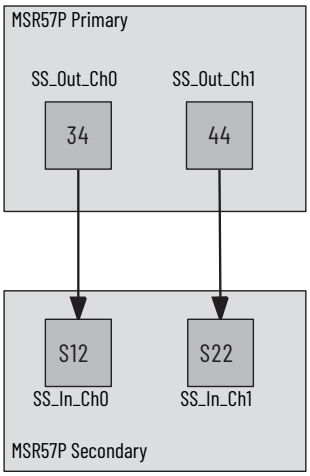
The safe state for this signal is off.

These outputs are typically used in multi-axis applications. In multi-axis applications, you can use these outputs to daisy-chain the primary to a secondary device.

For SS_Out to SS_In cascaded signals, the interface is a dual-channel sourcing, solid-state safety output that is connected to a dual-channel safety input that is configured as OSSD. The outputs are pulse-tested when the P72 [SS Out Mode] parameter is configured for pulse tests.

IMPORTANT The achievable SIL, Category, and PL ratings of the entire MSR57P safety relay safety system are reduced if you disable pulse tests on this output.

SS_Out to SS_In Connections for Multi-axis Applications



S12 and S22 are configured as two OSSD inputs.

For more information on multi-axis configurations, see Cascaded Configuration on page 55.

Alternately, you can use the first SS_Out output to signal a programmable logic controller (PLC) or a drive that a Safe Stop has been requested.

If the SS_In is on (closed) and a Safe Stop reset is successful, the SS_Out output turns on. If lock monitoring is not enabled or the door control logic state is 'unlock', the SS_Out signal turns on immediately when the SS_In turns on. If lock monitoring is enabled, and the door control logic state is 'lock', the SS_Out signal does not turn on until the DC_Out signal locks the door and the LM_In input is verified as on.

If the Safe Stop type is initiated or if a Safe Stop is initiated due to a fault, the SS_Out output turns off.

A fault occurs if the unit detects an error on either channel of the dual-channel output. I/O faults are Stop Category faults, which initiate the configured Safe Stop type. The fault is latches until the safety relay successfully resets.

For more information on faults, see Troubleshoot the MSR57P Safety Relay on page 143.

Safely-limited Speed Output (SLS_Out)

The safe state for this signal in all cases is off.

The configured Safety mode determines the SLS_Out output functionality. If the SLS_In is on and the unit performs a successful Safe Stop or Safely-limited Speed reset, the SLS_Out turns on in all Safely-limited Speed modes except Safely-limited Speed Status Only.

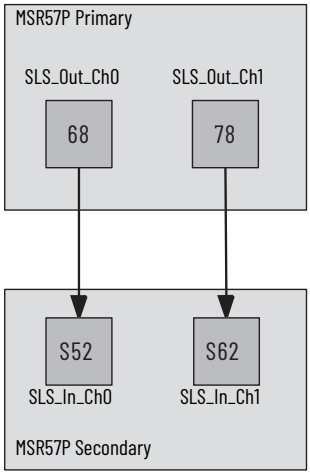
For the Safely-limited Speed modes (SLS), the SLS_Out is used to interconnect speed monitoring safety relays in multi-axis applications. For SLS_Out to SLS_In cascaded signals, the interface is a dual-channel sourcing solid-state safety output that connects to a dual-channel safety input, which is configured as OSSD. The outputs are pulse-tested when the P73 [SLS Out Mode] parameter is configured for pulse tests.

IMPORTANT The achievable SIL, Category, and PL ratings of the entire MSR57P safety relay safety system are reduced if you disable pulse tests on this output.

For a one-unit system or the last unit in a cascaded system, the SLS_Out is intended to connect to an input of a safety programmable logic controller (PLC). The same PLC can also control the Safe Stop function with a safe PLC output that is connected to the Safe Stop input (SS_In).

For the first or middle units in a cascaded system, the SLS_Out is intended to connect to the Safely-limited Speed input (SLS_In) of the next safety relay in the cascaded system. This connection lets one SLS switch simultaneously enable Safely-limited Speed on all axes.

SLS_Out to SLS_In Connections for Multi-axis Applications



For more information on multi-axis configurations, see Cascaded Configuration on page 55.

For Safely-limited Speed Status Only modes, the SLS_Out output is used as an indication that the Safely-limited Speed monitoring is active and the monitored speed is less than the configured safe speed limit. If the speed is greater than or equal to the safe speed limit, the SLS_Out turns off. When Safely-limited Speed monitoring is not active or the safety relay is in an SLS Monitoring Delay [LimSpd Mon Delay], the SLS_Out output is off. The SLS_Out output turns off when a Safe Stop is initiated, a fault occurs, or the safety relay is in the safe state.

See the SLS Status Only Mode on page 90 for more information.

A fault occurs if the unit detects an error on either channel of the dual-channel output. I/O faults are Stop Category faults, which initiate the configured Safe Stop type. The fault launches until the safety relay successfully resets.

For more information on faults, see Troubleshoot the MSR57P Safety Relay on page 143.

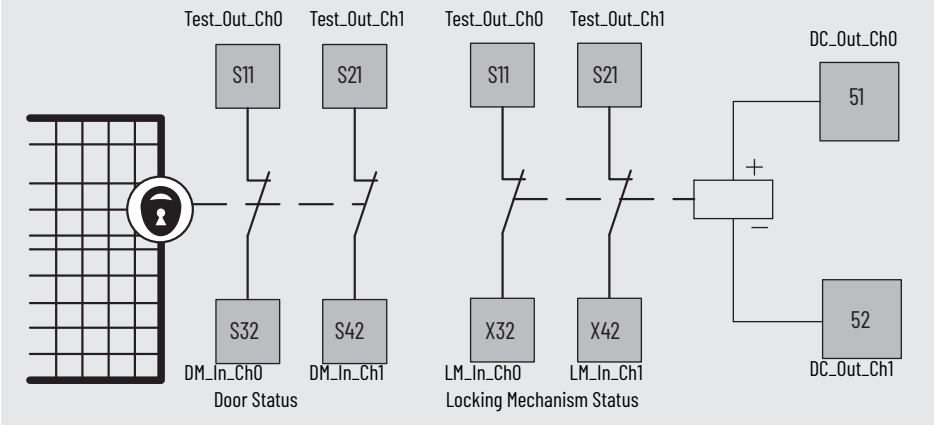
Door Control Output (DC_Out)

You can use DC_Out for door control in single-device and multi-axis systems. The output attempts to maintain the last state when a fault occurs. When no faults are present, you can use DC_Out in combination with the fault status as a standard status indication to a programmable controller, to identify that the system is at the Safely-limited Speed or standstill speed.

The DC_Out output, which is based on the door control logic status, updates the P57 [Door Out Type] parameter setting and any detectable Safe State faults.

The output unlocks only when motion is verified at standstill speed or Safely-limited Speed.

Door Control, Door Monitoring, and Lock Monitoring



Check your interlock switch for internal jumpers before installation.

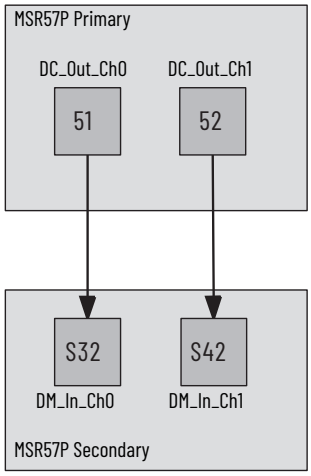
A fault occurs if the unit detects an error on either channel of the dual-channel output. I/O faults are Stop Category faults, which initiate the configured Safe Stop type. The fault latches until the safety relay successfully resets.

For more information on faults, see Troubleshoot the MSR57P Safety Relay on page 143.

You can use the DC_Out output as a bipolar output in Power to Release or Power to Lock configurations, or you can configure the output as cascading (2CH Sourcing).

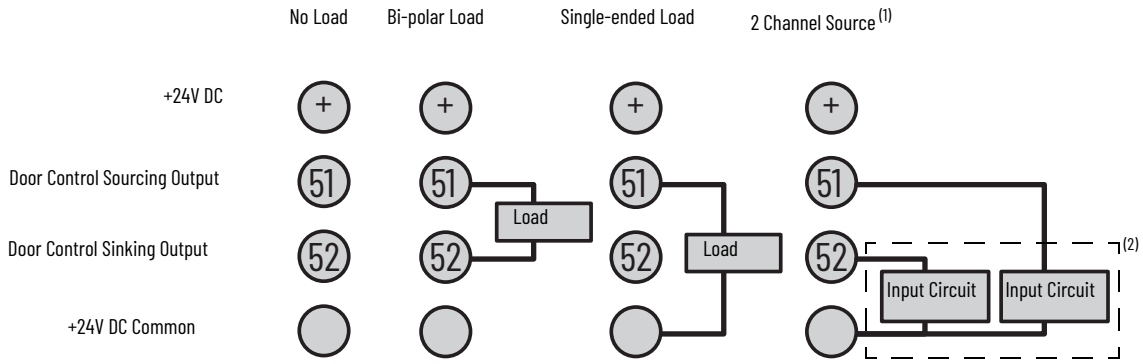
When you configure the door control output as cascading (2CH Sourcing), the dual-channel bipolar output acts as two sourcing outputs capable of driving the OSSD door monitor input (DM_In) of the next speed monitoring safety relay in the cascade chain. You can also use the DC_Out output as a source for general-purpose inputs. In this configuration, the current is limited to 20 mA.

Door Control Cascading Outputs



The door control output only supports wiring configurations that are shown in Figure 14.

Figure 14 - Door Control Output Wiring



(1) When wired as a source for a safety input, the current is limited to 20 mA per output.
(2) For example, SmartGuard™ 600 controller, Guard I/O™.

The unit detects short-circuits of the output loop to ground or 24V. For cascaded outputs, the unit detects cross loops.

The outputs are pulse-tested when the P74 [Door Out Mode] parameter is configured for pulse tests.

IMPORTANT The achievable SIL, Category, and PL ratings of the entire MSR57P safety relay safety system are reduced if you disable pulse tests on this output.

Motion Power Output (MP_Out)

The MP_Out output is used to remove power from the drive power circuits. It is compatible with Safe Torque Off enabled drives or applications that use standard drives with external contactors.

The safe state for this signal in all cases is off.

The MP_Out output turns off during the safe state and in Disabled mode.

IMPORTANT You must connect terminal 13 to a 24V DC source to provide power to terminals 14 and 24.

A successful reset to initiate safe speed monitoring turns on the MP_Out output. If lock monitoring is enabled and the door control logic state is 'lock', the MP_Out output does not turn on until the door locks via the door control output (DC_Out) and the lock monitor input (LM_In) is verified as on. If lock monitoring is disabled or the door control logic state is 'unlock', the MP_Out signal turns on immediately when the SS_In turns on.

Table 10 shows the on/off operation of the MP_Out output that is based on the configured Safe Stop type.

Table 10 - MP_Out On/Off Operation

Safe Stop Type	MP_Out Status
Safe Torque Off(1)	The MP_Out output is OFF while the safety relay is executing the Safe Stop.
Safe Stop 1	The MP_Out output is ON while the Safe Stop is executing, unless a fault occurs. It is OFF once Standstill Speed is reached.
Safe Stop 2	The MP_Out output remains ON while the Safe Stop is executing and after Standstill Speed has been reached unless a fault occurs during the Safe Stop.

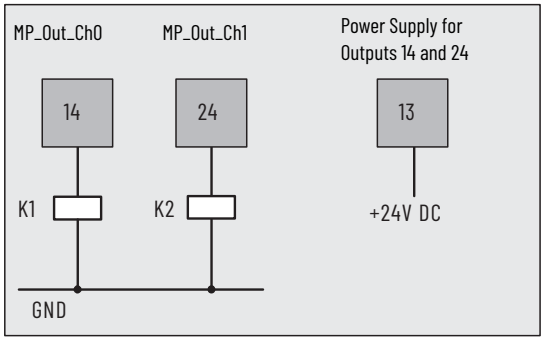
(1) With or without Standstill Checking.

The outputs are pulse-tested when the P71 [MP Out Mode] parameter is configured for pulse tests.

IMPORTANT The achievable SIL, Category, and PL ratings of the entire MSR57P safety relay safety system are reduced if you disable pulse tests on this output.

For applications that use standard drives with external contactors, wire the output as shown in Figure 15.

Figure 15 - Wiring for Standard Drives with External Contactors



A Motion Power Out fault (MP Out Flt) occurs if the unit detects an error on either channel of the dual-channel output. An MP Out Flt places the safety relay in the safe state. The fault is latches until a power cycle.

For more information on faults, see Troubleshoot the MSR57P Safety Relay on page 143.

Diagnostic Outputs

These signals are diagnostic status signals and are not safety signals.

Fault_Status Output

You can use the Fault_Status output to signal that the speed monitoring safety relay detects. The Fault_Status output turns on if a fault occurs.

The Fault_Status output turns off by a successful reset to initiate safe speed monitoring.

Stop_Command Output

This signal is off when the MSR57P safety relay is in the safe state.

The Stop_Command output turns off at the start of the Stop Delay [Max Stop Time] when the safety relay executes the configured Safe Stop type and the Stop Monitoring Delay [Stop Mon Delay], if configured, expires.

A successful reset to initiate safe speed monitoring turns on the Stop_Command output.

The Stop_Command output typically connects to the drive or standard PLC input card to request motion to stop. You can also use the Stop_Command output to signal a PLC or drive that the configured Stop Delay [Max Stop Time] has begun.

SLS_Command Output

The SLS_Command output is used to signal that Safely-limited Speed monitoring operation has been requested.

The SLS_Command is always off when Safely-limited Speed monitoring is not configured or the operating mode is Disabled.

System Status	SLS_Command State
The safety relay is in the safe state.	OFF
Safely-limited Speed monitoring is configured but inactive (SLS_In is closed).	OFF
A Safely-limited Speed Monitoring Delay [LimSpd Mon Delay] is in progress.	ON
Safely-limited Speed monitoring is active (SLS_In is open).	ON
The configured Safe Stop type is initiated.	Hold Last State
Standstill speed is reached at the end of a Safe Stop.	OFF

A successful Safe Stop reset turns on the SLS_Command output to initiate active Safely-limited Speed monitoring or to initiate a Safely-limited Speed Monitoring Delay [LimSpd Mon Delay].

This output typically connects to the drive or standard PLC input card to request a reduction in the speed of a machine.

SLS_Status Output

The SLS_Status output is on when Safely-limited Speed monitoring is active and the Safely-limited Speed Monitoring Delay [LimSpd Mon Delay], if configured, expires.

Notes:

General Safety Relay and Feedback Monitoring Configuration

Introduction

This chapter describes the general and feedback configuration settings that must be configured to operate the MSR57P speed monitoring safety relay.

Cascaded Configuration

You can use the safety relay in single-axis or multi-axis applications. The P20 [Cascaded Config] parameter indicates the safety relay's location in the system: Single Unit (Single), Cascaded First Unit (Multi First), Cascaded Middle Unit (Multi Mid), or Cascaded Last Unit (Multi Last). Single unit and cascaded first safety relays are system primaries.

See Secondary Modes for Multi-axis Cascaded Systems on page 95 for more information on cascaded configurations.

Safety Mode

You can configure the safety relay to operate in one of 11 user-selectable safety modes, which are based on combinations of the safety functions the safety relay supports. The modes, except for Disabled, are described in detail in the following chapters of this manual.

For These Modes	See
Primary, Safe Stop (Safe Stop)	Safe Stop and Safe Stop with Door Monitoring Modes on page 67
Primary, Safe Stop with Door Monitoring (Safe Stop DM)	
Primary, Safely-limited Speed (Lim Speed)	Safely-limited Speed (SLS) Modes on page 79
Primary, Safely-limited Speed with Door Monitoring (Lim Speed DM)	
Primary, Safely-limited Speed with Enabling Switch Control (Lim Speed ES)	
Primary, Safely-limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES)	
Primary, Safely-limited Speed Status Only (Lim Spd Stat)	
Secondary, Safe Stop (Slv Safe Stp)	Secondary Modes for Multi-axis Cascaded Systems on page 95
Secondary, Safely-limited Speed (Slv Lim Spd)	
Secondary, Safely-limited Speed Status Only (Slv Spd Stat)	

Reset Type

You can configure the reset type as automatic, manual, or manual monitored. The default is manual monitored. The configured reset type applies to both Safe Stop and Safely-limited Speed resets.

IMPORTANT Reset input does not require wiring for automatic reset configurations.

See Safe Stop Reset on page 71, SS Reset on page 77, Safely-limited Speed Reset on page 80, Safely-limited Speed Reset on page 83, and Safe Stop Reset (SS Reset) and Safely-limited Speed Reset (SLS Reset) on page 85 for details on how the reset type affects Safe Stop and Safely-limited Speed operation.

ATTENTION: For all types of reset (automatic, manual, or manual monitored), if a reset of the Safe Stop or Safely-limited Speed functions can result in machine operation, you must configure the other speed monitoring functions to detect and help prevent dangerous motion.

ATTENTION: The Safe Stop reset does not provide safety-related restart according to EN 60204-1. External measures must perform the restart if an automatic restart can result in a hazardous situation. You are responsible for determining whether automatic restart can pose a hazard.

Reset Qualification

You can configure reset qualifications for Safe Stop resets. If the reset qualification is configured, the MSR57P safety relay checks the feedback path to verify that the path is a closed circuit before the reset can occur.

The P23 [Reset Loop] parameter indicates whether the reset loop input (RL_In) is used to qualify a successful Safe Stop reset. If the P23 [Reset Loop] parameter equals 'qualified' by RL_In, the RL_in input must be on (closed) if the motion power output (MP_Out) is in the off state. If the RL_In is off (open circuit) when the MP_Out output is off, an RL fault is detected. An RL fault is a Stop Category fault, which helps prevent the reset from succeeding.

If the MP_Out output is on, the RL_In input is not required for qualification.

IMPORTANT Reset qualification applies only to Safe Stop reset and not to Safely-limited Speed reset.

Overspeed Response Time

The P24 [OverSpd Response] parameter setting determines the maximum reaction time from an overspeed event to the initiation of the configured Safe Stop type. The safety reaction time from an overspeed event that triggers a Safe Stop type, to the actual initiation of that Safe Stop type, is equal to the value of the P24 [OverSpd Response] parameter. The configurable options are 42, 48, 60, 84, 132, 228, and 420 ms.

The P24 [OverSpd Response] parameter setting also determines the achievable speed resolution. The overspeed response time and the encoder resolution both affect the speed resolution accuracy, see Table 11...Table 20 on page 59.

Speed Resolution Accuracy for Rotary Systems

Table 11 - Encoder Resolution 16 Lines/Rev

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	100,000
42	156.253	156.283	156.583	159.583	189.583	489.583
48	78.127	78.142	78.292	79.792	94.792	244.792
60	39.063	39.071	39.146	39.896	47.396	122.396
84	19.532	19.535	19.573	19.948	23.698	61.198
132	9.766	9.768	9.786	9.974	11.849	30.599
228	4.883	4.884	4.893	4.987	5.924	15.299
420	2.441	2.442	2.447	2.493	2.962	7.650

Table 12 - Encoder Resolution 128 Lines/Rev

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	93,750
42	19.535	19.565	19.865	22.865	52.865	332.031
48	9.767	9.782	9.932	11.432	26.432	166.016
60	4.884	4.891	4.966	5.716	13.216	83.008
84	2.442	2.446	2.483	2.858	6.608	41.504
132	1.221	1.223	1.242	1.429	3.304	20.752
228	0.610	0.611	0.621	0.715	1.652	10.376
420	0.305	0.306	0.310	0.357	0.826	5.188

Table 13 - Encoder Resolution 1000 Lines/Rev

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	12,000
42	2.503	2.533	2.833	5.833	35.833	42.500
48	1.252	1.267	1.417	2.917	17.917	21.250
60	0.626	0.633	0.708	1.458	8.958	10.625
84	0.313	0.317	0.354	0.729	4.479	5.313
132	0.156	0.158	0.177	0.365	2.240	2.656
228	0.078	0.079	0.089	0.182	1.120	1.328
420	0.039	0.040	0.044	0.091	0.560	0.664

Table 14 - Encoder Resolution 1024 Lines/Rev

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	11,718.75
42	2.445	2.475	2.775	5.775	35.775	41.504
48	1.222	1.237	1.387	2.887	17.887	20.752
60	0.611	0.619	0.694	1.444	8.944	10.376
84	0.306	0.309	0.347	0.722	4.472	5.188
132	0.153	0.155	0.173	0.361	2.236	2.594
228	0.076	0.077	0.087	0.180	1.118	1.297
420	0.038	0.039	0.043	0.090	0.559	0.648

Table 15 - Encoder Resolution 3000 Lines/Rev

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)				
	Speed (RPM)				
	1	10	100	1000	4000
42	0.837	0.867	1.167	4.167	14.167
48	0.418	0.433	0.583	2.083	7.083
60	0.209	0.217	0.292	1.042	3.542
84	0.105	0.108	0.146	0.521	1.771
132	0.052	0.054	0.073	0.260	0.885
228	0.026	0.027	0.036	0.130	0.443
420	0.013	0.014	0.018	0.065	0.221

Table 16 - Encoder Resolution 5000 Lines/Rev

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)				
	Speed (RPM)				
	1	10	100	1000	2400
42	0.503	0.533	0.833	3.833	8.500
48	0.252	0.267	0.417	1.917	4.250
60	0.126	0.133	0.208	0.958	2.125
84	0.063	0.067	0.104	0.479	1.063
132	0.031	0.033	0.052	0.240	0.531
228	0.016	0.017	0.026	0.120	0.266
420	0.008	0.008	0.013	0.060	0.133

Speed Resolution Accuracy for Linear Systems

Table 17 - Encoder Resolution 500 Lines/mm

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)					
	Speed (mm/s)					
	0.01	0.1	1	10	100	400
42	0.083	0.084	0.087	0.117	0.417	1.417
48	0.042	0.042	0.043	0.058	0.208	0.708
60	0.021	0.021	0.022	0.029	0.104	0.354
84	0.010	0.010	0.011	0.015	0.052	0.177
132	0.005	0.005	0.005	0.007	0.026	0.089
228	0.003	0.003	0.003	0.004	0.013	0.044
420	0.001	0.001	0.001	0.002	0.007	0.022

Table 18 - Encoder Resolution 1000 Lines/mm

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)					
	Speed (mm/s)					
	0.01	0.1	1	10	100	200
42	0.042	0.042	0.045	0.075	0.375	0.708
48	0.021	0.021	0.023	0.038	0.188	0.354
60	0.010	0.011	0.011	0.019	0.094	0.177
84	0.005	0.005	0.006	0.009	0.047	0.089
132	0.003	0.003	0.003	0.005	0.023	0.044
228	0.001	0.001	0.001	0.002	0.012	0.022
420	0.001	0.001	0.001	0.001	0.006	0.011

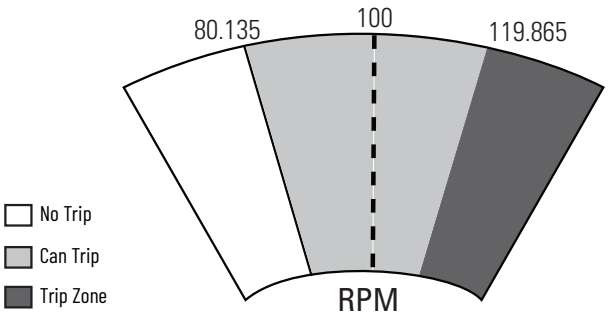
Table 19 - Encoder Resolution 5000 Lines/mm

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)				
	Speed (mm/s)				
	0.01	0.1	1	10	40
42	0.008367	0.008667	0.011667	0.041667	0.141667
48	0.004183	0.004333	0.005833	0.020833	0.070833
60	0.002092	0.002167	0.002917	0.010417	0.035417
84	0.001046	0.001083	0.001458	0.005208	0.017708
132	0.000523	0.000542	0.000729	0.002604	0.008854
228	0.000261	0.000271	0.000365	0.001302	0.004427
420	0.000131	0.000135	0.000182	0.000651	0.002214

Table 20 - Encoder Resolution 20,000 Lines/mm

Overspeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)			
	Speed (mm/s)			
	0.01	0.1	1	10
42	0.002117	0.002417	0.005417	0.035417
48	0.001058	0.011208	0.002708	0.017708
60	0.000529	0.000604	0.001354	0.008854
84	0.000265	0.000302	0.000677	0.004427
132	0.000132	0.000151	0.000339	0.002214
228	0.000066	0.000076	0.000169	0.001107
420	0.000033	0.000038	0.000085	0.000553

For example, an encoder resolution of 128 and overspeed response time of 42 ms results in a speed resolution accuracy of ±19.865 RPM, if your Safe Maximum Speed is configured for 100.0 RPM. An SMS Speed fault can occur when encoder 1 is at 80.135 RPM. However, the SMS Speed fault cannot occur until encoder 1 reaches 119.865 RPM.



If your encoder resolution is not listed in the previous tables, use the following equations.

For rotary systems, the conversion from Overspeed Response Time [OverSpd Response] to speed resolution in revolutions per minute is:

$$\text{Speed Resolution (RPM)} = \frac{15000}{(\text{OverSpd Response} - 36) \times \text{Feedback Resolution}} + \frac{\text{Speed (RPM)} \times 0.02}{(\text{OverSpd Response} - 36)}$$

For linear systems, the conversion from Overspeed Response Time [OverSpd Response] to mm/s is:

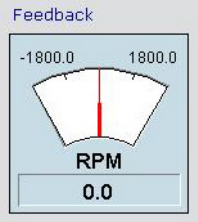
$$\text{Speed Resolution (mm/s)} = \frac{250}{(\text{OverSpd Response} - 36) \times \text{Feedback Resolution}} + \frac{\text{Speed (RPM)} \times 0.02}{(\text{OverSpd Response} - 36)}$$

Language Code

You can configure the safety relay for any one of seven language options: English, French, Spanish, Italian, German, Portuguese, and Dutch.

Max Display Speed

The configuration tool, HIM, or software, can display a speed value that is based on the output speed of encoder 1 [Fbk 1 Speed]. Use the P26 [Max Display Spd] parameter to determine the scaling for the display.



General Parameter List

Set these parameters to configure general safety relay operation.

Table 21 - Parameters

Parameter		Description	Setting	
20	Cascaded Config	Defines whether the safety relay is one unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Default:	0 = Single Unit (Single)
			Options:	0 = Single Unit (Single) 1 = Cascaded First Unit (Multi First) 2 = Cascaded Middle Unit (Multi Mid) 3 = Cascaded Last Unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Default:	1 = Primary, Safe Stop (Safe Stop)
			Options:	0 = Disabled 1 = Primary, Safe Stop (Safe Stop) 2 = Primary, Safe Stop with Door Monitoring (Safe Stop DM) 3 = Primary, Safely-limited Speed (Lim Speed) 4 = Primary, Safely-limited Speed with Door Monitoring (Lim Speed DM) 5 = Primary, Safely-limited Speed with Enabling Switch Control (Lim Speed ES) 6 = Primary, Safely-limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES) 7 = Primary, Safely-limited Speed Status Only (Lim Spd Stat) 8 = Secondary, Safe Stop (Slv Safe Stp) 9 = Secondary, Safely-limited Speed (Slv Lim Spd) 10 = Secondary, Safely-limited Speed Status Only (Slv Spd Stat)
22	Reset Type	Defines the type of reset that is used by the safety relay.	Default:	2 = Manual Monitored (Monitored)
			Options:	0 = Automatic 1 = Manual 2 = Manual Monitored (Monitored)
23	Reset Loop	Defines whether the Reset Loop input (RL_In) input is used to qualify a Safe Stop reset.	Default:	0 = Always qualified (Disable)
			Options:	0 = Always qualified (Disable) 1 = Qualified by RL_In (Enable)
24	OverSpd Response	Configuration for the feedback interface sample rate.	Default:	0 = 42 ms
			Options:	0 = 42 ms 1 = 48 ms 2 = 60 ms 3 = 84 ms 4 = 132 ms 5 = 228 ms 6 = 420 ms

Table 21 - Parameters (Continued)

Parameter		Description	Setting	
25	Language Code	Determines the language of the parameter display.	Default:	0 = English
			Options:	0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Reserved 6 = Portuguese 7 = Reserved 8 = Reserved 9 = Dutch
26	Max Display Spd	Determines scaling for the P33 [Fbk 1 Speed] process display value.	Default:	1800
			Range:	1...65,535 rpm or mm/s

Feedback Monitoring

The P27 [Fbk Mode] parameter defines whether the feedback monitoring devices are configured as one encoder or as dual encoders. When two encoders are used, the P27 [Fbk Mode] parameter also defines the type of discrepancy checks that are performed between the two encoders.

IMPORTANT Both feedback devices must be encoders.

Choose the type of feedback device, either sine/cosine or incremental for encoder 1 by using the P28 [Fbk 1 Type] parameter. You also choose the feedback type, resolution, and polarity of both encoders.

Configure the feedback type as rotary or linear by using the [Fbk *x* Units] parameter. Configure the resolution in lines per revolution or lines per millimeter by using the [Fbk *x* Resolution] parameter. In these parameter names, the *x* is '1' for encoder 1 and '2' for encoder 2.

For dual encoder configurations, the resolution of the first encoder can differ from the resolution of the second encoder. After discrepancy tests pass, the speed, relative position, and direction that is used by the safety relay are based on encoder 1.

IMPORTANT The resolution of encoder 1 must always be equal to or higher than the resolution of encoder 2.

Feedback Polarity

Configure the direction of polarity to be the same as the encoder, or reversed, by using the P30 [Fbk 1Polarity] parameter. The safety relay defines the normal positive direction for encoders as A leads B. To use encoders where B leads A, enter 1 for the P30 [Fbk 1 Polarity] parameter. Set the P35 [Fbk 2 Polarity] parameter so that the resulting speed direction is of the same polarity as encoder 1.

Single Encoder

If the P27 [Fbk Mode] parameter is set to one encoder, the single encoder input is processed redundantly and crosschecked in a 1oo2 architecture. The speed, direction, and stopped status are derived from the single encoder by the 1oo2 architecture.

Dual Encoders

If the P27 [Fbk Mode] parameter is set to two encoders, each encoder input is processed by one channel and crosschecked in a 1oo2 architecture. Discrepancy checks are performed between the two encoders. After the discrepancy checks pass, the speed, direction, and stopped status are derived from encoder 1.

IMPORTANT All monitoring functions are based on the speed of encoder 1. The encoder 2 signal is used for fault diagnostics.

The following parameters affect speed and direction checks:

- Dual Feedback Speed Ratio, P39 [Fbk Speed Ratio]
- Dual Feedback Position Tolerance, P41 [Fbk Pos Tol]
- Dual Feedback Speed Discrepancy Tolerance, P40 [Fbk Speed Tol]

Dual Feedback Speed Ratio

The dual feedback speed ratio, P39 [Fbk Speed Ratio], parameter defines the ratio of the expected speed of encoder 2, divided by the expected speed of encoder 1. This parameter configures the anticipated gearing between encoder 1 and encoder 2.

If P27 [Fbk Mode] equals 0 (one encoder), the only legal value for the P39 [Fbk Speed Ratio] parameter is 0.0.

If P27 [Fbk Mode] is greater than 0, the range of legal values for P39 [Fbk Speed Ratio] is from 0.0001…10,000.0.

For example, if the speed of encoder 2 is expected to be 1000 revolutions per second, while the speed of encoder 1 is expected to be 100 revolutions per second, then the P39 [Fbk Speed Ratio] must be configured as 10.0.

The units that are used to measure encoder speed could be either rotary (rev) or linear (mm). Any combination of rotary and linear units for the two encoders is allowed.

Dual Feedback Position Discrepancy Tolerance

The dual feedback position discrepancy tolerance, P41 [Fbk Pos Tol] parameter defines the cumulative position discrepancy that is tolerated between encoder 1 and encoder 2. The position discrepancy is defined as a position change relative to encoder 1.

IMPORTANT The relative position discrepancy difference is reset to zero at each Safe Stop reset.

Discrepancy checks are performed only while the Feedback mode [Fbk Mode] is equal to one of the values in Table 22.

Table 22 - Feedback Mode Parameter Setting

Feedback Mode, P27 [Fbk Mode] Parameter Setting	
1	Dual encoder with speed and position discrepancy checks
3	Dual encoder with position discrepancy checks

Table 23 defines the legal values for each Feedback mode value.

Table 23 - Feedback Mode Values

Feedback Mode, P27 [Fbk Mode] Values		Dual Feedback Position Discrepancy Tolerance, P41 [Fbk Pos Tol] Legal Values
0	One encoder	0
1	Dual encoder with speed and position discrepancy	1...65,535 in degrees (rotary encoders) or mm (linear encoders) relative to the resolution of encoder 1
2	Dual encoder with speed discrepancy checks	0
3	Dual encoder with position discrepancy checks	1...65,535 in degrees (rotary encoders) or mm (linear encoders) relative to the resolution of encoder 1

If an illegal value is detected, an Invalid Configuration fault occurs and the safety relay remains in the safe state.

IMPORTANT When setting discrepancy tolerances, a high gear ratio configuration between encoder 1 and encoder 2 results in a small movement of encoder 2, which translates into a large movement from the encoder 1 perspective. This configuration can lead to unexpected dual feedback position faults.

Dual Feedback Speed Discrepancy Tolerance

The dual feedback speed discrepancy tolerance, P40 [Fbk Speed Tol], parameter defines the discrepancy that is tolerated for a difference in speed between encoder 1 and encoder 2. This speed is relative to encoder 1. These discrepancy checks are performed only while the Feedback mode is equal to one of the values in Table 24.

Table 24 - Feedback Mode Parameter Setting

Feedback Mode, P27 [Fbk Mode] Parameter Setting	
1	Dual encoder with speed and position
2	Dual encoder with speed discrepancy checks

For rotary systems, the value is specified in revolutions per minute. For linear systems, the value is specified in mm per second.

Table 25 - Feedback Mode Values

Feedback Mode, P27 [Fbk Mode] Values		Dual Feedback Speed Discrepancy Tolerance, P40 [Fbk Speed Tol]
0	One encoder	0
1	Dual encoder with speed and position discrepancy checks	0.1...6553.5 in rev/min (rotary encoders) or mm/s (linear encoders)
2	Dual encoder with speed discrepancy checks	0.1...6553.5 in rev/min (rotary encoders) or mm/s (linear encoders)
3	Dual encoder with position discrepancy checks	0

If an illegal value is detected, an Invalid Configuration fault occurs and the safety relay remains in the safe state.

Feedback Voltage Monitor Range

Use the P32 [Fbk 1 Volt Mon] and P37 [Fbk 2 Volt Mon] parameters to set the feedback voltage monitoring range. The monitoring ranges help define the trip zone for encoder 1 and encoder 2, respectively.

	Fbk *x* Volt Mon Setting	**5**	**9**	**12**	**14**
	Range	**4.5...5.5V**	**7...12V**	**11...14V**	**11.5...15V**
	Trip Zone	< 4.5V	< 7V	< 11V	< 11.5V
The encoder must be specified to operate across the complete range or larger.	Can Trip	4.5...4.75V	7...7.4V	11...11.6V	11.5...12.25V
	No Trip	4.75...5.25V	7.4...11.4V	11.6...13.3V	12.25...14.75V
	Can Trip	5.25...5.5V	11.4...12.0V	13.3...14.0V	14.75...15.5V
	Trip Zone	> 5.5V	> 12.0V	> 14.0V	> 15.5V

The power supply must stay within the no trip range.

Feedback Fault

The allowable frequency of feedback input signals is limited. The safety relay monitors feedback signals whenever the safety relay configuration is valid and the safety mode is not configured as Disabled.

Encoder Type	**Maximum Frequency**
Sine/cosine	≤ 100 kHz
Incremental	≤ 200 kHz

If the feedback signals indicate greater than or equal to the maximum value, a Feedback_*x* fault (Safe State fault) occurs.
(*x* equals 1 or 2, depending on which encoder has the fault.)

Diagnostics are performed on the encoder input signals. If the encoder diagnostic tests fail, a Feedback_*x* fault (Safe State fault) occurs.

Feedback Parameter List

Set these perimeters to define the type of feedback used by the safety relay.

Table 26 - Feedback Parameters

Parameter		Description	Setting	
27	Fbk Mode	Selects the number of encoders and the type of discrepancy checks.	Default:	0 = 1 encoder (Single Fbk)
			Options:	0 = 1 encoder (Single Fbk) 1 = 2 encoders (Dual S/P Chk) 2 = 2 encoders speed discrepancy checks (Dual Spd Chk) 3 = 2 encoders position discrepancy checks (Dual Pos Chk)
28	Fbk 1 Type	Selects the type of feedback for encoder 1.	Default:	1 = TTL (Incremental)
			Options:	0 = Sine/cosine 1 = TTL (Incremental)
29	Fbk 1 Units	Selects linear or rotary feedback for encoder 1.	Default:	0 = Rotary (Rev)
			Options:	0 = Rotary (Rev) 1 = Linear (mm)
30	Fbk 1 Polarity	Defines the direction polarity for encoder 1.	Default:	0 = Same as encoder (Normal)
			Options:	0 = Same as encoder (Normal) 1 = Reversed
31	Fbk 1 Resolution	Counts/Revolution.	Default:	1024
			Range:	1...65,535 pulses/revolution or pulses/mm based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration.
32	Fbk 1 Volt Mon	Encoder 1 voltage to be monitored.	Default:	0 = Voltage not monitored
			Options:	0 = Voltage not monitored 5 = 5V ±10% 9 = 7...12V 12 = 11...14V 14 = 11.5...15.5V
33	Fbk 1 Speed (1)	Displays the output speed of encoder 1.	Range:	-214,748,364.8...214,748,364.7 rpm or mm/s based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration
34	Fbk 2 Units	Selects rotary or linear feedback system for encoder 2.	Default:	0 = Rotary (Rev)
			Options:	0 = Rotary (Rev) 1 = Linear (mm)
35	Fbk 2 Polarity	Defines the direction polarity for encoder 2.	Default:	0 = Same as encoder (Normal)
			Options:	0 = Same as encoder (Normal) 1 = Reversed
36	Fbk 2 Resolution	Counts/Revolution.	Default:	0
			Range:	0...65,535 pulses/revolution o pulses/mm based on rotary or linear configuration. P34 [Fbk 2 Units] parameter defines the configuration.
37	Fbk 2 Volt Mon	Encoder 2 voltage to be monitored.	Default:	0 = Voltage not monitored
			Options:	0 = Voltage not monitored 5 = 5V ±10% 9 = 7...12V 12 = 11...14V 14 = 11.5...15.5V
38	Fbk 2 Speed (1)	Displays the output speed of encoder 2.	Range:	-214,748,364.8...214,748,364.7 rpm or mm/s
39	Fbk Speed Ratio	Dual Feedback Speed Ratio. Defines the ratio of the expected speed of encoder 2 divided by the expected speed of encoder 1 Not valid when P27 [Fbk Mode] = 0 (1 encoder).	Default:	0.0000
			Range:	0.0001...10,000.0 ratio that is based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration.
40	Fbk Speed Tol	Dual Feedback Speed Discrepancy Tolerance. Acceptable difference in speed between [Fbk 1 Speed] and [Fbk 2 Speed].	Default:	0
			Range:	0...6553.5 rpm or mm/s units are based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration.
41	Fbk Pos Tol	Acceptable difference in position between encoder 1 and encoder 2.	Default:	0
			Range:	0...65,535 deg or mm units are based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration.

(1) Read-only.

Notes:

Safe Stop and Safe Stop with Door Monitoring Modes

Introduction

This chapter describes the Safe Stop modes of safety operation and provides a list of configuration parameters and wiring examples for each Safe Stop mode.

Safe Stop Mode

When properly configured for Safe Stop, the safety relay monitors the Safe Stop input (SS_In) and initiates the configured Safe Stop type upon deactivation of the input. The Safe Stop type is configurable as either Safe Torque Off with or without standstill checking, Safe Stop 1, or Safe Stop 2. The safety relay recognizes motion as stopped when the encoder 1 feedback signals indicate that the system has reached the configured standstill speed. Once standstill speed is reached, the Door Control output (DC_Out) sets to unlock.

You can also configure both the Stop Delay [Max Stop Time] and an optional Stop Monitoring Delay [Stop Mon Delay]. Stop Delay [Max Stop Time] is the period during which deceleration occurs after a Safe Stop is initiated. Stop Monitoring Delay [Stop Mon Delay] is a delay between the action that requests the Safe Stop and the initiation of the configured Safe Stop type. A Stop Monitoring Delay can be configured only for Safe Stop 1 or Safe Stop 2.

When properly configured for Safe Stop mode, the safety relay also monitors for faults and initiates the appropriate reaction. If the fault is a Safe State fault, the safety relay enters the safe state. If the fault is a Stop Category fault, the safety relay initiates the configured Safe Stop type.

Safe Stop Types

Use the P45 [Safe Stop Type] parameter to configure the type of stop that the system executes when a Safe Stop is initiated. A transition of the SS_In input from on to off or the occurrence of a Stop Category fault can initiate a Safe Stop 1.

While the safety relay executes the configured Safe Stop type, it continues to monitor the system. If the safety relay detects a Stop Category fault, the safety relay sets the outputs to a faulted state, but allows for the door control logic to set to unlock, if the feedback signals indicate that the configured standstill speed is reached.

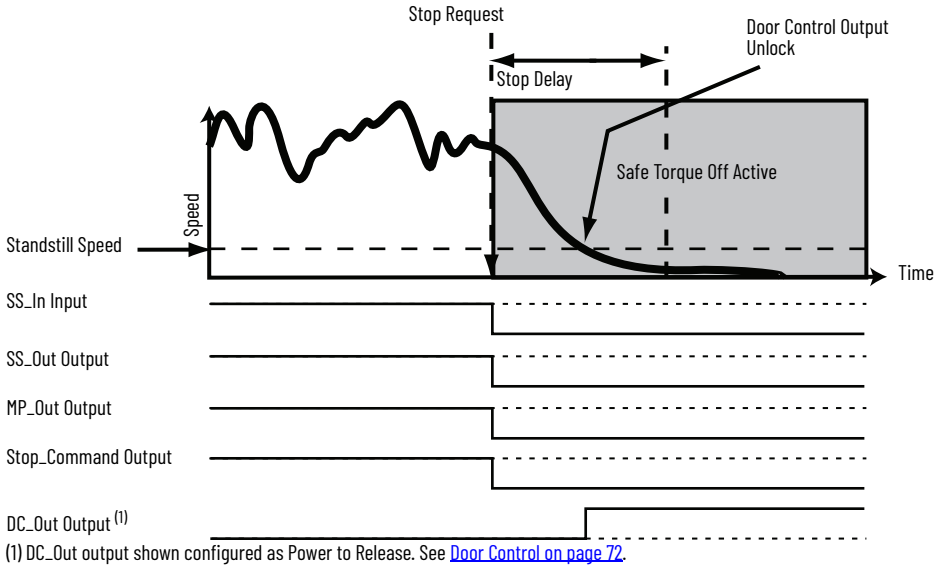
Safe Torque Off with Standstill Checking

This Safe Stop type lets you access the hazardous area immediately after motion is detected as stopped, rather than waiting until a specific time has elapsed.

When Safe Torque Off with Standstill Checking is initiated, power is removed from the Motion Power output (MP_Out) immediately and the configured Stop Delay [Max Stop Time] begins. If the configured standstill speed is detected anytime after the Safe Stop is initiated and before the end of the configured Stop Delay [Max Stop Time], the door control logic sets to unlock.

If the standstill speed is not detected by the end of the configured Stop Delay [Max Stop Time], a Stop Speed fault occurs and the door control logic remains set to lock until standstill speed is detected. A Stop Speed fault removes power from the Motion Power output (MP_Out) immediately.

Figure 16 - Timing Diagram for Safe Torque Off with Standstill Checking



(1) DC_Out output shown configured as Power to Release. See Door Control on page 72.

Safe Stop 1 and Safe Stop 2

When a transition of the SS_In input from on to off initiates Safe Stop 1 or 2, the safety relay does not initiate the configured Stop Delay [Max Stop Time] until after the optional Stop Monitoring Delay [Stop Mon Delay] expires, unless a Stop Category fault occurs during the stop monitoring delay.

When a Stop Category fault initiates Safe Stop 1 or 2, the Stop Delay [Max Stop Time] begins immediately, regardless of whether a Stop Monitoring Delay [Stop Mon Delay] is configured.

Deceleration monitoring takes place during the Stop Delay [Max Stop Time]. These three configurable parameters define the deceleration profile that is used.

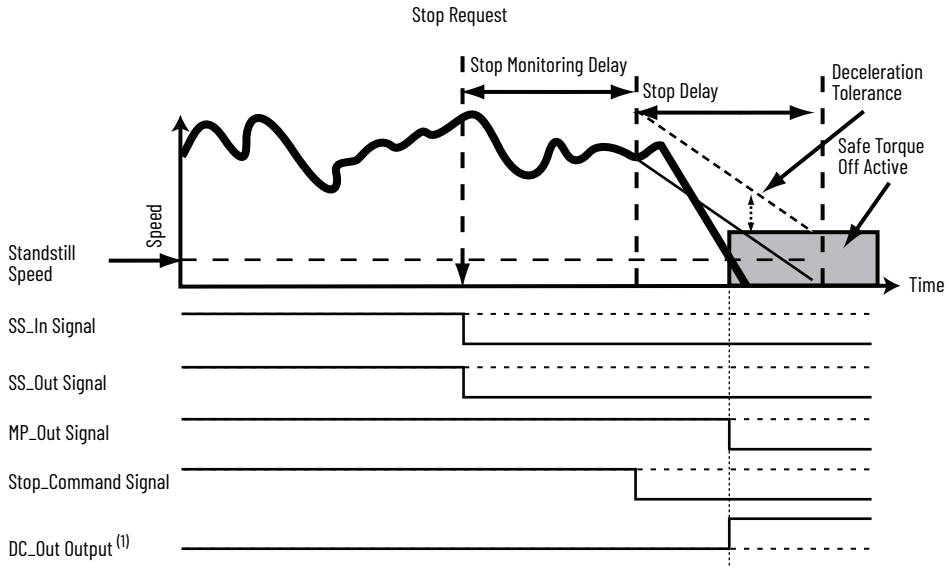
- Deceleration Reference Speed, P50 [Decel Ref Speed]
- Deceleration Tolerance, P51 [Stop Decel Tol]
- Stop Delay, P47 [Max Stop Time]

If standstill speed is detected anytime after the Safe Stop is initiated and before the Stop Delay [Max Stop Time] expires, the door control logic sets to unlock.

If the standstill speed is not detected by the end of the configured Stop Delay [Max Stop Time], a Stop Speed fault occurs.

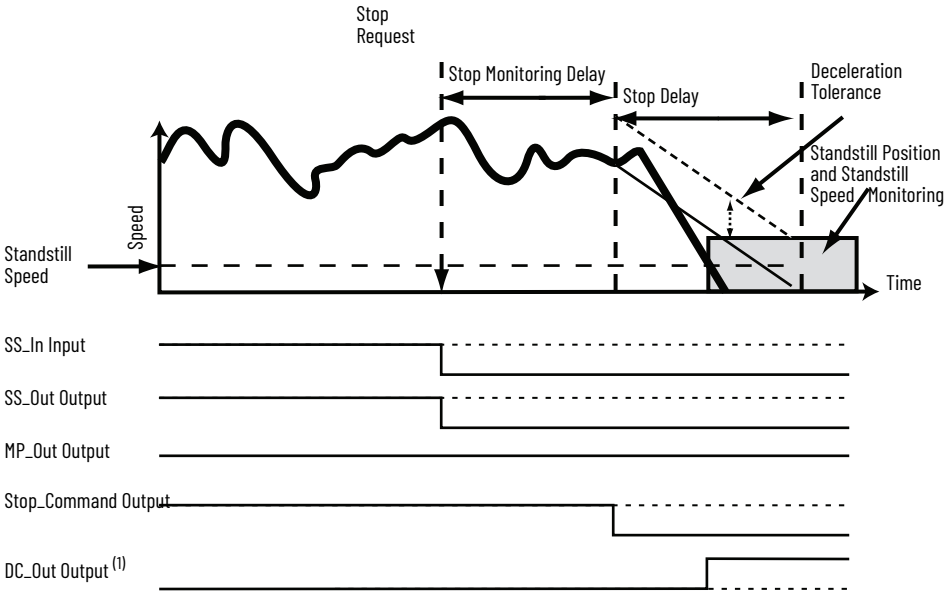
For Safe Stop 1, power is removed from the Motion Power output (MP_Out) when standstill speed is reached. For Safe Stop 2, power is not removed.

Figure 17 - Timing Diagram for Safe Stop 1



(1) DC_Out Output shown configured as Power to Release. See Door Control on page 72.

Figure 18 - Timing Diagram for Safe Stop 2

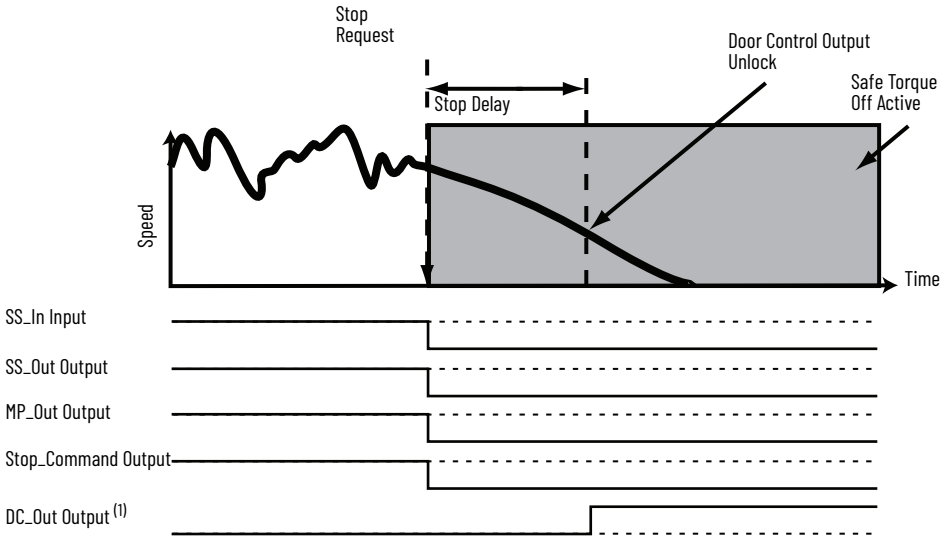


(1) DC_Out output shown configured as Power to Release. See Door Control on page 72.

Safe Torque Off without Standstill Checking

When Safe Torque Off without standstill checking is initiated, motion power is removed immediately and the configured Stop Delay [Max Stop Time] begins. Door control logic is set to unlock when the Stop Delay [Max Stop Time] expires, regardless of speed.

Figure 19 - Timing Diagram for Safe Torque Off without Standstill Checking



(1) DC_Out output shown configured as Power to Release. See Door Control on page 72.

All stop types require a connected encoder.

Standstill Speed and Position Tolerance

For Safe Stop types that include standstill checking, you set the standstill speed and standstill position tolerance.

IMPORTANT The P48 [Standstill Speed] and P49 [Standstill Pos] parameters are not used for Safe Torque Off without standstill checking configurations. Set these parameters to zero.

Standstill speed is used to declare motion as stopped. The system is at standstill when the speed detected is less than or equal to the configured standstill speed. The P48 [Standstill Speed] parameter defines the speed limit before the safety relay determines standstill is reached and the door control logic sets to unlock.

IMPORTANT Standstill detection relies on the encoder 1 signal. The encoder 2 signal is used for fault diagnostics.

The P49 [Standstill Pos] parameter defines the position limit in encoder 1 units that is tolerated after standstill is reached. If the position changes by more than the amount specified by the standstill position tolerance, a Motion After Stopped fault occurs after standstill is reached and the door unlocks. This type of fault causes the MSR57P safety relay to enter the safe state.

The time required to verify that the standstill speed is reached can be considerable when a small standstill speed is configured and the encoder resolution of encoder 1 is low.

- For rotary systems, the time (in seconds) exceeds 15 / [Standstill Speed (RPM) x Encoder 1 Resolution].
- For linear systems, the time (in seconds) exceeds 0.25 / [Standstill Speed (mm/s) x Encoder 1 Resolution].

Deceleration Monitoring

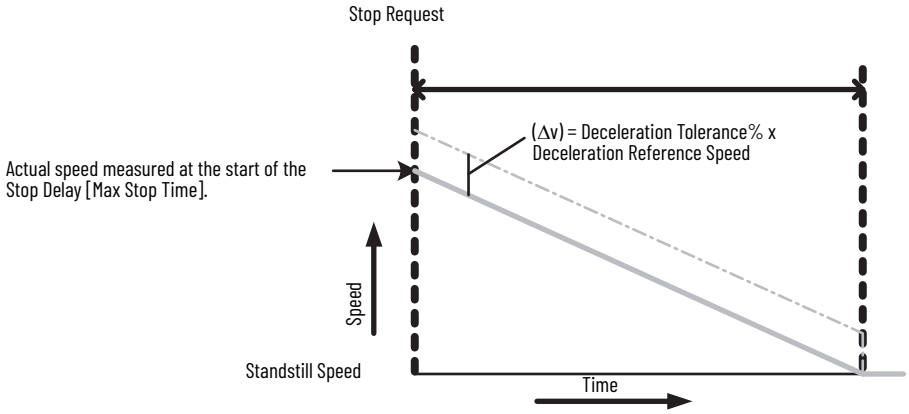
Deceleration monitoring takes place during the configured Stop Delay [Max Stop Time], when the Safe Stop type is configured as Safe Stop 1 or Safe Stop 2. The deceleration start speed is captured at the beginning of the Stop Delay [Max Stop Time] and used to calculate the deceleration profile.

These parameters define the deceleration profile.

- Deceleration Reference Speed, P50 [Decel Ref Speed]
- Deceleration Tolerance, P51 [Stop Decel Tol]
- Stop Delay, P47 [Max Stop Time]

The deceleration reference speed is relative to encoder 1. The P51 [Stop Decel Tol] parameter defines the percentage of the deceleration reference speed that is tolerated above the calculated deceleration profile.

Deceleration Monitoring



To account for system overshoot and drive delay, choose Δv and set P50 [Decel Ref Speed] to the highest normal operating speed to calculate the deceleration tolerance. Remember that the P51 [Stop Decel Tol] parameter is a percentage.

When deceleration monitoring is being performed, the speed limit that is monitored during the Stop Delay [Max Stop Time] must be less than the Deceleration Monitoring value, or a Deceleration fault occurs. A Deceleration fault places outputs in the faulted state, but allows the door unlock when the feedback signals indicate that standstill speed is reached.

Safe Stop Reset

The Safe Stop Reset (SS Reset) is a reset from the safe state or from a stopping condition to actively monitoring motion. The reset is successful if the SS_In input is on, no faults are present, and, if the reset qualification (P23 [Reset Loop]) is configured, the qualification is met.

ATTENTION: For all types of reset (automatic, manual, or manual monitored), if a reset of the Safe Stop or Safely-limited Speed functions can result in machine operation, you must configure the other speed monitoring functions to detect and help prevent dangerous motion.

ATTENTION: The Safe Stop reset does not provide safety-related restart according to EN 60204-1. External measures must perform the restart if an automatic restart can result in a hazardous situation. You are responsible for determining whether automatic restart can pose a hazard.

When an SS reset is requested, all diagnostic tests that can be performed before outputs energize are performed before a successful SS reset. If a diagnostic test can be performed only when outputs are energized, the test is performed immediately following the SS reset.

IMPORTANT An SS reset is not attempted if the 'wait no stop' attribute is set (1), which indicates that the HIM stop button is or a stop command is issued from DriveExecutive™ or DriveExplorer™ software.
The 'wait no stop' attribute is bit 26 of the P68 [Guard Status] parameter.

IMPORTANT An SS reset is not attempted if the Wait SS Cyc attribute is set (1), which indicates that an error occurred.
The Wait SS Cyc attribute is bit 25 of the P68 [Guard Status] parameter.

Automatic

If the SS reset is configured as automatic, the safety relay always attempts a reset if it is in the safe state or has initiated a Safe Stop type. The reset attempts when the SS_In input transitions from off to on or if SS_In is on at power-up.

Manual

If the SS reset is configured as manual, the reset occurs when the SS_In input is on and the Reset_In input is on.

Manual Monitored

A manual monitored reset requires an off-to-on-to-off transition of the Reset_In input.

The reset ends if at any time before the close and open of the Reset_In input, the SS_In input transitions from on to off.

Faults

If a fault occurs, other than an Invalid Configuration fault or an ESM Monitoring fault, the SS_In input must turn off and on again to reset the Wait SS Cyc bit before a successful SS reset can occur.

Door Control

The status of the door control logic (Lock or Unlock) and the Door Monitor Input (DM_In), along with the location of the safety relay in the system [Cascaded Config] and Door Control Output Type [Door Out Type], determine whether the Door Control output (DC_Out) is locked or unlocked during normal operation.

When the DC_Out output has no faults, the safety relay is configured for Safe Stop, and the safety relay is monitoring motion, the door control logic state is locked. It remains locked while a Safe Stop executes. For all Safe Stop types, except Safe Torque Off without standstill checking, door control logic sets to unlock only when standstill speed is reached. If the Safe Stop type is Safe Torque Off without standstill checking, the door control logic sets to unlock when the Stop Delay [Max Stop Time] is elapsed, regardless of speed.

Configuration

You configure the type of door control for each speed monitoring safety relay in the system.

Configure Door Control Output Type

P57 [Door Out Type] Settings		DC_Out Status and Lock State
Single and Last Units	**First and Middle Units**	
0 = Power to Release	Not valid	ON = Door is unlocked. OFF = Door is locked.
1 = Power to Lock	Not valid	ON = Door is locked. OFF = Door is unlocked.
2 = Cascading (2 CH Sourcing)	2 = Cascading (2 CH Sourcing)	ON = Door is unlocked. OFF = Door is locked.

One safety relay or the last safety relay in a cascaded system can be configured for any door output type setting. For example, choose 2 CH sourcing to connect to a safety programmable controller input. First or middle safety relays in a cascaded system must be configured as 2 CH sourcing.

ATTENTION: When the DC_Out output is configured as Power to Lock (P57 [Door Out Type] = 1), the safe state and faulted state is unlocked.
ATTENTION: Make sure that this possibility does not create a hazard.

IMPORTANT When the DC_Out output is configured for no pulse tests (P74 [Door Out Mode] = 1), the P57 [Door Out Type] setting is Power to Lock, and a reset is attempted, the DC_Out output is pulsed low for 12 ms. During the 12 ms, the door unlocks.

Effect of Faults

These fault conditions, which affect the integrity of the DC_Out output, force the DC_Out output to its safe state (off), regardless of the status of door control logic:

- DC Out fault
- Invalid Configuration fault
- Internal Power Supply or MPU faults

ATTENTION: If a fault occurs after standstill speed is reached, door control remains unlocked.

For fault conditions where the DC_Out output can maintain its integrity, both the door control logic and the DC_Out output hold last state. If the hold last state cannot be maintained, faults can turn off the DC_Out output.

ATTENTION: If a fault occurs while the door is unlocked, it can remain unlocked. Verify that this possibility does not create a hazard.

Lock Monitoring

If lock monitoring is enabled, the Lock Monitoring input (LM_In) must be in the on state anytime the Door Control output (DC_Out) is in the lock state, except for the 5 seconds following the transition of the DC_Out output from the unlocked to the locked state. A Lock Monitoring fault occurs if the LM_In input is not on during this time. The LM_In input must be off when the DM_In input transitions from on to off (the door opens).

A Lock Monitoring fault is a Stop Category fault, which initiates the configured Safe Stop type.

Safe Stop Parameter List

To configure the safety relay for Safe Stop mode, set the parameters that are listed in Table 27, General Parameter List on page 60, Feedback Parameter List on page 65.

Table 27 - Safe Stop Parameters

Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	1 = Safe Stop
44	Safe Stop Input	Configuration for Safe Stop input (SS_In).	Default:	1 = Dual-channel equivalent
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)
45	Safe Stop Type	Safe operating stop type selection. Defines the type of Safe Stop that is performed if a stop type condition initiates the Safe Stop function.	Default:	0 = Safe Torque Off with Standstill Checking (Torque Off)
			Options:	0 = Safe Torque Off with Standstill Checking (Torque Off) 1 = Safe Stop 1 2 = Safe Stop 2 3 = Safe Torque Off without Standstill Checking (Trq Off NoChk)
46	Stop Mon Delay	Defines the monitoring delay between the request for a Safe Stop and the start of the Stop Delay [Max Stop Time] when an SS_In input ON to OFF transition initiates the request for a Safe Stop 1 or a Safe Stop 2. If the Safe Stop type is Safe Torque Off with or without Speed Checking, the Stop Monitoring Delay must be 0 or an Invalid Configuration fault occurs.	Default:	0
			Range:	0...6553.5 s
47	Max Stop Time	Stop Delay Defines the maximum stop delay time that is used when a stop type condition initiates the Safe Stop.	Default:	0
			Range:	0...6553.5 s
48	Standstill Speed	Defines the speed limit that is used to declare motion as stopped. Not valid for Safe Torque Off without Standstill Checking.	Default:	0.001
			Range:	0.001...65.535 rpm or mm/s based on rotary or linear configuration, which encoder 1 feedback configuration P29 [Fbk 1 Units] parameter defines
49	Standstill Pos	Standstill Position Window. Defines the position limit in encoder 1 degrees or mm, which will be tolerated after a Safe Stop condition has been detected. Not valid for Safe Torque Off without Standstill Checking.	Default:	10
			Range:	0...65,535 degrees (360° = 1 revolution) or mm based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration.
50	Decel Ref Speed	Decel Reference Speed. Determines deceleration rate to monitor for Safe Stop 1 or Safe Stop 2.	Default:	0
			Range:	0...65,535 rpm or mm/s based on rotary or linear configuration. P29 [Fbk 1 Units] parameter defines the configuration.
51	Stop Decel Tol	Decel Tolerance. This setting is the acceptable tolerance above the deceleration rate set by the Decel Ref Speed parameter.	Default:	0
			Range:	0...100% of Decel Ref Speed

Table 27 - Safe Stop Parameters (Continued)

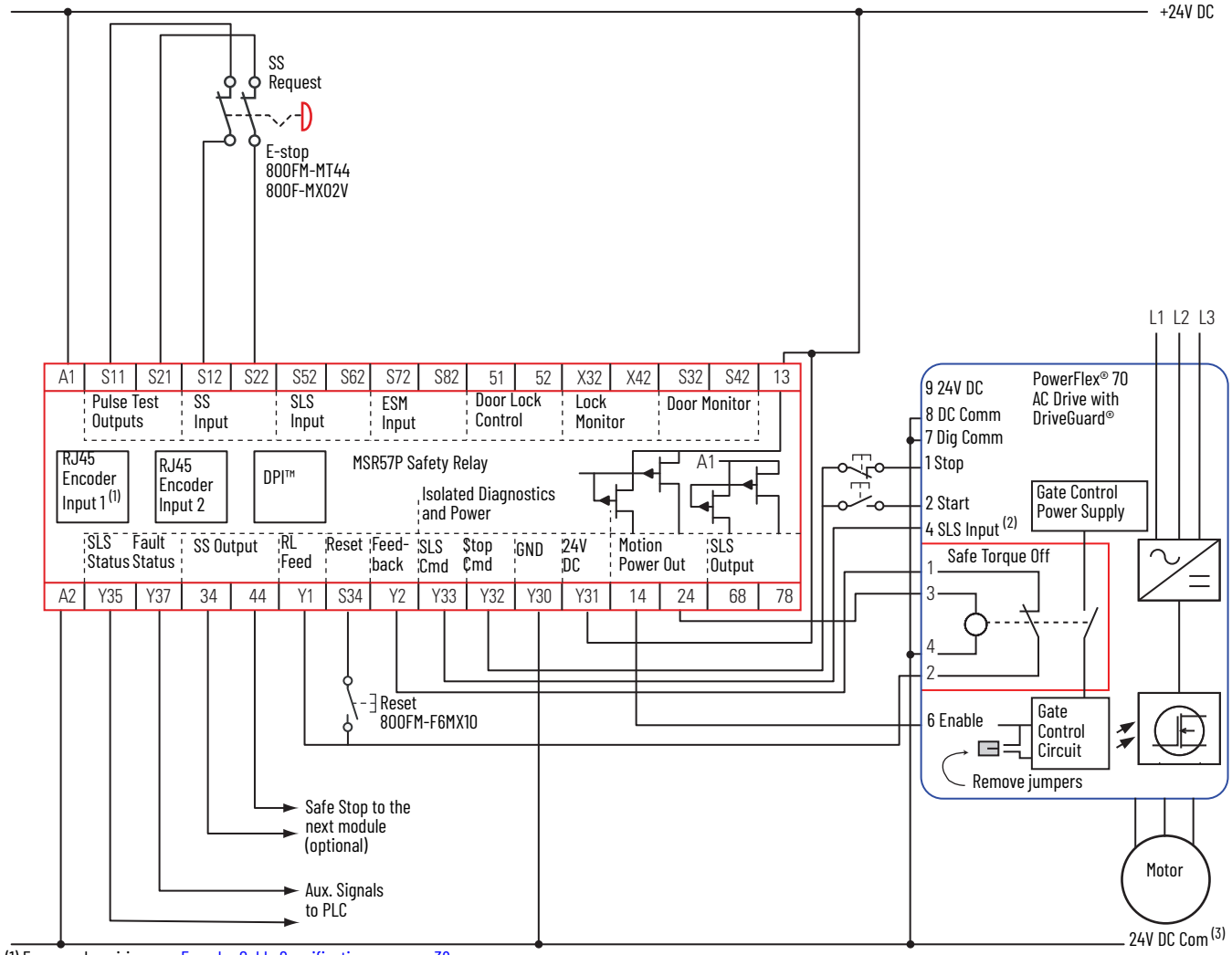
Parameter		Description	Setting	
57	Door Out Type	Defines the lock and unlock state for the door control output (DC_Out). Door Out type can be 0 or 1 only for a single-axis system or for the last unit in a multi-axis system. The first and middle units of a multi-axis system must be configured as cascading (2).	Default:	0 = Power to Release (Pwr to Rel)
			Options:	0 = Power to Release (Pwr to Rel) 1 = Power to Lock (Pwr to Lock) 2 = Cascaded (2 CH Sourcing)
59	Lock Mon Enable	Lock Monitoring can be enabled only when the speed monitoring safety relay is one unit or as the first unit in a multi-axis system (P20 [Cascaded Config] equals 0 or 1).	Default:	0 = Disabled
			Options:	0 = Disabled 1 = Enabled
60	Lock Mon Input	Configuration for the Lock Monitor input (LM_In).	Default:	0 = Not used
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)
71	MP Out Mode	Defines whether the MP_Out output is pulse-tested.(1)	Default:	0 = Pulse Test
			Options:	0 = Pulse test 1 = No pulse test
72	SS Out Mode	Defines whether the SS_Out output is pulse-tested.(1)	Default:	0 = Pulse Test
			Options:	0 = Pulse test 1 = No pulse test
74	Door Out Mode	Defines whether the DC_Out output is pulse-tested.(1)	Default:	0 = Pulse Test
			Options:	0 = Pulse test 1 = No pulse test

(1) If pulse-testing is turned off for any output, the SIL, Category, and PL rating is reduced for the entire MSR57P safety relay safety system.

Safe Stop Wiring Example

Figure 20 illustrates an example of Safe Stop wiring.

Figure 20 - Primary, Safe Stop (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Stop with Door Monitoring Mode

When properly configured for Safe Stop with door monitoring, the safety relay monitors the Safe Stop input (SS_In) and initiates the configured Safe Stop type upon deactivation of the input as described in Safe Stop Mode on page 67.

In addition, the speed monitoring safety relay verifies through monitoring the Door Monitor input (DM_In) that the device controlled by the Door Control output (DC_Out) is in an expected state. The DM_In input is on when the door is closed and off when the door is open. If the door is monitored as opened during Safe Stop monitoring, a Door Monitoring fault occurs and the speed monitoring safety relay initiates the configured Safe Stop type.

You can monitor the status of the door with or without using the door control (lock/unlock) function. When door control logic is set to lock, the MSR57P safety relay puts the solenoid into the locked state when the machine is not at a safe speed or at standstill speed.

Lock Monitoring

If a Safety mode that includes door monitoring is selected and lock monitoring is enabled, the Lock Monitor input (LM_In) signal must be off anytime that the Door Monitor input (DM_In) transitions from on to off.

IMPORTANT If your application uses lock monitoring without door monitoring, you must use some means to verify that the lock monitor is not stuck at a lock indication.

SS Reset

If the Door Monitor input (DM_In) is off when a Safe Stop (SS) reset is attempted in any state other than actively monitoring Safely-limited Speed, a Door Monitoring fault occurs and the speed monitoring safety relay initiates the configured Safe Stop type.

Safe Stop with Door Monitoring Parameter List

To configure the safety relay for Safe Stop with door monitoring, set the DM input parameter and the Safe Stop parameters that are listed in Safe Stop Parameter List on page 74.

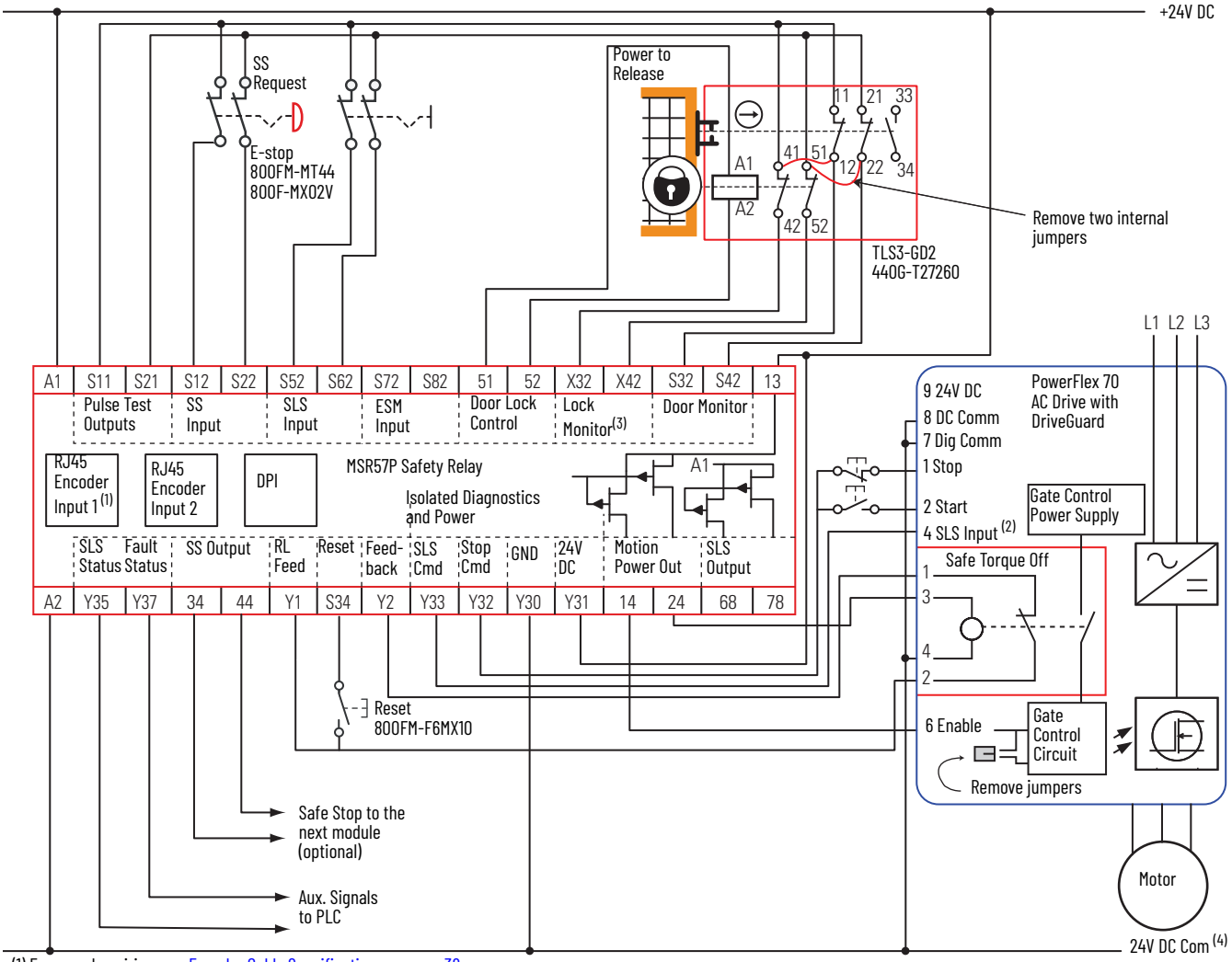
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	2 = Primary, Safe Stop with Door Monitoring (Safe Stop DM)
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default:	0 = Not used(1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)

(1) You must configure this parameter with a nonzero value in this mode.

Safe Stop with Door Monitoring Wiring Example

Figure 21 illustrates wiring for Safe Stop with door monitoring.

Figure 21 - Primary, Safe Stop with Door Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safe Stop with Door Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safely-limited Speed (SLS) Modes

Introduction

This chapter describes the Safely-limited Speed (SLS) modes of the safety operation and provides a list of configuration parameters and wiring examples for each mode.

SLS Mode

When properly configured for Safely-limited Speed, the safety relay performs Safely-limited Speed (SLS) monitoring functions and the Safe Stop function that is described in Safe Stop Mode on page 67. When the Safely-limited Speed input (SLS_In) is off, feedback velocity is monitored and compared against a configurable safe speed limit.

If the feedback velocity is below the safe speed limit during Safely-limited Speed monitoring, the Door Control output (DC_Out) unlocks after the Safely-limited Speed Monitoring Delay [Lim Spd Mon Delay], if configured, expires.

ATTENTION: Verify that an unlocked door does not result in a hazardous situation.
If a Safe Stop type is initiated or a fault occurs while the safety relay is actively monitoring Safely-limited Speed, the door control remains unlocked. The safe state of the SLS_In input can allow the door unlock.

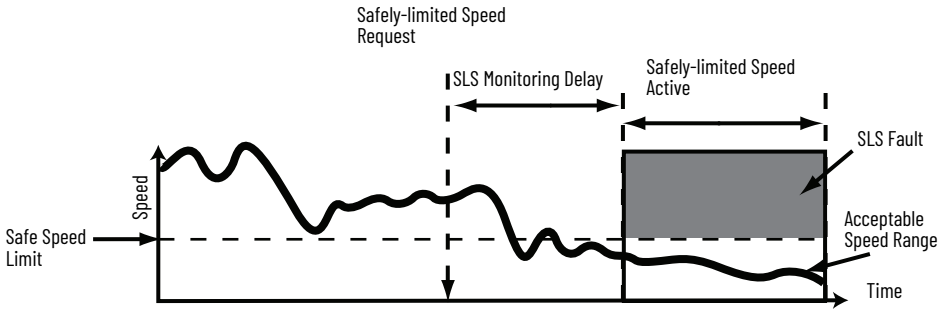
If the measured velocity exceeds the safe speed limit, an SLS fault occurs and the configured Safe Stop type initiates. You can configure an optional Safely-limited Speed Monitoring Delay [Lim Spd Mon Delay] to delay the start of Safely-limited Speed monitoring.

A transition of the Safely-limited Speed input (SLS_In) from on to off requests Safely-limited Speed monitoring. When the SLS_In input is on, the safety relay does not monitor for Safely-limited Speed and the measured velocity can be above or below the safe speed limit.

ATTENTION: If the reset type is configured as automatic, Safely-limited Speed monitoring is disabled when the SLS_In input turns on and the machine operates at its normal run speed. Verify that the SLS_In input cannot transition to on while someone is in the hazardous area.

If you configure a Safely-limited Speed Monitoring Delay [Lim Spd Mon Delay], the delay begins when the SLS_In transition from on to off requests Safely-limited Speed monitoring. The safety relay begins monitoring for Safely-limited Speed when the delay times out. If the system speed is greater than or equal to the configured safe speed limit during Safely-limited Speed monitoring, an SLS fault occurs and the safety relay initiates the configured Safe Stop type.

Timing Diagram for Safely-limited Speed (SLS)



Safely-limited Speed Reset

A Safely-limited Speed (SLS) reset is a transition out of actively monitoring Safely-limited Speed. It can also occur during a Safely-limited Speed Monitoring Delay [Lim Spd Mon Delay], if configured. When an SLS reset occurs, the safety relay no longer monitors for Safely-limited Speed and the door locks. Speed is no longer restricted to the configured safe speed limit.

The SLS reset function monitors the SLS_In input. If an SLS reset is requested, the safety relay checks that no faults are present and verifies that the SLS_In input is on (closed circuit) before the reset is performed.

When the input is off, Safely-limited Speed monitoring takes place after the SLS Monitoring Delay [Lim Spd Mon Delay], if configured. An SLS reset can be requested during active Safely-limited Speed monitoring or during a Safely-limited Speed monitoring delay. If a reset is requested during a Safely-limited Speed monitoring delay, the reset does not wait for the delay to time out.

Automatic

Once the SLS_In input is on (closed), the safety relay lets the drive resume normal operating speed. No reset button is required to reenter the normal run state.

Manual

An SLS_Reset attempts when the SLS_In input transitions from off to on and the Reset_In input is on.

If the SLS_In transitions from off to on and the Reset_In input is off, the safety relay stays in its current state. This transition occurs whether the safety relay is actively monitoring Safely-limited Speed or is in a Safely-limited Speed Monitoring Delay. The safety relay waits for the Reset_In input to transition to on before attempting the SLS_Reset. The SLS_Reset cancels if at any time the SLS_In input transitions back to off.

Manual Monitored

When the SLS_In input transitions from off to on, the safety relay waits for an off-to-on-to-off transition of the Reset_In input before it attempts an SLS_Reset. The SLS_Reset cancels if the SLS_In input transitions back to off at any time during the transition period.

SLS Parameter List

To configure the safety relay for Safely-limited Speed monitoring, set the parameters that are listed in Table 28 and Table 26 on page 65.

Table 28 - Safely-limited Speed Parameters

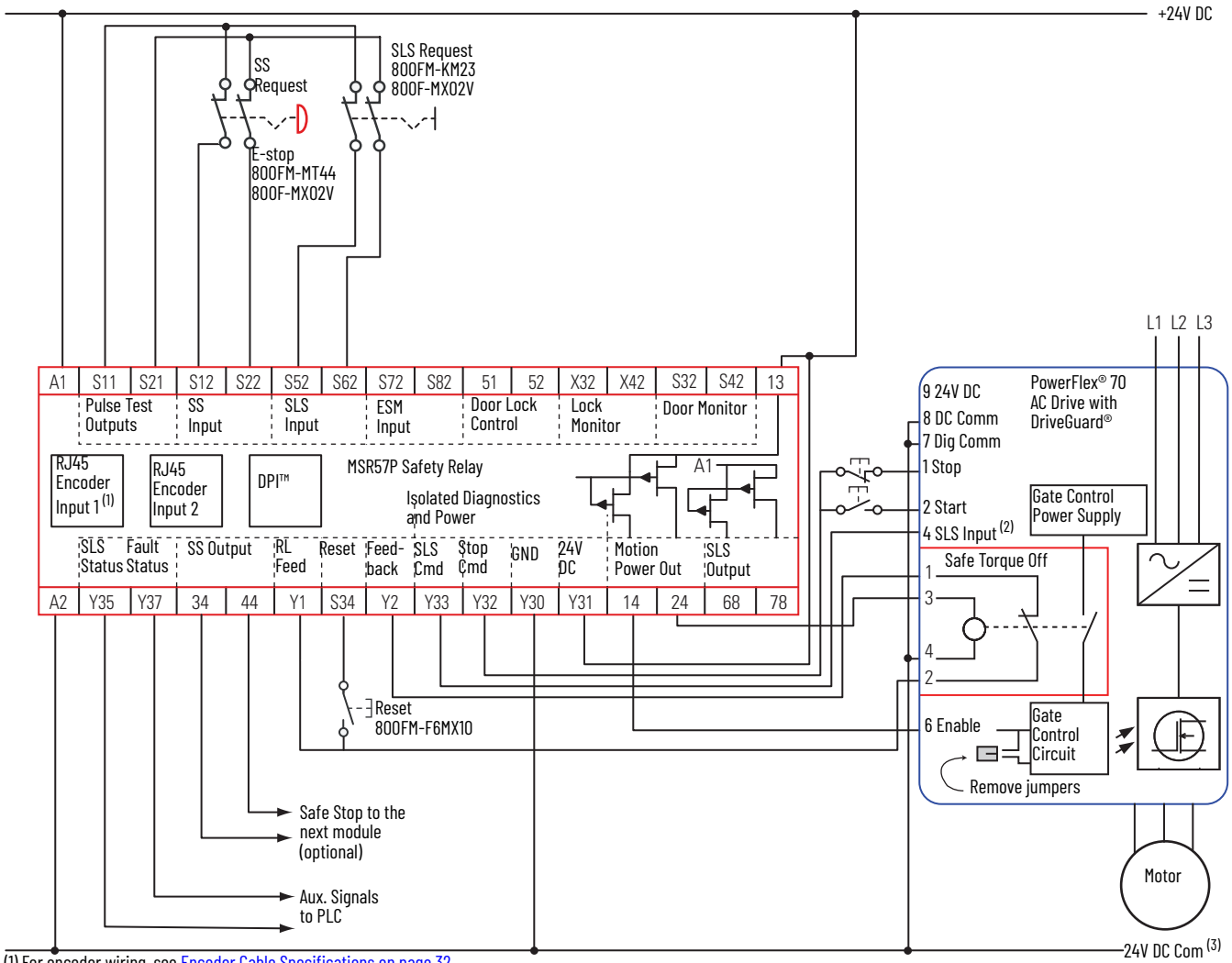
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	3 = Primary, Safely-limited Speed (Lim Speed)
52	Lim Speed Input	Configuration for the Safely-limited Speed input (SLS_In).	Default:	0 = Not used (1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)
53	LimSpd Mon Delay	Defines the Safely-limited Speed Monitoring Delay between the SLS_In on to off transition and the initiation of the Safely-limited Speed (SLS) monitoring.	Default:	0
			Range:	0...6553.5 s
55	Safe Speed Limit	Defines the speed limit that is monitored in Safely-limited Speed (SLS) mode.	Default:	0
			Range:	0...6553.5 rpm or mm/s based on the rotary or linear configuration, which the encoder 1 feedback configuration defines. P29 [Fbk 1 Units] parameter
73	SLS Out Mode	Defines whether the SLS_Out output is pulse-tested.(2)	Default:	0 = Pulse Test
			Options:	0 = Pulse test 1 = No pulse test

(1) You must configure this parameter with a nonzero value in this mode.
(2) If pulse tests are turned off for any output, the SIL, Category, and PL rating reduces for the entire MSR57P safety relay system.

SLS Wiring Example

The example that is shown in Figure 22 illustrates Safely-limited Speed wiring.

Figure 22 - Primary, Safely-limited Speed (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

SLS with Door Monitoring Mode

When properly configured for Safely-limited Speed with Door Monitoring, the safety relay performs Safely-limited Speed (SLS) monitoring functions, see SLS Mode on page 79, and Safe Stop functions, see Safe Stop Mode on page 67.

In addition, the speed monitoring safety relay verifies through monitoring the Door Monitor input (DM_In) that the device controlled by the Door Control output (DC_Out) is in the expected state. If the door is monitored as open when it must be closed, the speed monitoring safety relay initiates the configured Safe Stop type.

The Door Monitor input (DM_In) is on when the door is closed and off when the door is open. The DM_In input must be on (door closed) whenever Safely-limited Speed monitoring is inactive (SLS_In is on, meaning the circuit is closed). The DM_In input must also be on (door closed) during a Safely-limited Speed Monitoring Delay [LimSpd Mon Delay]. A Door Monitor fault is a Stop Category fault, which initiates the configured Safe Stop type.

If Safely-limited Speed monitoring is active (SLS_In input is off) and the safety relay has verified a safe speed condition, the door can be unlocked and opened.

ATTENTION: Verify that an unlocked door does not result in a hazardous situation.
If a Safe Stop type initiates or a fault occurs while the safety relay is actively monitoring Safely-limited Speed, the door control remains unlocked. The safe state of the SLS_In input can allow the door to unlock.

You can monitor the door's status with or without the door control (lock/unlock) function. When door control logic is set to lock, it helps prevent personnel from entering the hazardous area when the machine is not at a safe speed or at standstill speed.

Safely-limited Speed Reset

When properly configured for Safely-limited Speed with door monitoring, the safety relay must monitor motion (SLS_In input is off) if the door is open (DM_In is off). Verify that the door is closed before you request an SLS reset.

A Safely-limited Speed reset results in a Door Monitoring fault if the door is open (DM_In is off) when a transition of the SLS_In input from off to on requests the reset. A Door Monitor fault is a Stop Category fault, which initiates the configured Safe Stop type.

SLS with Door Monitoring Parameter List

To configure the safety relay for Safely-limited Speed with door monitoring, set the DM input parameter in Table 29, the Safe Stop parameters (Table 27 on page 74), and the Safely-limited Speed parameters (Table 28 on page 81).

Table 29 - Safely-limited Speed with Door Monitoring Parameters

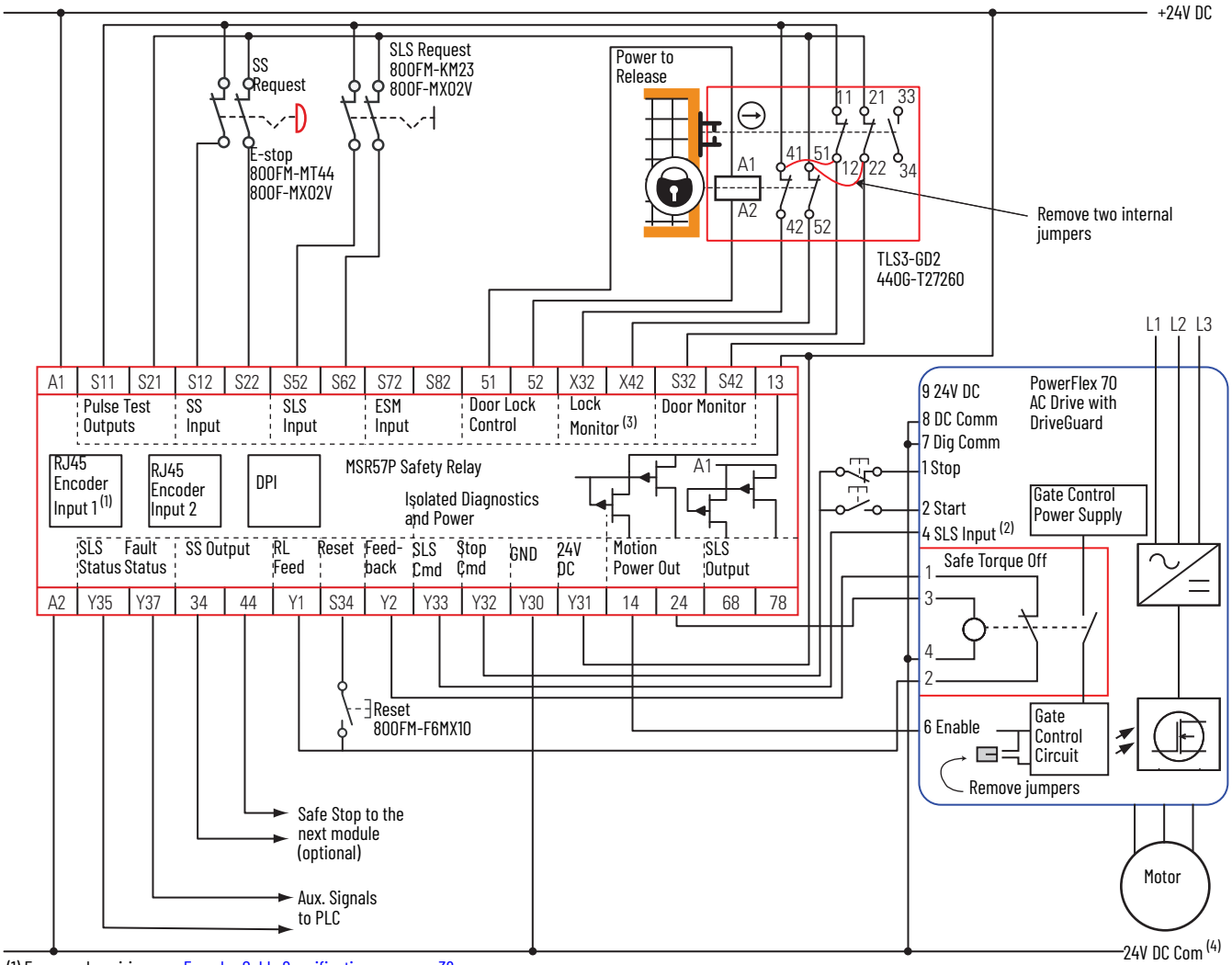
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	4 = Primary, Safely-limited Speed with Door Monitoring (Lim Speed DM)
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default:	0 = Not used (1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single-channel equivalent (1NC)

(1) You must configure this parameter with a nonzero value in this mode.

SLS with Door Monitoring Wiring Example

The example in Figure 23 illustrates wiring for SLS with door monitoring.

Figure 23 - Primary, Safely-limited Speed with Door Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safely-limited Speed with Door Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

SLS with Enabling Switch Monitoring Mode

When properly configured for Safely-limited Speed with enabling switch monitoring, the safety relay performs Safely-limited Speed (SLS) monitoring functions as described in SLS Mode on page 79 and the Safe Stop functions as described in Safe Stop Mode on page 67.

In addition, the safety relay monitors the Enabling Switch Monitor input (ESM_In) after the Safely-limited Speed Monitoring Delay [LimSpd Mon Delay] times out. The ESM_In input must be on when the delay times out and Safely-limited Speed monitoring begins, or an ESM Monitoring fault occurs. An ESM Monitoring fault is a Stop Category fault, which initiates the configured Safe Stop type.

IMPORTANT When Safely-limited Speed monitoring is inactive, the ESM_In input is not monitored.

Safe Stop Reset (SS Reset) and Safely-limited Speed Reset (SLS Reset)

If an ESM Monitoring fault occurs because the ESM_In input turns off (enabling switch is released), the safety relay can be reset without cycling the SS_In input. To perform an SLS reset, first return the ESM_In input to on (grip the enabling switch in the middle position). Then, press and release the reset button. This case is the only situation where the SS_In input does not need to cycle to reset the safety relay following a fault.

While Safely-limited Speed is being monitored after the SLS Monitoring Delay [LimSpd Mon Delay] times out, if the SLS_In input is on and an SLS reset occurs, the ESM_In is not monitored.

ATTENTION: Verify that the SLS_In input cannot transition to on while someone is in the hazardous area.
Use appropriate procedures when selecting Safely-limited Speed to help prevent other users from changing the mode while personnel are in the machine area.

If you attempt an SS reset when the SLS_In input is off and the ESM_In input is off, an ESM Monitoring fault occurs. An ESM Monitoring fault is a Stop Category fault, which initiates the configured Safe Stop type.

SLS with Enabling Switch Monitoring Parameter List

To configure the safety relay for Safely-limited Speed with enabling switch monitoring, set the P54 [Enable SW Input] parameter (Table 30), the Safe Stop parameters (Table 25 on page 74), and the Safely-limited Speed parameters (Table 27 on page 74).

Table 30 - Safely-limited Speed with Enabling Switch Monitoring Parameters

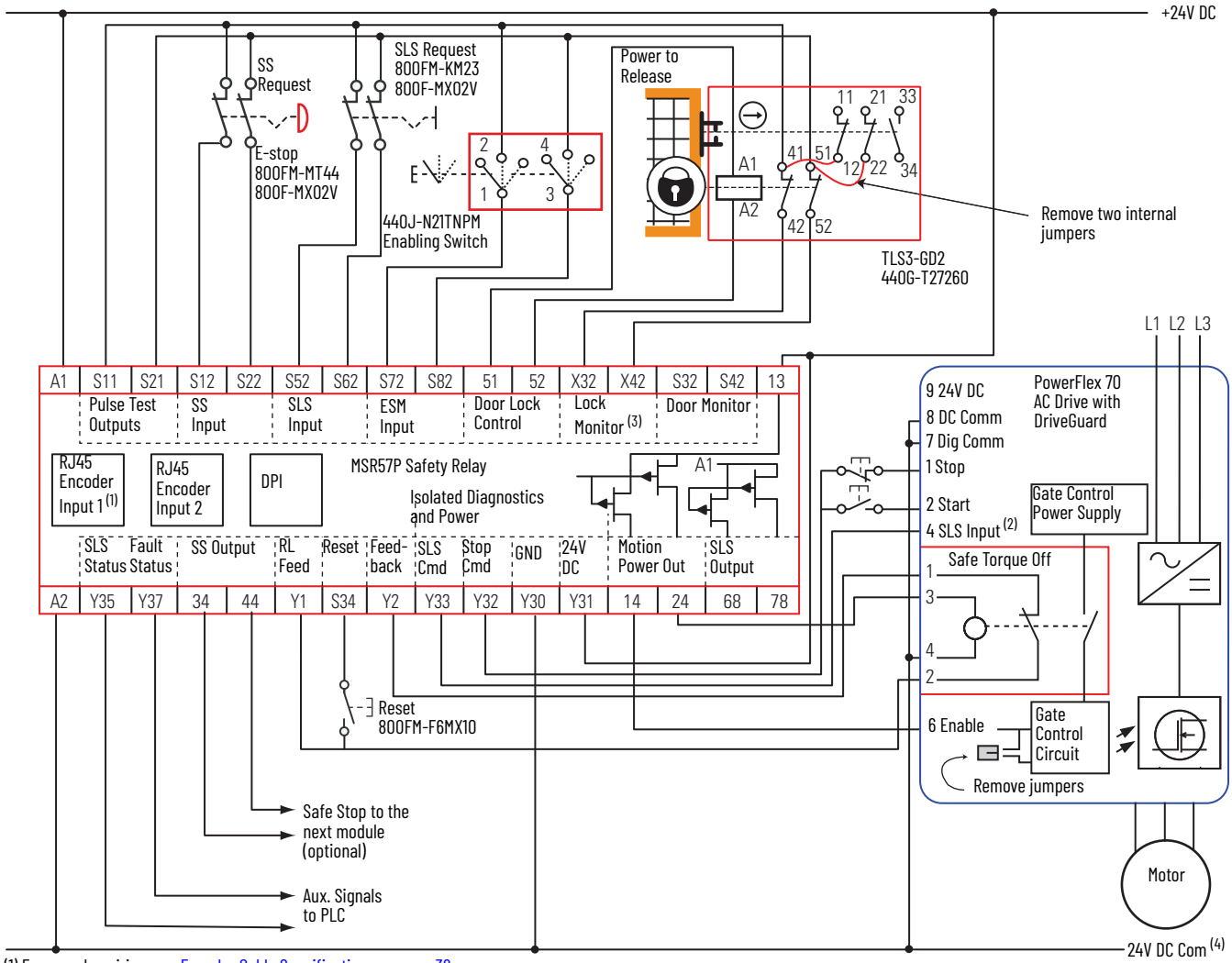
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	5 = Primary, Safely-limited Speed with Enabling Switch Control (Lim Speed ES)
54	Enable SW Input	Configuration for the Enabling Switch input (ESM_In).	Default:	0 = Not used (1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single-channel equivalent (1NC)

(1) You must configure this parameter with a nonzero value in this mode.

SLS with Enabling Switch Monitoring Wiring Example

The example in Figure 24 illustrates wiring for SLS with enabling switch monitoring.

Figure 24 - Primary, Safely-limited Speed with Enabling Switch Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safely-limited Speed with Enabling Switch Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

SLS with Door Monitoring and Enabling Switch Monitoring Mode

When properly configured for Safely-limited Speed with door monitoring and enabling switch monitoring, the safety relay performs Safely-limited Speed (SLS) monitoring functions as described in SLS Mode on page 79, and to the Safe Stop functions as described in Safe Stop Mode on page 67.

The safety relay also monitors both the Enabling Switch Monitor input (ESM_In) and the Door Monitor input (DM_In).

This mode lets you access the hazardous area when the machine is under a Safely-limited Speed condition. The following is a typical procedure for accessing the hazardous area by using this mode:

1. Set the SLS_In input to off.

   The safe speed limit must not be exceeded after the Safely-limited Speed Monitoring Delay [LimSpd Mon Delay], if configured, times out.
2. After the Safely-limited Speed monitoring delay times out, hold the enabling switch in the middle position.

Once a safe speed is detected and the enabling switch is in the middle position, the safety relay unlocks the door.

3. Continue to hold the enabling switch while you open the door, enter the hazardous area, and perform the required maintenance.

Follow these steps to remove the safe speed condition and resume normal run operation:

1. Leave the hazardous area while holding the enabling switch.
2. Hold the enabling switch until the door closes and you disable the SLS_In input by setting it to on, or closed position.
3. Press the reset button, if manual reset is configured.
4. Release the enabling switch.

   The machine resumes normal run operation.

ATTENTION: Verify that the SLS_In input cannot transition to on while someone is in the hazardous area.
Use appropriate procedures when selecting Safely-limited Speed to help prevent other users from changing the mode while personnel are in the machine area.

Behavior During SLS Monitoring

When Safely-limited Speed monitoring is active, door control logic is set to unlock if the ESM_In input is on and the speed is detected at below the Safe Speed Limit.

If the ESM_In input is on, the door can open (DM_In transitions from on to off). However, if the ESM_In input transitions to off after the door is open, an ESM Monitoring fault occurs. An ESM Monitoring fault is a Stop Category fault, which initiates the configured Safe Stop type.

If the DM_In input transitions from on to off (door is opened), while the ESM_In input is off, a Door Monitoring fault occurs. A Door Monitoring fault is a Stop Category fault, which initiates the configured Safe Stop type.

ATTENTION: While Safely-limited Speed monitoring is active, the ESM_In input is not monitored until the DM_In input is detected as off. Verify that the ESM_In input is not relied upon for safety until the DM_In input transitions to off.

After the DM_In input turns off, it can turn back on if the door closes behind the operator, but the ESM_In input is still monitored.

Behavior While SLS Monitoring is Inactive

If Safely-limited Speed monitoring is inactive, the DM_In input must be on (door closed) or a Door Monitoring fault occurs and the safety relay initiates the configured Safe Stop type. The ESM_In input can be on or off.

Behavior During SLS Monitoring Delay

The status of the ESM_In input does not affect the operation of the system during a Safely-limited Speed Monitoring Delay [LimSpd Mon Delay]. However, the DM_In input must be on (door closed) during the delay or a Door Monitoring fault occurs and the safety relay initiates the configured Safe Stop type.

Safe Stop Reset (SS Reset) and Safely-limited Speed Reset (SLS Reset)

The door must be closed when an SS reset or SLS reset is requested. An SS reset results in a Door Monitoring fault if a transition of the SS_In input from off to on requests the reset when the door is open. An SLS reset also results in a Door Monitoring fault if a transition of the SLS_In input from off to on requests the reset when the door is open. A Door Monitor fault is a Stop Category fault, which initiates the configured Safe Stop type.

If an SS reset is attempted while the SLS_In input is off, an ESM Monitoring fault occurs. An ESM Monitoring fault is a Stop Category fault, which initiates the configured Safe Stop type.

SLS with Door Monitoring and Enabling Switch Monitoring Parameter List

To configure the safety relay for Safely-limited Speed with door monitoring and enabling switch monitoring, set the P58 [DM Input] and P54 [ESM Input] parameters (Table 31), the Safe Stop parameters (Table 27 on page 74), and the Safely-limited Speed parameters (Table 28 on page 81).

Table 31 - Safely-limited Speed with Door Monitoring and Enabling Switch Monitoring Perimeters

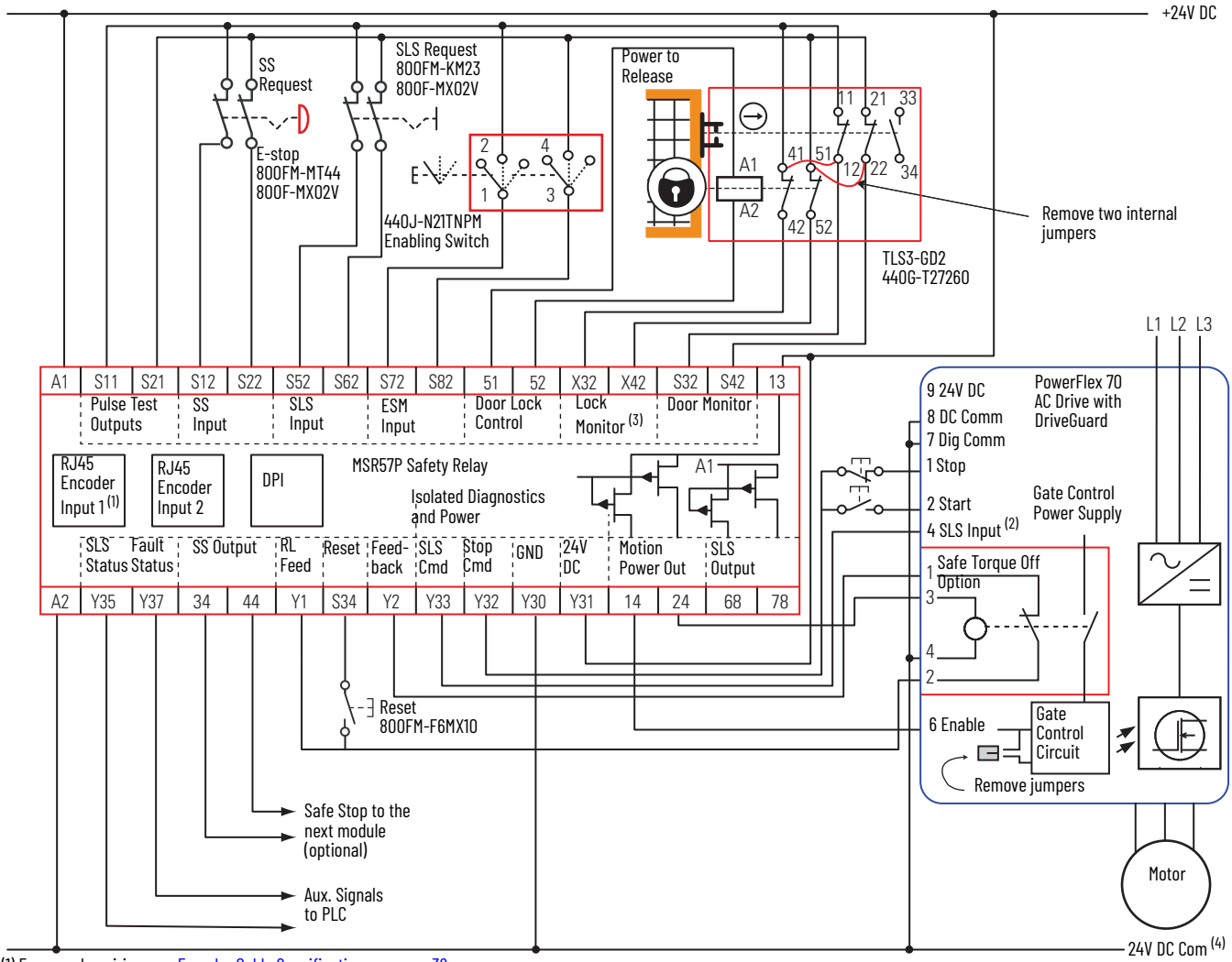
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	6 = Primary, Safely-limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES)
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default:	0 = Not used
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single-channel equivalent (1NC)
54	Enable SW Input	Configuration for the Enabling Switch input (ESM_In).	Default:	0 = Not used(1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single-channel equivalent (1NC)

(1) You must configure this parameter with a nonzero value in this mode.

SLS with Door Monitoring and Enabling Switch Monitoring Wiring Example

The example in Figure 25 illustrates wiring for SLS with door monitoring and enabling switch monitoring.

Figure 25 - Primary, Safely-limited Speed with Door Monitoring and Enabling Switch Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safely-limited Speed with Door Monitoring and Enabling Switch Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

SLS Status Only Mode

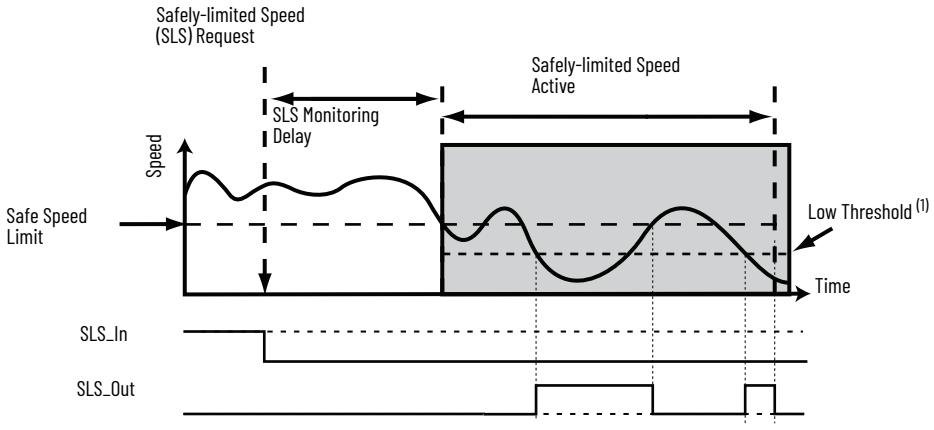
When properly configured for Safely-limited Speed status only, the safety relay provides Safely-limited Speed status information and the Safe Stop functions as described in Safe Stop Mode on page 67.

When the Safely-limited Speed input (SLS_In) is off, the feedback velocity is monitored and compared against a configurable safe speed limit. If the measured velocity exceeds the limit, no stopping action takes place. Instead the system status is made available as a safe output intended for a safety programmable logic controller (PLC). You can program an optional Safely-limited Speed Monitoring Delay [Lim Spd Mon Delay] to delay the start of Safely-limited Speed monitoring. In this mode, door monitoring and enabling switch monitoring are not available.

ATTENTION: When the safety relay is properly configured for Safely-limited Speed Status Only mode, it does not automatically initiate a Safe Stop if there is an overspeed condition.

A transition of the SLS_In input from on to off requests Safely-limited Speed monitoring. If you configure a Safely-limited Speed monitoring delay, the delay begins when the SLS_In input transition from on to off requests Safely-limited Speed monitoring. The safety relay begins monitoring for Safely-limited Speed when the delay times out. The SLS_Out output is on if Safely-limited Speed monitoring is active and the speed is below the configured safe speed limit, with the consideration of hysteresis.

Figure 26 - Timing Diagram for Safely-limited Speed Status Only



(1) Low Threshold = (Speed Hysteresis/100) x Safe Speed Limit

Speed Hysteresis

The P56 [Speed Hysteresis] parameter provides hysteresis for the SLS_Out output when the safety relay is configured for SLS status only and Safely-limited Speed monitoring is active. The SLS_Out output turns on if the speed is less than the low threshold, which equals {(Speed Hysteresis/100) x Safe Speed Limit}. The SLS_Out output turns off when the speed is greater than or equal to the configured Safe Speed Limit.

The SLS_Out output remains off if Safely-limited Speed monitoring begins when the detected speed is less than the configured safe speed limit but greater than or equal to the low threshold {(Speed Hysteresis/100) x Safe Speed Limit}.

The SLS_Out output is held in its last state when the speed is less than the configured safe speed limit and the speed is greater than or equal to the low threshold {(Speed Hysteresis/100) x Safe Speed Limit}.

SLS Status Only Parameter List

To configure the safety relay for Safely-limited Speed status only monitoring, set the parameters that are shown in Table 32, and the Safe Stop parameters (Table 27 on page 74).

Table 32 - Safely-limited Speed Status Only Parameters

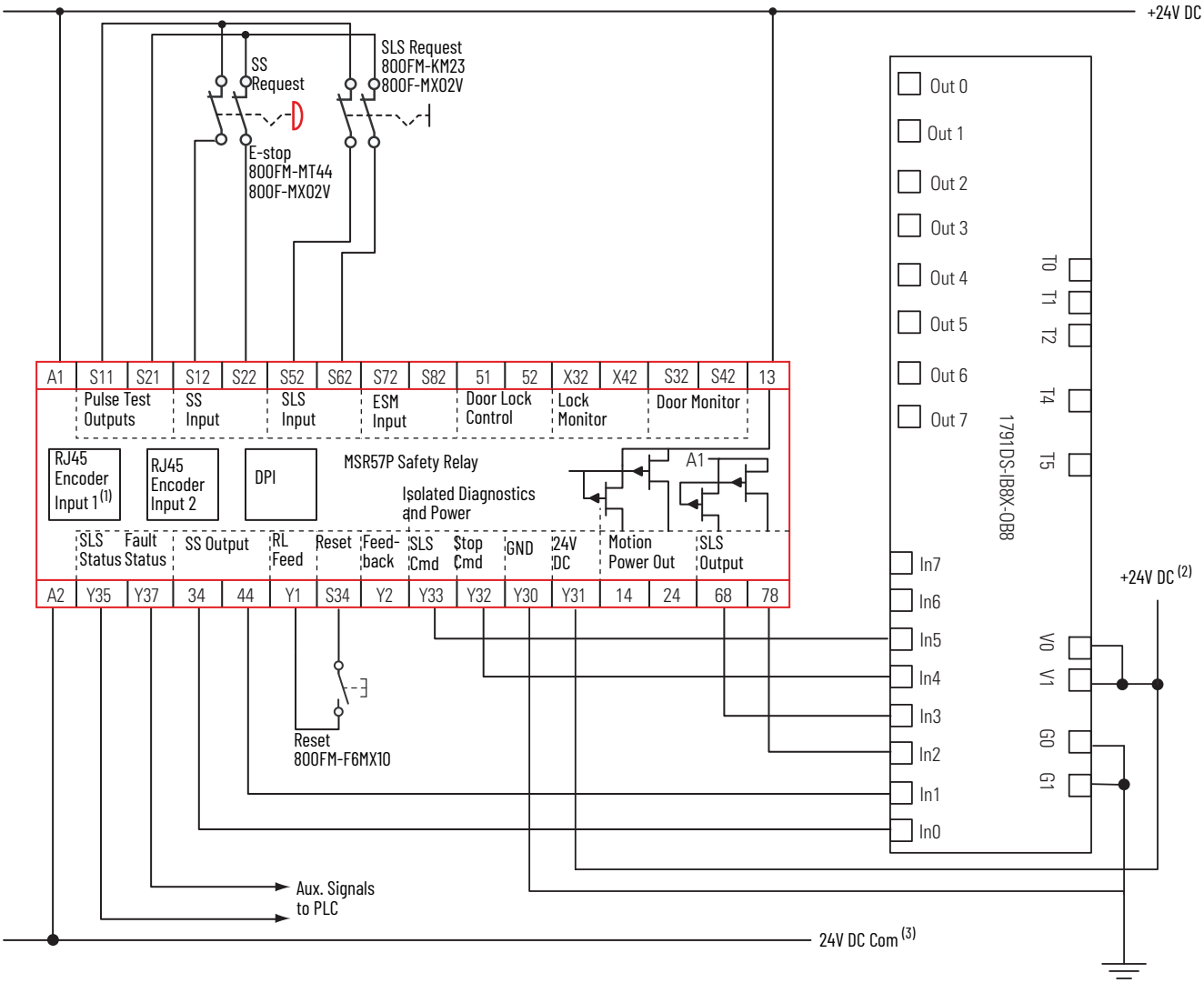
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	7 = Primary, Safely-limited Speed Status Only (Lim Spd Stat)
52	Lim Speed Input	Configuration for the Safely-limited Speed input (SLS_In).	Default:	0 = Not used (1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single-channel equivalent (1NC)
53	LimSpd Mon Delay	Defines the Safely-limited Speed Monitoring Delay between the SLS_In ON to OFF transition and the initiation of the Safely-limited Speed (SLS) monitoring.	Default:	0
			Range:	0...6553.5 s
55	Safe Speed Limit	Defines the speed limit that is monitored during the Safely-limited Speed (SLS) mode.	Default:	0
			Range:	0...6555.3 rpm or mm/s based on rotary or linear configuration. The encoder 1 feedback configuration P29 [Fbk 1 Units] parameter defines the configuration.
56	Speed Hysteresis	Provides hysteresis for SLS_Out output when Safely-limited Speed monitoring is active.	Default:	0 (2)
			Range:	10...100%

(1) You must configure this parameter with a nonzero value in this mode.
(2) You must configure this parameter with a value in the range from 10...100% in this mode.

SLS Status Only Wiring Examples

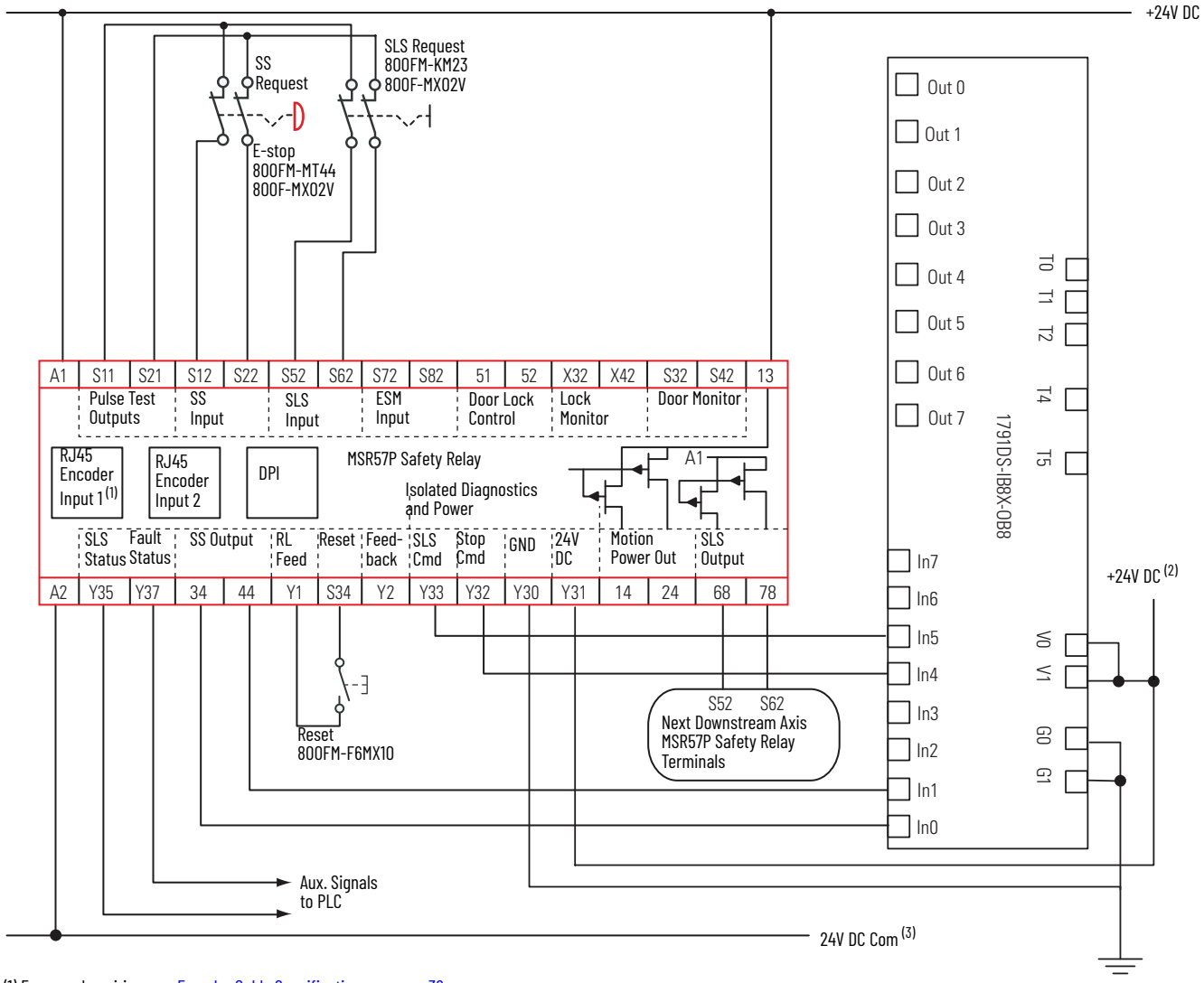
The examples in Figure 27 and Figure 28 on page 93 illustrate the wiring for SLS status only operation.

Figure 27 - Primary, Safely-limited Speed Status Only (Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Power supply can be isolated.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Figure 28 - Primary, Safely-limited Speed Status Only (First Unit)



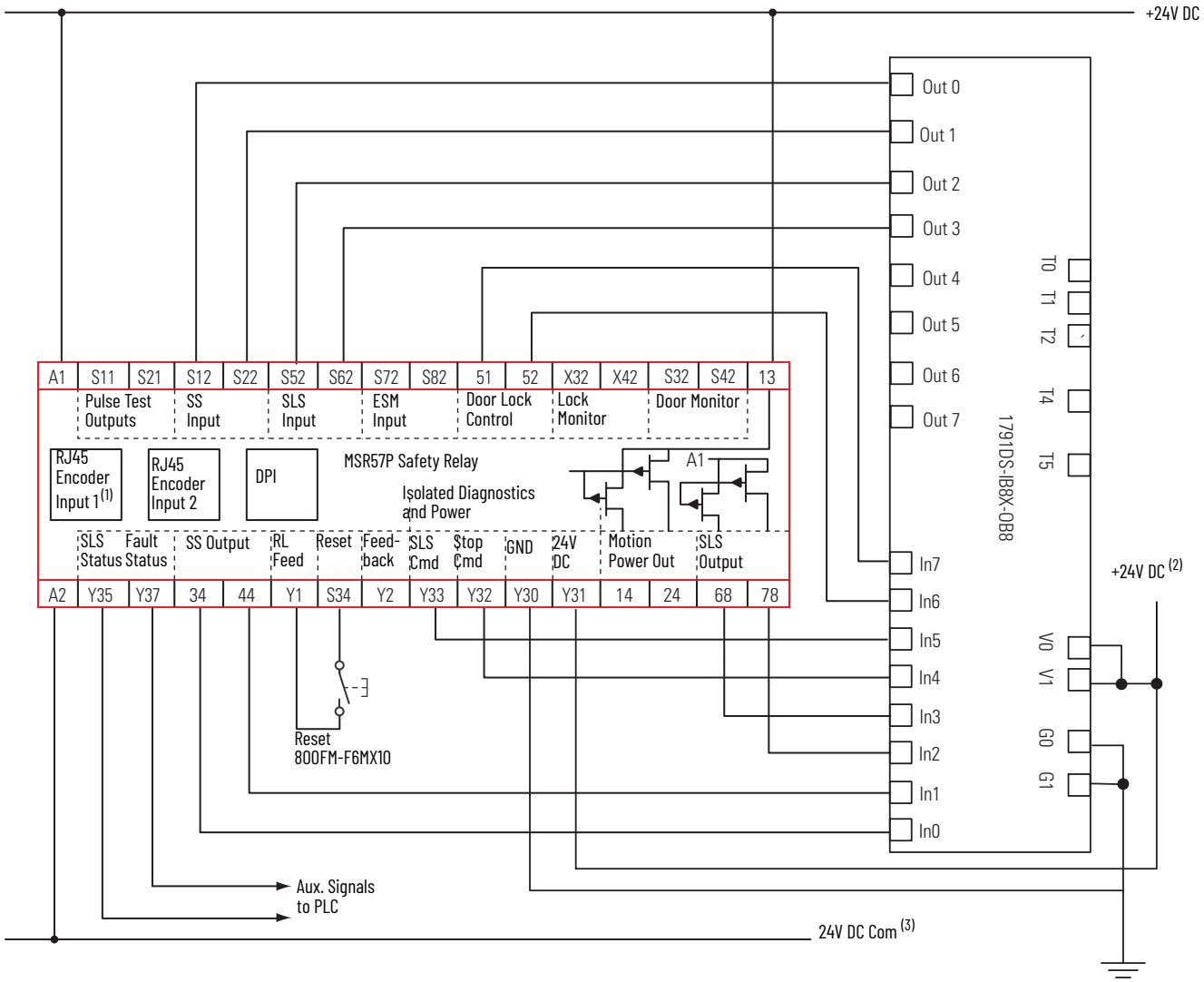
(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Power supply can be isolated.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

The example that is shown in Figure 29 on page 94 assumes that a programmable safety controller is monitoring all MSR57P safety relay functions and controlling the safety relay. The SS_In and SLS_In inputs connect to the I/O module; however, you can also use standard safety component inputs.

The following functions are not performed by the MSR57P safety relay in this scenario:

- Guard locking switch inputs
- Door locking
- Door status (open or closed)
- Enabling switch

Figure 29 - Safely-limited Speed Status Only with Programmable Controller Monitoring



(1) For encoder wiring, see Encoder Cable Specifications on page 32.
(2) Power supply can be isolated.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

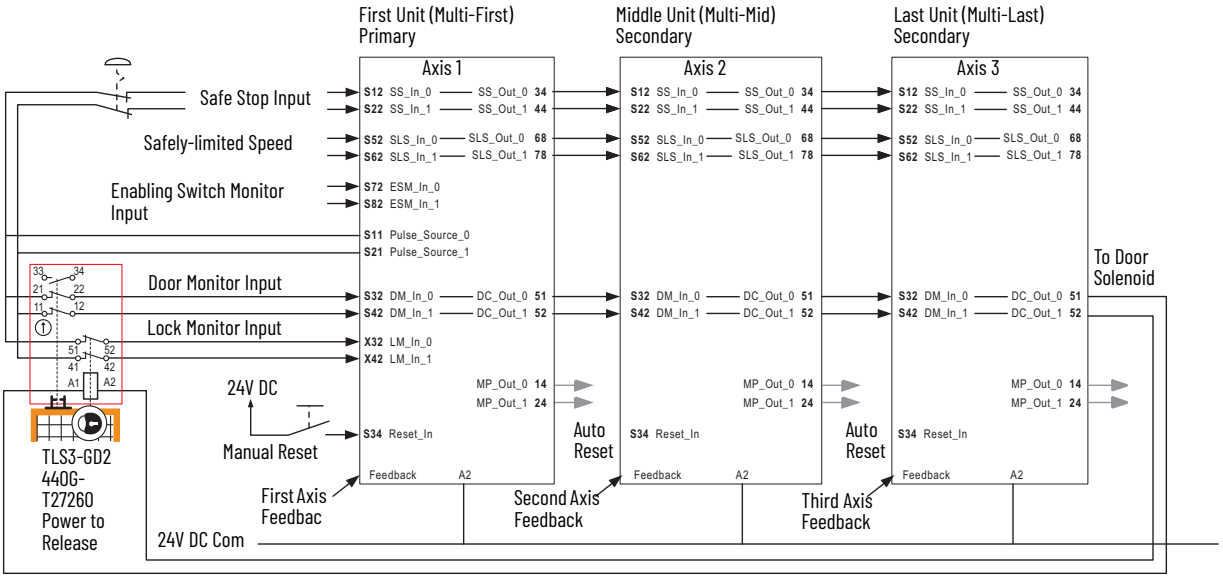
Secondary Modes for Multi-axis Cascaded Systems

Cascaded Configurations

You can configure only the middle or last safety relays in a multi-axis system for secondary modes. Use the P20 [Cascaded Config] parameter to define the position of the safety relay in the system as single unit (Single), cascaded first unit (Multi First), cascaded middle unit (Multi Mid), or cascaded last unit (Multi Last).

For cascaded speed monitoring safety relays, connect the safety switches to the safety inputs (SS_In, SLS_In, DM_In, ESM_In, and LM_In) of the first (primary) axis only. Each feedback and the Motion Power output (MP_Out) for Safe Stop functions are connected to their respective axis. The inputs are cascaded from one safety relay to the next by connecting the outputs from the previous safety relay to the inputs of the next safety relay.

Figure 30 - Cascaded Connections



The first safety relay (primary), monitors the inputs from the safety switches. A Safely-limited Speed reset that the first safety relay detects, cascades to the subsequent safety relays via the SLS_Out to SLS_In chain. Although all MSR57P safety relay units can be configured for any reset type, we recommend using automatic reset in all secondary units to follow the primary units reset type.

The first safety relay detects any fault or transition of the SS_In input to off and the first safety relay initiates the configured Safe Stop type to all safety relays via the SS_Out to SS_In chain.

Any fault in a secondary safety relay initiates the configured Safe Stop type only to that safety relay and to secondary safety relays further down the chain.

IMPORTANT Safe Stop monitoring is not initiated for non-faulted safety relays earlier in the cascaded chain.

IMPORTANT The safety reaction time for a cascaded system includes the sum of the reaction times of each safety relay in the chain.

Secondary, Safe Stop Mode

When properly configured for Secondary, Safe Stop mode, the safety relay performs the same functions as Safe Stop, except that the safety relay regards the door monitor input as a door control output from an upstream axis. The safety relay performs a logical AND with its internal door control signal to form the cascaded door control output. This action confirms that the door control output only commands the door to unlock if all units command the door to unlock.

Secondary, Safe Stop Parameter List

To configure the safety relay for a Secondary, Safe Stop mode, set the parameters that are shown in Table 33. See Multi-axis Connections on page 105 for details on secondary configuration of the safety relays.

Table 33 - Secondary, Safe Stop Parameters

Parameter		Description	Setting	
20	Cascaded Config	Defines whether the speed monitoring safety relay is one unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Options:	2 = Cascaded middle unit (Multi Mid) 3 = Cascaded last unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Option:	8 = Secondary, Safe Stop (Slv Safe Stop)
44	Safe Stop Input	Configuration for Safe Stop input (SS_In).	Option:	5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s)
45	Safe Stop Type	Safe operating stop type selection. Defines the type of Safe Stop that is performed if a stop type condition initiates the Safe Stop function.	Default:	0 = Safe Torque Off with Standstill Checking (Torque Off)
			Options:	0 = Safe Torque Off with Standstill Checking (Torque Off) 1 = Safe Stop 1 2 = Safe Stop 2 3 = Safe Torque Off without Standstill Checking (Trq Off NoChk)
46	Stop Mon Delay	Defines the monitoring delay between the request for a Safe Stop and the start of the Stop Delay [Max Stop Time] when an SS_In input on to off transition initiates the request for a Safe Stop 1 or a Safe Stop 2. If the Safe Stop type is Safe Torque Off with or without speed checking, the stop monitoring delay must be 0 or an Invalid Configuration fault occurs.	Default:	0
			Range:	0...6553.5 s
47	Max Stop Time	Defines the maximum stop delay time that is used when a stop type condition initiates the Safe Stop function.	Default:	0
			Range:	0...6553.5 s
48	Standstill Speed	Defines the speed limit that is used to declare motion as stopped. Not valid for Safe Torque Off without Standstill Speed Checking.	Default:	0.001
			Range:	0.001...65.535 rpm or mm/s based on rotary or linear configuration that encoder 1 feedback configuration defines the P29 [Fbk 1 Units] parameter
49	Standstill Pos	Standstill Position Window. Defines the position limit in encoder 1 degrees or mm that will be tolerated after a Safe Stop condition has been detected.	Default:	10
			Range:	0...65,535 degrees (360° = 1 revolution) or mm based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines
50	Decel Ref Speed	Decel Reference Speed. Determines deceleration rate to monitor for Safe Stop 1 or Safe Stop 2.	Default:	0
			Range:	0...65,535 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines

Table 33 - Secondary, Safe Stop Parameters (Continued)

Parameter		Description	Setting	
51	Stop Decel Tol	Decel Tolerance. The acceptable tolerance above the deceleration rate set by the P50 [Decel Ref Speed] parameter.	Default:	0
			Range:	0...100% of Decel Ref Speed
57	Door Out Type	Door Control Output Type. Defines the lock and unlock state for door control output (DC_Out). The first and middle units of a multi-axis system must be configured as cascading (2).	Default:	0 = Power to Release (Pwr to Rel)
			Options:	0 = Power to Release (Pwr to Rel) 1 = Power to Lock (Pwr to Lock) 2 = Cascaded (2 CH Sourcing)
58	DM Input Type	Door Monitor Input Type. Configuration for the door monitor input (DM_In).	Option:	5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s)

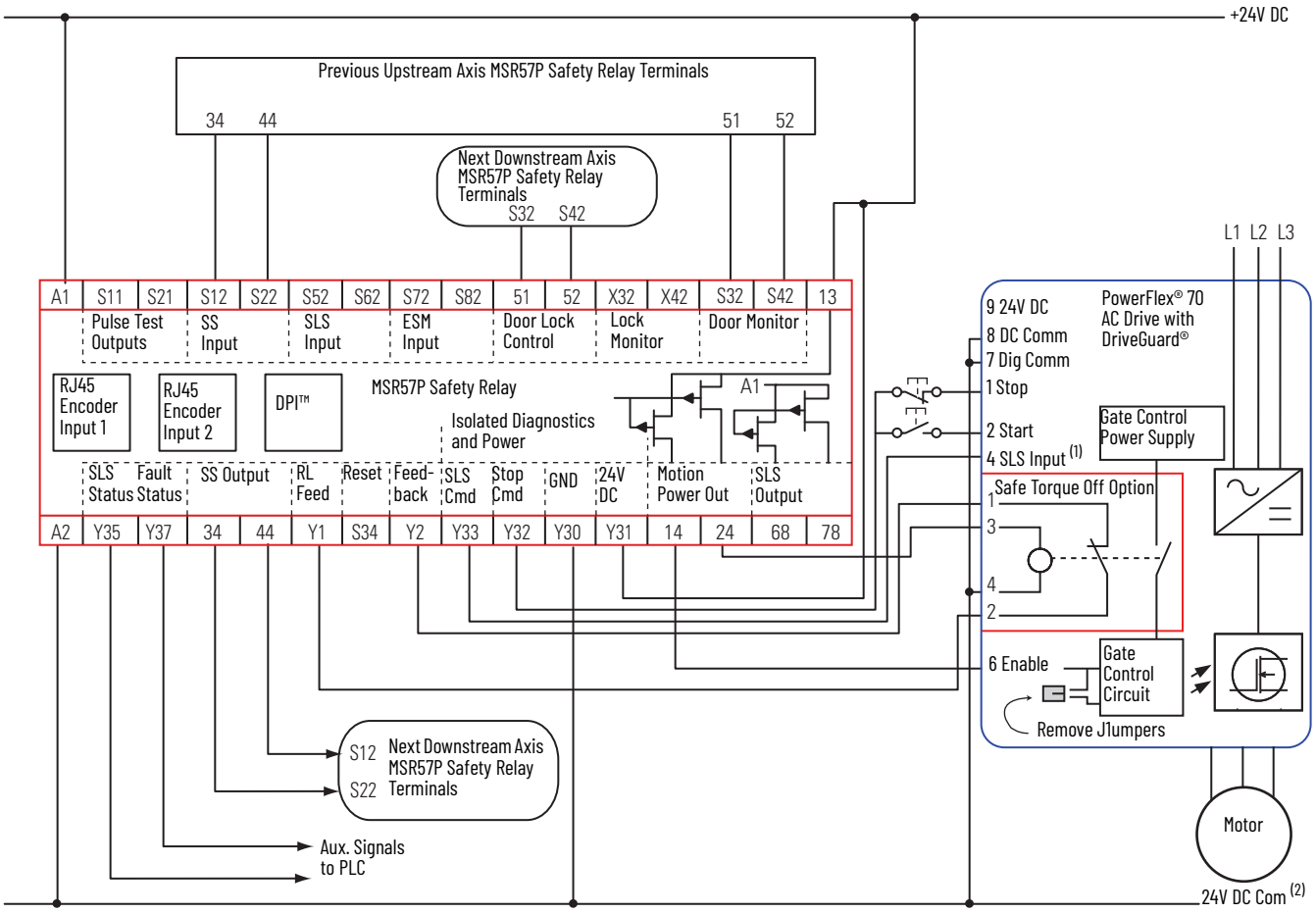
Secondary, Safe Stop Wiring Examples

The examples in Figure 31...Figure 33 on page 99 show two different Secondary, Safe Stop configurations.

Figure 31 shows an MSR57P safety relay that is configured as a cascaded middle unit via the P20 [Cascaded Config] parameter (Multi Mid). It has SS_In and DM_In input connections from the previous upstream MSR57P safety relay, and SS_Out and DC_Out output connections to the next downstream MSR57P safety relay. This unit is configured with automatic reset so it follows the function of the previous axis.

See Safe Stop with Door Monitoring Wiring Example on page 78 for an example of a first (primary) unit.

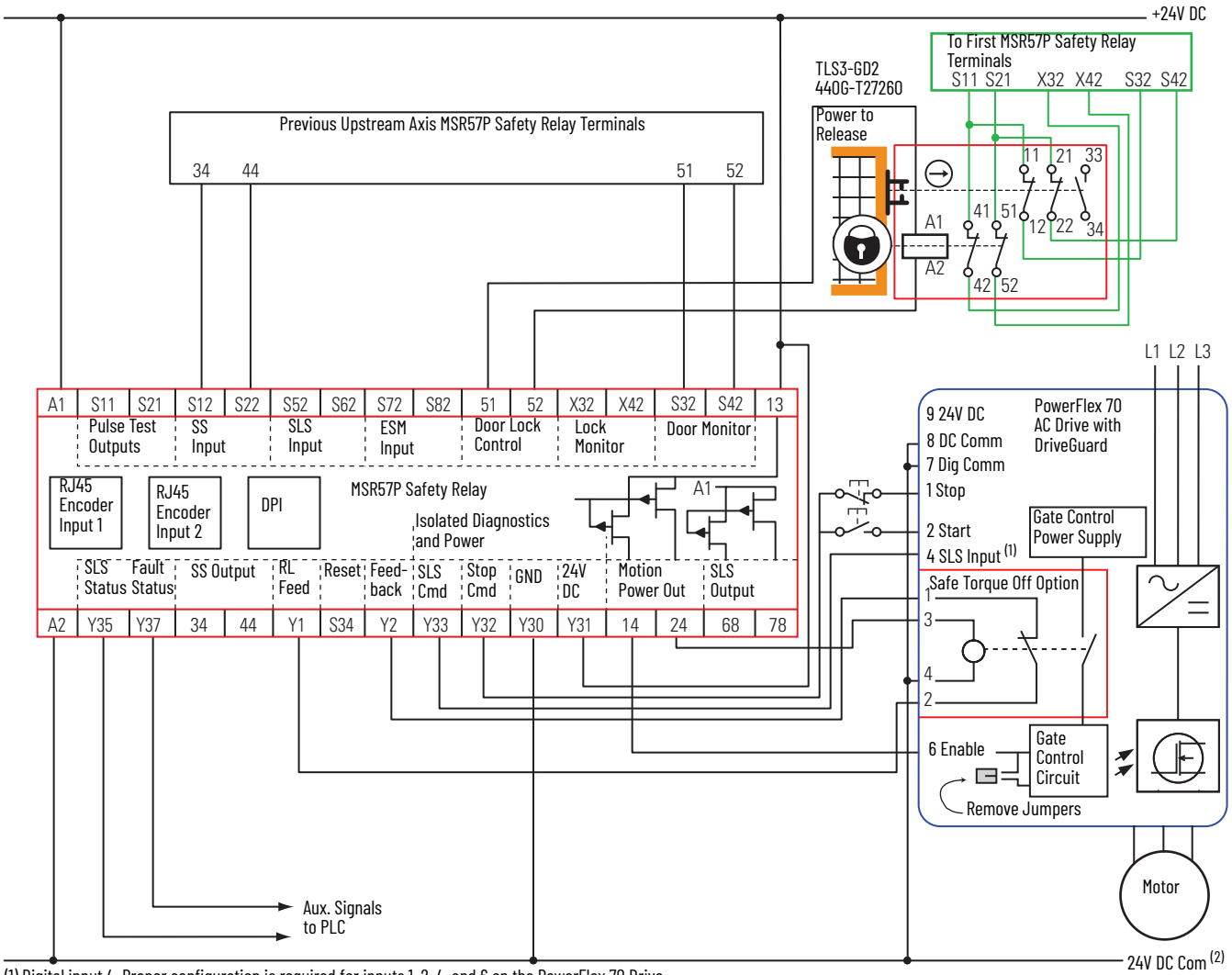
Figure 31 - Secondary, Safe Stop, Middle Unit



(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(2) All cascaded MSR57P safety relay units must share a common ground. 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Figure 32 shows the last cascaded secondary safety relay in the system. It has SS_In and DM_In inputs from the previous upstream MSR57P safety relay, but the DC_Out output is connected to a guard locking interlock switch. This unit is configured with automatic reset to follow the function of the previous axis.

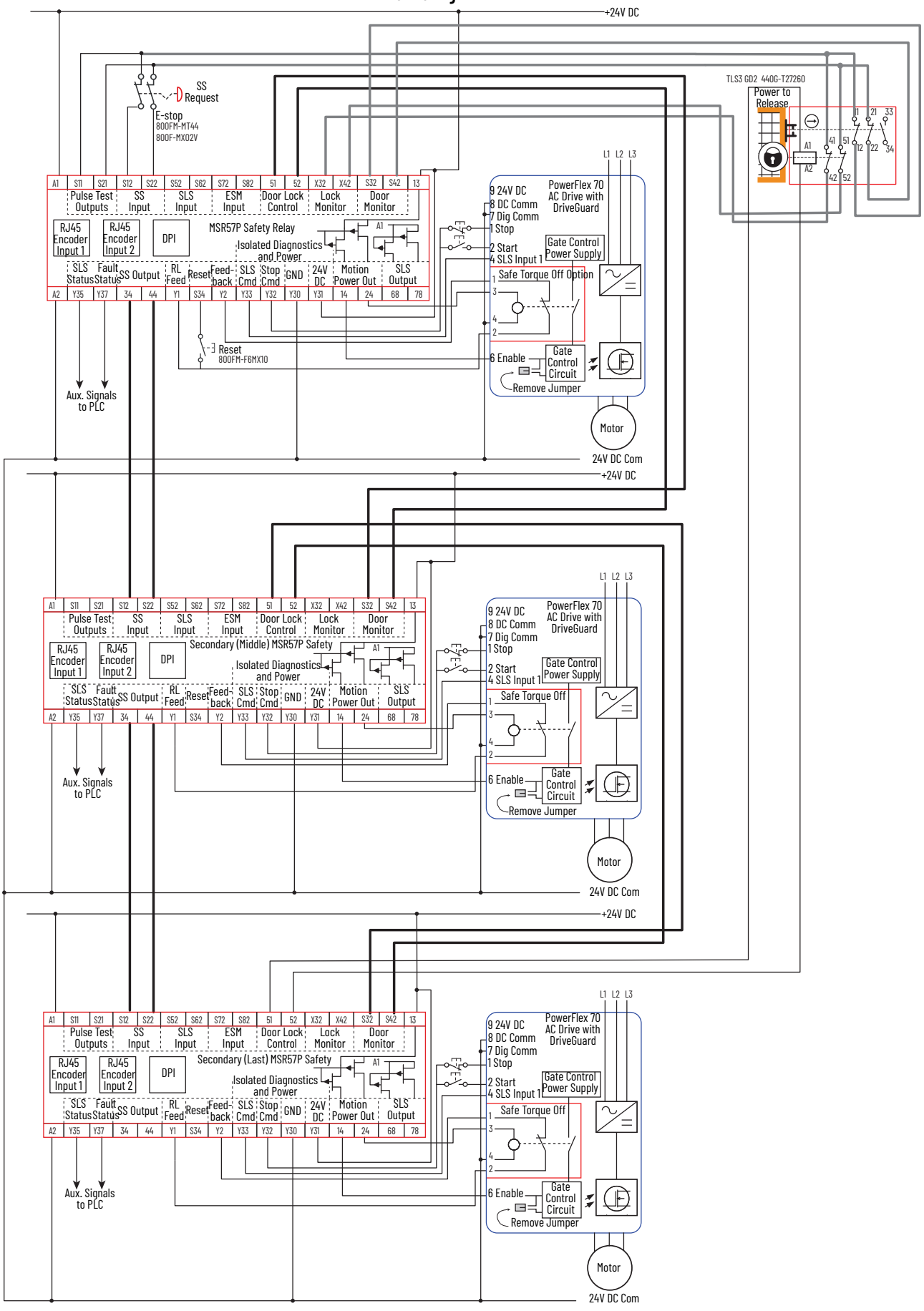
Figure 32 - Secondary, Safe Stop, Last Unit



(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(2) All cascaded MSR57P safety relay units must share a common ground. 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Figure 33 on page 99 shows three safety relays connected together in a cascaded system. All safety relays must have a shared common ground.

Figure 33 - First, Middle, and Last Safety Relays in a Cascaded System with Door Control and Lock Monitoring



Secondary, Safely-limited Speed Mode

When properly configured for Secondary, Safely-limited Speed mode, the speed monitoring safety relay performs the same functions as Safely-limited Speed mode as described on page SLS Mode on page 79.

However, the safety relay regards the door monitor input as a door control output from an upstream axis, and performs a logical AND with its internal door control signal to form the cascaded door control output. Door monitoring, enabling switch monitoring, and lock monitoring functions are not allowed in this mode.

For the door to unlock, all axes must be below Safely-limited Speed.

Only the middle and last safety relays in a multi-axis system can be configured for secondary modes.

Secondary, Safely-limited Speed Parameters List

To configure the safety relay for secondary, Safely-limited Speed monitoring, set the parameters in Table 34 and Secondary, Safe Stop Parameter List on page 96. See Multi-axis Connections on page 105 for details on secondary configuration of safety relays.

Table 34 - Secondary, Safely-limited Speed Parameters

Parameter		Description	Setting	
20	Cascaded Config	Defines whether the speed monitoring safety relay is one unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Options:	2 = Cascaded middle unit (Multi Mid) 3 = Cascaded last unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Option:	9 = Secondary, Safely-limited Speed (Slv Lim Spd)
52	Lim Speed Input	Configuration for the Safely-limited Speed input (SLS_In).	Option:	5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s)
53	LimSpd Mon Delay	Defines the Safely-limited Speed Monitoring Delay between the SLS_In ON to OFF transition and the initiation of the Safely-limited Speed (SLS) monitoring.	Default:	0
			Range:	0…6553.5 s
55	Safe Speed Limit	Defines the speed limit that is monitored during the Safely-limited Speed (SLS) mode.	Default:	0 (1)
			Range:	0…6553.5 rpm or mm/s based on the rotary or linear configuration that the encoder 1 feedback configuration defines the P29 [Fbk 1 Units] parameter

(1) You must configure a value greater than zero for this parameter in this mode.

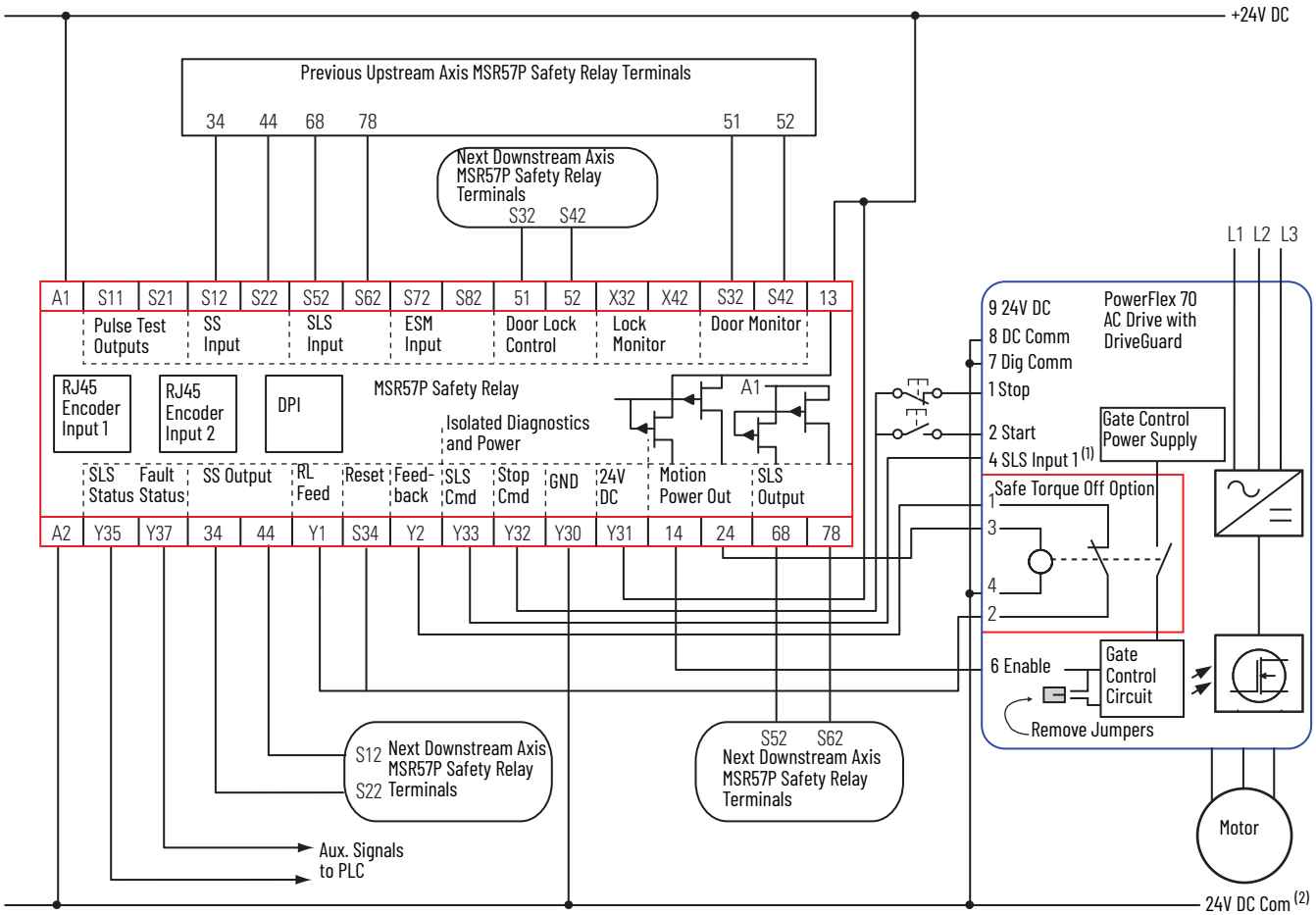
Secondary, Safely-limited Speed Wiring Examples

Figure 34 on page 101 and Figure 35 on page 102 show two different secondary, Safely-limited Speed configuration examples.

Figure 34 on page 101 is configured as a cascaded middle unit via the P20 [Cascaded Config] parameter (Multi Mid). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P safety relay, and SS_Out, SLS_Out, and DC_Out output connections to the next downstream MSR57P safety relay.

See SLS with Door Monitoring Wiring Example on page 84 for an example of a first (primary) unit.

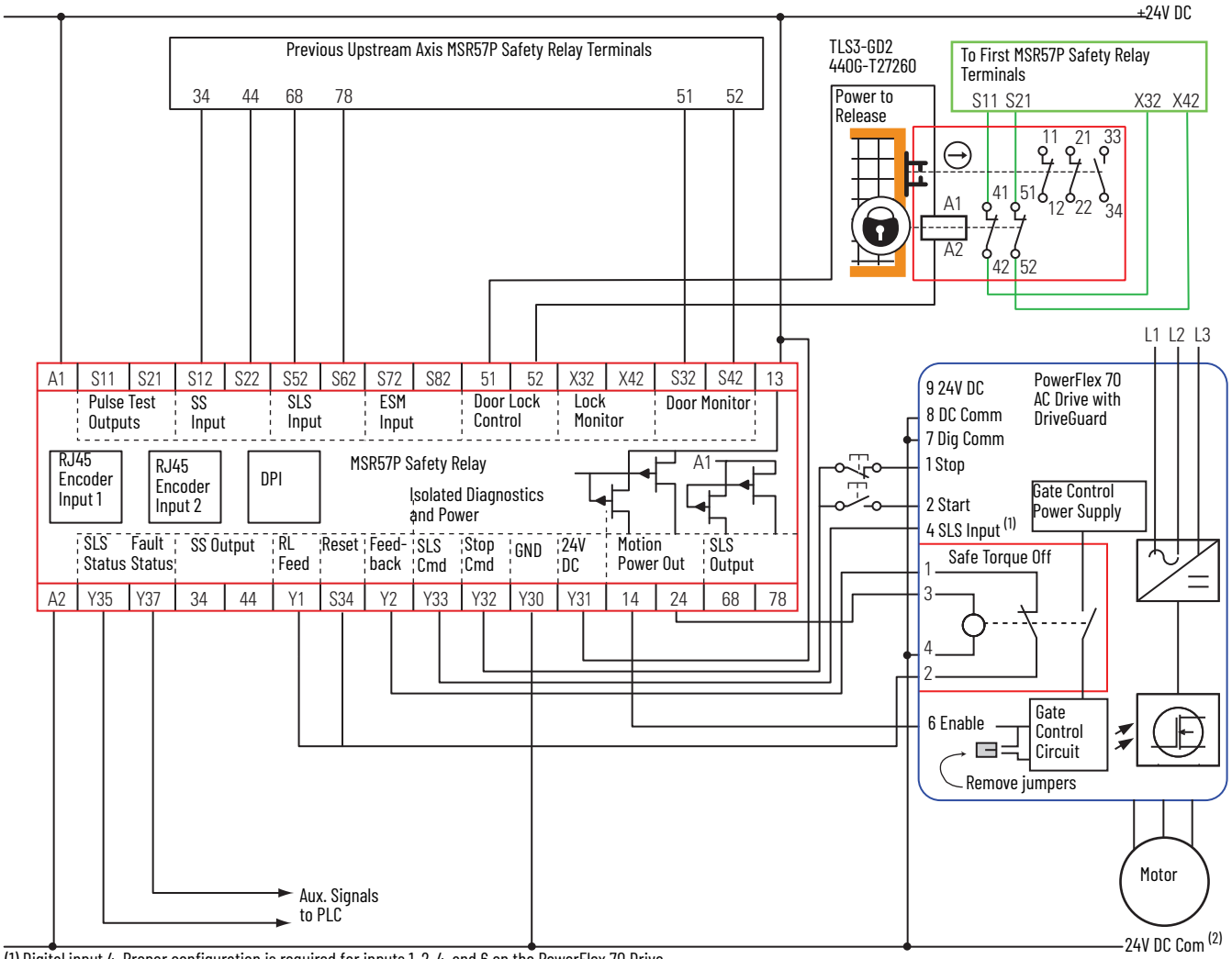
Figure 34 - Secondary, Safely-limited Speed, Middle Unit



(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(2) All cascaded MSR57P safety relay units must share a common ground.24V DC Com must be at the same potential as the drive common because of the encoder signal.

Figure 35 is configured as a cascaded last unit via the P20 [Cascaded Config] parameter (Multi Last). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P safety relay, but the DC_Out output is connected to a guard locking interlock switch.

Figure 35 - Secondary, Safely-limited Speed, Last Unit



(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(2) All cascaded MSR57P safety relay units must share a common ground. 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Secondary, Safely-limited Speed Status Only Mode

When properly configured for Secondary, Safely-limited Speed Status Only mode, the speed monitoring safety relay performs the same functions as Safely-limited Speed Status Only mode, see SLS Status Only Mode on page 90. However, the safety relay regards the door monitor input as a door control output from an upstream axis, and performs a logical AND with the internal Door Control signal to form the cascaded door control output.

The SLS_Out output of the last MSR57P safety relay in a cascaded chain goes high only when all axes are below the safe speed limit. In Safely-limited Speed Status Only mode, each subsequent unit does not enable Safely-limited Speed until the previous unit has reached the safe speed limit.

Door monitoring and enabling switch monitoring functions are not allowed in this mode.

Only the middle and last safety relays in a multi-axis system can be configured for secondary modes.

Secondary, Safely-limited Speed Status Only Parameter List

To configure the safety relay for secondary, Safely-limited Speed status only monitoring, set the parameters in Table 35 on page 103, Secondary, Safe Stop Parameter List on page 96, and Secondary, Safely-limited Speed Parameters List on page 100. See Multi-axis Connections on page 105 for details on secondary configuration of safety relays.

Table 35 - Secondary, Safely-limited Speed Status Only Parameter List

Parameter		Description	Setting	
20	Cascaded Config	Defines whether the speed monitoring safety relay is one unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Options:	2 = Cascaded system middle unit (Multi Mid) 3 = Cascaded system last unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety relay.	Option:	10 = Secondary, Safely-limited Speed Status Only (Slv Spd Stat)
56	Speed Hysteresis	Provides hysteresis for SLS_Out output when Safely-limited Speed monitoring is active.	Default:	0
			Range:	10…100%

Secondary, Safely-limited Speed Status Only Wiring Examples

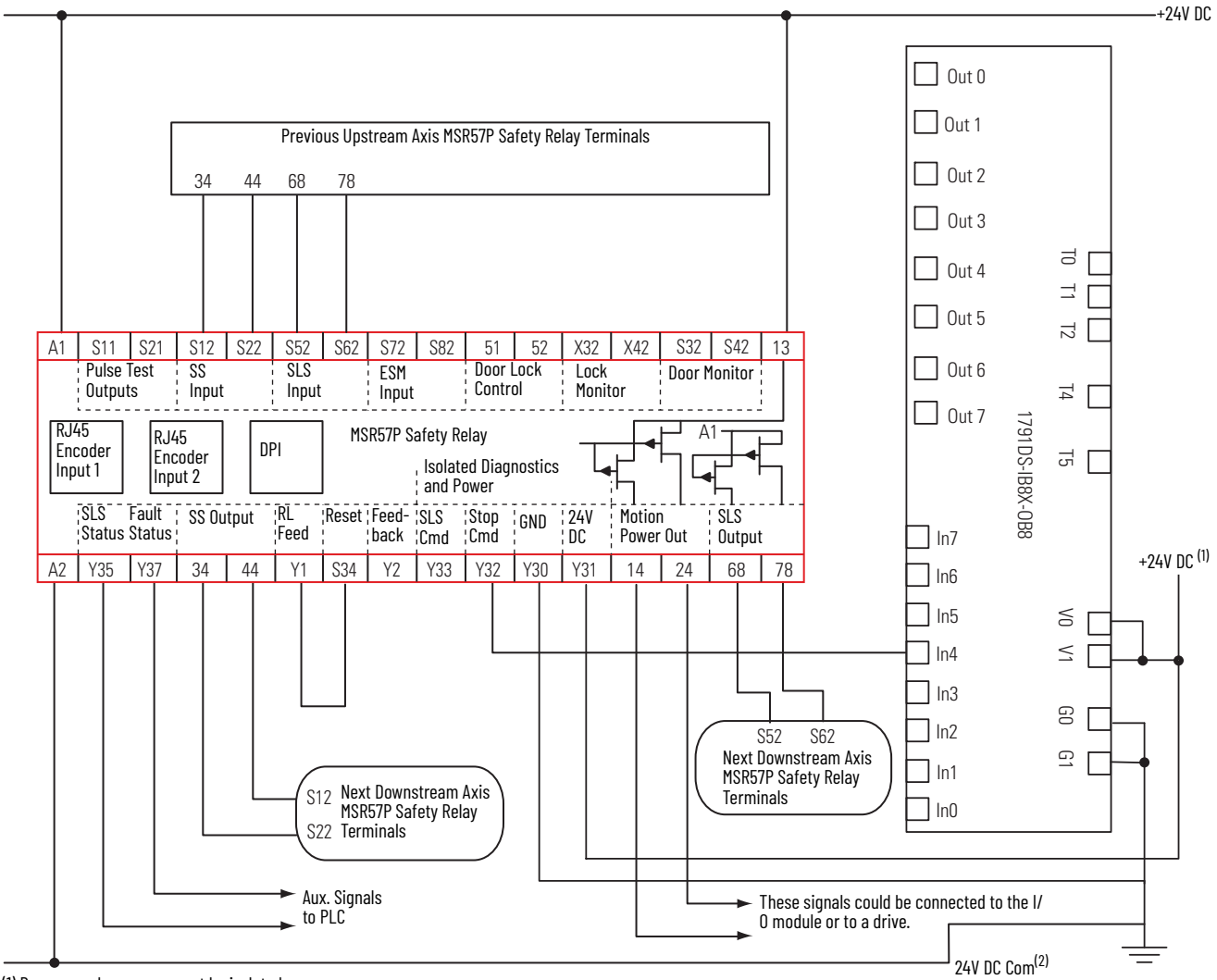
Figure 36 on page 104 and Figure 37 on page 105 show two different secondary, Safely-limited Speed status only configurations.

Figure 36 on page 104 is configured as a cascaded middle unit via the P20 [Cascaded Config] parameter (Multi Mid). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P safety relay, and SS_Out, SLS_Out, and DC_Out output connections to the next downstream MSR57P safety relay. SLS command and stop command outputs are connected to a 1791DS module.

IMPORTANT The SLS_Out signals change state immediately, based on the speed relative to the Safe Speed Limit if the Safely-limited Speed Monitoring Delay [Lim Spd Mon Delay] is set to zero.

See SLS Status Only Wiring Examples on page 92 for an example of a first (primary) unit.

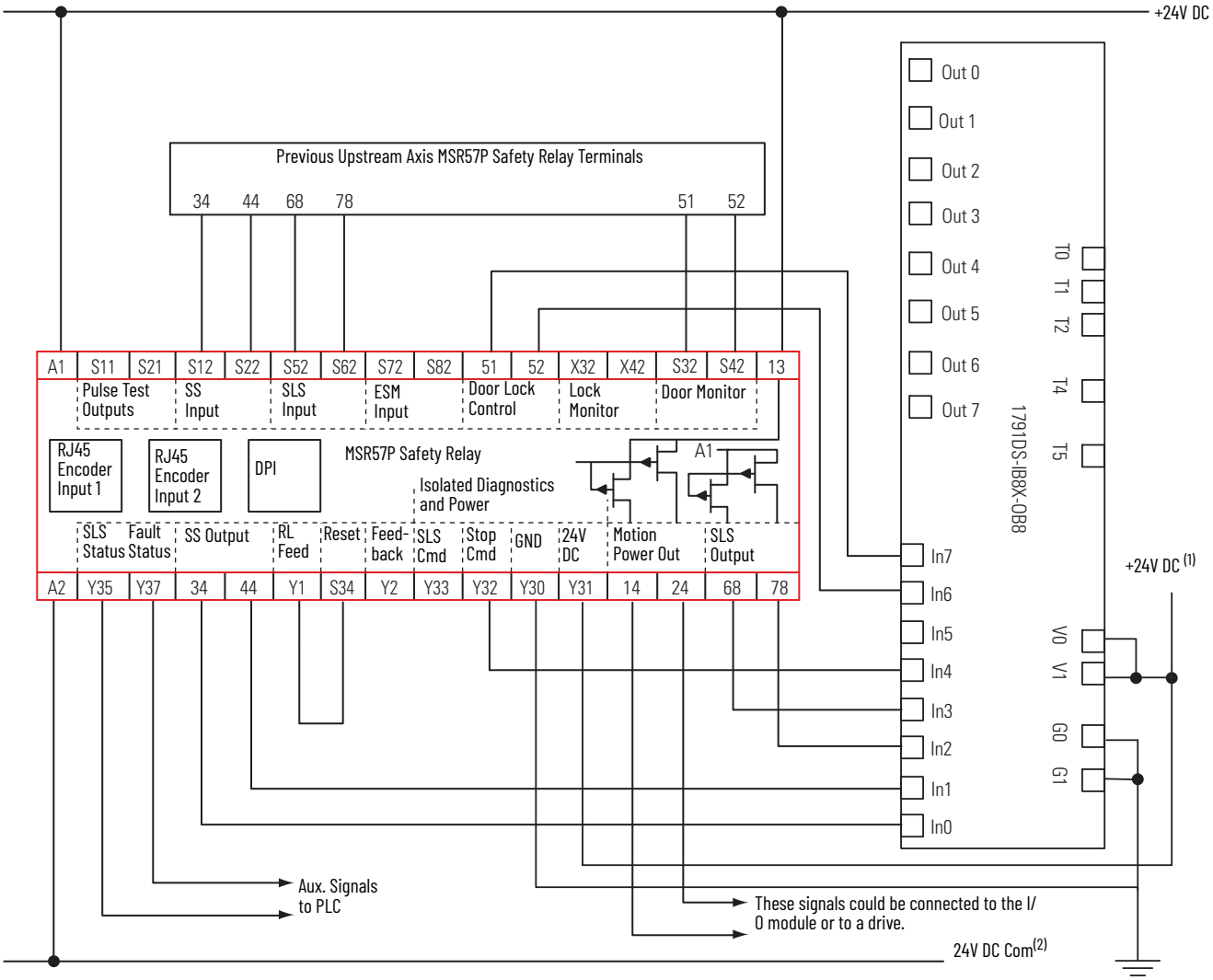
Figure 36 - Secondary, Safely-limited Speed Status Only, Middle Safety Relay



(1) Power supply can or cannot be isolated.
(2) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Figure 37 is configured as a cascaded last unit via the P20 [Cascaded Config] parameter (Multi Last). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P safety relay, but the SS_Out, SLS_Out, and door lock control outputs are connected to a 1791DS module.

Figure 37 - Secondary, Safely-limited Speed Status Only, Last Safety Relay



(1) Power supply can or cannot be isolated.
(2) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Multi-axis Connections

When configuring a multi-axis system, you must consider each safety relay's location in the system. The type of cascaded connections that you can make are dependent upon the Safety mode configurations of the primary and secondary safety relays and their positions in the system.

Middle and last safety relays in the cascaded chain can be configured for automatic reset. One reset by the first unit also resets all following units in the chain. If a fault occurs after the first axis in the cascaded chain, only the subsequent axis enters the safe state. To reset all axes, you must cycle the SS_In input on the first axis.

For secondary safety relays in a multi-axis system, the SS_In, SLS_In, and DM_In input signal types (if used) must be configured for output switching signal devices (OSSD). This configuration is because the output from the previous MSR57P safety relay is also configured for OSSD.

For middle or last safety relays in multi-axis systems, the safety relay regards the door monitor input as a door control output from an upstream axis. The safety relay performs a logical AND with the internal door control signal to form the cascaded door control output.

For information on door control in the primary safety relay, see Door Control on page 72.

Table 36 - Safety Mode Combinations for Primary and First Secondary Safety Relays

Typical Safety Mode Combinations		Cascaded Connections Allowed		
Primary Safety Relay	**First Secondary Safety Relay[1] (Second Safety Relay in System)**	**SS_Out to SS_In**	**SLS_Out to SLS_In**	**DC_Out to DM_In[2]**
Safe Stop	Secondary - Safe Stop	Yes	–	Yes
Safe Stop with Door Monitoring	Secondary - Safe Stop	Yes	–	Yes
Safely-limited Speed	Secondary - Safe Stop	Yes	–	Yes
	Secondary - Safely-limited Speed	Yes	Yes	Yes
Safely-limited Speed with Door Monitoring	Secondary - Safe Stop	Yes	–	Yes
	Secondary - Safely-limited Speed	Yes	Yes	Yes
Safely-limited Speed with Enabling Switch Monitoring	Secondary - Safe Stop	Yes	–	Yes
	Secondary - Safely-limited Speed	Yes	Yes	Yes
Safely-limited Speed with Door Monitoring and Enabling Switch Monitoring	Secondary - Safe Stop	Yes	–	Yes
	Secondary - Safely-limited Speed	Yes	Yes	Yes
Safely-limited Speed Status Only	Secondary - Safe Stop	Yes	Yes	Yes
	Secondary - Safely-limited Speed Status Only	Yes	Yes	Yes

(1) P20 [Cascaded Config] parameter equals Cascaded Middle Unit (Multi Mid).
(2) DC_Out to DM_In connections are only required for systems that implement door control.

Table 37 shows the supported Safety modes for secondary safety relays (n+1) cascaded from secondaries (n).

Table 37 - Safety Mode Combinations for Cascaded (Middle and Last) Secondary Safety Relays

Supported Safety Mode Combinations		Cascaded Connections Allowed		
Secondary Safety Relay (*n*)	**Secondary Safety Relay (*n*+1)**	**SS_Out to SS_In**	**SLS_Out to SLS_In**	**DC_Out to DM_In[1]**
Secondary - Safe Stop	Secondary - Safe Stop	Yes	–	Yes
Secondary - Safely-limited Speed	Secondary - Safe Stop	Yes	–	Yes
	Secondary - Safely-limited Speed	Yes	Yes	Yes
Secondary - Safely-limited Speed Status Only	Secondary - Safe Stop	Yes	–	Yes
	Secondary - Safely-limited Speed Status Only	Yes	Yes	Yes

(1) DC_Out to DM_In connections are required only for systems that implement door control.

Cascaded System Examples

Figure 38...Figure 47 on page 111 show various possible cascaded configurations.

Figure 38 - Safe Stop Only (3-wire) Connections

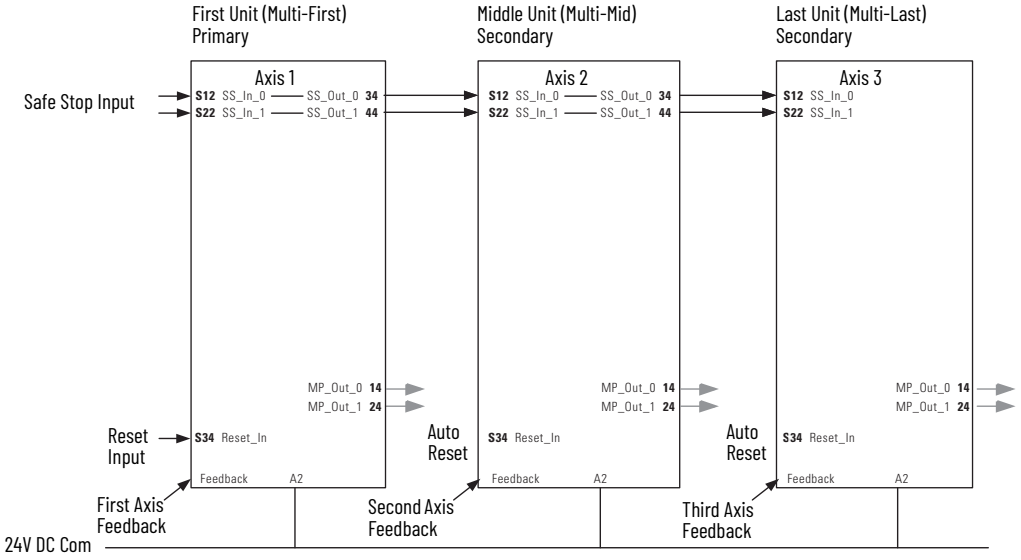


Figure 39 - Safe Stop and Safely-limited Speed (5-wire) Connections

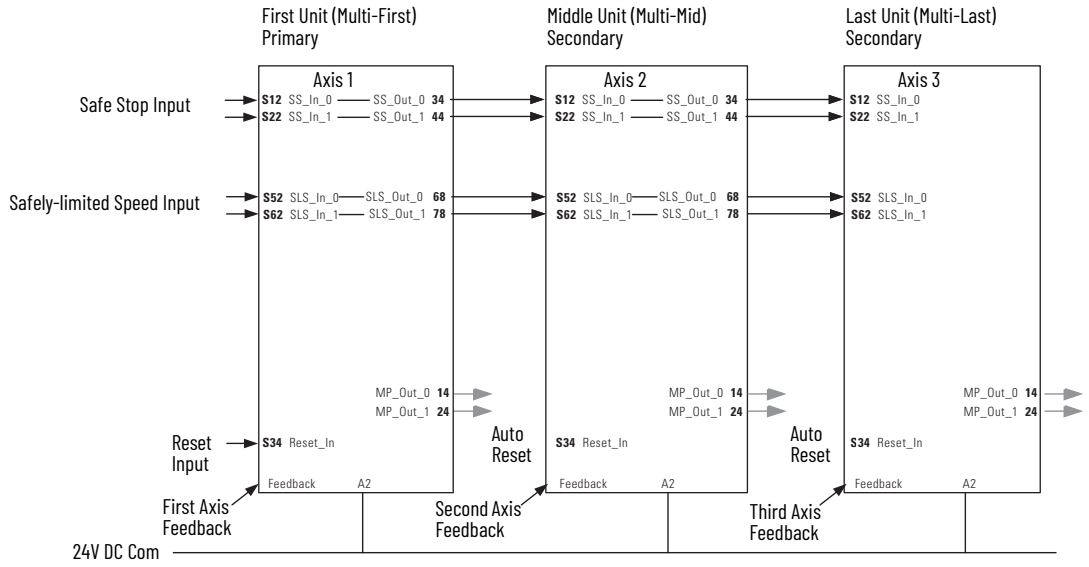


Figure 40 - Safe Stop with Door Monitoring (3-wire) Connections

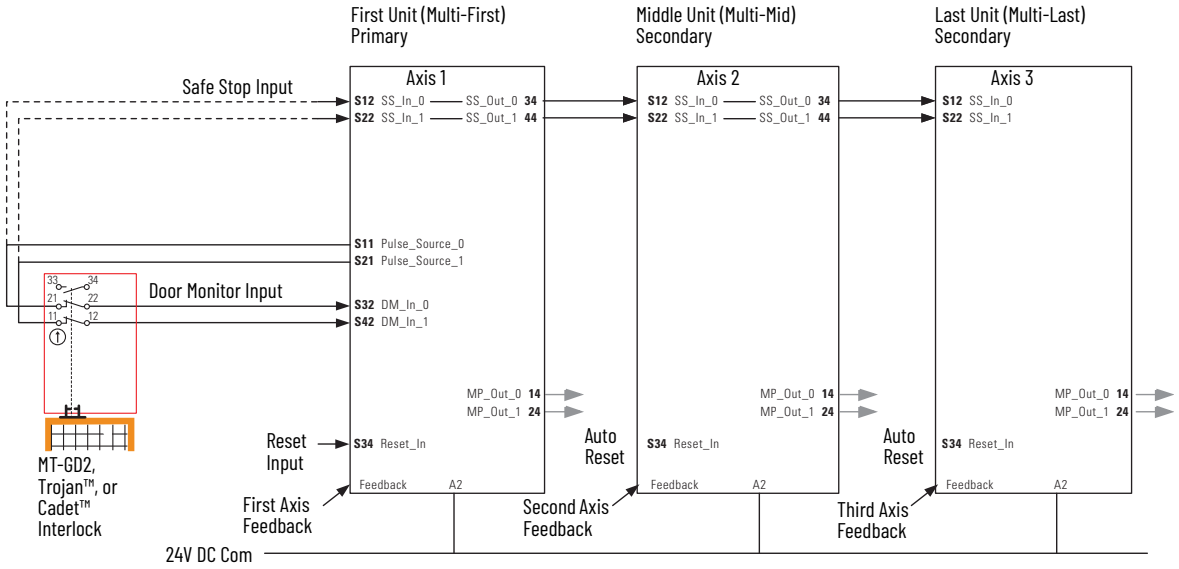


Figure 41 - Safe Stop and Safely-limited Speed with Door Monitoring (5-wire) Connections

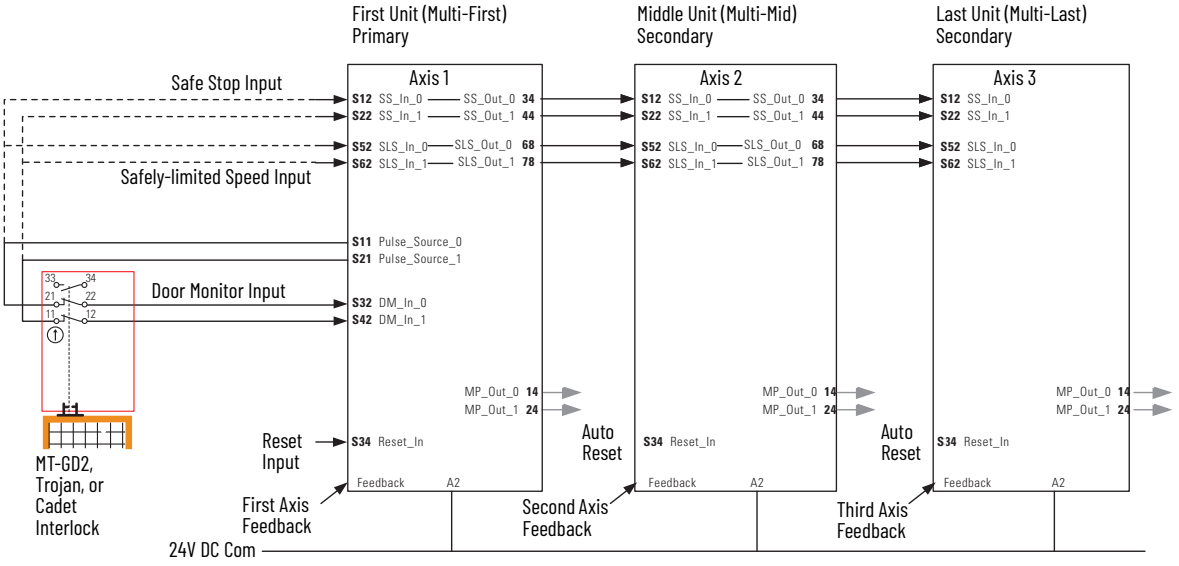


Figure 42 - Safe Stop, Safely-limited Speed, and Enabling Switch with Door Monitoring (5-wire) Connections

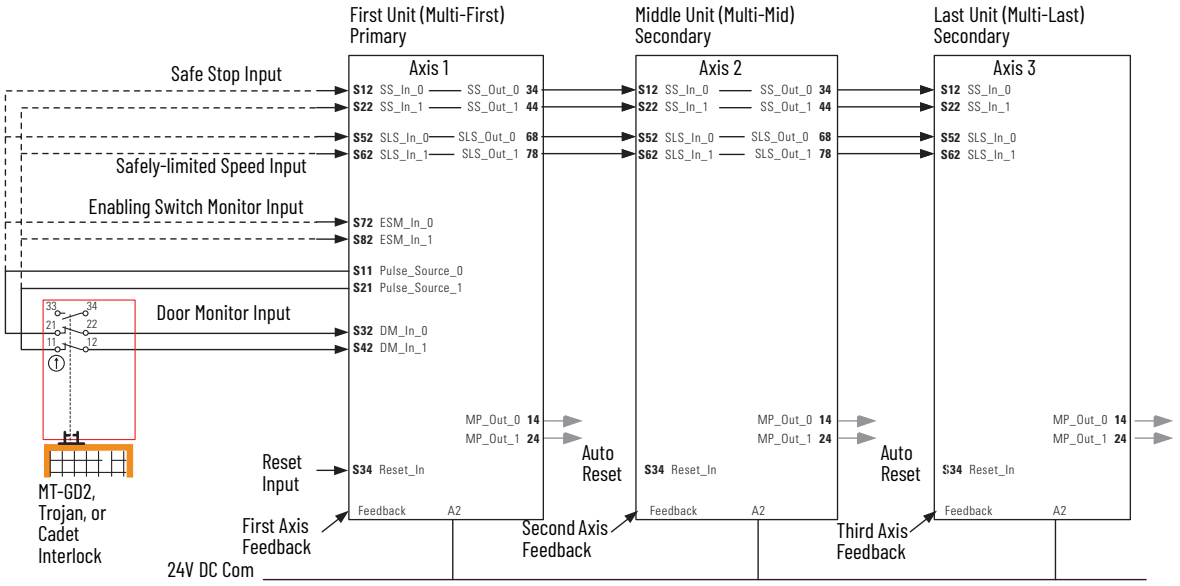


Figure 43 - Safe Stop with Door Monitoring and Door Control (5 + 2-wire) Connections

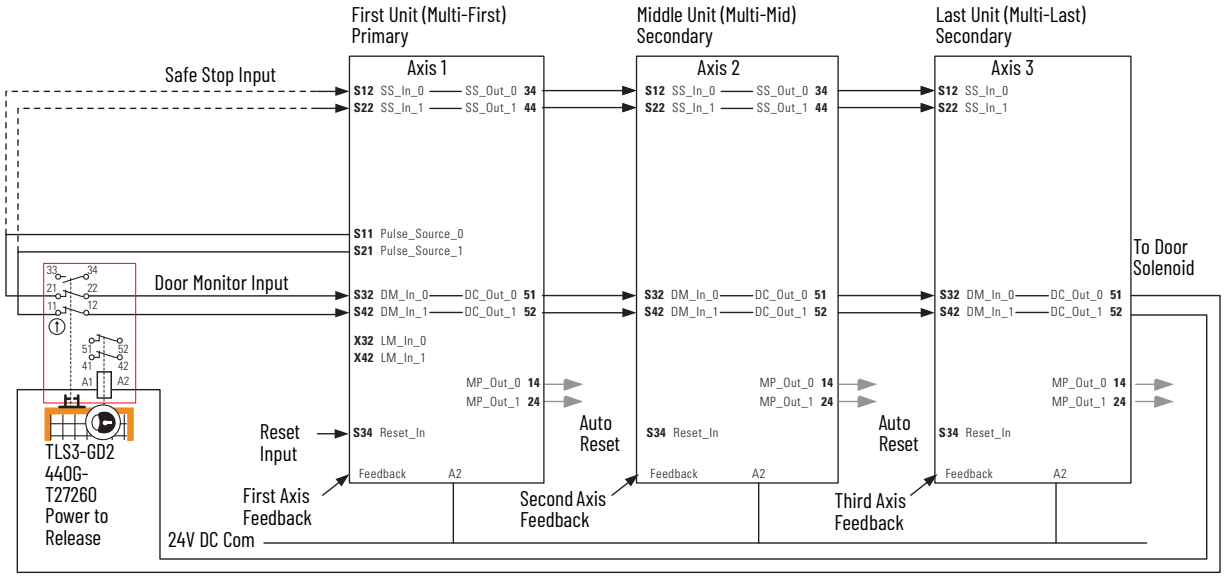


Figure 44 - Safe Stop with Door Monitoring, Door Control, and Lock Monitoring (5+2-wire) Connections

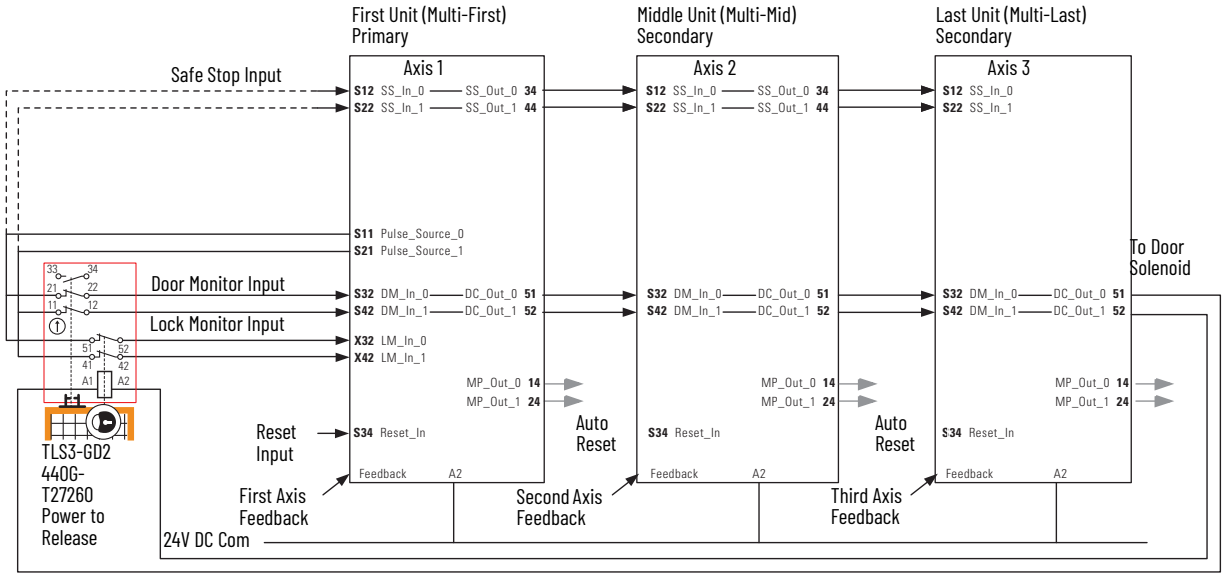


Figure 45 - Safe Stop and Safely-limited Speed with Door Monitoring, Door Control, and Lock Monitoring (7 + 2-wire) Connections

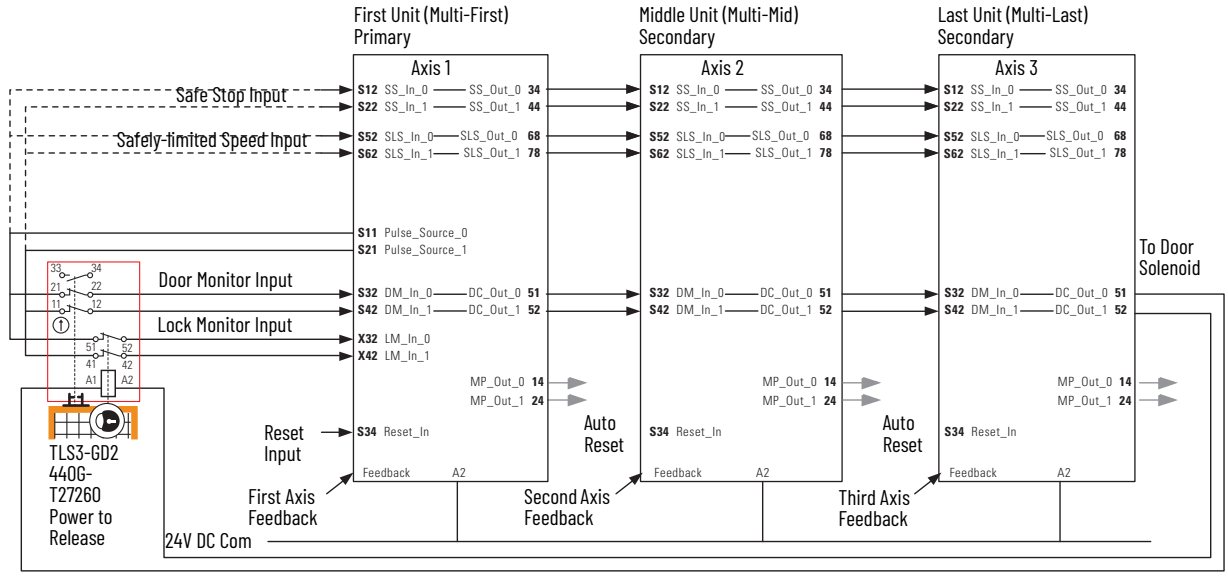


Figure 46 - Safe Stop, Safely-limited Speed, and Enabling Switch with Door Monitoring, Door Control, and Lock Monitoring (7 + 2-wire) Connections

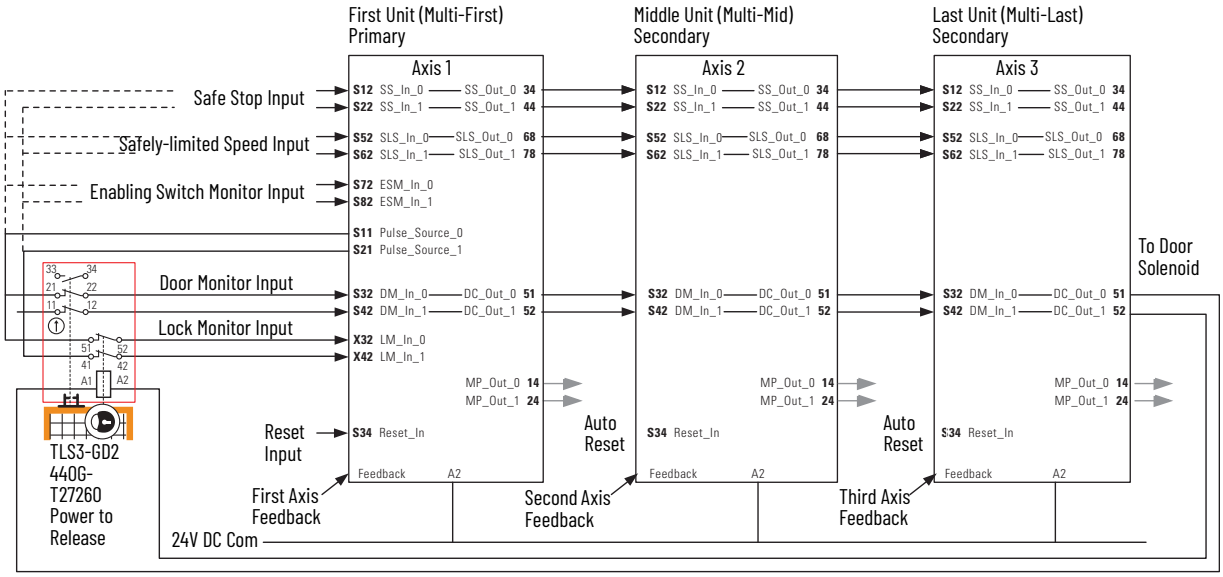
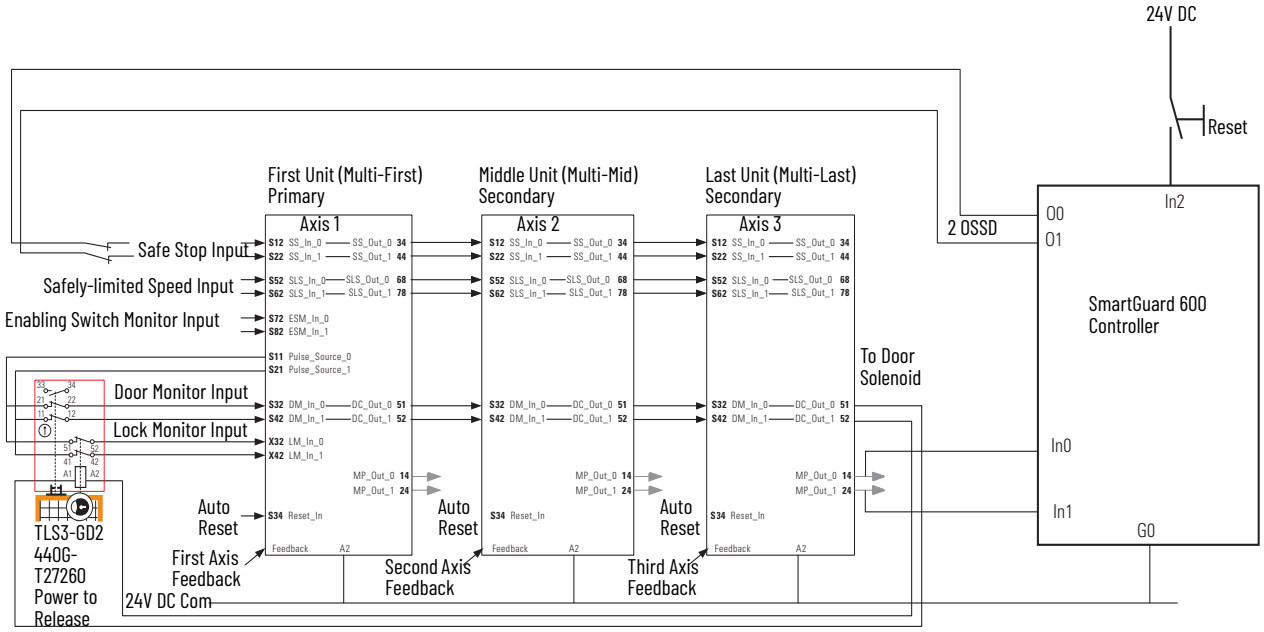


Figure 47 shows that the SmartGuard™ 600 controller performs the reset control. Any fault on any axis shuts down the entire system. The SmartGuard 600 controller controls the reset.

Figure 47 - Safe Stop with Door Monitoring, Safely-limited Speed, Lock Monitoring, and Enabling Switch (7 + 2-wire) Connections



Notes:

Safe Maximum Speed and Direction Monitoring

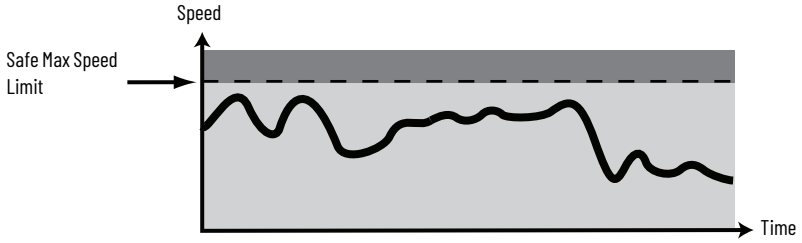
Safe Maximum Speed (SMS) Monitoring

Configure Safe Maximum Speed monitoring by setting the P61 [Max Speed Enable] parameter to enable. When configured, Safe Maximum Speed monitoring is active anytime the safety relay configuration is valid and Safety mode is not disabled.

When you configure the safety relay for Safe Maximum Speed, the feedback velocity is monitored and compared against a user-configurable limit.

You set the safe max speed limit, which is relative to encoder 1. If the monitored speed is greater than or equal to the configured safe max speed limit, an SMS Speed fault (Stop Category fault) occurs.

Safe Max Speed Timing Diagram



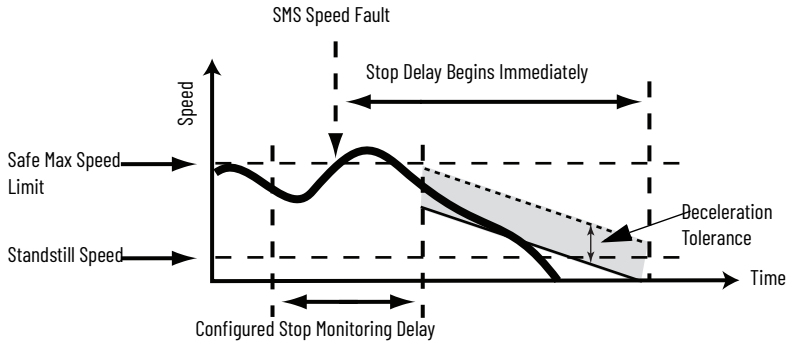
Use the P63 [Max Spd Stop Typ] parameter to define the Safe Stop type that the safety relay initiates if there is an SMS Speed fault.

Safe Maximum Speed Monitoring Stop Behavior

P63 [Max Spd Stop Typ] Parameter	Description
0 = Use Safe Torque Off with Check for Standstill (Torque Off)	The speed monitoring safety relay initiates Safe Torque Off with Check for standstill anytime an SMS Speed fault is detected while the safety relay is monitoring motion.
1 = Use Configured Stop Type (Safe Stp Typ)	The speed monitoring safety relay initiates the configured Safe Stop type (parameter 45) anytime an SMS Speed fault is detected while the safety relay is monitoring motion.

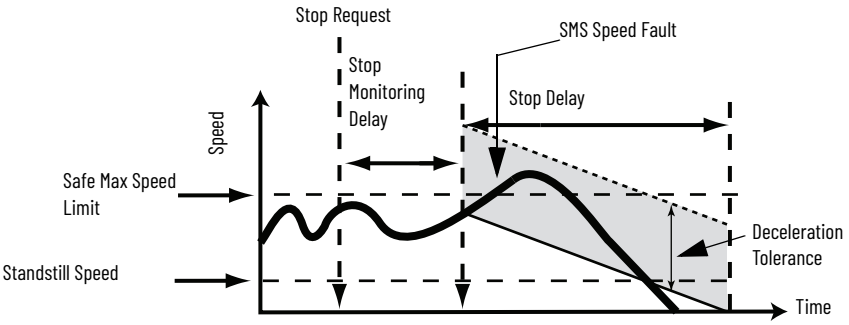
If an SMS Speed fault is detected during a Stop Monitoring Delay [Stop Mon Delay], the delay ends immediately and the configured Stop Delay [Max Stop Time] begins.

SMS Speed Fault During Stop Monitoring Delay



If an SMS Speed fault is detected during the Stop Delay [Max Stop Time], and the P63 [Max Spd Stop Typ] parameter equals Use Configured Stop Type (Safe Stp Typ), and the feedback signals indicate less than the maximum frequency [(a)] for your encoder type, the fault is reported, but no further action is taken. Deceleration monitoring performs the safety function during the Stop Delay [Max Stop Time]. That is, if an SMS Speed fault occurs during the Stop Delay [Max Stop Time], the fault is ignored and the stopping action continues.

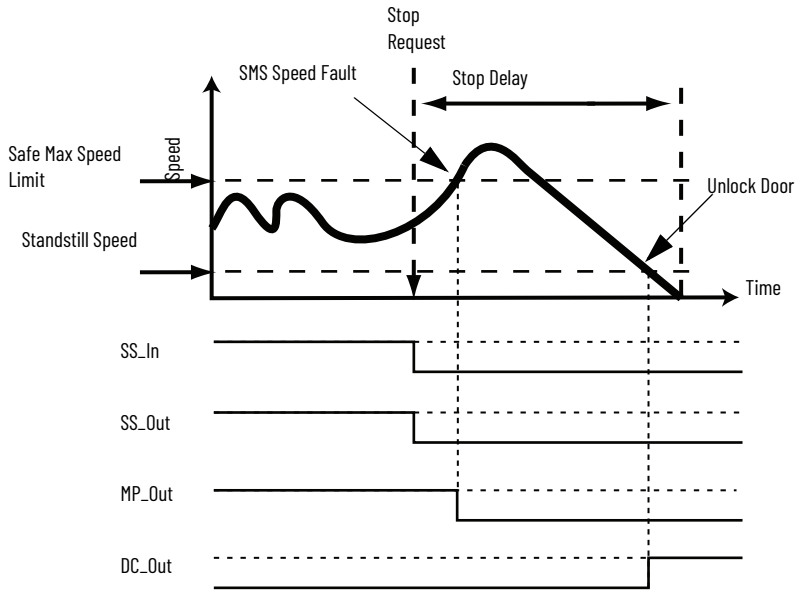
SMS Speed Fault When P63 [Max Spd Stop Typ] Set to Use Configured Stop Type (Safe Stp Typ)



If an SMS Speed fault is detected during the Stop Delay [Max Stop Time] and the P63 [Max Spd Stop Typ] parameter equals Use Safe Torque Off with Check for Standstill (Torque Off), the SMS Speed fault is reported and the MP_Out output sets to off. The Stop Delay [Max Stop Time] continues with standstill checking enabled.

(a) 100 kHz for Sin/Cos or 200 kHz for Incremental

SMS Speed Fault When P63 [Max Spd Stop Typ] Set to Use Safe Torque Off with Check for Standstill (Torque OFF)



For more information about faults, see Fault Reactions on page 146.

Safe Maximum Acceleration (SMA) Monitoring

Configure Safe Maximum Acceleration monitoring by setting the P64 [Max Accel Enable] parameter to enable. When configured, Safe Maximum Acceleration monitoring is active anytime the safety relay configuration is valid and Safety mode is not set to disabled.

The resolution accuracy of the acceleration monitoring in revolutions/second^2 is equal to the speed resolution in

$$\frac{(\text{RPM} \times 2) \div 60}{[(\text{OverSpd Response} - 36)/1000]\ \text{seconds}}$$

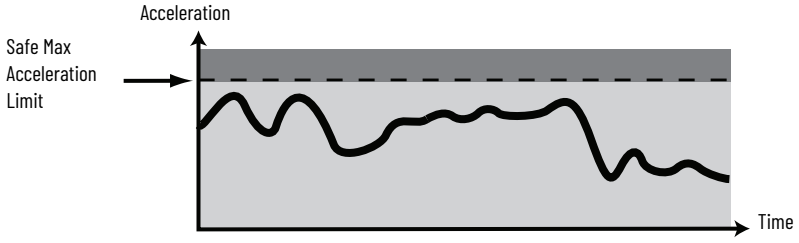
The resolution accuracy of the acceleration monitoring in mm/second^2 is equal to the speed resolution in

$$\frac{(\text{mm/s} \times 2)}{[(\text{OverSpd Response} - 36)/1000]\ \text{seconds}}$$

IMPORTANT Acceleration is measured within the overspeed response time, P24 [OvrSpd Response].

When you configure the safety relay for Safe Maximum Acceleration, the safety relay monitors the acceleration rate and compares it to a configured Safe Maximum Acceleration limit, P65 [Safe Accel Limit]. If the acceleration is greater than or equal to the configured Safe Maximum Acceleration limit, an Acceleration fault (Stop Category fault) occurs.

Safe Max Acceleration Timing Diagram



Use the P66 [Max Acc Stop Typ] parameter to define the Safe Stop type that the safety relay initiates if there is an Acceleration fault.

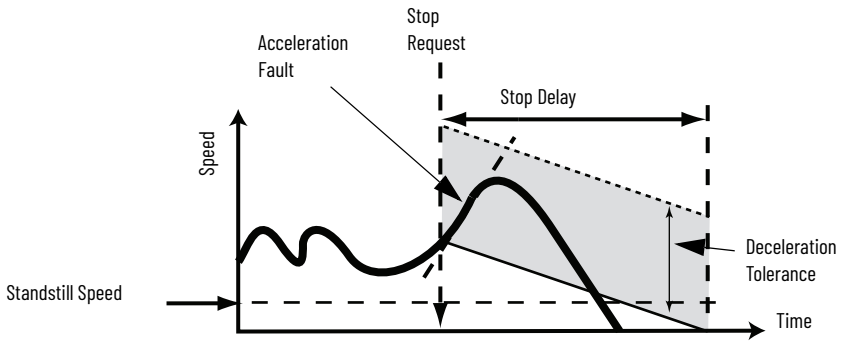
Safe Maximum Acceleration Monitoring Stop Behavior

P66 [Max Acc Stop Typ] Parameter	Description
0 = Use Safe Torque Off with Check for Standstill (Torque Off)	The speed monitoring safety relay initiates Safe Torque Off with check for standstill anytime an Acceleration fault is detected while the safety relay is monitoring motion.
1 = Use Configured Stop Type (Safe Stp Typ)	The speed monitoring safety relay initiates the configured Safe Stop type anytime an Acceleration fault is detected while the safety relay is monitoring motion.

If an Acceleration fault is detected during a Stop Monitoring Delay [Stop Mon Delay] and the P66 [Max Acc Stop Typ] parameter is configured as Use Safe Torque Off with Check for Standstill (Torque Off), the Stop Monitoring Delay [Stop Mon Delay] ends immediately and the Stop Delay [Max Stop Time] begins.

If an Acceleration fault is detected during the Stop Delay [Max Stop Time], and the P66 [Max Acc Stop Typ] parameter equals Use Configured Stop Type (Safe Stp Typ), and feedback signals indicate less than the maximum frequency [(a)] for your encoder type, then the fault occurs with no further action. Deceleration monitoring performs the safety function during the Stop Delay [Max Stop Time]. That is, if an Acceleration fault occurs during the Stop Delay [Max Stop Time], the fault is ignored and the stopping action continues.

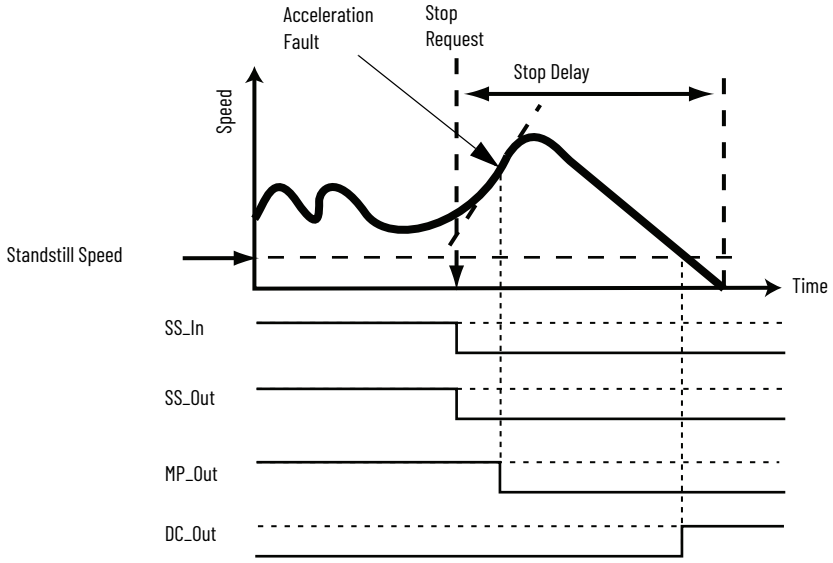
Acceleration Fault When P66 [Max Acc Stop Typ] Set to Use Configured Stop Type (Safe Stp Typ)



If an Acceleration fault is detected during the Stop Delay [Max Stop Time] and the P66 [Max Acc Stop Typ] parameter equals Use Safe Torque Off with Check for Standstill (Torque Off), the Acceleration fault is reported and the MP_Out output sets to off. The Stop Delay [Max Stop Time] continues with standstill checking enabled.

(a) 100 kHz for Sin/Cos or 200 kHz for Incremental

Acceleration Fault When P66 [Max Acc Stop Typ] Set to Use Safe Torque Off with Check for Standstill (Torque OFF)



For more information about faults, see Fault Reactions on page 146.

Safe Direction Monitoring (SDM)

When configured for Safe Direction monitoring, the safety relay monitors the feedback direction and initiates the configured Safe Stop type when motion in the illegal direction is detected. Use the P42 [Direction Mon] parameter to configure Safe Direction monitoring. This parameter also determines the direction, positive or negative, in which motion is allowed.

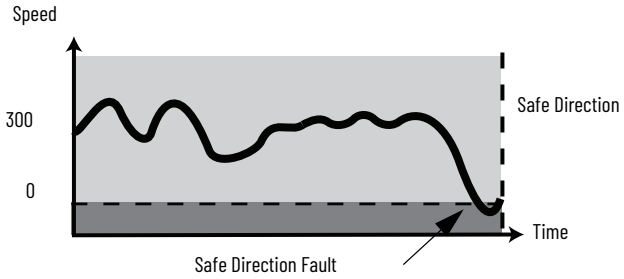
Enable Safe Direction Monitoring

P42 [Direction Mon] Parameter	Description
0 = Disabled	Safe Direction Monitoring is disabled.
1 = Positive Always	Safe Direction Monitoring is active anytime the configuration is valid and not Disabled.
2 = Negative Always	
3 = Positive During SLS	Safe Direction Monitoring is performed only when the safety relay is actively monitoring Safely-limited Speed.
4 = Negative During SLS	

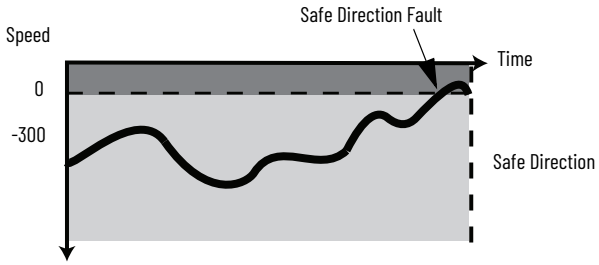
IMPORTANT Be sure to set the P30 [Fbk 1 Polarity] and P35 [Fbk 2 Polarity] configuration parameters properly for a consistent direction between encoder 1 and encoder 2.

Use the P43 [Direction Tolerance] parameter to configure a position limit (in encoder units) that is tolerated in the wrong direction before a Direction fault occurs.

Positive Safe Direction Monitoring Diagram



Negative Safe Direction Monitoring Diagram



If motion is detected in the incorrect direction while Safe Direction monitoring is active, a Direction fault occurs. If a Direction fault is detected while the safety relay is monitoring motion, the configured Safe Stop type is initiated and direction monitoring is not performed during the Safe Stop. If a Direction fault is first detected after the initiation of the Safe Stop, then all outputs go to their faulted state.

For more information about faults, see Fault Reactions on page 146.

Max Speed, Max Accel, and Direction Monitoring Parameter List

Set the parameters in Table 38 to configure Safe Maximum Speed, Safe Maximum Acceleration, and Safe Direction monitoring.

Table 38 - Max Speed, Max Accel, and Direction Monitoring Parameters

Parameter		Description	Setting	
30	Fbk 1 Polarity	Defines the direction polarity for encoder 1.	Default:	0 = Same as encoder (Normal)
			Options:	0 = Same as encoder (Normal) 1 = Reversed
35	Fbk 2 Polarity	Defines the direction polarity for encoder 2.	Default:	0 = Same as encoder (Normal)
			Options:	0 = Same as encoder (Normal) 1 = Reversed
42	Direction Mon	Defines the allowable direction if Safe Direction monitoring is enabled.	Default:	0 = Disabled
			Options:	0 = Disabled 1 = Positive always (Pos Always) 2 = Negative always (Neg Always) 3 = Positive during Safely-limited Speed monitoring (Pos in SLS) 4 = Negative during Safely-limited Speed monitoring (Neg in SLS)
43	Direction Tol	The position limit in encoder units tolerated in the wrong direction when Safe Direction monitoring is active.	Default:	10
			Range:	0...65,535 deg or mm based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines
61	Max Speed Enable	Enable Safe Maximum Speed monitoring.	Default:	0 = Disabled
			Options:	0 = Disabled 1 = Enabled
62	Safe Max Speed	Defines the maximum speed limit that is tolerated if Safe Maximum Speed monitoring is enabled.	Default:	0
			Range:	0...65,535 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines
63	Max Spd Stop Typ	Safe Maximum Speed monitoring stop behavior. Defines the stopping behavior that is initiated if there is an SMS Speed fault. See Safe Maximum Speed (SMS) Monitoring on page 113.	Default:	0 = Use Safe Torque Off with Standstill Checking (Torque Off)
			Options:	0 = Use Safe Torque Off with Standstill Checking (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)
64	Max Accel Enable	Enable Safe Maximum Acceleration monitoring.	Default:	0 = Disabled
			Options:	0 = Disabled 1 = Enabled
65	Safe Accel Limit	Defines the Safe Maximum Acceleration limit, relative to encoder 1, for which the system is being monitored.	Default:	0
			Range:	0...65,535 rev/s^2 or mm/s^2 based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines
66	Max Acc Stop Typ	Safe max acceleration monitoring stop behavior. Defines the stopping behavior that is initiated if there is an Acceleration fault. See Safe Maximum Acceleration (SMA) Monitoring on page 115.	Default:	0 = Use Safe Torque Off with Check for Standstill (Torque Off)
			Range:	0 = Use Safe Torque Off with Check for Standstill (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)

Notes:

Safety Configuration and Verification

Safety Configuration

When you configure a speed monitoring safety system, you must record and verify the configuration signature, and set the safety-lock status of the system configuration. You can configure an optional password to help protect the system configuration from unauthorized modifications.

Configuration Signature ID

The configuration signature ID is an identification number that uniquely identifies a specific configuration for a safety device. Each time the system is configured or reconfigured, a new configuration signature generates to identify that specific configuration.

You can access the P10 [Signature ID] parameter to view the configuration signature ID.

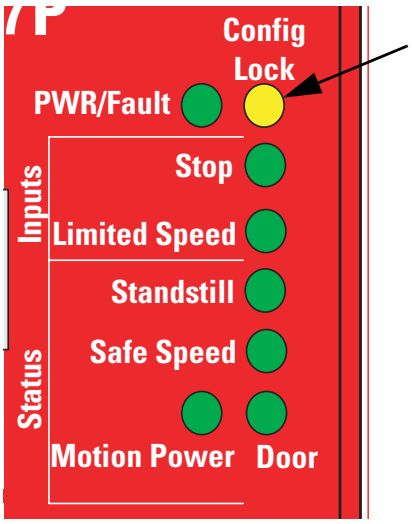
Safety-lock

When you have verified the operation of the system and recorded the configuration signature ID, you must lock the configuration to protect it from modification.

IMPORTANT	If you do not safety-lock the configuration, untested or unintentional changes can be made to the device configuration, which could result in unexpected system behavior.

Use the P5 [Lock State] parameter to lock the configuration.

The Config Lock status indicator on the safety relay illuminates steady yellow when the configuration is locked, and flashes yellow when the configuration is unlocked.



You can also check the safety-lock status of the system by viewing the configuration lock bit (bit 1) in the P68 [Guard Status] parameter. If the bit equals 1, the configuration is locked. If it equals 0, the configuration is unlocked.

Set a Password

Use an optional password to protect the system configuration. If you set a password, edits to the configuration, safety-locking, and safety relay reset operations require the password to be entered. You can set a password when the safety relay is not safety-locked and the P6 [Operating Mode] parameter value equals 0 (Program).

Follow these steps to set a new password.

1. Use the P1 [Password] parameter to enter a password (if previously configured).
2. Use the P13 [New Password] parameter to enter the new password.
3. Set the P17 [Password Command] parameter to 1 (Change Password).

Parameter		Description	Setting	
1	Password	Password for lock and unlock function.	Range:	0...4,294,967,295
13	New Password	32-bit configuration password	Range:	0...4,294,967,295
17	Password Command	Save new password command.	Default:	0 = No action
			Options:	0 = No action 1 = Change Password 2 = Reset Password

Reset the Password

If you forget the password and must reset it, follow these steps.

1. Read the contents of the P18 [Security Code] parameter.
2. Contact Rockwell Automation® Technical Support at rok.auto/support and provide the security code value and the serial number of the safety relay.

   A technical support representative uses the security code to calculate a vendor password value.
3. Enter the value provided by your Rockwell Automation Technical Support representative into the P19 [Vendor Password] parameter.
4. Set the P17 [Password Command] parameter to 2 (Reset Password).
5. Use the P13 [New Password] parameter to enter the new password.
6. Set the P17 [Password Command] parameter to 1 (Change Password).

Reset the Safety Relay

When the safety relay is unlocked and the P6 [Operating Mode] parameter equals 0 (Program), you can set the P7 [Reset Defaults] parameter to 1 to reset the configuration parameters of the safety relay to the factory default settings. The reset parameters are sent to the safety relay when the P6 [Operating Mode] parameter changes to 1 (Run).

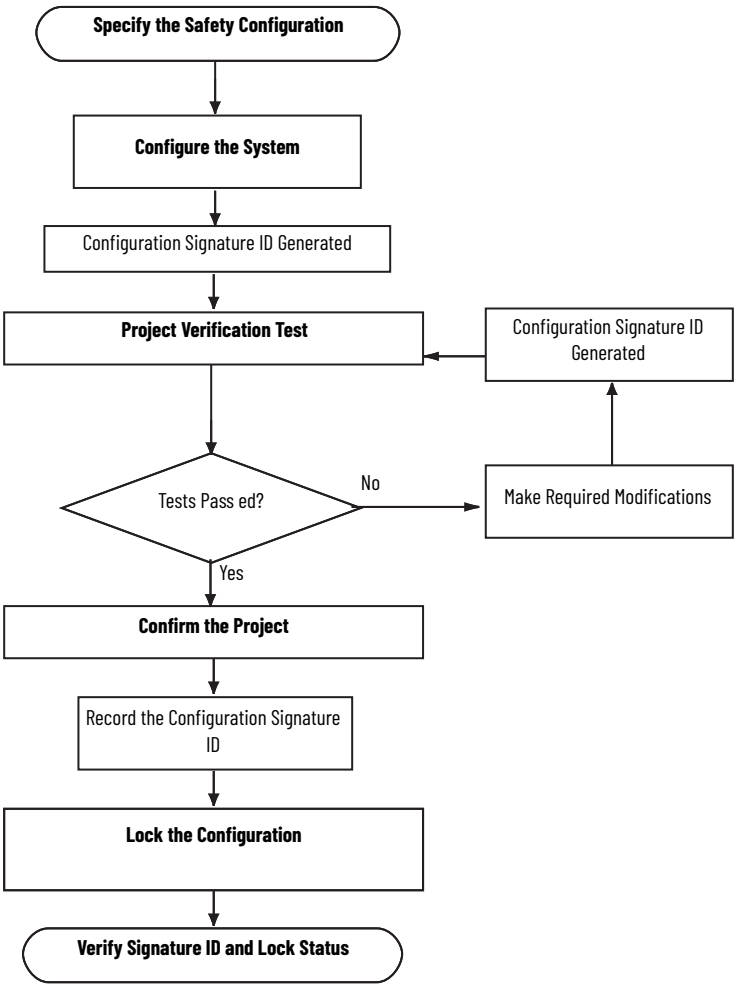
Basics of Application Development and Testing

The system integrator or a user who is trained and experienced in safety applications can configure the intended SIL CL 3, PLe, or Cat 4 system. The developer must follow good design practices.

- Use functional specifications, including flowcharts, timing diagrams and sequence charts.
- Perform a configuration review.
- Perform configuration validation.

Commission the System

The flowchart shows the steps required steps for commissioning a speed monitoring safety system. The items in bold are explained in the following sections.



Specify the Safety Configuration

You must create a specification for the system configuration that addresses the safety requirements that the risk assessment of your application defines. Use the specification to verify that the configuration is selected correctly and fully addresses the functional and safety control requirements of your application. The specification must be a detailed description that can include (if applicable):

- A sequence of operations.
- Flow and timing diagrams.
- Sequence charts.
- A configuration description of each parameter.

- Documented descriptions of the steps with step conditions and actuators to be controlled.
- Input and output definitions.
- I/O wiring diagrams and references.
- A theory of operation.
- A matrix or table of stepped conditions and the actuators to be controlled, including sequence and timing diagrams.
- A definition of marginal conditions, for example, operating modes.

The I/O portion of the specification must contain the analysis of field circuits (the type of sensors and actuators).

- Sensors (digital or analog)
  - Signal in standard operation (dormant current principle for digital sensors, sensors off means no signal).
  - Determination of redundancies required for SIL levels.
  - Discrepancy monitoring and visualization, including your diagnostic logic.
- Actuators
  - Position and activation in standard operation (normally off).
  - Safe reaction/positioning when switching off or power failure.
  - Discrepancy monitoring and visualization, including your diagnostic logic.

Configure the Speed Monitoring Safety Relay

Use a HIM (catalog number 20-HIM-A3) to set the configuration parameters to configure the safety relay. You can also use DriveExplorer™ software, version 5.02 or later, or DriveExecutive™ software, version 4.01 or later.

The safety relay is configured in the safe state. You must unlock the safety relay to configure. You must provide the password (if configured) to unlock the safety relay.

Follow these steps to configure the safety relay:

1. Unlock the safety relay configuration (if locked), by setting the P5 [Lock State] parameter to 0 (Unlock).
2. If an error occurs, you must use the P1 [Password] parameter to enter the password.
3. Place the safety relay in Program mode by setting the P6 [Operating Mode] parameter to 0.

   If you are using DriveExplorer or DriveExecutive software, the P10 [Signature ID] parameter value changes to 0.

   IMPORTANT When the safety relay is in Program mode, the P69 [IO Diag Status] parameter does not update or refresh.
4. Edit parameters to meet your system configuration specification and risk assessment requirements.
5. When you have edited the parameters, set the P6 [Operating Mode] parameter to 1, which puts the safety relay into Run mode.

   A configuration signature ID generates.
6. Record the configuration signature ID from the contents of the P10 [Signature ID] parameter.

7. Enter the password, if necessary.
8. Set the P5 [Lock State] parameter to 1 (Lock).

For a complete list of parameters and settings for the MSR57P safety relay, see Appendix B on page 155.

Project Verification Test

To check if the configuration of the speed monitoring safety relay adheres to the application specification, you must generate a suitable set of test cases that cover the application. File and retain the set of test cases as the test specification. You must include a set of tests to prove the validity of the safety configuration parameters.

Perform a complete functional test of the entire system before the operational startup of a safety-related system.

Confirm the Project

You must check each parameter to verify it is set to the correct value, according to your system configuration specification.

Safety Validation

An independent, third-party review of the safety system can be required before the system is approved for operation. An independent, third-party certification is required for IEC 61508 SIL CL 3.

Verify the Signature and Lock at the Speed Monitoring Safety Relay

To meet SIL CL 3, PLe, Cat 4 requirements, you must verify that the correct configuration is locked in the speed monitoring safety relay.

To check the configuration signature ID, view the contents of the P10 [Signature ID] parameter and verify that it matches the configuration signature ID you recorded as part of the configuration process in Configure the Speed Monitoring Safety Relay on page 124.

To verify the lock status, view the Config Lock status indicator on the speed monitoring safety relay. The Config Lock status indicator is steady yellow when the configuration is locked and flashing yellow when it is unlocked.

To verify the lock status, view the status of the P5 [Lock State] parameter and the status of the Configuration Lock bit (bit 1) of the P68 [Guard Status] parameter. If the bit equals 1, the configuration is locked. If the bit equals 0, the configuration is unlocked.

Editing the Configuration

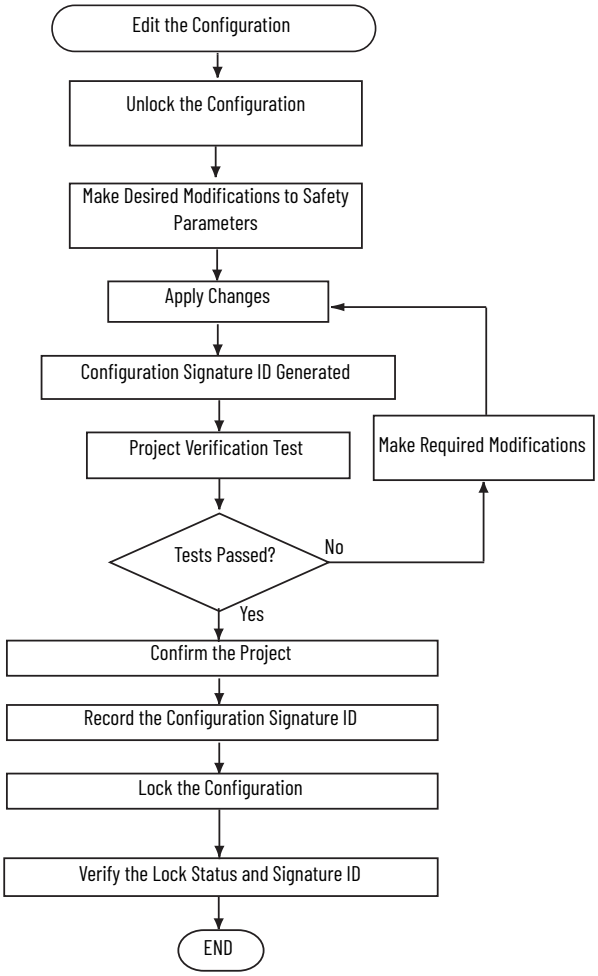
Only authorized, specially trained personnel can edit the configuration. These personnel must use all supervisory methods available, for example, software password protections.

When authorized, specially trained personnel make edits, they assume the central safety responsibility while the changes are in progress. These personnel must also maintain safe application operation.

You must sufficiently document all edits, including:

- Authorization.
- Impact analysis.
- Execution.
- Test information.
- Revision information.

The flowchart shows the steps necessary to edit the speed monitoring safety relay configuration.



Configuration Examples

Introduction

The following examples guide you through the basic steps that are required to program an application that uses some of the safety functions of the MSR57P Safety Relay. The remaining chapters of this manual provide detailed information on the operation of each safety function.

Example Application 1

This example application uses the following basic configuration in a single-axis system:

- Safe Stop (SS) enabled with an E-stop button.
- Safely-limited Speed (SLS) initiated with a 2 N.C. contact switch.
- Door Monitoring (DM) of a guard locking switch (TLS-3 GD2) configured as Power to Release.
- A Reset button with one N.O. contact.
- One encoder that connects with the sin/cos output signal and resolution of 1024.
- A configured Safe Maximum Speed (SMS) limit.

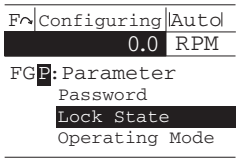
Each of the following sections describes the settings that you must enter for each parameter group. Use a HIM, or DriveExplorer™ or DriveExecutive™ software to configure the safety relay.

For information on how to connect and use a HIM, see Appendix C on page 163. For information on how to connect to a personal computer and use software for configuration, see Appendix D on page 165.

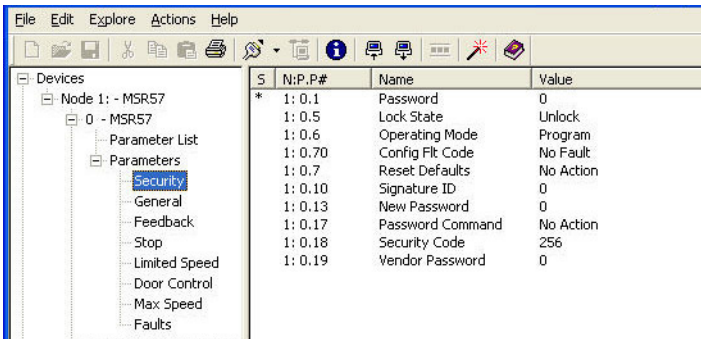
Initial Security Group Settings

Figure 48 - Security Group Parameters

HIM Screen



Software Screen



Follow these steps to put the safety relay into Program mode for configuration:

1. From the security group, choose the P5 [Lock State] parameter.

   The default value of the Lock State parameter is 0 (Unlocked). The Config Lock status indicator on the front of the safety relay indicates the locked or unlocked state. Flashing yellow is unlocked; steady yellow is locked.
2. If the safety relay is locked (Lock State parameter value equals 1), set the P5 [Lock State] parameter value to 0.

   If an error occurs, a password was configured to protect the safety relay configuration.
3. Choose the P1 [Password] parameter.
4. Type the password.
5. Choose the P6 [Operating Mode] parameter.

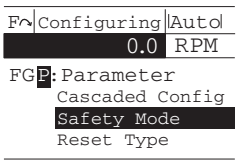
   The default value is 0, which equals program.
6. If the safety relay is in Run mode (Operating mode parameter equals 1), set the P6 [Operating Mode] parameter to 0 to enter a new configuration.
7. To configure a password or change the password, choose the P13 [New Password] parameter.

   The default value is 0. Enter a value from 0...4,294,967,295.
8. Type the new password value.
9. Choose the P17 [Password Command] parameter.
10. Set the P17 [Password Command] parameter value to 1, which equals Change Password (Change PW).
11. Go to the next section to set the parameters found in the general parameters group.

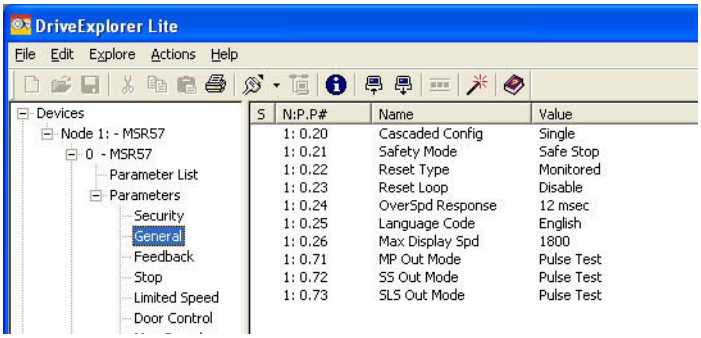
General Group Settings

Figure 49 - General Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the general operation of the safety relay:

1. From the general group, choose the P20 [Cascaded Config] parameter.
2. To configure the safety relay as one unit, set the P20 [Cascaded Config] parameter to 0 (default).
3. Choose the P21 [Safety Mode] parameter.

   The default setting is 1, which equals Safe Stop.
4. Set the P21 [Safety Mode] parameter value to 4 for Primary, Safely-limited Speed with Door Monitoring mode (Lim Speed DM).

In this mode, the door locks when the machine speed is above a configured Safe Speed Limit. The door can unlock when the machine is at standstill speed or is at or below the Safe Speed Limit and the SLS_In input is off.

5. Choose the P22 [Reset Type] parameter.
6. Set the P22 [Reset Type] parameter value to 2 (default), which equals Manual Monitored (Monitored).

   The manual monitored setting requires the reset circuit to close and open to reset.
7. Choose the P23 [Reset Loop] parameter.
8. To disable reset qualification monitoring, set the P23 [Reset Loop] parameter value to 0 (default).

   This setting assumes that there are no external contactors or devices that are connected to the system that require monitoring.
9. Choose the P24 [OverSpd Response] parameter.

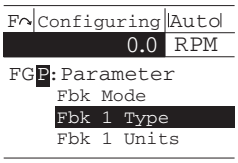
   The default overspeed response time is 42 ms.
10. Set the P24 [OverSpd Response] parameter value to 1, which equals 48 ms.

    See Overspeed Response Time on page 56 for details.
11. Go to the next section to use the feedback parameters group to configure the type of feedback.

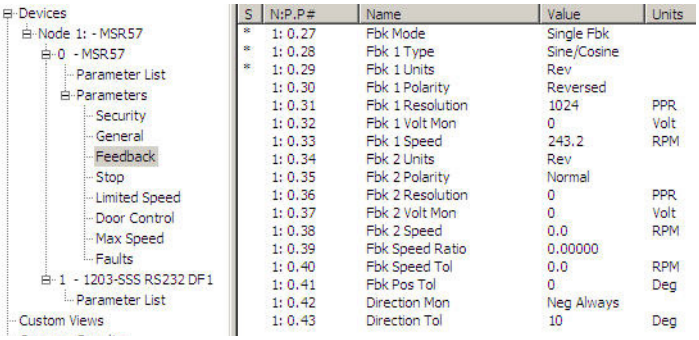
Feedback Group Settings

Figure 50 - Feedback Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the type of feedback used by the safety relay:

1. From the feedback group, choose the P27 [Fbk Mode] parameter.
2. Set the P27 [Fbk Mode] parameter value to 0 (default) for redundant processing and cross-checking of the single encoder input in a 1002 architecture.
3. Choose the P28 [Fbk 1 Type] parameter.

   The default value is 1 for incremental encoder input.
4. Set the P28 [Fbk 1 Type] parameter value to 0 for sine/cosine and internal monitoring of the single encoder input.
5. Choose the P29 [Fbk 1 Units] parameter.
6. Set the P29 [Fbk 1 Units] parameter to 0 (default), which equals rotary feedback.
7. Choose the P30 [Fbk 1 Polarity] parameter.
8. To configure the direction for monitoring to be the same as the encoder direction (Normal), set the P30 [Fbk 1 Polarity] parameter to 0 (default).
9. Choose the P31 [Fbk 1 Resolution] parameter.

10. Choose 1024 (default) or enter a value between 1...65,535 pulses/revolution based on the encoder's specifications.
11. Choose the P32 [Fbk 1 Volt Mon] parameter.
12. To monitor voltage in accordance with the specifications of the encoder, enter 5, 9, 12, or 14V. To disable encoder voltage monitoring, enter 0 (default)

    The P33 [Fbk 1 Speed] parameter displays the output speed of the encoder as a value between -214,748,364.8...214,748,364.8 rpm that is based on the configuration of the encoder. You do not need to enter a setting or value for this parameter.

13. Choose the P42 [Direction Mon] parameter.
14. Set the P42 [Direction Mon] parameter value to 0 (default), which equals disabled.

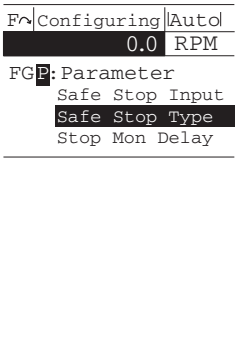
    You can disable Safe Direction monitoring if only one direction of rotation is possible or there is no safety-related restriction on the direction of rotation.

15. Go to the next section to set the parameters found in the stop parameters group.

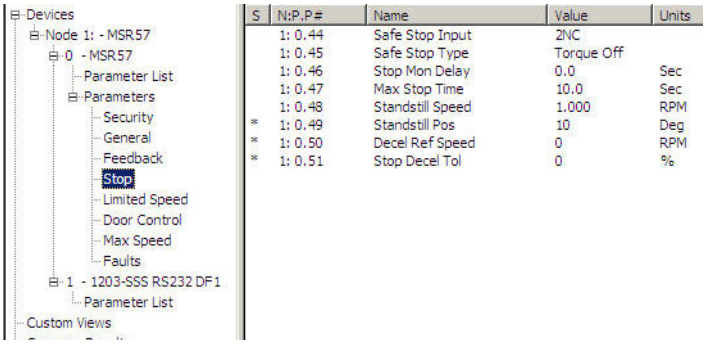
Stop Group Settings

Figure 51 - Stop Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the stop operation of the safety relay.

1. From the stop group, choose the P44 [Safe Stop Input] parameter.
2. Set the P44 [Safe Stop Input] parameter value to 1 (default) for 2NC (dual-channel equivalent) operation.

   In this example application, the Safe Stop input (SS_In) monitors an E-stop button with two normally closed (2NC) contacts.

3. Choose the P45 [Safe Stop Type] parameter.
4. Set the P45 [Safe Stop Type] parameter value to 0 (default), which equals Safe Torque Off with Standstill Speed Checking (Torque Off).

   Safe Torque Off with Standstill Speed Checking (Torque Off) switches off motion power immediately after an E-stop command and sets door control to unlock when the standstill speed is detected.

5. Choose the P47 [Max Stop Time] parameter.

   Enter a value from 0...6553.5 s, the default value is 10 s.

6. Type the value of the expected coast-to-stop time plus a reasonable tolerance after the Safe Stop command initiates.

   If the speed of the machine is not below the standstill speed within the Stop Delay [Max Stop Time] you entered, a Stop Speed fault occurs and door control remains set to lock until the standstill speed is reached.

7. Choose the P48 [Standstill Speed] parameter.

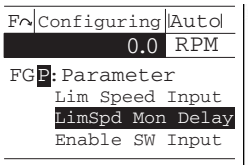
   Enter a value from 0.001…65,535 rpm, the default value is 0.001 rpm. The standstill speed is measured in revolutions per minute because the P29 [Fbk 1 Units] parameter is configured for rotary feedback.
8. To define the speed at which the safety relay determines standstill is reached, enter a value in the P48 [Standstill Speed] parameter field.
9. Choose the P49 [Standstill Pos] parameter.

   Enter a value from 0…65,535°, the default value is 10°. The standstill position is measured in degrees because the P29 [Fbk 1 Units] parameter is configured for rotary feedback.
10. Enter the value in encoder units that defines the tolerated position limit after standstill is reached.
11. Go to the next section to set the parameters found in the limited speed parameters group.

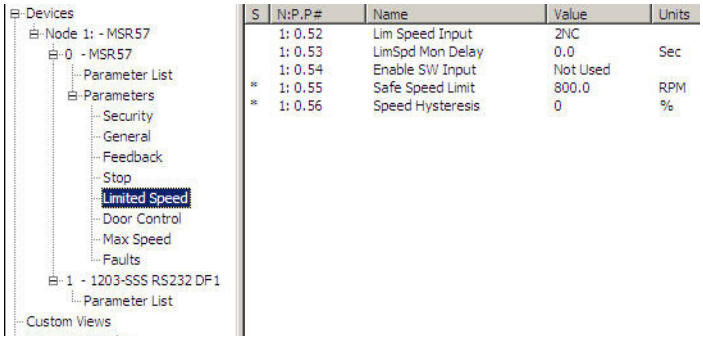
Limited Speed Group Settings

Figure 52 - Limited Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the Safely-limited Speed operation:

1. From the limited speed group, choose the P52 [Lim Speed Input] parameter.

   The default value is 0 (Disabled), for applications without Safely-limited Speed control.
2. Set the P52 [Lim Speed Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the Safely-limited Speed input (SLS_In) monitors a switch with two normally closed (2NC) contacts. If the N.C. contacts are open and speed exceeds the configured Safely-limited Speed, the safety relay initiates the configured Safe Stop type.

   When the safety relay is actively monitoring Safely-limited Speed and the speed of the machine is at or below the configured safe speed limit, the gate interlock releases and the door can be opened.
3. Choose the P55 [Safe Speed Limit] parameter.

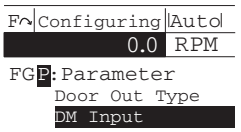
   The default value is 0 rpm or mm/s. The valid range is from 0…6553.5.
4. Type the maximum allowable rpm value for safe (reduced) velocity.

   The speed is calculated in rpm, based on the P29 [Fbk 1 Units] parameter setting (0 = rotary feedback) entered previously.
5. Go to the next section to set the parameters that configure door control operation.

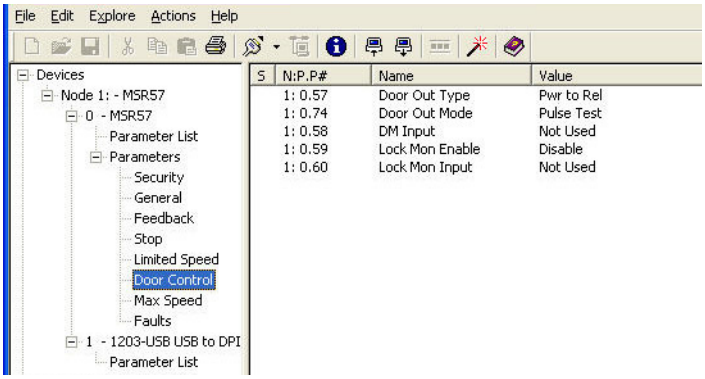
Door Control Group Settings

Figure 53 - Door Control Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the door control operation for the safety relay:

1. From the door control group, choose the P57 [Door Out Type] parameter.
2. Set the P57 [Door Out Type] parameter to 0 (default), which equals Power to Release (Pwr to Rel).

   This parameter is chosen because power must be applied to the solenoid inside the TLS-3 GD2 gate switch to release the gate interlock.
3. Choose the P58 [DM Input] parameter.

   The default setting is 0 for applications that do not use an interlock switch.
4. Set the P58 [DM Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the DM Input (DM_In) monitors the TLS-3 GD2 switch, which has two normally closed (2NC) safety contacts.
5. Choose the P59 [Lock Mon Enable] parameter.

   The default value is 0 (Disabled) for applications without an interlock switch.
6. Set the P59 [Lock Mon Enable] parameter value to 1 (Enabled) because this application uses the TLS-3 GD2 interlock switch.
7. Choose the P60 [Lock Mon Input] parameter.

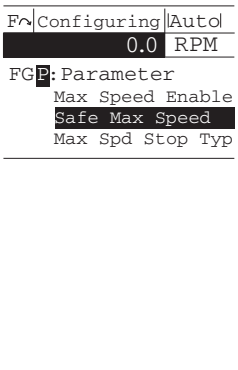
   The default value is 0 (Not Used) for applications that do not use an interlock switch.
8. Set the P60 [Lock Mon Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the Lock Monitor Input (LM_In) monitors the TLS-3 GD2 switch, which has two normally closed (2NC) interlock monitoring contacts.
9. Go to the next section to set the parameters that configure Safe Maximum Speed monitoring.

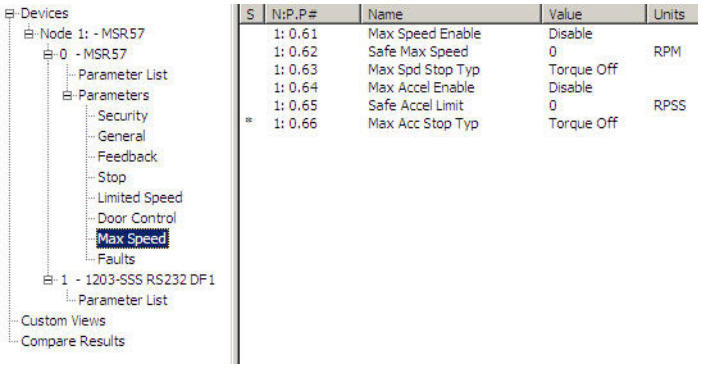
Max Speed Group

Figure 54 - Max Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure maximum speed monitoring for the safety relay:

1. From the max speed group, choose the P61 [Max Speed Enable] parameter.

   The default value is 0 (Disabled) for no maximum speed limitation.
2. Set the P61 [Max Speed Enable] parameter value to 1 (Enabled), which monitors that the encoder feedback signal, does not exceed the velocity that is configured by using the safe max speed parameter.
3. Choose the P62 [Safe Max Speed] parameter.

   The default value is 0 rpm or mm/s. Enter a value from 0…6553.5.
4. Type the maximum allowable rpm value for velocity.

   The speed is calculated in rpm, which is based on the P29 [Fbk 1 Units] parameter setting (0 = Rotary feedback) entered previously.
5. Choose the P63 [Max Spd Stop Typ] parameter.
6. Set the P63 [Max Spd Stop Typ] parameter value to 0 (default), which equals Use Safe Torque Off with Standstill Checking (Torque Off).

   With this configuration, if speed exceeds the configured safe max speed, the safety relay initiates a Safe Torque Off with standstill checking type of Safe Stop, regardless of the configured Safe Stop type.
7. To put the safety relay into Run mode and lock the configuration, proceed to the next section.

Final Security Group Settings

This example includes only the steps for entering a configuration with the use of the HIM or software program. You must also follow the requirements that are described in Safety Configuration and Verification on page 121.

ATTENTION: You must verify the configuration and validate the entire system, including a complete functional test, before the operational startup of any safety-related system.
Only authorized, specially trained personnel, who are experienced in the commissioning and operation of safety-related systems can configure, test, and confirm the project.

Follow these steps to put the safety relay into Run mode, generate a configuration signature, and lock the configuration:

1. From the security group, choose the P6 [Operating Mode] parameter.
2. Set the P6 [Operating Mode] parameter value to 1, which equals Run mode.

   A configuration signature is generated.
3. Choose the P10 [Signature ID] parameter and record the configuration signature value that is stored in this parameter.
4. If you configured a password, choose the P1 [Password] parameter and type the password.
5. Choose the P5 [Lock State] parameter.
6. To lock the configuration, set the P5 [Lock State] parameter value to 1 (Lock).

The Config Lock status indicator is steady yellow when the safety relay configuration is locked.

Example Application 2

This example application shows how to change the default configuration settings to configure the MSR57P safety relay for an application with these basic parameters:

- Safe Stop (SS) enabled with an E-stop button.
- Safely-limited Speed (SLS) initiated with a 2NC contact switch.
- A configured Safe Maximum Speed (SMS) limit.
- Door Monitoring (DM).
- Door Control (DC) to control a guard locking switch (TLS-3 GD2, Power to Release style).
- A Reset button with one N.O. contact.
- Enabling Switch (ESM) with two N.C. contacts. Hold the switch in the middle position to access the machine for maintenance while it is running at Safely-limited Speed.
- One encoder that is connected with the sin/cos output signal and resolution of 1024.

Each of the following sections describes the settings that you must enter for each parameter group. Use a HIM, or DriveExplorer or DriveExecutive software to configure the safety relay.

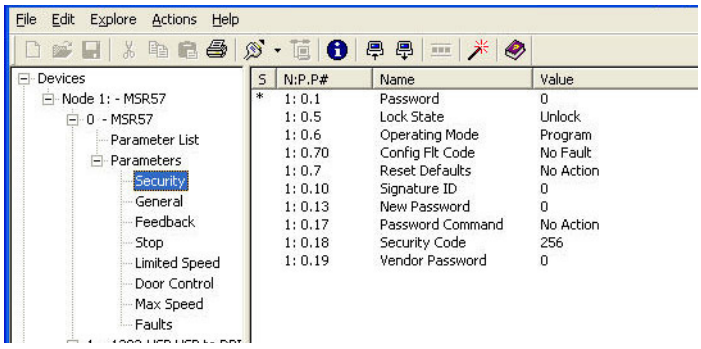
For information on how to connect and use a HIM, see Appendix C on page 163. For information on how to connect to a personal computer and use software for configuration, see Appendix D on page 165.

Initial Security Group Settings

Figure 55 - Security Group Parameters

HIM Screen

Software Screen



Follow these steps to put the safety relay into Program mode for configuration:

1. From the security group, choose the P5 [Lock State] parameter.

   The default value of the lock state parameter is 0 (Unlocked). The Config Lock status indicator on the front of the safety relay also indicates the locked or unlocked state. Flashing yellow is unlocked; steady yellow is locked.
2. If the safety relay is locked (Lock State parameter value equals 1), set the P5 [Lock State] parameter value to 0.

   If an error occurs, a password is configured to protect the safety relay configuration.
3. Choose the P1 [Password] parameter.
4. Type the password.
5. Choose the P6 [Operating Mode] parameter.

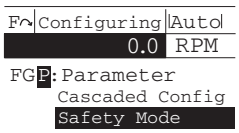
   The default value is 0 (Program).
6. If the safety relay is in Run mode (Operating Mode parameter equals 1), set the P6 [Operating Mode] parameter to 0 to enable you to enter a new configuration.
7. If you want to configure a password or change the password, choose the P13 [New Password] parameter.

   The default value is 0. Enter a value from 0...4,294,967,295.
8. Type the new password value.
9. Choose the P17 [Password Command] parameter.
10. Set the P17 [Password Command] parameter value to 1, which equals Change Password (Change PW).
11. To set the parameters found in the general parameters group, proceed the next section.

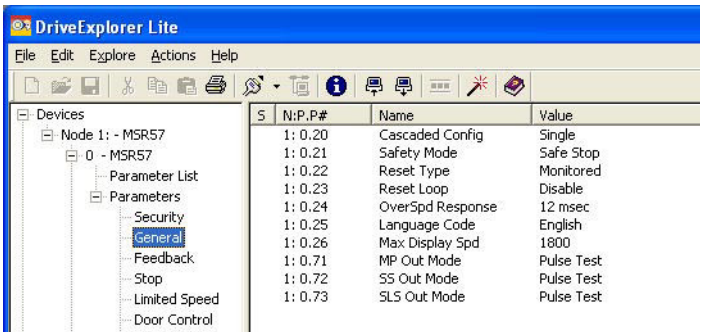
General Group Settings

Figure 56 - General Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the general operation of the safety relay:

1. From the general group, choose the P20 [Cascaded Config] parameter.
2. To configure the safety relay as one unit, set the P20 [Cascaded Config] parameter to 0 (default).
3. Choose the P21 [Safety Mode] parameter.

   The default setting is 1 (Safe Stop).
4. Set the P21 [Safety Mode] parameter value to 6 for Primary, Safely-limited Speed with Door Monitoring and Enabling Switch Monitoring mode (Lim Speed DM ES).

   In this mode, the door locks when the machine speed is above a configured safe speed limit. The door can unlock when a stop is requested and the machine is at standstill speed. The door can also unlock when Safely-limited Speed monitoring (SLS_In input = OFF) and the speed is below the configured safe speed limit. When the enabling switch is held in the middle position, the door can open while the machine is running below the safe speed limit.
5. Choose the P22 [Reset Type] parameter.
6. Set the P22 [Reset Type] parameter value to 2 (default), which equals Manual Monitored (Monitored).

   The manual monitored setting requires the reset circuit to open and close to reset.
7. Choose the P23 [Reset Loop] parameter.
8. To disable reset qualification monitoring, set the P23 [Reset Loop] parameter value to 0 (default).

   This setting assumes that there are no external contactors or devices that are connected to the system that require monitoring.
9. Choose the P24 [OverSpd Response] parameter.

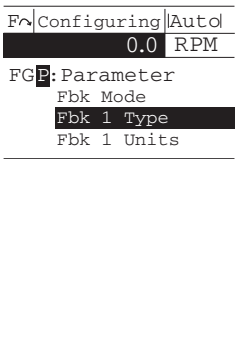
   The default overspeed response time is 42 ms.
10. Set the P24 [OverSpd Response] parameter value to 0 (42 ms).

    See Overspeed Response Time on page 56 for details.
11. To use the feedback parameters group to configure the type of feedback, proceed the next section.

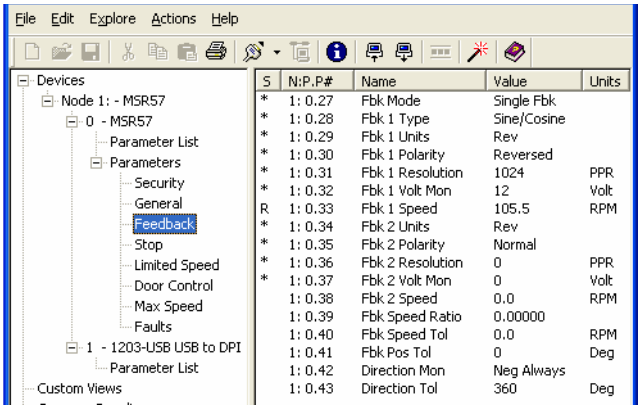
Feedback Group Settings

Figure 57 - Feedback Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the type of feedback used by the safety relay:

1. From the feedback group, choose the P27 [Fbk Mode] parameter.
2. Set the P27 [Fbk Mode] parameter value to 0 (default) for redundant processing and cross-checking of the single encoder input in a 1oo2 architecture.
3. Choose the P28 [Fbk 1 Type] parameter.

   The default value is 1 for incremental encoder input.
4. Set the P28 [Fbk 1 Type] parameter value to 0 for sine/cosine and internal monitoring of the single encoder input.
5. Choose the P29 [Fbk 1 Units] parameter.
6. Set the P29 [Fbk 1 Units] parameter to 0 (default), which equals rotary feedback.
7. Choose the P30 [Fbk 1 Polarity] parameter.
8. To configure the direction for monitoring to be the same as the encoder direction (Normal), set the P30 [Fbk 1 Polarity] parameter to 0 (default).
9. Choose the P31 [Fbk 1 Resolution] parameter.
10. Choose 1024 (default) or enter a value between 1...65,535 pulses/revolution based on the specifications of the encoder.
11. Choose the P32 [Fbk 1 Volt Mon] parameter.
12. To monitor voltage in accordance with the specifications of the encoder, enter 5, 9, 12, or 14V. To disable encoder voltage monitoring, enter 0 (default)

    The P33 [Fbk 1 Speed] parameter displays the output speed of the encoder as a value between -214,748,364.8...+214,748,364.8 rpm, which is based on the configuration of the encoder. It is not necessary to enter a setting or value for this parameter.
13. Choose the P42 [Direction Mon] parameter.
14. Set the P42 [Direction Mon] parameter value to 2, to configure the normal monitored direction as negative always.
15. Choose the P43 [Direction Tol] parameter.
16. Enter a value between 0...65,535° that is based on the specifications of the encoder.

    The default value is 10°.

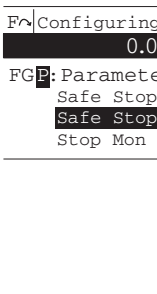
    This value sets the position limit that is tolerated in the wrong direction when Safe Direction monitoring is enabled. A value of 360 equals one revolution in the forward direction before a Direction fault occurs.

17. To set the parameters found in the stop parameters group, proceed to the next section.

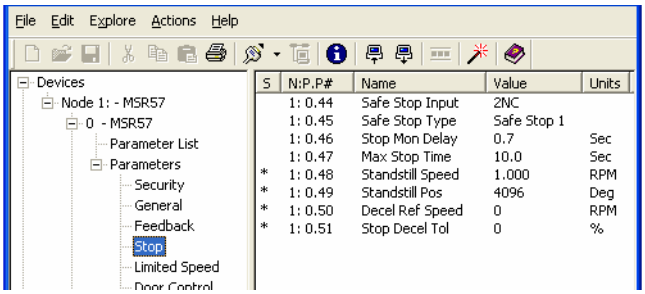
Stop Group Settings

Figure 58 - Stop Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the stop operation of the safety relay:

1. From the stop group, choose the P44 [Safe Stop Input] parameter.
2. Set the P44 [Safe Stop Input] parameter value to 1 (default) for 2NC (dual-channel equivalent) operation.

   In this example application, the Safe Stop input (SS_In) monitors an E-stop button with two normally closed (2NC) contacts.
3. Choose the P45 [Safe Stop Type] parameter.
4. Set the P45 [Safe Stop Type] parameter value to 1 (Safe Stop 1).

   Safe Stop 1 monitors deceleration profiles. When standstill speed is detected within the Stop Delay [Max Stop Time], the safety relay switches off motion power and sets door control logic to unlock.
5. Choose the P47 [Max Stop Time] parameter.

   Enter a value from 0…6553.5 s, the default value is 0 s.
6. Type the value of the expected Ramp to Stop time plus a reasonable tolerance after the Safe Stop command initiates.

   If the speed of the machine is not below the standstill speed within the Stop Delay [Max Stop Time], a Stop Speed fault occurs and door control logic remains set to lock until standstill speed is reached.
7. Choose the P48 [Standstill Speed] parameter.

   Enter a value from 0.001…65,535 rpm, the default value is 0.001 rpm. The standstill speed is measured in revolutions per minute because the P29 [Fbk 1 Units] parameter is configured for rotary feedback.
8. To define the speed at which the safety relay determines standstill is reached, enter a value in the P48 [Standstill Speed] parameter field.
9. Choose the P49 [Standstill Pos] parameter.

   Enter a value from 0…65,535°, the default value is 10°. The standstill position is measured in degrees because the P29 [Fbk 1 Units] parameter is configured for rotary feedback.
10. Enter the value in encoder units that defines the tolerated position limit after standstill is reached.
11. Choose the P50 [Decel Ref Speed] parameter.

    Enter a value from 0…65,535 rpm, the default value is 0 rpm. The Decel Ref Speed parameter verifies that the speed is decelerating at the desired rate.
12. Enter a number greater than the max speed (2000 in this example).
13. Choose the P51 [Stop Decel Tol] parameter.

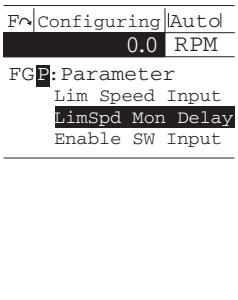
The Stop Decel Tol parameter determines the total percentage of the Decel Ref Speed that is used as the upper limit of deceleration speed.

14. Enter 100% for this example.
15. To set the parameters found in the limited speed parameters group, proceed the next section.

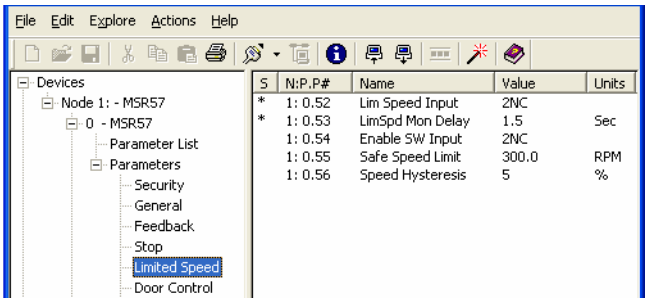
Limited Speed Group Settings

Figure 59 - Limited Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the Safely-limited Speed operation:

1. From the limited speed group, choose the P52 [Lim Speed Input] parameter.

   The default value is 0 (Disabled), for applications without Safely-limited Speed control.
2. Set the P52 [Lim Speed Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the Safely-limited Speed input (SLS_In) monitors a switch with two normally closed (2NC) contacts. If the N.C. contacts are open and speed exceeds the configured Safely-limited Speed, the safety relay initiates the configured Safe Stop type.

   When the safety relay actively monitors Safely-limited Speed and the speed of the machine is at or below the configured safe speed limit, the gate interlock releases and the door can open.
3. Choose the P53 [LimSpd Mon Delay] parameter.

   The default value is 0 s. The valid range is from 0…6553.5 s.

   Type a value to define the desired delay between the SLS_In input on to off transition and the start of Safely-limited Speed monitoring.
4. Choose the P54 [Enable SW Input] parameter.

   The default value is 0 (Not Used) for applications without an enabling switch.
5. Set the P54 [Enable SW Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the ESM_In input monitors an enabling switch with two normally closed (2NC) contacts. As long as the enabling switch is held in the middle position, the safety gate can open during Safely-limited Speed monitoring.
6. Choose the P55 [Safe Speed Limit] parameter.

   The default value is 0 rpm or mm/s. Enter a value from 0…6553.5.
7. Type the maximum allowable rpm value for safe (reduced) velocity.

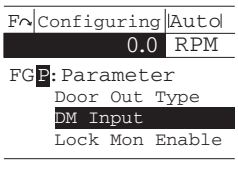
   The speed is calculated in rpm, which is based on the P29 {Fbk 1 Units] parameter setting (0 = Rotary feedback) entered previously.

8. To set the parameters that configure door control operation, proceed to the next section.

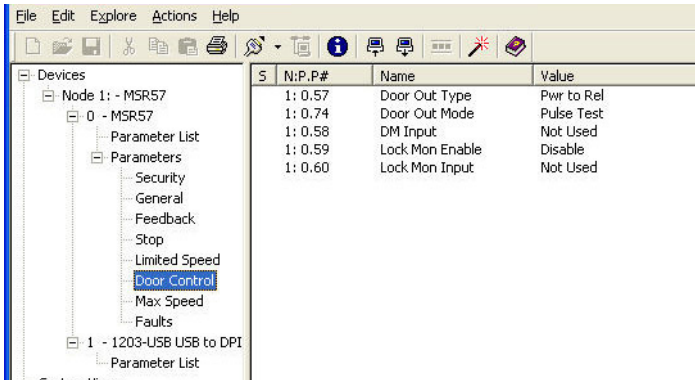
Door Control Group Settings

Figure 60 - Door Control Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the door control operation for the safety relay:

1. From the door control group, choose the P57 [Door Out Type] parameter.
2. Set the P57 [Door Out Type] parameter to 0 (default), which equals Power to Release (Pwr to Rel).

   This setting was chosen because power must be applied to the solenoid inside the TLS-3 GD2 gate switch to release the gate interlock.
3. Choose the P58 [DM Input] parameter.

   The default setting is 0 for applications that do not use an interlock switch.
4. Set the P58 [DM Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the DM Input (DM_In) monitors the TLS-3 GD2 switch, which has two normally closed (2NC) safety contacts.
5. Choose the P59 [Lock Mon Enable] parameter.

   The default value is 0 (Disabled) for applications without an interlock switch.
6. Set the P59 [Lock Mon Enable] parameter value to 1 (Enabled) because this application uses the TLS-3 GD2 interlock switch.
7. Choose the P60 [Lock Mon Input] parameter.

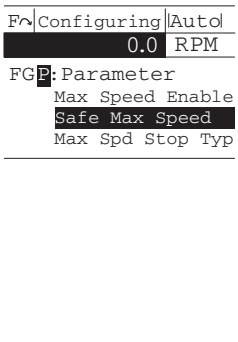
   The default value is 0 (Not Used) for applications that do not use an interlock switch.
8. Set the P60 [Lock Mon Input] parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the Lock Monitor Input (LM_In) monitors the TLS-3 GD2 switch, which has two normally closed (2 NC) interlock monitoring contacts.
9. To set the parameters that configure Safe Maximum Speed monitoring, proceed to the next section.

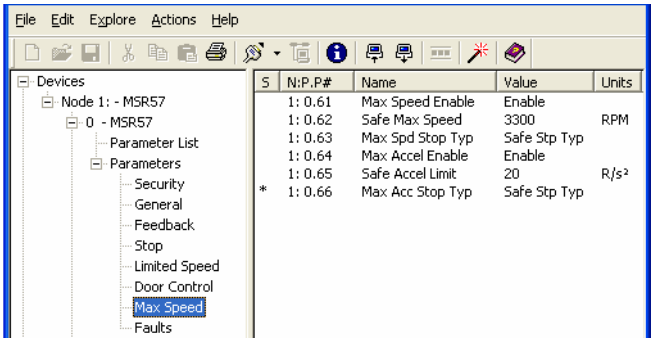
Max Speed Group

Figure 61 - Max Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure maximum Safe Maximum Speed monitoring for the safety relay:

1. From the max speed group, choose the P61 [Max Speed Enable] parameter.

   The default value is 0 (Disabled) for no maximum speed limitation.
2. Set the P61 [Max Speed Enable] parameter value to 1 (Enabled), which monitors that the encoder feedback signal does not exceed the velocity that is configured with the safe max speed parameter.
3. Choose the P62 [Safe Max Speed] parameter.

   The default value is 0 rpm or mm/s. Enter a value from 0...6553.5.
4. Type the maximum allowable rpm value for velocity.

   The speed is calculated in rpm, based on the Fbk 1 Units parameter setting (0 = Rotary feedback) entered previously.
5. Choose the P63 [Max Spd Stop Typ] parameter.
6. Set the P63 [Max Spd Stop Typ] parameter value to 1, which equals Use Configured Safe Stop Type (Safe Stp Typ).

   With this configuration, if speed exceeds the configured safe max speed, the safety relay initiates the configured Safe Stop type.
7. To put the safety relay into Run mode and lock the configuration, proceed to the next section.

Final Security Group Settings

This example only includes the steps for entering a configuration using the HIM or software program. You must also follow the requirements that are described in Safety Configuration and Verification on page 121.

ATTENTION: You must verify the configuration and validate the entire system, including a complete functional test, before the operational startup of any safety-related system.
Only authorized, specially trained personnel who are experienced in the commissioning and operation of safety-related systems can configure, test, and confirm the project.

Follow these steps to put the safety relay into Run mode, generate a configuration signature, and lock the configuration:

1. From the security group, choose the P6 [Operating Mode] parameter.
2. Set the P6 [Operating Mode] parameter value to 1, which equals Run mode.

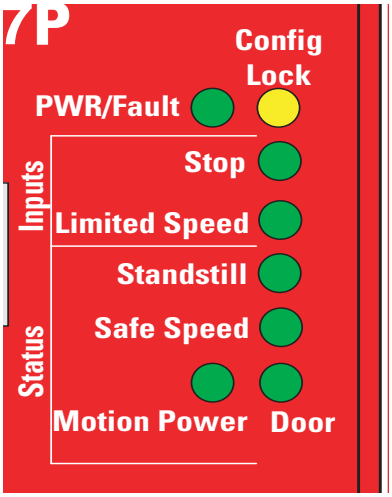
A configuration signature generates.

3. Choose the P10 [Signature ID] parameter and record the configuration signature value that is stored in this parameter.
4. If you configured a password, choose the P1 [Password] parameter and type the password.
5. Choose the P5 [Lock State] parameter.
6. To lock the configuration, set the P5 [Lock State] parameter value to 1 (Lock).

The Config Lock status indicator is steady yellow when the safety relay configuration is locked.

Troubleshoot the MSR57P Safety Relay

Status Indicators



The MSR57P safety relay features eight indicators to provide status information.

Indicator	Status	Description
PWR/Fault (1)	Green/on	The safety relay is operating normally and is in Run mode.
	Red/flashing	A recoverable fault occurred.
	Red/on	A nonrecoverable fault occurred. (All other indicators are off.)
	Red/green flashing	The configuration is being downloaded or a firmware update is in progress.
Config Lock(1)	Yellow/on	The configuration is locked.
	Yellow/flashing	The configuration is unlocked.
Stop	Green/on	The Safe Stop (SS) input is closed.
	Red/on	The SS input is open or pressed.
	Red/flashing	The SS input has a fault.
Limited Speed	Green/on	The Safely-limited Speed (SLS) input is closed for normal run operation.
	Green/flashing	The SLS input is open for a safe speed request to allow access to the machine (maintenance operation).
	Off	The SLS function is not configured.
	Red/flashing	The SLS input has a fault.
Motion Power	Green/on	The Motion Power (MP) output is ON.
	Off	The MP output is off.
	Red/flashing	The MP output has a fault.
Door(2)	Green/on	The door is closed.
	Red/on	The door is open.
	Red/flashing	Door monitor or lock monitor input switch has a fault.
	Off	Door monitoring is not configured.
Safe Speed(3)	Green/on	Safely-limited Speed is actively monitored and is below the configured Safely-limited Speed value after an SLS request is made.
	Off	Safely-limited Speed is not monitored.
	Red/flashing	An SLS Speed fault occurred.
Standstill	Green/on	Standstill speed is detected.
	Off	Speed is greater than the configured standstill speed.
	Red/flashing	Motion is detected after stopped condition or a Stop Speed fault occurred.

(1) PWR/Fault green status indicator and Config Lock status indicator flash in sync when the safety relay is in Program mode.
(2) In cascading applications, only by the Door status indicator on the primary unit indicates the status of the door. The Door status indicators on middle and last units remain off.
(3) When the safety relay is configured for Secondary, SLS Status Only mode, the Safe Speed status indicator is steady green when the monitored speed of an individual MSR57P safety relay unit is below the safe speed limit, following hysteresis. The Safe Speed status indicator is off when the monitored speed is above the configured safe speed limit. In this mode, the SLS_In value does not affect the state of the Safe Speed status indicator.

When you apply power to the safety relay, the red/green status indicators flash alternate colors and the Config Lock status indicator flashes on and off twice before all status indicators except for PWR/Fault turn off. The PWR/Fault status indicator remains flashing until the safety relay enters Run or Program mode.

Nonrecoverable Faults

The safety relay also generates nonrecoverable faults when an anomaly with the safety relay hardware is detected. These faults are Safe State faults. If a Safe State fault occurs, all safety control outputs set to their safe state.

To clear a nonrecoverable fault, cycle power. If the nonrecoverable fault persists, the safety relay can require replacement.

Fault Recovery

If the fault is no longer present, a successful SS reset can clear the fault condition, except if there is an Invalid Configuration fault, MP Out fault, or Reset On At PwrUp fault. A successful reconfiguration clears an Invalid Configuration fault. An MP Out fault or Reset On At PwrUp fault clears at power down or by a successful reconfiguration.

Input and Output Faults

Several wiring fault conditions during commissioning or normal operation can cause an Input or Output fault indication. If an Input fault occurs, check for the following:

- One of the channels shorted to a 24V DC source.
- One of the channels shorted to a GND source.
- Two input channels shorted together.
- An overcurrent condition in one or both output channels.

An Input fault can also occur if only one of the channels in a dual-channel system changed state after a 3-second discrepancy time interval, if the inputs are configured with one of the following settings:

- 2 = Dual-channel equivalent 3 s (2NC 3 s)
- 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s)
- 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s)

Fault Codes and Descriptions

Faults fall into one of three categories: Stop Category fault, Fault While Stopping fault, and Safe State fault. Stop Category faults can be Motion faults, Monitor faults, or I/O faults.

The HIM or configuration software can display a fault history queue, which provides a record of the faults that the safety relay detected. The fault history queue stores the fault codes and time stamps for the last 10 faults that occurred. To avoid confusion about when faults occurred, a power-up marker (code 32) is placed between faults in the queue if the safety relay is powered up or reset when the queue is not empty. Code 0 equals No Entry.

Table 39 on page 145...Table 41 on page 145 list the faults, fault codes, and display text for the faults. These faults can be viewed by accessing the P67 [Fault Status] parameter.

See Appendix C on page 163 for information on how to use a HIM to access the fault history queue. See Appendix D on page 165 for information on how to use DriveExplorer™ software to access the fault history queue.

Table 39 - Safe State Faults

Code	Display Text	Description
0	Combined Flt	A combined fault is indicated if any error occurred.
1	Core Error	A nonrecoverable microprocessor error occurred.
2	Invalid Cfg	An Invalid Configuration fault occurs if a configuration parameter is set to an illegal value or combination of values. See Configuration Fault Codes on page 150.
3	MP Out Flt	An MP Output fault indicates an error in the MP_Out output.
4	Reset PwrUp	A Reset Power-up fault occurs if the reset type is configured for Manual or Manual Monitored and the Reset_In input is detected as on when power is cycled.
5	Fbk 1 Flt	A Feedback 1 fault occurs if any of the following conditions are detected at encoder 1: • An open wire. • A short-circuit. • A Sine/Cosine fault, which is the amplitude of the sine signal squared plus the amplitude of the cosine signal squared is not equal to a constant value. • The feedback signals indicate a frequency greater than or equal to 100 kHz for a sine/cosine encoder or 200 kHz for an incremental encoder. • Illegal encoder signal transitions.
6	Fbk 2 Flt	A Feedback 2 fault occurs if any of the following conditions are detected at encoder 2: • Illegal encoder signal transitions. • The feedback signals indicate a frequency greater than or equal to 200 kHz.
7	Dual Fbk Spd	A Dual Feedback Speed fault occurs if an error is detected between the speed from the first encoder and the speed from the second encoder. The configured Feedback Speed Ratio and Feedback Speed Tolerance determine the valid speed-comparison values.
8	Dual Fbk Pos	A Dual Feedback Position fault occurs if a discrepancy is detected between the relative position change of the encoder 1 and the relative position change of encoder 2 since the last SS reset.
13	Mov in Stop	If the safety relay is configured for a stop type that includes stopped speed checking, a Move in Stop fault occurs if either of the following is detected after the system stops and the door is unlocked: • Speed greater than the configured standstill speed • A position change greater than the configured standstill position limit
27	Fbk 1V Fault	An Encoder 1 Voltage fault occurs if the encoder voltage at encoder 1 is detected as out of range.
28	Fbk 2V Fault	An Encoder 2 Voltage fault occurs if the encoder voltage at encoder 2 is detected as out of range.

Table 40 - Fault While Stopping Faults

Code	Display Text	Description
11	Decel Flt	A Deceleration fault occurs if the speed is detected at greater than the limit specified for the configured Stop Delay [Max Stop Time] when the configured Safe Stop type is Safe Stop 1 or 2.
12	Stop Spd Flt	A Stop Speed fault occurs when the safety relay is configured for a Safe Stop type that includes standstill speed checking (Safe Stop 1 or 2, and Safe Torque Off with Standstill Speed Checking) and the detected speed is greater than the configured standstill speed at the end of the configured Stop Delay [Max Stop Time].

Table 41 - Stop Category Fault Descriptions

Code	Display Text	Description	
9	SS In Flt	I/O Faults[1]	An SS_In fault occurs if an error is detected in the SS_In dual-channel input.
10	SS Out Flt		An SS_Out fault occurs if an error is detected in the SS_Out dual-channel output.
14	SLS In Flt		An SLS_In fault occurs if an error is detected in the SLS_In dual-channel input.
15	SLS Out Flt		An SLS_Out fault occurs if an error is detected in the SLS_Out dual-channel output.
20	DM In Flt		A DM_In fault occurs if an error is detected in the DM_In dual-channel input.
22	DC Out Flt		A DC_Out fault occurs if an error is detected in the DC_Out dual-channel output.
23	LM In Flt		An LM_In fault occurs if an error is detected in the LM_In dual-channel input.
25	ESM In Flt		An ESM_In fault occurs if an error is detected in the ESM_In dual-channel input.
16	SLS Speed Flt	Motion Faults	The monitored speed is detected at greater than or equal to the safe speed limit during Safely-limited Speed monitoring.
17	SMS Spd Flt		A Safe Maximum Speed fault indicates that Safe Maximum Speed (SMS) monitoring is enabled and the monitored speed is detected at greater than or equal to the configured safe max speed.
18	Accel Flt		An Acceleration fault indicates that the monitored speed was detected as greater than or equal to the configured safe accel rate during safe acceleration monitoring.
19	Dir Flt		A Direction fault indicates that motion is detected in the restricted direction during Safe Direction Monitoring (SDM).

Table 41 - Stop Category Fault Descriptions (Continued)

Code	Display Text	Description	
21	Door Mon Flt	Monitor Fault	If the safety relay is configured for Safely-limited Speed (SLS), but SLS monitoring is not active, the DM_In input must be on (door closed) or a Door Monitoring fault occurs. A Door Monitoring fault occurs if the door is open (DM_In input is off) when an SS reset or SLS reset is requested (SLS_In transitions to on). If a configured SLS Monitoring Delay [Lim Spd Mon Delay] is in progress before Safely-limited Speed monitoring is active and the DM_In input is off (door open), a Door Monitoring fault occurs. If the safety relay is configured for door monitoring and enabling switch monitoring and is actively monitoring Safely-limited Speed, a Door Monitoring fault occurs if the DM_In input transitions from on to off (the door is opened), while the ESM_In input is off.
26	ESM Mon Flt		If the safety relay is configured for enabling switch monitoring and is actively monitoring Safely-limited Speed, the ESM_In input must be on or an ESM Monitoring fault occurs. If the safety relay is configured for enabling switch monitoring only and a configured SLS Monitoring Delay [Lim Spd Mon Delay] is in progress, the ESM_In input must be on when the delay times out or an ESM Monitoring fault occurs. If the ESM_In input is on while the safety relay is actively monitoring Safely-limited Speed, the door can open (DM_In transitions from on to off) if no Lock Monitoring fault exists. However, if the ESM_In input transitions to off after the door opens, an ESM Monitoring fault occurs. If you attempt an SS reset while the SLS_In input is off and the ESM_In input is off, an ESM Monitoring fault occurs.
24	Lock Mon Flt		If the safety relay is configured for lock monitoring, a Lock Monitoring fault occurs when: • The LM_In input is detected as off while the door control output is in the lock state, except for the 5 seconds following the transition of the DC_Out output from unlock to lock. • The LM_In input is detected as on when the DM_In signal transitioned from on to off.
29	RL Flt		An RLM Reset fault occurs if the MSR57P safety relay is configured to qualify an SS reset with the RL_In input and an SS reset is attempted when the MP_Out output is off and the RL_In input is off.

(1) For more information on these faults, see Input and Output Faults on page 144.

Fault Reactions

When a fault occurs, the type of fault and the status of the system determine the resulting state of the system.

Safe State Faults

If a Safe State fault occurs in any operational state including the disabled state, the safety relay goes to the safe state. In the safe state, all safety outputs are in their safe states.

Stop Category Faults and Fault While Stopping Faults

If a Stop Category fault or Fault While Stopping fault occurs while the safety relay is monitoring the motion, the safety relay initiates the configured Safe Stop type.

The type of fault that is detected determines the response of the safety relay when the fault occurs while the safety relay is executing the configured Safe Stop type.

Table 42 - Faults Detected While Executing a Safe Stop

Type of Fault	Response
Fault While Stopping faults: • Deceleration fault (Decel Flt) • Stop Speed fault (Stop Spd Flt)	Outputs are placed in a faulted state, but door control logic can be set to unlock if feedback signals indicate that standstill speed is reached. The safety relay continues to monitor for faults.
These Stop Category faults: • SMS Speed fault when the P63 [Max Spd Stop Typ] is configured for Use Safe Torque Off with Check for Standstill (Torque Off) • Acceleration fault when the P66 [Max Acc Stop Typ] is configured for Use Safe Torque Off with Check for Standstill (Torque Off) • Direction fault (Dir Flt), if the fault occurred while a Safe Stop was in progress.	
These Stop Category faults: • SLS Speed fault (SLS Spd Flt) • Direction fault (Dir Flt), if the fault is detected before the Safe Stop initiates. In this case, the safety relay does not perform direction monitoring while executing the configured Safe Stop type. • Door Monitoring fault (Door Mon Flt) • ESM Monitoring fault (ESM Mon Flt) • Lock Monitoring fault (Lock Mon Flt) • RLM Reset fault (RL Flt) • SMS Speed fault when the P63 [Max Spd Stop Typ] is configured for Use Configured Safe Stop Type (Safe Stp Typ) • Acceleration fault when the P66 [Max Acc Stop Typ] is configured for Use Configured Safe Stop Type (Safe Stp Typ)	The safety relay continues to execute the configured Safe Stop type and monitor for faults.

If outputs are already in a faulted state due to a previous fault, and a subsequent Stop Category fault or Fault While Stopping fault occurs, outputs remain in a faulted state, door control logic can set to unlock if feedback signals indicate that standstill speed is reached, and the safety relay continues to monitor for faults.

If a Stop Category fault or Fault While Stopping fault occurs after standstill speed is reached and the safety relay sets door control logic to unlock, the safety relay goes to the safe state.

ATTENTION: If a fault occurs after standstill speed is reached, door control logic can remain unlocked.
A Safe State fault can set the Door Control output (DC_Out) to off.

Status Attributes

For diagnostic purposes only, you can view status attributes by accessing the P68 [Guard Status] parameter and the P69 [IO Diag Status] parameter from a HIM or via DriveExplorer or DriveExecutive™ software.

The status attributes are valid only when the MSR57P safety relay is in Run mode. If the MSR57P safety relay is in Program mode or has an Invalid Configuration fault, the status attributes do not update.

Guard Status Attributes

These attributes are stored in the P68 [Guard Status] parameter. Each bit corresponds to another attribute.

Table 43 - Guard Status

Bit	Display Text	Description
0	StatusOK	This bit indicates when there are no faults. It is set (1), when all fault status bits 1...31 are 0 (no faults). The bit is 0 if any fault status bit from 1...31 indicates a fault (1).
1	Config Lock	This bit shows the status of the P5 [Lock State] parameter. 1 indicates that the configuration is locked; 0 indicates that the configuration is unlocked.
2	MP_Out	This bit sets to 0 if the MP_Out dual-channel output is commanded to the off state. This bit sets to 1 if the MP_Out dual-channel output is commanded to the on state. This bit is the commanded value, not the readback value.
3	SS In	This bit displays the logical value, 1 or 0, evaluated for the dual-channel SS_In input.
4	SS Req	This bit sets to 1 when either a transition of the SS_In input from on to off or a Stop Category fault initiates a Safe Stop. This bit resets to 0 when a successful SS reset occurs and when the Safety mode is set to disabled (0).
5	SS In Prog	This bit sets to 1 when the transition of the SS_In input from on to off with no active fault conditions initiates a Safe Stop. It is not set to 1 when a Stop Category fault initiates a Safe Stop. While set to 1, this bit resets (0) if standstill speed is reached or any fault condition is detected.
6	SS Decel	This bit sets to 1 if the configured Stop Delay [Max Stop Time] is active for a Safe Stop 1 or Safe Stop 2 while the safety relay is executing the Safe Stop. This bit is not set during a Category 0 Safe Torque Off Safe Stop. This bit is reset (0) when Standstill Speed is detected, a Safe State fault occurs, or an SS reset occurs.
7	SS Stopped	This bit sets to 1 if a successful Safe Stop has been executed and the speed is less than or equal to the standstill speed. This bit sets to 0 by an SS reset or the occurrence of a Stop Category fault. It is always 0 when the safety relay is configured for a Safe Torque Off without standstill speed checking.
8	SS Out	This bit sets to 1 if the dual-channel SS_Out output is being commanded to the on state. This bit is the commanded value, not a readback value. This bit sets to 0 if the SS_Out output is being commanded to the off state.
9	SLS In	This bit reflects the logical value that is evaluated for the dual-channel SLS_In input.
10	SLS Req	This bit sets to 1 if the Safely-limited Speed operation has been requested while the safety relay is actively monitoring motion or an SLS Monitoring Delay [LimSpd Mon Delay] is in progress.
11	SLS In Prog	This bit sets to 1 when Safely-limited Speed monitoring is active.
12	SLS Out	This bit sets to 1 if the dual-channel SLS_Out output is being commanded to the on state. This bit is the commanded value, not a readback value.
13	SMS In Prog	This bit sets to a 1 if Safe Maximum Speed monitoring is enabled and Safe Maximum Speed is being monitored.
14	SMA In Prog	This bit sets to 1 if Safe Maximum Acceleration monitoring is enabled and Safe Maximum Acceleration is actively being monitored.
15	SDM In Prog	If Safe Direction monitoring is enabled and configured for positive always or negative always, the SDM_In_Progress bit sets to 1 anytime the safety relay is configured for any Safety mode other than Disabled. If Safe Direction monitoring is enabled and configured for positive during SLS or negative during SLS, then this bit sets to 1 if the safety relay is actively monitoring for Safely-limited Speed. It sets to 0 in any other operating mode.
16	DC Lock	This bit sets to 1 if door control logic status is Lock. This bit sets to 0 if door control logic status is Unlock.
17	DC Out	This bit sets to 1 if the dual-channel DC_Out output is being commanded to the on state. This setting is the commanded value, not the readback value. This bit sets to 0 if the dual-channel DC_Out output is being commanded to the off state.
18	DM In	This bit sets to 1 if the logical value of the dual-channel DM_In input is evaluated as 1. This bit sets to 0 if the logical value of the dual-channel DM_In input is evaluated as 0.
19	DM In Prog	The status of this bit is dependent on the speed monitoring configuration of the safety relay. The bit is 1 when: • The safety relay is configured for Safe Stop with door monitoring and is monitoring motion, or is executing a Safe Stop. • The safety relay is configured for Safely-limited Speed with door monitoring and the safety relay is not actively monitoring for Safely-limited Speed, is in an SLS Monitoring Delay [LimSpd Mon Delay], or is executing a Safe Stop. • The safety relay is configured for Safely-limited Speed with door monitoring and enabling switch monitoring, and – The safety relay is not actively monitoring for Safely-limited Speed, is in an SLS Monitoring Delay [LimSpd Mon Delay], or is executing a Safe Stop. – The safety relay is actively monitoring for Safely-limited Speed when the ESM_In input is off and the DM_In input is on. This bit is always set to 0 when the safety relay is not configured for Door Monitoring.
20	LM In	This bit sets to 1 if the logical value of the dual-channel LM_In input is evaluated as 1. This bit sets to 0 if the logical value of the dual-channel LM_In input is evaluated as 0.
21	ESM In	This bit sets to 1 if the logical value of the dual-channel ESM_In input is evaluated as 1. This bit sets to 0 if the logical value of the dual-channel ESM_In input is evaluated as 0.
22	ESM In Prog	This bit sets to 1 if the Safety mode is configured for enabling switch monitoring, Safely-limited Speed monitoring is active, and the SLS_In input is off. It is also set to 1 if the Safety mode is configured for enabling switch monitoring and door monitoring and the DM_In input is off. This bit sets to 0 when the Safety mode is not configured for enabling switch monitoring.

Table 43 - Guard Status (Continued)

Bit	Display Text	Description
23	Reset In	This status bit reflects the state of the Reset_In input. 1 indicates the Reset_In input is on; 0 indicates the Reset_In input is off.
24	Wait Reset	This bit indicates when an SS reset is required. The bit sets to 1 whenever the safety relay is successfully configured and is in the Safe State or when standstill speed has been reached.
25	Wait SS Cyc	This bit indicates when the SS_In input must be cycled before an SS reset being performed. The bit sets to 1 if the SS_In input is on and a fault is detected or the Wait Stop Request attribute equals 1. It sets to 0 if the SS_In input is detected as off.
26	Wait No Stop	This bit is set (1) when a stop request is made by using the HIM stop button. It sets to 0 when the HIM start button is pushed, following a reset, or at power-up.
27	SLS Cmd	This bit reflects the status of the SLS_Command output. 1 indicates that the output is on; 0 indicates that the output is off. See SLS_Command Output on page 53.
28	Stop Cmd	This bit reflects the status of the Stop_Command output. 1 indicates that the output is on; 0 indicates that the output is off. See SLS_Command Output on page 53.
29 ⋮ 31	Reserved	

I/O Diagnostic Status Attributes

These attributes are stored in the P69 [I/O Diagnostic Status] parameter. Each bit reflects the present state of the I/O signal and is used for diagnostics: 0 = open; 1 = closed.

Table 44 - I/O Diag Status

Bit	Display Text
0	SS In CH 0
1	SS In CH 1
2	SS Out CH 0
3	SS_Out CH 1
4	SLS In CH 0
5	SLS In CH 1
6	SLS Out CH 0
7	SLS Out CH 1
8	ESM In CH 0
9	ESM In CH 1
10	DM In CH 0
11	DM In CH 1
12	DC Out CH 0
13	DC Out CH 1
14	LM In CH 0
15	LM In CH 1
16	Reset In
17	RL In
18	SLS Cmd
19	Stop Cmd
20	MP Out CH 0
21	MP Out CH 1
Bits 22...31 are Reserved (0).	

IMPORTANT When the MSR57P safety relay is not in Run mode, the P69 [I/O Diagnostic Status] parameter does not update.

Configuration Fault Codes

Use these fault codes, which are stored in P70 [Config Flt Code], to identify the reason for an Invalid Configuration fault.

Value	Description	Display
0	No fault.	No Fault
1	Password required.	Password Req
2	Safety Mode (P21) value not legal based on Cascaded Config (P20) value.	P21 (P20)
3	Door Out type (P57) value not legal based on Cascaded Config (P20) value.	P57 (P20)
4	Stop Mon Delay (P46) value not legal based on Safe Stop type (P45) value.	P46 (P45)
5	Decel Ref Spd (P50) value not legal based on Fbk 1 Resolution (P31) value.	P50 (P31)
6	Standstill Speed (P48) value not legal based on Cascaded Config (P20) value.	P48 (P20)
7	LimSpd Mon Delay (P53) value not legal based on Safety Mode (P21) value.	P53 (P21)
8	Safe Speed Limit (P55) value not legal based on Safety Mode (P21) and Fbk 1 Resolution (P31) value.	P55 (P21 P31)
9	Speed Hysteresis (P56) value not legal based on Safety Mode (P21) value.	P56 (P21)
10	Safe Max Speed (P62) value not legal based on Fbk 1 Resolution (P31) value.	P62 (P31)
11	Direction Mon (P42) value not legal based on Safety Mode (P21) value.	P42 (21)
12	Lock Mon Enable (P59) value not legal based on Safety Mode (P21) value.	P59 (P21)
13	Fbk 2 Resolution (P36) value not legal based on Fbk Mode (P27) value.	P36 (P27)
14	Fbk 2 Polarity (P35) value not legal based on Fbk Mode (P27) value.	P35 (P27)
15	Fbk Speed Ratio (P39) value not legal based on Fbk Mode (P27) value.	P39 (P27)
16	Fbk Pos Tol (P41) value not legal based on Fbk Mode (P27) value.	P41 (P27)
17	Fbk Speed Tol (P40) value not legal based on Fbk Mode (P27) value.	P40 (P27)
18	Safe Stop In Typ (P44) value not legal based on Safety Mode (P21) value.	P44 (P21)
19	Lim Speed Input (P52) value not legal based on Safety Mode (P21) value.	P52 (P21)
20	DM Input type (P58) value not legal based on Cascaded Config (P20) and Safety Mode (P21) value.	P58 (P 20, P21)
21	Enable SW In Typ (P54) value not legal based on Safety Mode (P21) value.	P54 (P21)
22	Lock Mon In type (P60) value not legal based on Safety Mode (P21) value and Lock Mon Enable (P59) value.	P60 (P21, P59)
23	Illegal Cascaded Config (P20) value.	P20
24	Illegal Reset type (P22) value.	P22
25	Illegal Reset Loop (P23) value.	P23
26	Illegal Safe Stop type (P45) value.	P45
27	Illegal Stop Decel Tol (P51) value.	P51
28	Illegal Fbk Mode (P27) value.	P27
29	Illegal Fbk 1 type (P28) value.	P28
30	Illegal Fbk 1 Resolution (P31) value.	P31
31	Illegal Fbk1 Volt Mon (P32) value.	P32
32	Illegal Fbk 2 Volt Mon (P37) value.	P37
33	Illegal OverSpd Response (P24) value.	P24
34	Illegal MP_Out Mode (P71) value.	P71
35	Unknown error.	Unknown Err

Specifications

General Specifications

Attribute	Value
Standards	IEC/EN60204-1, ISO12100, IEC 61508, IEC 61800-5-2
Safety category	Cat. 4 and PLe per EN ISO 13849-1; SIL CL 3 per IEC 61508 and EN 62061
Power supply	24V DC, 0.8...1.1 x rated voltage (1) PELV or SELV
Aggregate current of MSR57P	10.4 A max at terminal A1 + 13
Power consumption	5 W
MP outputs 14, 24, SLS outputs 68, 78	24V DC, 2 A, short-circuit protected
SS outputs 34, 44	24V DC, 100 mA, short-circuit protected
SLS_Status output Y35, Fault_Status output Y37	24V DC, 50 mA, short-circuit protected
Door control outputs 51, 52	24V DC, short-circuit protected • 1.5 A, bipolar (Power to Release/Power to Lock) configuration • 20 mA per output, cascading (2 CH Source) configuration
Stop_Command output Y32,	24V DC, 100 mA, short-circuit protected
SLS_Command output Y33	24V DC, 100 mA, short-circuit protected
Output Y1	24V DC, 20 mA, short-circuit protected
Pulse outputs S11, S21	24V DC, 100 mA, short-circuit protected
Pulse inputs S12, S22, S32, S42, S52, S62, S72, S82, X32, X42	11 mA per input, max
Inputs S34, Y2	11 mA per input, max
Input on voltage, min	11V
Input off voltage, max	5V
Input off current, max	2 mA
Input-to-output response time (SS_In, SLS_In, DM_In, ESM_In, LM_In)	20 ms
Overspeed response time	User-configurable
Power-on delay, max	3 s
Pollution degree	2
Enclosure protection	IP40
Terminal protection	IP20
Wire type	Use copper that withstands 60/75 °C (140/167 °F)
Conductor size(2)	0.2...2.5 mm^2 (12...24 AWG)
Terminal screw torque	0.6...0.8 N•m (5...7 lb•in)
Case material	Polyamide PA 6.6
Mounting	35 mm (1.38 in.) DIN rail
Weight, approx.	350 g (0.77 lb)

(1) Safety outputs need an additional fuse for reverse voltage protection of the control circuit. Install a 6 A slow-blow or 10 A fast-acting fuse.
(2) See publication 1770-4.1.

Environmental Specifications

Attribute	Value
Temperature, operating	-5…+55 °C (23…131 °F)
Relative humidity	90% RH noncondensing
Vibration	10…55 Hz, 0.35 mm (0.01 in.) displacement
Shock, operating	10 g (0.02 lb), 16 ms, 100 shocks
ESD immunity	4 kV contact discharges; 8 kV air discharges
Radiated RF immunity	10V/m from 80…1000 MHz; 3V/m from 1.4…2.0 GHz; 1V/m from 2.0…2.7GHz
EFT/B immunity	Power, DC: ±2 kV I/O signal lines: ±1 kV
Surge transient immunity	Power, DC: ±0.5 kV line-line and ±0.5 kV line-earth I/O signal lines: ±1 kV line-earth
Conducted RF immunity	10V rms from 150 kHz…80 MHz
Radiated emissions	Group 1, Class A

Certifications

Certification (1)	Value
cULus	UL Listed, certified for US and Canada.
CE	2014/30/EU Electromagnetic Compatibility Directive (EMC) and 2006/42/EC Machinery Directive (MD), compliant with: • EN 61000-6-4; Industrial Emissions • EN ISO 13849-1 Safety of Machinery - Safety-related parts of control systems - Part 1: General principles for design • EN 61800-5-2 Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional • EN 61131-2 Programmable Controllers (Clause 8, Zone A & B) • EN 61326-3-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity
UKCA	2016 No. 1091 Electromagnetic Compatibility Regulations and 2008 No. 1597 Supply of Machinery (Safety) Regulations, compliant with: • EN 61000-6-4; Industrial Emissions. • EN ISO 13849-1 Safety of Machinery - Safety-related parts of control systems - Part 1: General principles for design • EN 61800-5-2 Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional • EN 61131-2 Programmable Controllers (Clause 8, Zone A & B). • EN 61326-3-1; Meas./Control/Lab., Industrial Requirements. • EN 61000-6-2; Industrial Immunity.
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions.
Functional Safety	Certified by TÜV for Functional Safety: Up to SIL CL 3, according to IEC 61508 and EN 62061; up to Performance Level PLe and Category 4, according to EN ISO 13849-1; when used as described in publication 440R-UM004.

(1) When the product is marked

See rok.auto/certifications for Declarations of Conformity, Certificates, and other certifications details.

Encoder Specifications

Type	Parameter	Description
Generic Incremental	TTL incremental encoder support	5V, differential A quad B
	Differential input voltage (AM and BM)	1.0…7.0V
	Input signal frequency (AM and BM)	200 kHz, max

Type	Parameter	Description
Generic Sin/Cos	AM/BM differential input voltage (p-p)	0.6...1.2V
	AM/BM input frequency	100 kHz, max
Stegmann Sin/Cos	AM/BM differential input voltage (p-p)	1V ±10%
	AM/BM input frequency	100 kHz, max

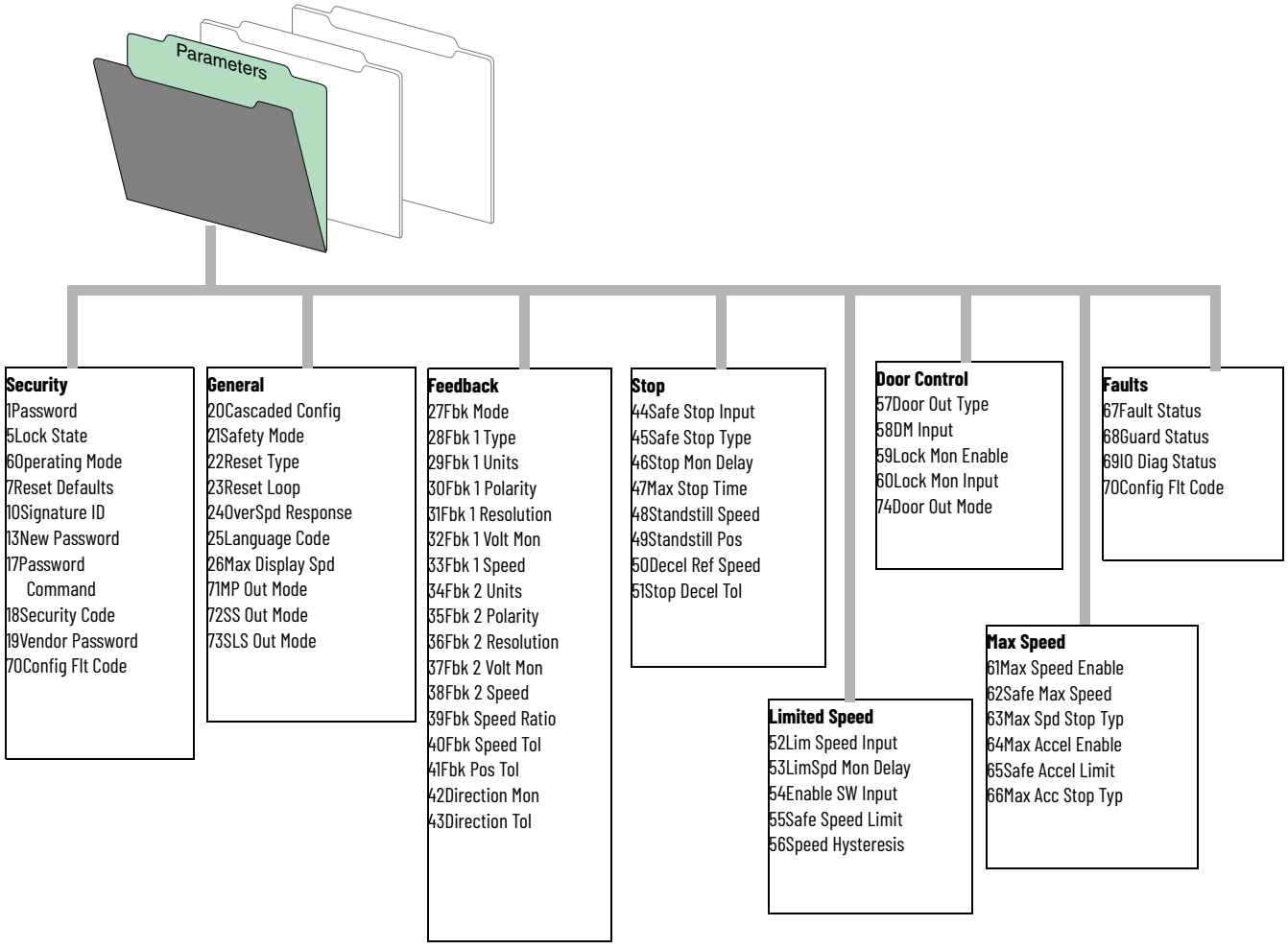
Parameter Data

Parameters are organized into both a linear list by parameter number, and into device-specific files and groups.

Parameter Groups

Parameters for the speed monitoring safety relay appear in the groups security, general, feedback, stop, limited speed, door control, max speed, and faults.

Figure 62 - MSR57P Safety Relay Parameter Groups



Parameters and Settings in a Linear List

Table 45 lists the configurable parameters and their valid settings in numerical order. If any values other than the values that are listed in the table are configured for any of the parameters, an Invalid Configuration fault occurs.

Table 45 - List of Parameters

No.	Name	Description	Values	Read/ Write
1	Password	Password for Lock and Unlock function.	Range: 0...4,294,967,295	R
2	Reserved			
3				
4				
5	Lock State	Command to lock or unlock the safety relay configuration.	Default: 0 = Unlock Options: 0 = Unlock 1 = Lock	R/W
6	Operating Mode	Command to place the system in Program or Run mode.	Default: 0 = Program Options: 0 = Program 1 = Run 2 = Config flt	R/W
7	Reset Defaults	Resets safety relay to factory defaults.	Options: 0 = No action 1 = Reset to factory defaults (Reset Fac)	R/W
8	Reserved			
9				
10	Signature ID	Safety configuration identifier.	Range: 0...4,294,967,295	R
11	Reserved			
12				
13	New Password	32-bit configuration password.	Range: 0...4,294,967,295	W
14	Reserved			
15				
16				
17	Password Command	Save new password command.	Default: 0 = No action Options: 0 = No action 1 = Change Password (Change PW) 2 = Reset Password (Reset PW)	R/W
18	Security Code	Used for Reset Password command.	Range: 0...65,535	R
19	Vendor Password	Vendor password for Reset Password command.	Range: 0...65,535	R/W
20	Cascaded Config	Defines whether the speed monitoring safety relay is one unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Default: 0 = Single Unit System (Single) Options: 0 = Single Unit System (Single) 1 = Cascaded System First Unit (Multi First) 2 = Cascaded System Middle Unit (Multi Mid) 3 = Cascaded System Last Unit (Multi Last)	R/W
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Default: 1 = Primary, Safe Stop (Safe Stop) Options: 0 = Disabled 1 = Primary, Safe Stop (Safe Stop) 2 = Primary, Safe Stop with Door Monitoring (Safe Stop DM) 3 = Primary, Safely-limited Speed (Lim Speed) 4 = Primary, Safely-limited Speed with Door Monitoring (Lim Speed DM) 5 = Primary, Safely-limited Speed with Enabling Switch Control (Lim Speed ES) 6 = Primary, Safely-limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES) 7 = Primary, Safely-limited Speed Status Only (Lim Spd Stat) 8 = Secondary, Safe Stop (Slv Safe Stp) 9 = Secondary, Safely-limited Speed (Slv Lim Spd) 10 = Secondary, Safely-limited Speed Status Only (Slv Spd Stat)	R/W
22	Reset Type	Defines the type of reset that is used by the safety relay.	Default: 2 = Manual Monitored (Monitored) Options: 0 = Automatic 1 = Manual 2 = Manual Monitored (Monitored)	R/W
23	Reset Loop	Defines whether the Reset Loop input (RL_In) is used to qualify a Safe Stop Reset.	Default: 0 = Always Qualified (Disable) Options: 0 = Always Qualified (Disable) 1 = Qualified by RL_In (Enable)	R/W

Table 45 - List of Parameters (Continued)

No.	Name	Description	Values	Read/ Write
24	OverSpd Response	Configuration for the feedback interface sampling rate.	Default: 0 = 42 ms Options: 0 = 42 ms 1 = 48 ms 2 = 60 ms 3 = 84 ms 4 = 132 ms 5 = 228 ms 6 = 420 ms	R/W
25	Language Code	Determines the language of the parameter display.	Default: 0 = English Options: 0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Reserved 6 = Portuguese 7 = Reserved 8 = Reserved 9 = Dutch	R/W
26	Max Display Spd	Determines scaling for Fbk 1 speed process display value.	Default: 1800 Range: 1...65,535 rpm or mm/s	R/W
27	Fbk Mode	Selects the number of encoders and the type of discrepancy checking.	Default: 0 = 1 Encoder (Single Fbk) Options: 0 = 1 Encoder (Single Fbk) 1 = 2 Encoders with Speed and Position Discrepancy Checking (Dual S/P Chk) 2 = 2 Encoders Speed Discrepancy Checking (Dual Spd Chk) 3 = 2 Encoders Position Discrepancy Checking (Dual Pos Chk)	R/W
28	Fbk 1 Type	Selects the type of feedback for encoder 1.	Default: 1 = TTL (Incremental) Options: 0 = Sine/Cosine 1 = TTL (Incremental)	R/W
29	Fbk 1 Units	Selects rotary or linear feedback for encoder 1.	Default: 0 = Rotary (Rev) Options: 0 = Rotary (Rev) 1 = Linear (mm)	R/W
30	Fbk 1 Polarity	Defines the direction polarity for encoder 1.	Default: 0 = Same as encoder (Normal) Options: 0 = Same as encoder (Normal) 1 = Reversed	R/W
31	Fbk 1 Resolution	Counts/Revolution.	Default: 1024 Range: 1...65,535 pulses/revolution or pulses/mm based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	R
32	Fbk 1 Volt Mon	Encoder 1 voltage to be monitored.	Default: 0 = Voltage not monitored Options: 0 = Voltage not monitored 5 = 5V ±10% 9 = 7...12V 12 = 11...14V 14 = 11.5...15.5V	R/W
33	Fbk 1 Speed	Displays the output speed of encoder 1	Range: -214,748,364.8...214,748,364.7 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	R
34	Fbk 2 Units	Selects rotary or linear feedback system for encoder 2.	Default: 0 = Rotary (Rev) Options: 0 = Rotary (Rev) 1 = Linear (mm)	R/W
35	Fbk 2 Polarity	Defines the direction polarity for encoder 2.	Default: 0 = Same as encoder (Normal) Options: 0 = Same as encoder (Normal) 1 = Reversed	R/W
36	Fbk 2 Resolution	Counts/Revolution.	Default: 0 Range: 0...65,535 pulses/revolution or pulses/mm based on the rotary or linear configuration that the P34 [Fbk 2 Units] parameter defines	R

Table 45 - List of Parameters (Continued)

No.	Name	Description	Values		Read/ Write
37	Fbk 2 Volt Mon	Encoder 2 voltage to be monitored.	Default:	0 = Voltage not monitored	R/W
			Options:	0 = Voltage not monitored 5 = 5V ±10% 9 = 7…12V 12 = 11…14V 14 = 11.5…15.5V	
38	Fbk 2 Speed	Displays the output speed of encoder 2.	Range:	-214,748,364.8…214,748,364.7 rpm or mm/s	R
39	Fbk Speed Ratio	Dual Feedback Speed Ratio. Defines the ratio of the expected speed of encoder 2 divided by the expected speed of encoder 1 Not valid when Fbk Mode = 0 (1 encoder).	Default:	0.0000	R/W
			Range:	0.0001…10,000.0 ratio is based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
40	Fbk Speed Tol	Dual Feedback Speed Discrepancy Tolerance. Acceptable difference in speed between Fbk 1 Speed and Fbk 2 Speed.	Default:	0	R/W
			Range:	0…6553.5 rpm or mm/s units are based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
41	Fbk Pos Tol	Acceptable difference in position between encoder 1 and encoder 2.	Default:	0	R/W
			Range:	0…65,535 deg or mm units are based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
42	Direction Mon	Defines the allowable direction if Safe Direction Monitoring is enabled.	Default:	0 = Disabled	R/W
			Options:	0 = Disabled 1 = Positive always (Pos Always) 2 = Negative always (Neg Always) 3 = Positive during Safely-limited Speed monitoring (Pos in SLS) 4 = Negative during Safely-limited Speed monitoring (Neg in SLS)	
43	Direction Tol	The position limit in encoder units tolerated in the wrong direction when Safe Direction Monitoring is active.	Default:	10	R/W
			Range:	0…65,535 deg or mm based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
44	Safe Stop Input	Configuration for Safe Stop input (SS_In).	Default:	1 = Dual-channel equivalent (2NC)	R/W
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)	
45	Safe Stop Type	Safe operating stop type selection. Defines the type of Safe Stop that is performed if a stop type condition initiates the Safe Stop function.	Default:	0 = Safe Torque Off with Standstill Checking (Torque Off)	R/W
			Options:	0 = Safe Torque Off with Standstill Checking (Torque Off) 1 = Safe Stop 1 2 = Safe Stop 2 3 = Safe Torque Off without Standstill Checking (Trq Off NoCk)	
46	Stop Mon Delay	Defines the monitoring delay between the request and the Stop Delay [Max Stop Time] when an SS_In input on to off transition initiates the request for a Safe Stop 1 or a Safe Stop 2. If the Safe Stop type is Safe Torque Off with or without Standstill Speed Checking, the Stop Monitor Delay must be 0 or an Invalid Configuration fault occurs.	Default:	0	R/W
			Range:	0…6553.5 s	
47	Max Stop Time	Stop Delay Defines the maximum stop delay time that is used when a stop type condition initiates the Safe Stop function.	Default:	0	R/W
			Range:	0…6553.5 s	
48	Standstill Speed	Defines the speed limit that is used to declare motion as stopped. Not valid for Safe Torque Off without Standstill Checking.	Default:	0.001	R/W
			Range:	0.001…65.535 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
49	Standstill Pos	Standstill Position Window. Defines the position limit window in encoder 1, degrees or mm that is tolerated after a Safe Stop condition is detected. Not valid for Safe Torque Off without Standstill Checking.	Default:	10	R/W
			Range:	0…65,535° (360° = 1 revolution) or mm based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
50	Decel Ref Speed	Deceleration Reference Speed. Determines deceleration rate to monitor for Safe Stop 1 or Safe Stop 2.	Default:	0	R/W
			Range:	0…65,535 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	

Table 45 - List of Parameters (Continued)

No.	Name	Description	Values	Read/ Write
51	Stop Decel Tol	Decel Tolerance. The acceptable tolerance above the deceleration rate set by the P50 [Decel Ref Speed] parameter.	Default: 0 Range: 0...100% of Decel Ref Speed	R/W
52	Lim Speed Input	Configuration for the Safely-limited Speed input (SLS_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)	R/W
53	LimSpd Mon Delay	Defines the Safely-limited Speed Monitoring Delay between the SLS_In on to off transition and the initiation of the Safely-limited Speed (SLS) monitoring.	Default: 0 Range: 0...6553.5 s	R/W
54	Enable SW Input	Configuration for the Enabling Switch input (ESM_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)	R/W
55	Safe Speed Limit	Defines the speed limit that is monitored in Safely-limited Speed (SLS) mode.	Default: 0 Range: 0...6553.5 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	R/W
56	Speed Hysteresis	Provides hysteresis for SLS_Out output when Safely-limited Speed monitoring is active.	Default: 0 Range: 0% when P21 [Safety Mode] = 1, 2, 3, 4, 5, 6, 8, or 9 10...100% when P21 [Safety Mode] = 7 or 10	R/W
57	Door Out Type	Door Control Output type. Defines the lock and unlock state for door control output (DC_Out). When Door Out type equals Power to Release, DC_Out is off in the lock state and on in the unlock state. When Door Out type equals Power to Lock, DC_Out is on in the lock state and off in the unlock state. The first and middle units of a multi-axis system must be configured as cascading (2).	Default: 0 = Power to Release (Pwr to Rel) Options: 0 = Power to Release (Pwr to Rel) 1 = Power to Lock (Pwr to Lock) 2 = Cascaded (2 CH Sourcing)	R/W
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)	R/W
59	Lock Mon Enable	Lock Monitoring can be enabled only when the speed monitoring safety relay is one unit or as the first unit in a multi-axis system (P20 [Cascaded Config] equals 0 or 1).	Default: 0 = Disable Options: 0 = Disable 1 = Enable	R/W
60	Lock Mon Input	Configuration for the Lock Monitor input (LM_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3 s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3 s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3 s) 6 = Single channel (1NC)	R/W
61	Max Speed Enable	Enable Safe Maximum Speed Monitoring.	Default: 0 = Disable Options: 0 = Disable 1 = Enable	R/W
62	Safe Max Speed	Defines the maximum speed limit that is tolerated if Safe Maximum Speed monitoring is enabled.	Default: 0 Range: 0...65,535 rpm or mm/s based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	R/W

Table 45 - List of Parameters (Continued)

No.	Name	Description	Values		Read/ Write
63	Max Spd Stop Typ	Safe Maximum Speed Monitoring Stop Behavior. Defines the Safe Stop type that is initiated if there is an SMS Speed fault.	Default:	0 = Use Safe Torque Off with Check for Standstill (Torque Off)	R/W
			Options:	0 = Use Safe Torque Off with Check for Standstill (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)	
64	Max Accel Enable	Enable Safe Maximum Acceleration Monitoring.	Default:	0 = Disable	R/W
			Options:	0 = Disable 1 = Enable	
65	Safe Accel Limit	Defines the Safe Maximum Acceleration Limit, relative to encoder 1, for which the system is being monitored.	Default:	0	R/W
			Range:	0...65,535 rev/s^2 or mm/s^2 based on the rotary or linear configuration that the P29 [Fbk 1 Units] parameter defines	
66	Max Acc Stop Typ	Safe Maximum Acceleration Monitoring Stop Behavior. Defines the Safe Stop type that is initiated if there is an Acceleration fault.	Default:	0 = Use Safe Torque Off with Check for Standstill (Torque Off)	R/W
			Range:	0 = Use Safe Torque Off with Check for Standstill (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)	
67	Fault Status	Bit-encoded faults.	Bit 0: Bit 1: Bit 2: Bit 3: Bit 4: Bit 5: Bit 6: Bit 7: Bit 8: Bit 9: Bit 10: Bit 11: Bit 12: Bit 13: Bit 14: Bit 15: Bit 16: Bit 17: Bit 18: Bit 19: Bit 20: Bit 21: Bit 22: Bit 23: Bit 24: Bit 25: Bit 26: Bit 27: Bit 28: Bit 29: Bit 30: Bit 31:	Combined Fault Status (Combined Flt) Reserved for Core Error (Core Error) Invalid Configuration Fault (Invalid Cfg) MP Out Fault (MP Out Flt) Reset On at PwrUp Fault (Reset PwrUp) Feedback 1 Fault (Fbk 1 Flt) Feedback 2 Fault (Fbk 2 Flt) Dual FB Speed Fault (Dual Fbk Spd) Dual FB Position Fault (Dual Fbk Pos) SS_In Fault (SS In Flt) SS_Out Fault (SS Out Flt) Deceleration Fault (Decel Flt) Stop Speed Fault (Stop Spd Flt) Motion After Stopped Fault (Mov in Stop) SLS_In Fault (SLS In Flt) SLS_Out Fault (SLS Out Flt) SLS_Speed Fault (SLS Spd Flt) SMS_Speed Fault (SMS Spd Flt) Acceleration Fault (Accel Flt) Direction Fault (Dir Flt) DM_In Fault (DM In Flt) Door Monitoring Fault (Door Mon Flt) DC_Out Fault (DC Out Flt) LM_In Fault (LM In Flt) Lock Monitoring Fault (Lock Mon Flt) ESM_In Fault (ESM In Flt) ESM Monitoring Fault (ESM Mon Flt) Encoder 1 Voltage Fault (Fbk 1 V Flt) Encoder 2 Voltage Fault (Fbk 2 V Flt) RLM Reset Fault (RL Flt) Reserved Reserved	R

Table 45 - List of Parameters (Continued)

No.	Name	Description	Values	Read/ Write
68	Guard Status	Bit 0: StatusOK Bit 1: Configuration_Lock (Config Lock) Bit 2: MP_Out_Value (MP Out) Bit 3: SS_In_Value (SS In) Bit 4: SS_Request_Status (SS Req) Bit 5: SS_In_Progress (SS In Prog) Bit 6: SS_Decelerating_Status (SS Decel) Bit 7: SS_Axis_Stopped_Status (SS Stopped) Bit 8: SS_Output_Value (SS Out) Bit 9: SLS_In_Value (SLS In) Bit 10: SLS_Request_Status (SLS Req) Bit 11: SLS_In_Progress (SLS In Prog) Bit 12: SLS_Output_Value (SLS Out) Bit 13: SMS_In_Progress (SMS In Prog Bit 14: SMA_In_Progress (SMA In Prog) Bit 15: SDM_In_Progress (SDM In Prog) Bit 16: DC_Lock_Status (DC Lock) Bit 17: DC_Out_Value (DC Out) Bit 18: DM_In_Value (DM In) Bit 19: DM_In_Progress (DM In Prog) Bit 20: LM_In_Value (LM In) Bit 21: ESM_In_Value (ESM In) Bit 22: ESM_In_Progress (ESM In Prog) Bit 23: Reset_In_Value (Reset In) Bit 24: Waiting_for_SS_Reset (Wait Reset) Bit 25: Waiting_for_Cycle_SS_In (Wait SS Cyc) Bit 26: Waiting_for_Stop_Request_Removal (Wait No Stop) Bit 27: SLS_Comand_Value (SLS Cmd) Bit 28: Stop_Command_Value (Stop Cmd) Bit 29...Bit 31: Reserved	0 = Fault; 1 = OK 0 = Unlock; 1 = Lock 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 1 = Lock; 0 = Unlock 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Off; 1 = On	R
69	IO Diag Status	Indicates the present state of I/O used for diagnostics. Bit 0: SS_in_ch_0 status (SS In CH 0) Bit 1: SS_in_ch_1 status (SS In CH 1) Bit 2: SS_out_ch_0 status (SS Out CH 0) Bit 3: SS_out_ch_1 status (SS Out CH 1) Bit 4: SLS_in_ch_0 status (SLS In CH 0) Bit 5: SLS_in_ch_1 status (SLS In CH 1) Bit 6: SLS_out_ch_0 status (SLS Out CH 0) Bit 7: SLS_out_ch_1 status (SLS Out CH 1) Bit 8: ESM_in_ch_0 status (ESM In CH 0) Bit 9: ESM_in_ch_1 status (ESM In CH 1) Bit 10: DM_in_ch_0 status (DM In CH 0) Bit 11: DM_in_ch_1 status (DM In CH 1) Bit 12: DC_out_ch_0 status (DC Out CH 0) Bit 13: DC_out_ch_1 status (DC Out CH 1) Bit 14: LM_in_ch_0 status (LM In CH 0) Bit 15: LM_in_ch_1 status (LM In CH 1) Bit 16: Reset_In status (Reset In) Bit 17: RL_In status (RL In) Bit 18: SLS_command status (SLS Cmd) Bit 19: Stop_command status (Stop Cmd) Bit 20: MP_Out_Ch_0 status (MP Out CH 0) Bit 21: MP_Out_Ch_1 status (MP Out CH 1) Bit 22: Reserved (0) Bit 23: Reserved (0) Bit 24: Reserved (0) Bit 25: Reserved (0) Bit 26: Reserved (0) Bit 27: Reserved (0) Bit 28: Reserved (0) Bit 29: Reserved (0) Bit 30: Reserved (0) Bit 31: Reserved (0)	0 = Open; 1 = Closed **IMPORTANT** When the MSR57P safety relay is not in the Run mode, the P69 [IO Diag Status] parameter does not update.	R

Table 45 - List of Parameters (Continued)

No.	Name	Description	Values	Read/ Write
70	Config Flt Code	Configuration Fault Code.	Options: 0 = No Fault 1 = Password Required (Password Req) 2 = P21 [Safety Mode] value not legal based on P20 [Cascaded Config] value. 3 = P57 [Door Out Type] value not legal based on P20 [Cascaded Config] value. 4 = P46 [Stop Mon Delay] value not legal based on P45 [Safe Stop Type] value. 5 = P50 [Decel Ref Speed] value not legal based on P31 [Fbk 1 Resolution] value. 6 = P48 [Standstill Speed] value not legal based on P20 [Cascaded Config] value. 7 = P53 [LimSpd Mon Delay] value not legal based on P21 [Safety Mode] value. 8 = P55 [Safe Speed Limit] value not legal based on P21 [Safety Mode] and P31 [Fbk 1 Resolution] value. 9 = P56 [Speed Hysteresis] value not legal based on P21 [Safety Mode] value. 10 = P62 [Safe Max Speed] value not legal based on P31 [Fbk 1 Resolution] value. 11 = P42 [Direction Mon] value not legal based on P21 [Safety Mode] value. 12 = P59 [Lock Mon Enable] value not legal based on P21 [Safety Mode] value. 13 = P36 [Fbk 2 Resolution] value not legal based on P27 [Fbk Mode] value. 14 = P35 [Fbk 2 Polarity] value not legal based on P27 [Fbk Mode] value. 15 = P39 [Fbk Speed Ratio] value not legal based on P27 [Fbk Mode] value. 16 = P41 [Fbk Pos Tol] value not legal based on P27 [Fbk Mode] value. 17 = P40 [Fbk Speed Tol] value not legal based on P27 [Fbk Mode] value. 18 = P44 [Safe Stop In Typ] value not legal based on P21 [Safety Mode] value. 19 = P52 [Lim Speed Input] value not legal based on P21 [Safety Mode] value. 20 = P58 [DM Input Type] value not legal based on P20 [Cascaded Config] and P21 [Safety Mode] value. 21 = P54 [Enable SW In Typ] value not legal based on P21 [Safety Mode] value. 22 = P60 [Lock Mon In Type] value not legal based on P21 [Safety Mode] value and P59 [Lock Mon Enable] value. 23 = Illegal P20 [Cascaded Config] value. 24 = Illegal P22 [Reset Type] value. 25 = Illegal P23 [Reset Loop] value. 26 = Illegal P45 [Safe Stop Type] value. 27 = Illegal P51 [Stop Decel Tol] value. 28 = Illegal P27 [Fbk Mode] value. 29 = Illegal P28 [Fbk 1 Type] value. 30 = Illegal P31 [Fbk 1 Resolution] value. 31 = Illegal P32 [Fbk1 Volt Mon] value. 32 = Illegal P37 [Fbk 2 Volt Mon] value. 33 = Illegal P24 [OverSpd Response] value. 34 = Illegal P71 [MP Out Mode] value. 35 = Unknown error (Unknown Err).	R
71	MP Out Mode	Defines whether the MP_Out output is pulse-tested.(1)	Default: 0 = Pulse Test Options: 0 = Pulse test 1 = No pulse test	R/W
72	SS Out Mode	Defines whether the SS_Out output is pulse-tested.(1)	Default: 0 = Pulse Test Options: 0 = Pulse test 1 = No pulse test	R/W
73	SLS Out Mode	Defines whether the SLS_Out output is pulse-tested.(1)	Default: 0 = Pulse Test Options: 0 = Pulse test 1 = No pulse test	R/W
74	Door Out Mode	Defines whether the DC_Out output is pulse-tested.(1)	Default: 0 = Pulse Test Options: 0 = Pulse test 1 = No pulse test	R/W

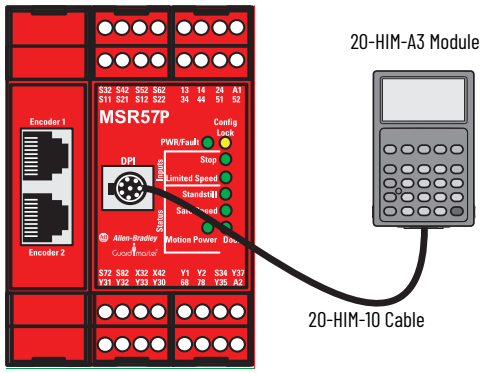
(1) If pulse-testing is turned off for any output, the SIL, Category, and PL rating is reduced for the entire MSR57P safety relay safety system.

Human Interface Module (HIM) Usage

Connect a HIM

You can set the MSR57P safety relay parameters by using a HIM or a personal computer running DriveExplorer™ or DriveExecutive™ software.

Connect the module (catalog number 20-HIM-A3) to the safety relay by using a cable (catalog number 20-HIM-H10).

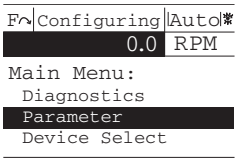


Set Parameters with a HIM

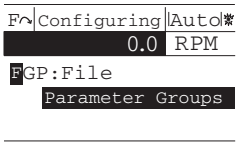
A HIM displays only one parameter at a time. The keypad lets you scroll through the HIM menu structure to find the parameters you must set.

Once the HIM is connected to the safety relay, follow these steps to set parameters:

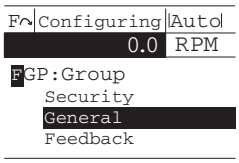
1. If necessary, configure the HIM to display parameters by logical groups.
   a. Press ALT + Sel.
   b. Press ▲ or ▼ to select File - Group - Par from the Param Dspy Item menu and press ↵.



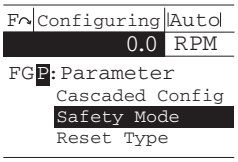
2. In the Main Menu, press ▲ or ▼ to scroll to Parameter and press ↵.



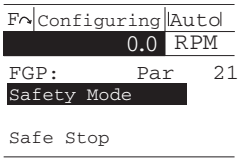
3. Press Enter to choose the Parameter file and display the groups in that file.



4. Scroll to the desired group and press Enter to display the parameters in that group.



5. Scroll to the desired parameter and press Enter to display the parameter value screen.



6. Press Enter to edit the parameter.
7. Press Up or Down to change the value.
8. If desired, press Sel to move from digit to digit, letter to letter, or bit to bit.
   Digits or bits that you can change are highlighted.
9. Press Enter to save the value or Esc to cancel the change.
10. Press Esc to return to the group list.

Numeric Keypad Shortcut

You can also press ALT + +/– to access a parameter by typing its number.

ATTENTION: The red stop button on the HIM keypad does not have safety integrity. Do not use the stop button to execute a Safe Stop.

If the red stop button on the HIM keypad is pressed, you must press the green button on the HIM keypad to reset the MSR57P safety relay.

Access Fault History Queue

To view the contents of the fault history queue, choose Diagnostics>Faults>View Fault Queue from the top-level menu.

Use DriveExplorer or DriveExecutive Software

Connect a Personal Computer

You must have either DriveExplorer™ or DriveExecutive™ software that is installed on your personal computer and a serial or USB converter.

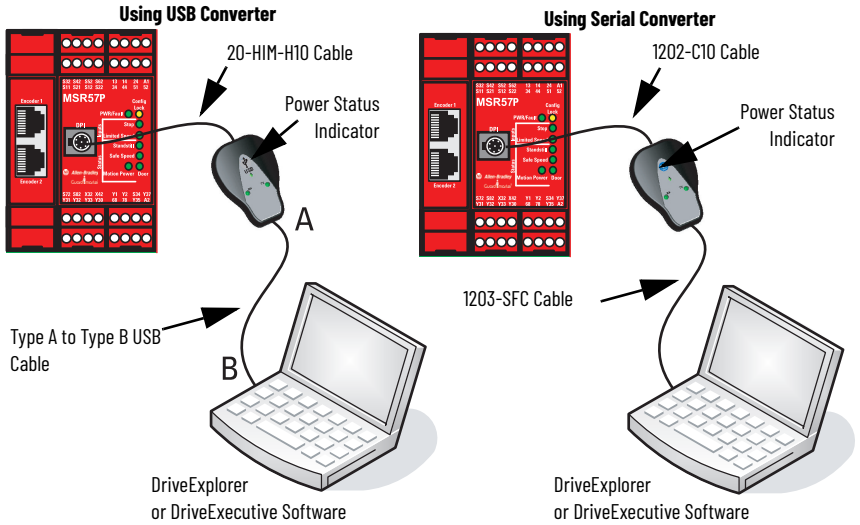
Description	Cat. No.	Version
DriveExplorer software	9306-4EXP02ENE	5.02 or later
DriveExecutive software	9303-4DTE01ENE	4.01 or later
RSLinx (1) software	9355 series	2.50.00 or later
Serial converter (2)	1203-SSS (Series B)	3.004 or later
Universal Serial Bus converter (3)	1203-USB	1.001 or later

(1) The DriveExecutive software requires RSLinx® software, but the DriveExplorer software does not.
(2) The serial converter, catalog number 1203-SSS (Series B), contains: 1203-SFC cable from a personal computer serial to the converter, 1202-C10 cable from the converter to the DPI port, and a serial converter body.
(3) Catalog number 1203-USB contains the converter body, a 20-HIM-H10 cable to connect to the DPI port, and a type A to type B USB cable to connect the 1203-USB converter to a personal computer.

A free version of DriveExplorer Lite software is available for download at rok.auto/pcdc.

To connect the personal computer to the DPI™ port on the front of the safety relay:

1. Connect the appropriate cable between the COM port on your personal computer and the communication port on the serial or USB converter.
2. Connect the appropriate cable between the serial or USB converter and the DPI connector on the safety relay.



3. To verify that the serial or USB converter has power, observe the status indicator.
4. To configure communication, follow the steps in Use DriveExplorer Software on page 166 or Use DriveExecutive Software on page 167.

Use DriveExplorer Software

You must configure communication between DriveExplorer software and the DPI port on the safety relay before you can use the software to edit the parameters of the safety relay.

Configure Serial Communication

Follow these steps to configure communication between DriveExplorer software on your personal computer, the serial or USB communication converter, and the DPI port on the safety relay.

If you use the 1203-USB converter, you must install the USB drivers on your personal computer. The drivers are provided on the DriveExplorer Lite CD that is supplied with the converter.

For information on driver installations, refer to publication DRIVES-UM001.

1. Launch DriveExplorer software.
2. From the Explore menu, choose Connect and Configure Communication.
3. On the Configure Communication dialog box, choose the serial port to which you are connected and type the communication rate.

   If you are using the USB converter, the communication port must match the port that was mapped when you installed the USB drivers and the communication rate must be set to 115,200 bps.

When communication is established, DriveExplorer software maps your safety relay.

Successful uploading of your safety relay parameters results in an MSR57P safety relay parameter display.

Edit Parameters in DriveExplorer Software

In DriveExplorer software, you can choose parameters from the linear list or by using the file and group.

The left pane of the DriveExplorer software interface shows the connected devices and the right pane lists the parameters available.

Figure 63 - DriveExplorer MSR57P Safety Relay Parameter Display

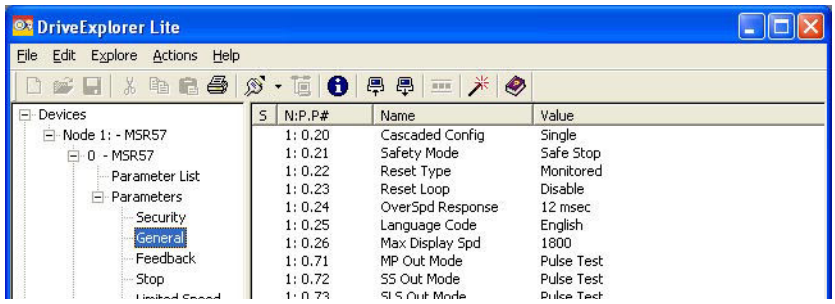


Table 46 - DriveExplorer Software Parameter Information

Column	Description of Contents	
S	Status R = * =	 Read-only Editable
N:P,P#	N = P = P# =	The node number of the device on the network The port number (0 if a device) The parameter number associated with a specific programming parameter
Name	The item name	
Value	The present value of the item	
Units	The unit of measurement for the item	

Follow these steps to edit a parameter:

1. Expand the MSR57P safety relay.
2. Choose either Parameter List or expand the Parameter file to display the parameter groups.

   You can only edit the configuration when the MSR57P safety relay is unlocked and in Program mode.

3. To edit a parameter, double-click the parameter and enter the new value.
4. To configure the MSR57P safety relay, follow the procedure in Configure the Speed Monitoring Safety Relay on page 124.

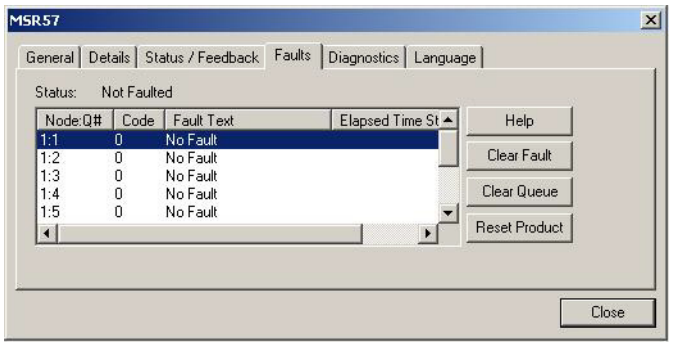
After you edit the parameters, upload and save the parameters to a file on your personal computer. The file can be printed, downloaded to another MSR57P safety relay, or used as a backup.

For detailed information on how to use DriveExplorer software, consult online help.

Access the Fault History Queue

Follow these steps to view the contents of the fault history queue.

1. From the DriveExplorer menu, choose Explore>Device Properties.
2. Click the Faults tab on the device dialog box.



Use DriveExecutive Software

You must configure communication between DriveExecutive software and the DPI port on the safety relay before you can use the software to edit the parameters of the safety relay.

Configure Serial Communication

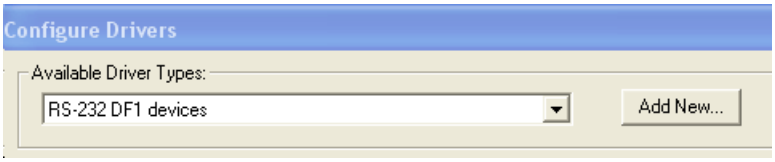
Follow these steps to configure communication between DriveExecutive software on your personal computer, the AnaCANda™ or USB communication converter, and the DPI port on the safety relay.

1. Open RSLinx software.

   IMPORTANT DriveExecutive software must exchange information via RSLinx software. This exchange requires serial communication between the DPI port on the safety relay and your personal computer. The Ethernet network, or other communication standards are not compatible.

2. In RSLinx software, configure a communication driver to interface between your personal computer and the DPI port on the safety relay.

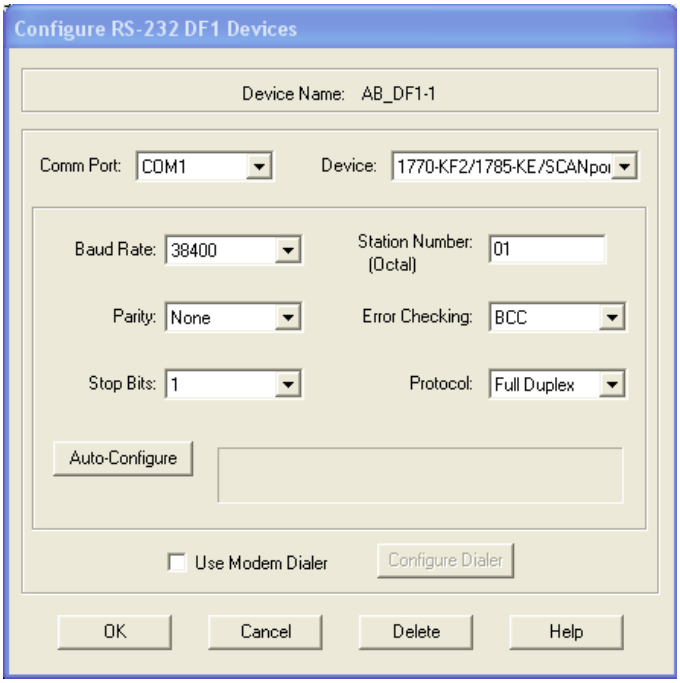
   a. Click Add New.



   b. From the Available Driver Types pull-down menu, choose RS-232 DF1.

   c. Click OK.

3. Configure the RS232 DF1 device as shown.



   a. Choose the Comm Port to which you are connected.

      If you are using the USB converter, the comm port must be the port that was mapped when you installed the USB drivers.

   b. Choose the correct communication rate for the safety relay.

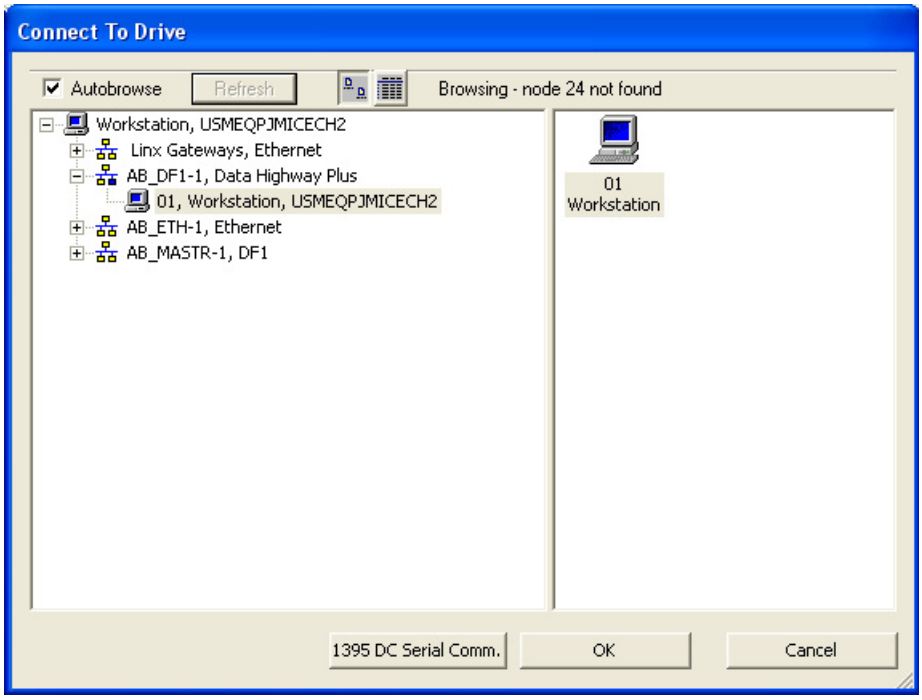
      If you are using the USB converter, the correct communication rate is 115,200 bps.

   c. Close any conflicting programs that might be using this port currently.

   d. From the Device pull-down menu, choose the SCANport™ device.

   e. In the Station Number box, type 01.

4. Click OK.
5. Open RSWho in RSLinx software to verify that the new driver is recognized.



6. Close RSLinx software.
7. Open DriveExecutive software.
8. Advance to Drive Selection and choose Connect to Drive.
9. Choose your workstation (01 in the preceding diagram) and click OK.

   DriveExecutive software connects with the safety relay and begins to upload its parameters. A parameter upload initially occurs, followed by a file group upload. Each upload displays in a separate dialog.

Edit Parameters

In DriveExecutive software, you can choose parameters from the linear list or by using the file and group.

The left pane of the DriveExecutive software dialog shows the connected devices and the right pane lists the parameters available.

Table 47 - DriveExecutive Parameter Information

Column	Description of Contents
#	Parameter number.
Parameter Name	Short name of the parameter.
Value	Current value of the parameter.
Units	Units of measurement for this parameter.
Internal Value	Internal values are unscaled values that are used by the device and by controllers that communicate with the device. The information in this field provides the scaling information to calculate the internal value from a scaled value.
Comment	Displays comments that are previously entered.
Default	Displays the default setting.
Min	The minimum value is the lowest possible value for this parameter.
Max	The maximum value is the highest possible value for this parameter.
Alias	Displays an alias, or alternative name, previously entered.

To edit a parameter:

1. Expand the MSR57P safety relay.
2. To display the parameter groups, choose either Parameter List or expand the Parameter file under the MSR57P safety relay.
3. To edit a parameter, double-click the parameter and type the new value.
4. To configure the MSR57P safety relay, follow the procedure in Configure the Speed Monitoring Safety Relay on page 124.

After you edit the parameters, you can upload them and save them to a file on your personal computer. The file can be printed, downloaded to another MSR57P safety relay, or used as a backup.

For detailed information on how to use the DriveExecutive software, consult online help.

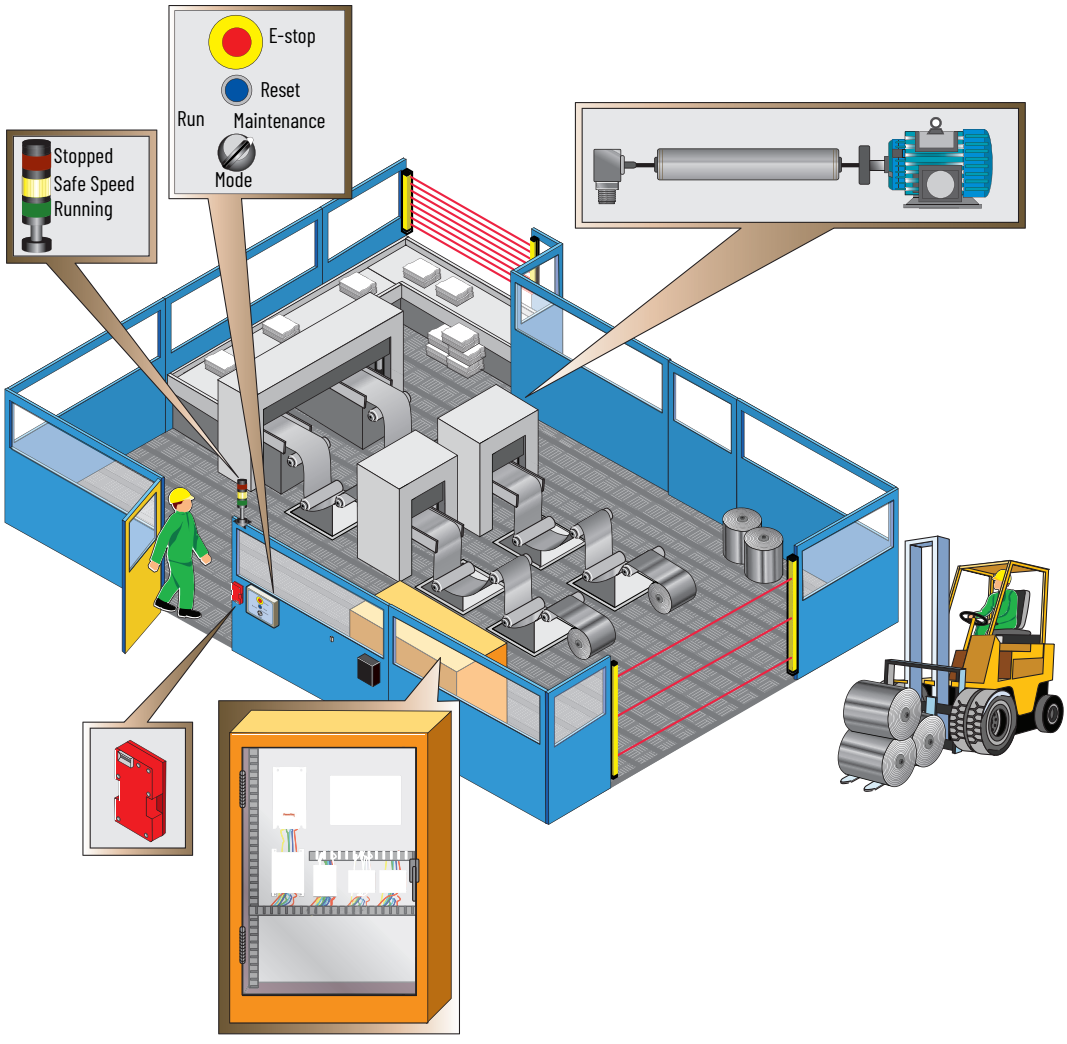
Application Examples

Introduction

This application appendix provides examples of safety relay and drive combinations. See the manuals that are listed in the Additional Resources on page 11 for important information on how to install, ground, wire, and operate the devices that are shown in the appendix.

ATTENTION: Implementation of safety circuits and risk assessment is the responsibility of the machine builder.

PowerFlex 70 Drive with Safe Torque Off Application Example



The example that is shown in Figure 64 and Figure 65 on page 173 is configured for
Safe Stop 1. The control cabinet contains an MSR57P safety relay, a PowerFlex® 70 AC Drive with Safe Torque Off function, and a PanelView™ terminal. The MSR57P safety relay monitors speed via an incremental encoder that is connected to the PowerFlex 70 drive.

The control panel lets the operator select Run or Maintenance speeds. The door has an interlock switch with guard locking to limit access to the machine when the machine is operating at normal run speed.

A tower light indicates machine status.

Figure 64 - PowerFlex 70 Drive System Layout

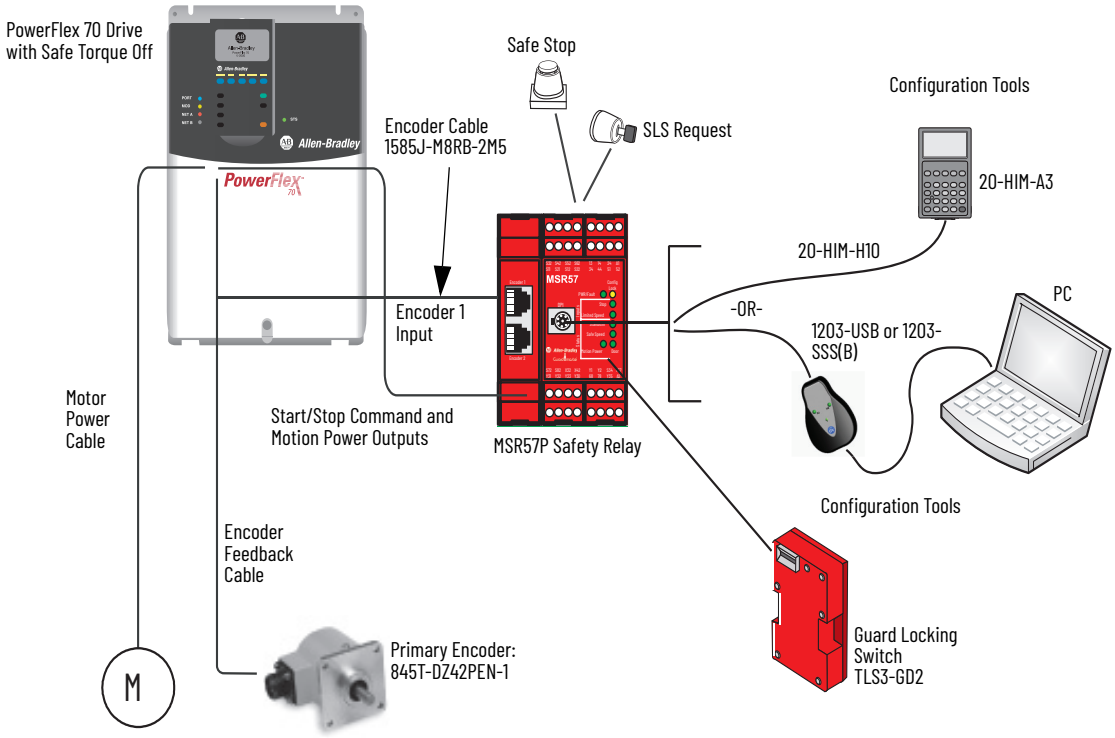
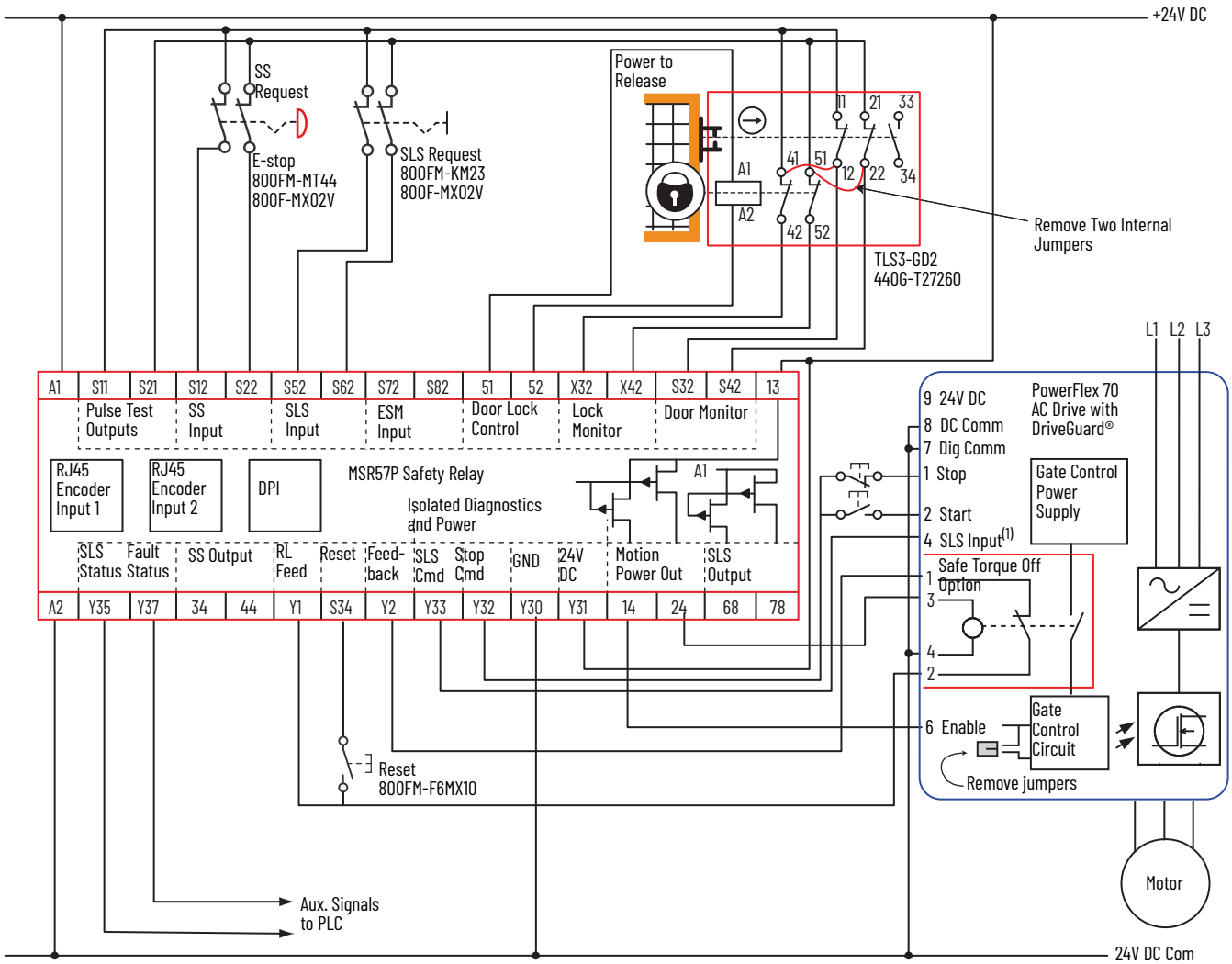


Figure 65 - PowerFlex 70 Drive Example Wiring Diagram



(1) Digital input 4.
Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.

PowerFlex 700 Drive without Safe Torque Off

Figure 66 - PowerFlex 700 Drive System Layout

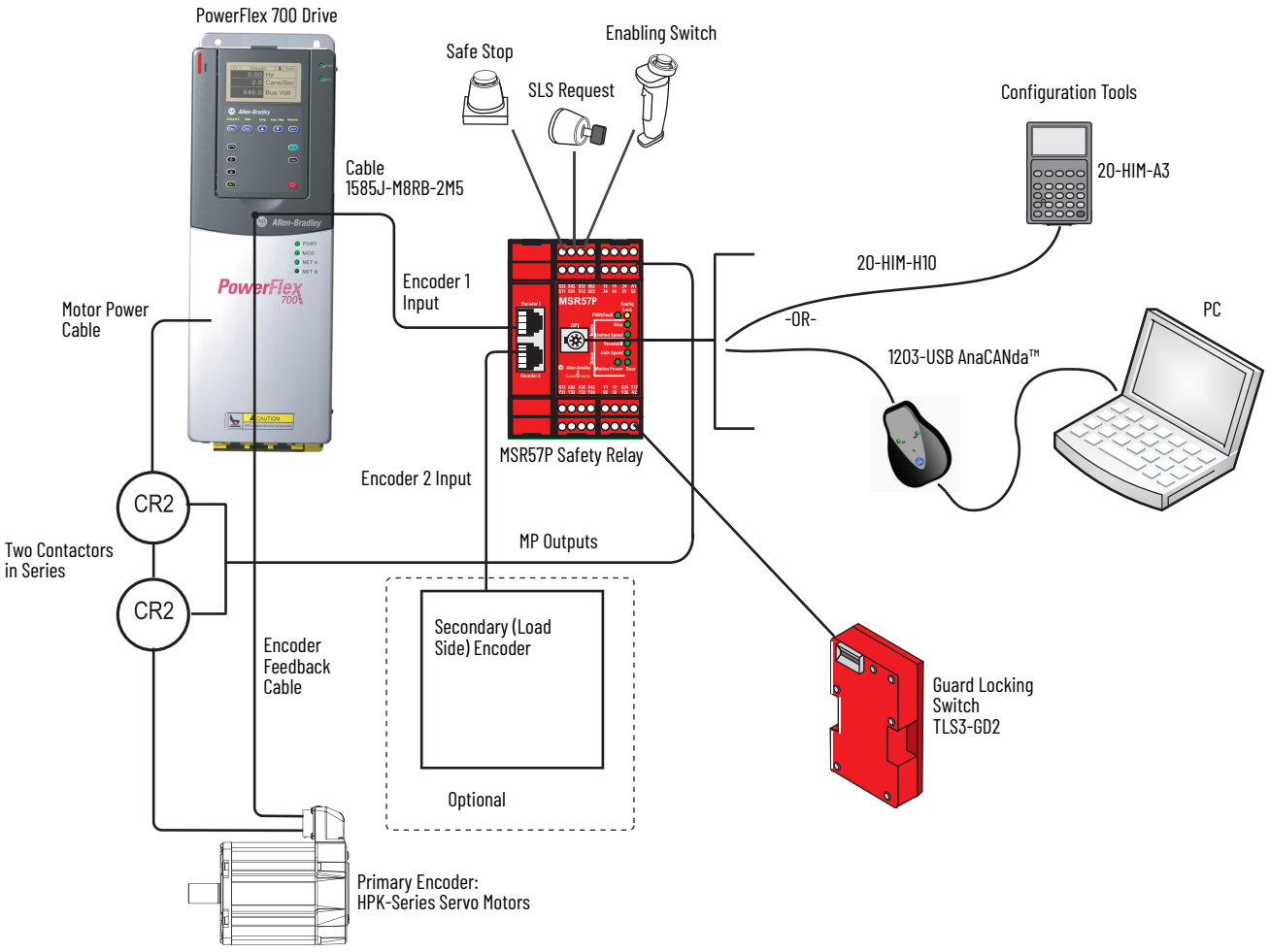
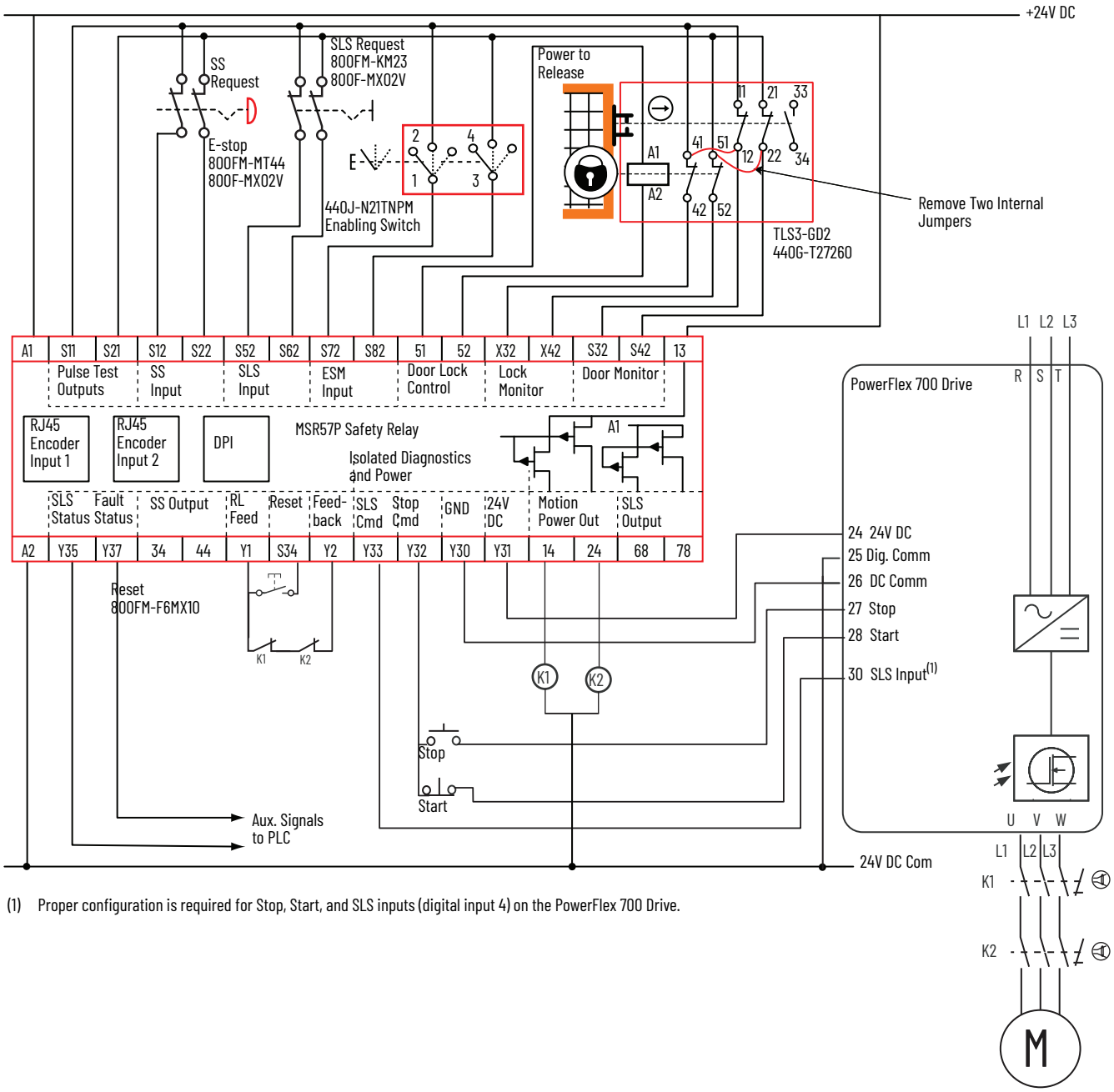
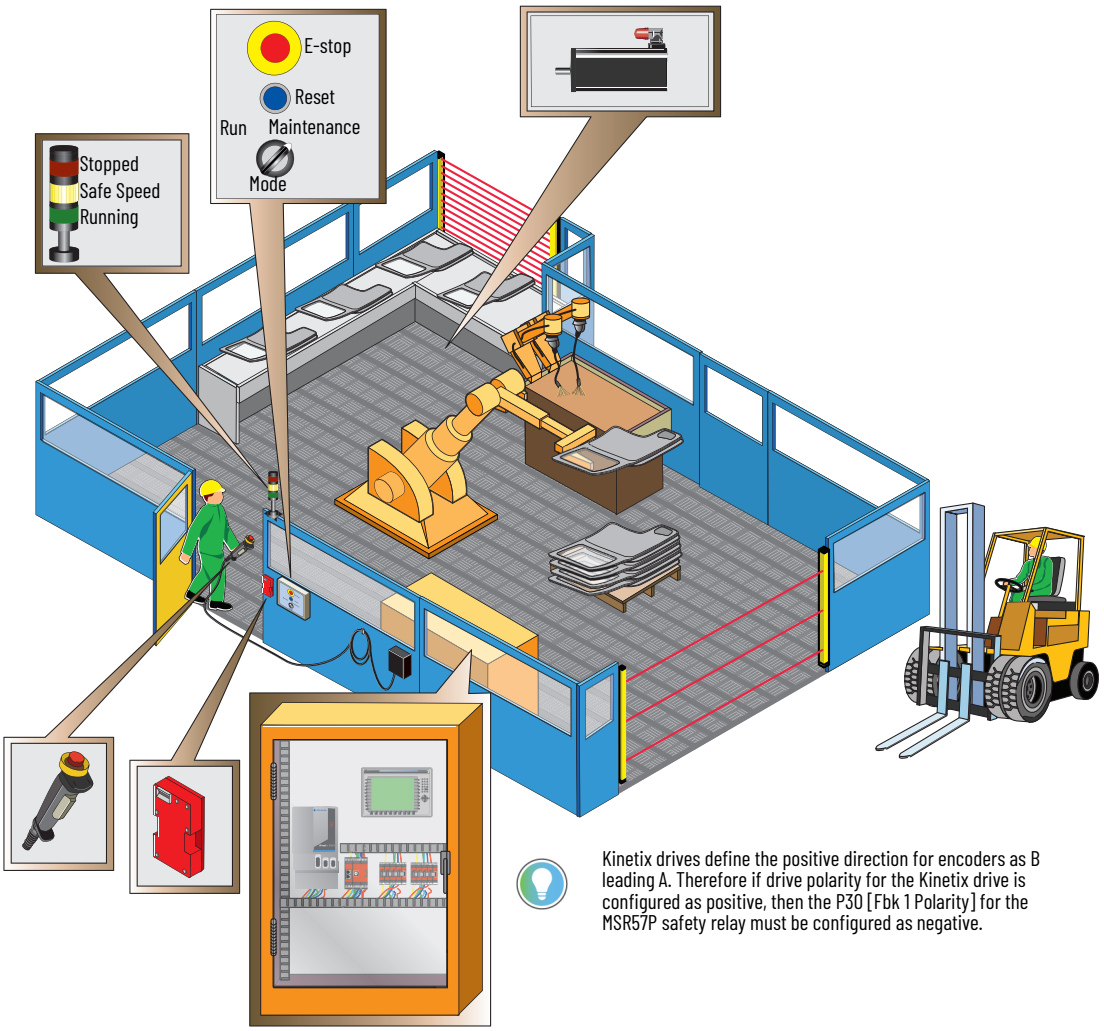


Figure 67 - PowerFlex 700 Drive Wiring Diagram



(1) Proper configuration is required for Stop, Start, and SLS inputs (digital input 4) on the PowerFlex 700 Drive.

Kinetix 6000 or Kinetix 7000 Drives with Safe Torque Off Example



Kinetix drives define the positive direction for encoders as B leading A. Therefore if drive polarity for the Kinetix drive is configured as positive, then the P30 [Fbk 1 Polarity] for the MSR57P safety relay must be configured as negative.

The example that is shown in Figure 68 on page 177 and Figure 69 on page 177 is configured for Safe Stop 1. The control cabinet contains an MSR57P safety relay, a Kinetix® 6000 drive with Safe Torque Off function, and a PanelView terminal. The MSR57P safety relay monitors speed via a Sin/Cos encoder that is connected to the Kinetix 6000 drive.

The control panel lets the operator select Run or Maintenance speeds. The door has an interlock switch with guard locking to limit access to the machine when the machine is operating at normal run speed. In addition, an enabling switch must be held in the middle position while operators are within the machine environment to keep the machine running at safe speed.

A tower light indicates machine status.

Figure 68 - Kinetix 6000 or Kinetix 7000 Drive System Layout

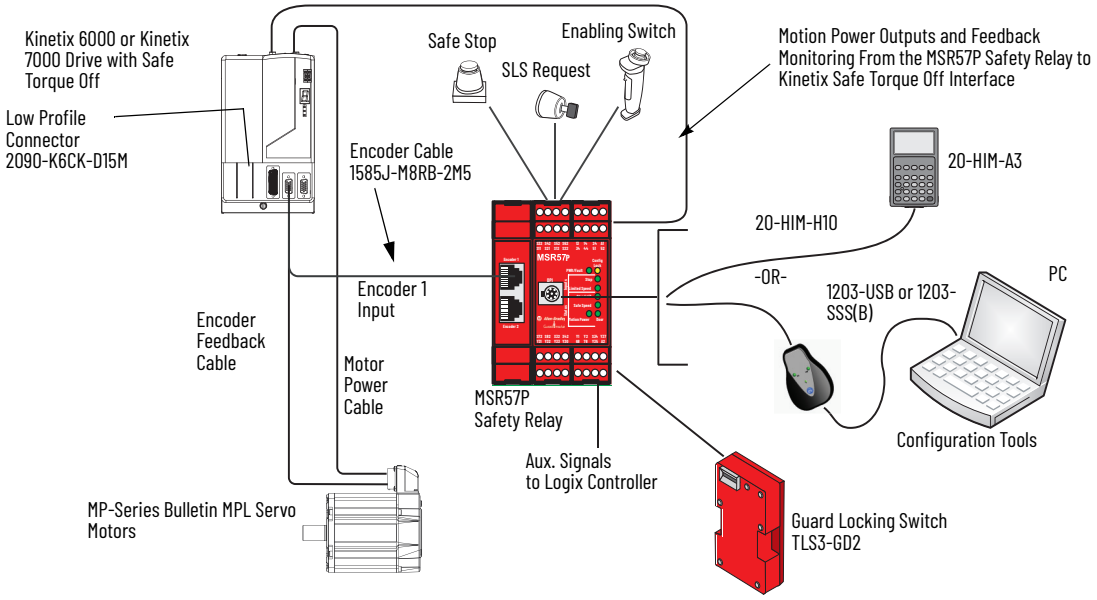
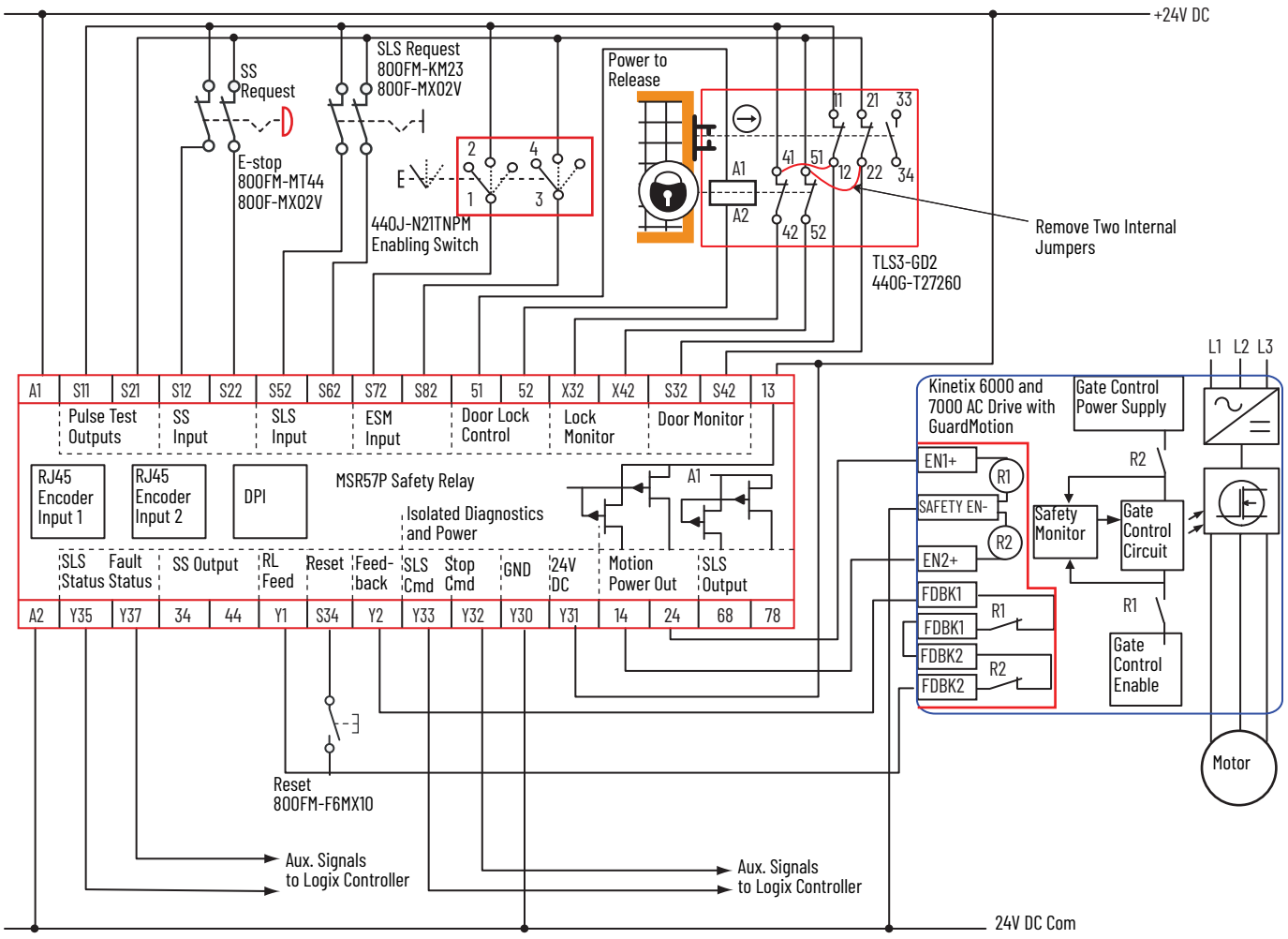


Figure 69 - Kinetix 6000 or Kinetix 7000 Drive Wiring Example



Kinetix 2000 Drive without Safe Torque Off Example

Figure 70 - Kinetix 2000 Drive System Layout

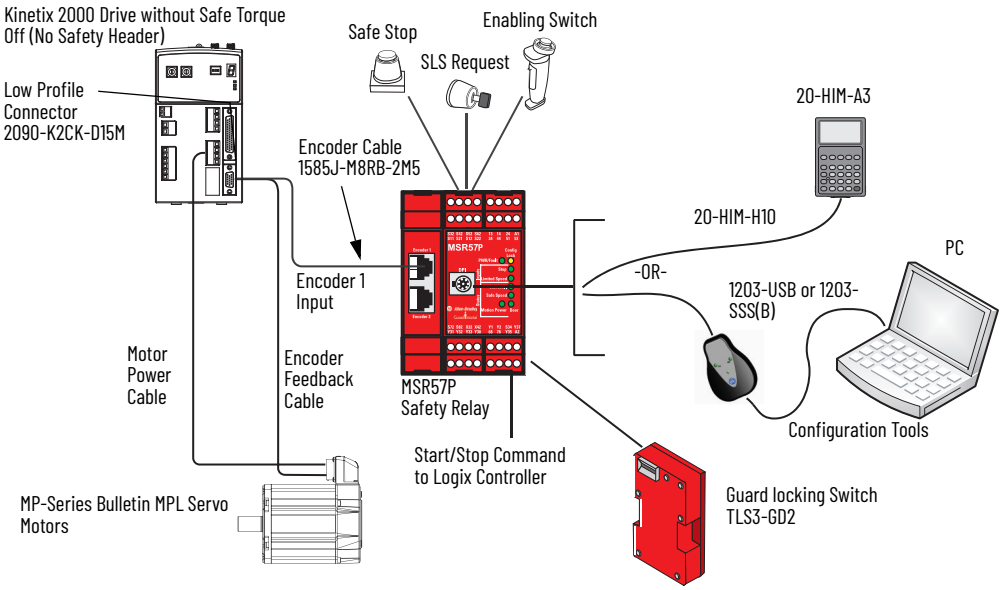
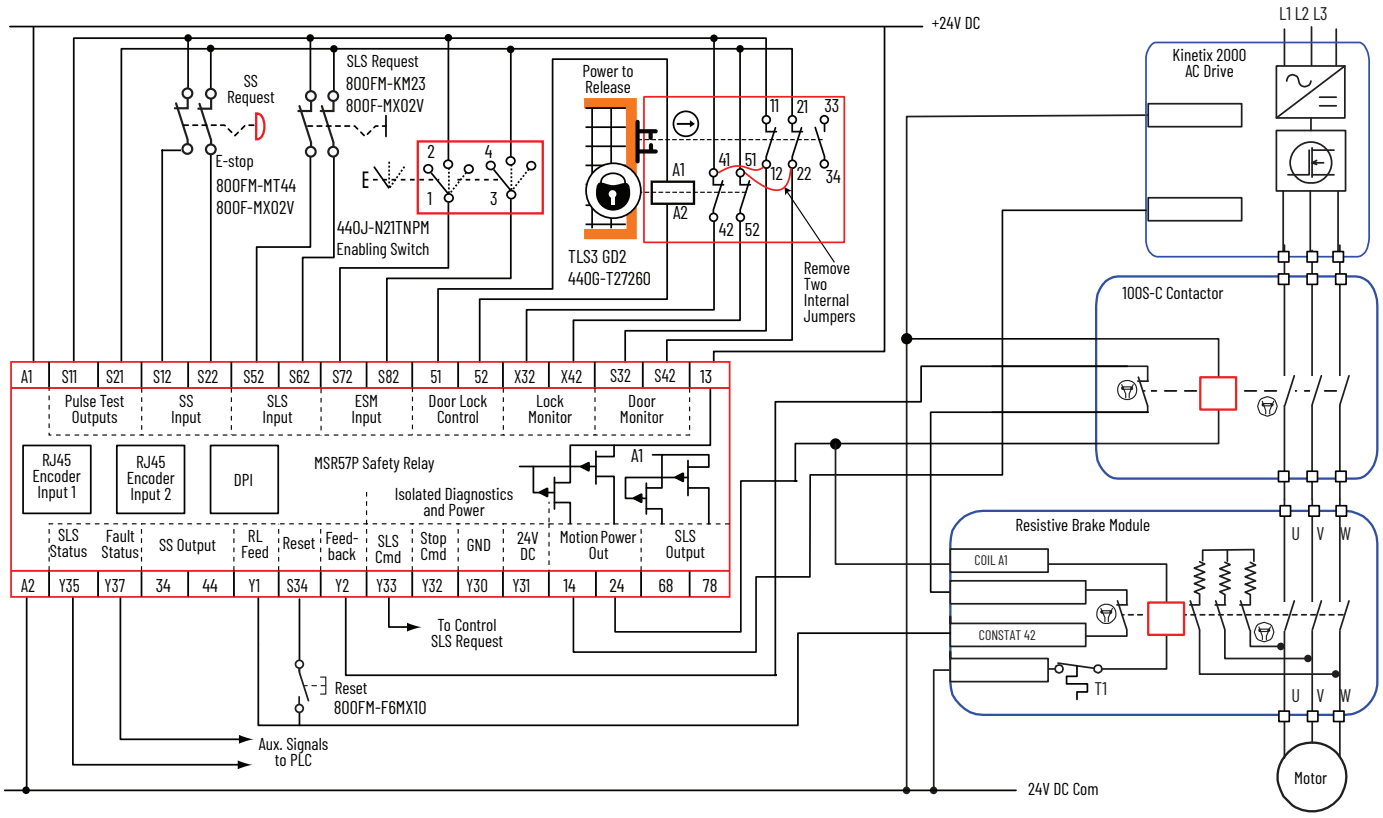


Figure 71 - Kinetix 2000 Drive Wiring Diagram



Proper configuration in RSLogix 5000® software is required. To enable safety functions, choose Drive Enable Input Checking on the Drive/Motor tab in the Axis Properties dialog of the drive.

For more information, see publication 2093-UM001.

Symbols

Numerics

A

C

D

E

F

G

H

I

L

M

O

P

R

S

T

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V

W

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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