User Manual

Original Instructions

Allen-Bradley

Guardmaster®

TLSZ Guardmaster Guard Locking Switch

Catalog Numbers 440G-TZS21UPRH, 440G-TZS21UPLH, 440G-TZS21UTRH, 440G-TZS21UTLH

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.

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).

Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- Who would use this manual
- The purpose of this manual
- Related documentation
- Conventions used in this manual

Who Should Use This Manual

Use this manual to design, install, program, or troubleshoot systems that use the TLSZ Guardmaster® guard locking safety switches.

You are required to have a basic understanding of electrical circuitry and familiarity with safety-related control systems. If you do not, obtain the proper training before using this product.

Purpose of This Manual

This manual is a reference guide for the Guardmaster TLSZ guard locking switch. It describes the procedures you use to install, wire, and troubleshoot your switch. This manual:

- Explains how to install and wire your TLSZ switch,
- Provides an overview of the Guardmaster TLSZ guard locking switch.

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.

Additional Resources

The following documents offers additional information about related Rockwell Automation products.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installation of a Rockwell Automation® industrial system.
Product Certifications website, rok.auto/certifications	Provides declarations of conformity, certificates for the TLSZ guard locking switch.
Rockwell Automation Functional Safety Data Sheet	Provides functional safety data and details for Rockwell Automation products.
Guardmaster 440C-CR30 Configurable Safety Relay Wiring Diagrams	Provides example wiring diagrams for the CR30 software configuration safety relay.
Allen-Bradley Industrial Automation Glossary	Glossary of industrial automation terms and abbreviations

You can view and download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documents, contact your local Rockwell Automation distributor or sales representative.

Terminology

The Industrial Automation Glossary contains terms and abbreviations used by Rockwell Automation to describe industrial automation systems. Below is a list of specific terms and abbreviations used in this manual.

NC	No connection
N.C. (Normally Closed)	An electrical contact whose normal state (for example, no pressure or electrical potential applied) is in the closed position.
N.O. (Normally Open)	An electrical contact whose normal state (i.e., no pressure or electrical potential applied) is in the open position.
PLC	A programmable logic controller or a programmable automation controller.
PTL (Power to Lock)	Apply 24V to the lock command to lock the switch. This command applies to the TLSZL switch.
PTL (Power to Release)	Apply 24V to the lock command to unlock the switch. This command applies to the TLSZR switch.
Reaction Time	Describes the time between the true state of the input to the ON state of the output.
Response Time	Describes the time between the trigger of the input to the OFF state of the output. Throughout this manual, the safety outputs may be described as turning off immediately. This means that the safety outputs will turn off within the response time.
RFID	Radio frequency identification.
OSSD (Output Signal Switching Device)	Typically a pair of solid-state signals pulled up to the DC source supply. The signals are usually tested for short circuits to the DC power supply, short circuits to the DC common, and short circuits between the two signals.
Standard coding	Same as Low coding as defined in EN ISO 14119:2013
TLSZL	TLSZ power-to-lock guard locking switch
TLSZR	TLSZ power-to-release guard locking switch
Unique coding	Same as High coding as defined in EN ISO 14119:2013

General Description

Guardmaster TLSZ Overview

This Guardmaster® TLSZ guard locking switch functions by locking it actuator, which prohibits the opening of a guard.

The TLSZ uses radio frequency identification, RFID, coding to detect the appropriate target.

This version of the Guardmaster TLSZ guard locking switch features OSSD outputs. These outputs are enabled only when the actuator is locked and the RF target is sensed.

This device is intended to be part of the safety-related control system of a machine. Perform a risk assessment before installation to determine whether the specifications of this device are suitable for all operational and environmental characteristics of the machine. See Specifications on page 55 for certification information and ratings.

Use nonremovable screws, bolts, or nuts to mount the switch and actuators. Do not over torque the mounting hardware.

TLSZ guard locking switches are classified according to ISO 14119 as Type 4 switching devices. The RFID targets are classified as having a high level of coding.

Measures are to be taken to minimize the need to defeat and to manage the use and availability of spare RFID targets.

Catalog Numbers

The schema for the TLSZ catalog number is shown in Table 1. The parts of the schema are shown in Table 2.

Table 1 - TLSZ Catalog Number Setup

440	G	T	Z	S21	U	P	R	H
1	2	3	4	5	6	7	8	9

Table 2 - TLSZ Catalog Number Detail

Parameter	Value	Description
1	440	Safeguards the Product
2	G	Guard locking switch
3	T	Titan Locking Switch
4	Z	PLe rated, cascadable safety signals
5	S21	Solid-state outputs, 2 safety (OSSD), 1 aux
6	U	Unique coded RFID target
7	P T	Aux signal shows lock status Aux signal shows door status
8	R L	Power to Release Power to Lock
9	H	8-pin M12 QD connector

ATTENTION: Guard lock switches that use the Power to Lock principle can only be used after a risk assessment has shown that the Power to Release principle is inappropriate for the application. If a power supply loss occurs with Power to Lock switches, the switches immediately become unlocked and the user may have access to the hazards.

Packaging Contents

Figure 1 shows the contents in the shipping package. The contents include:

- Switch
- Actuator
- RFID target
- T20 security Torx bit
- Two steel bolts and nuts
- Plug
- Installation instructions (not shown)

Figure 1 - Package Contents

Notes:

Installation

General Considerations

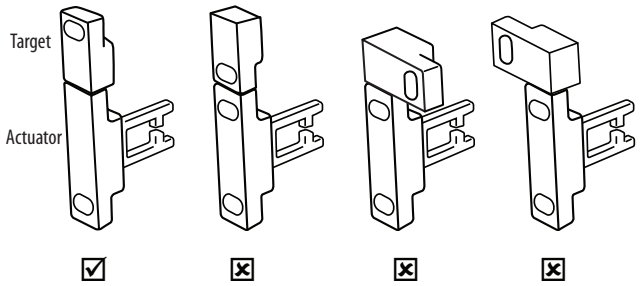
The TLSZ guard locking switch is designed for use on guards that are engineered to be rigid and without sag. The TLSZ uses radio frequency identification, RFID, coding to detect the appropriate target.

Actuator/Target Mounting

Figure 2 shows the correct and incorrect ways to mount the target with the actuator.

The TLSZ must only be used with the fully flexible actuator. The replacement part number for the actuator is catalog number 440G-A27143.

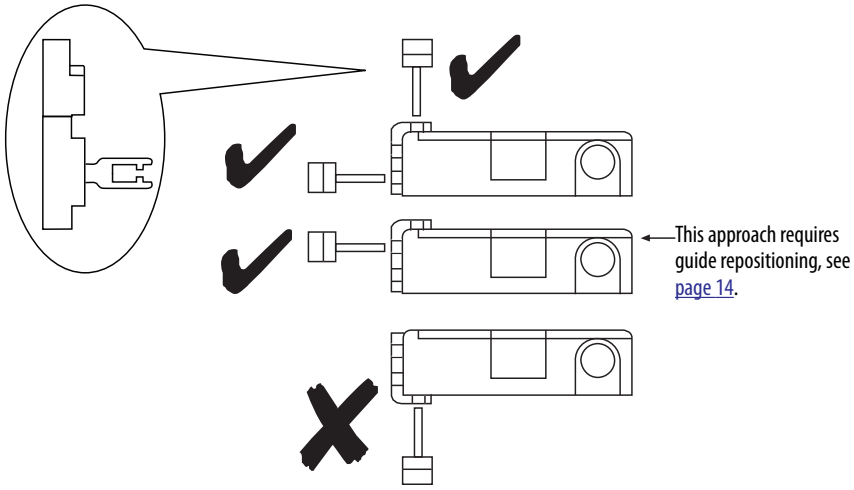
Figure 2 - Target/Actuator Mounting



Allowable Approach Directions

The actuator and target must be always mounted as “close coupled” and can approach the switch in any of the three entry slot positions that are shown in Figure 3. Approach from the underside is not allowed, as the distance from the target to the internal RF sensor is too far for reliable operation.

Figure 3 - Allowable Approach Direction



Minimum Operating Radius

When applied to hinged doors, the minimum operating distances along the length and perpendicular is shown in Figure 4.

Figure 4 - Minimum Operating Distance [mm (in.)]

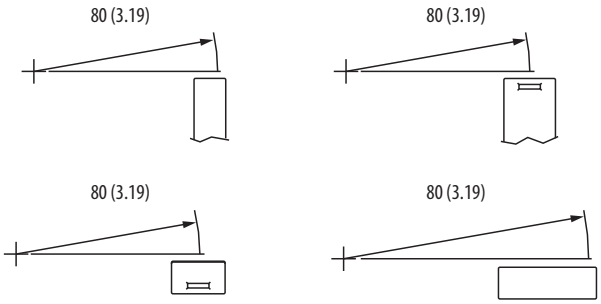


Figure 5 shows the location of the two 1.5 mm (0.06 in.) set screws that can be adjusted to preset the actuator to an optimal angle, if needed.

Figure 5 - Actuator Set Screw

Manual Release

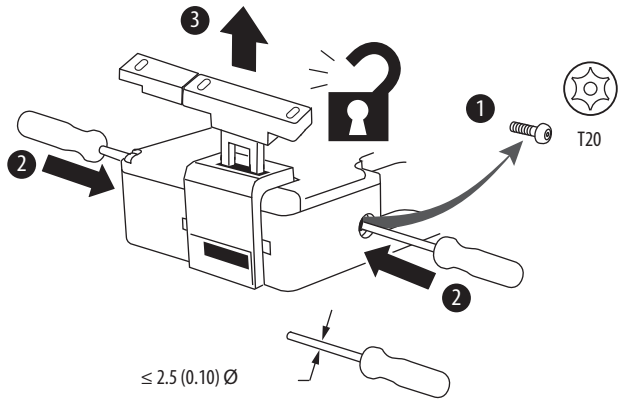
The manual release feature only applies to TLSZR (Power to Release) switch. In some cases, you must manually release the locked actuator.

Figure 6 shows the two locations from which the actuator can be manually released.

1. Remove the T20 Torx screw.
2. To release the actuator, insert a small screwdriver or rod in the hole.

If power is applied to the switch when the actuator is released, the OSSD safety outputs turn OFF and the switch goes to a faulted state with the status indicator flashing red at 4 Hz. Power then has to be cycled to the switch to return it to an operational state.

Figure 6 - Manual Release

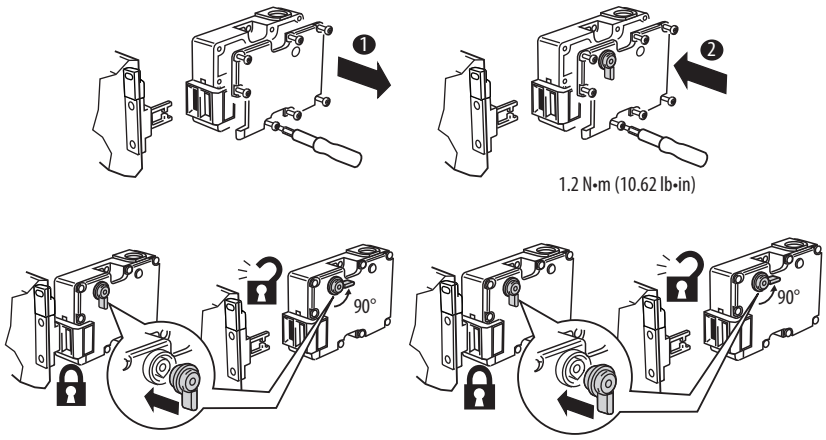


Manual Override Cover

Figure 7 on page 14 shows an optional cover that is available only for the TLSZR (Power to Release) switch. This cover has a lever that allows you to manually unlock the actuator at any time. Rotate the lever 90° to unlock the actuator.

If power is applied to the switch when the actuator is released, the OSSD safety outputs turn OFF, and the switch goes to a faulted state with the status indicator flashing red at 4 Hz. Power is then cycled to the switch to return it to an operational state.

Figure 7 - Manual Override Cover



Pair Proximity

If a pair of TLSZ switches are mounted too close to each other, the two RF fields could interact causing crosstalk. Cross talk results in nuisance faults.

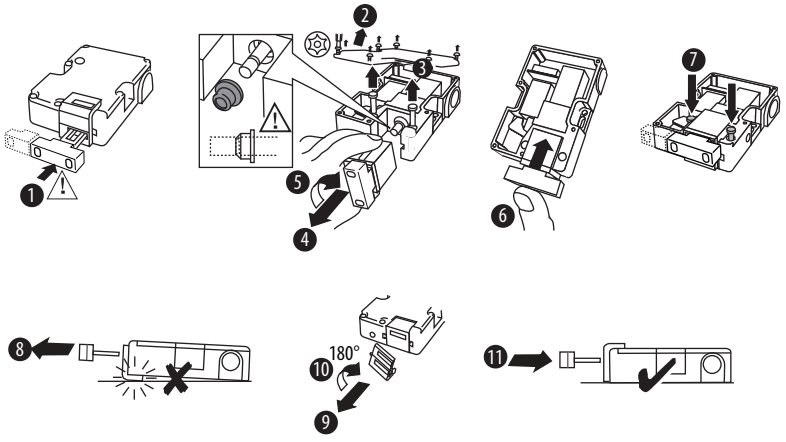
An absolute minimum of 200 mm (8 in.) must be used to help achieve correct operation.

The restriction also applies if a TLSZ switch is mounted close to the 440G-LZ guard locking and the 440N-Z SensaGuard™ switches.

Guide Repositioning

The actuator guide can be repositioned to facilitate alignment of the actuator. In steps 8...11, rotate the metal guide to allow the switch body to be fastened flush to the mounting surface.

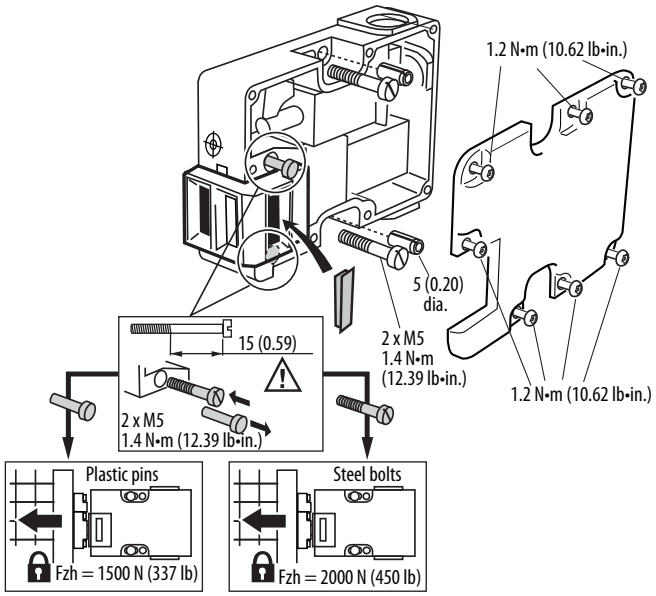
Figure 8 - Guide Repositioning



Steel Locking Bolts

The TLSZ is assembled in the factory with plastic pins that secure the actuator guide. The plastic pins are rated for a holding force of 1500 N (337 lb). The plastic pins must be replaced with the steel bolts to achieve a holding force of 2000 N (585 lb). Figure 9 shows how to remove the cover to replace the blue plastic pins with steel bolts.

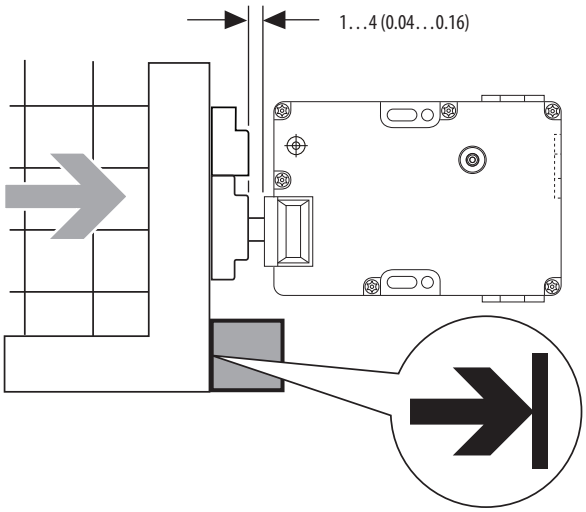
Figure 9 - Steel Bolt Installation



Actuator Clearance

Figure 10 shows the clearance requirements for the TLSZ. The switch must not be used as a guard stop. You must provide a mechanical stop at least 1 mm (0.04 in.) away from the actuator guide. The actuator must be inserted within 4 mm (0.16 in.) or less from the actuator guide to be sure it locks.

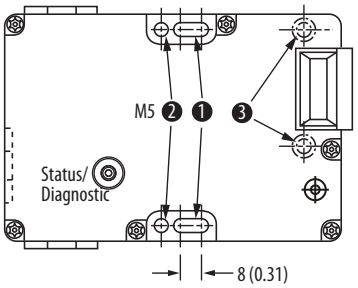
Figure 10 - Clearance and Insertion Distance



As shown in Figure 11, the TLSZ has two slotted holes to facilitate installation. The slots allow up to 8 mm (0.31 in.) of movement of the switch body to achieve the proper clearance with the actuator.

1. Use the slotted holes for initial installation.
2. After alignment with the actuator, secure the switch body in place by adding mounting hardware in the circular holes.
3. To attain the maximum holding force, replace the plastic pins with steel screws inside the cover.

Figure 11 - Mounting Slots for Alignment [mm (in.)]



Dimensions

Figure 12 shows the dimensions for the switch, target, and actuator.

Figure 12 - Dimensions [mm (in.)]

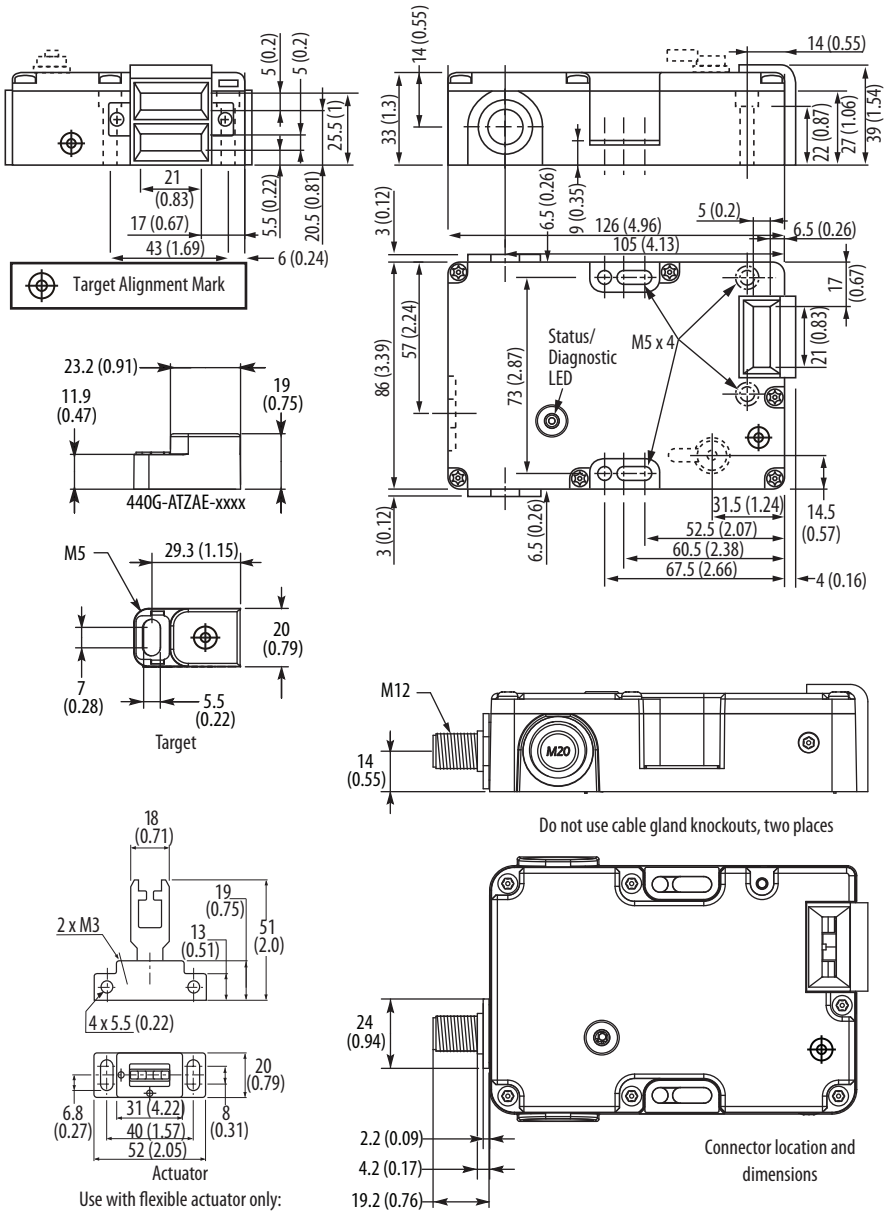
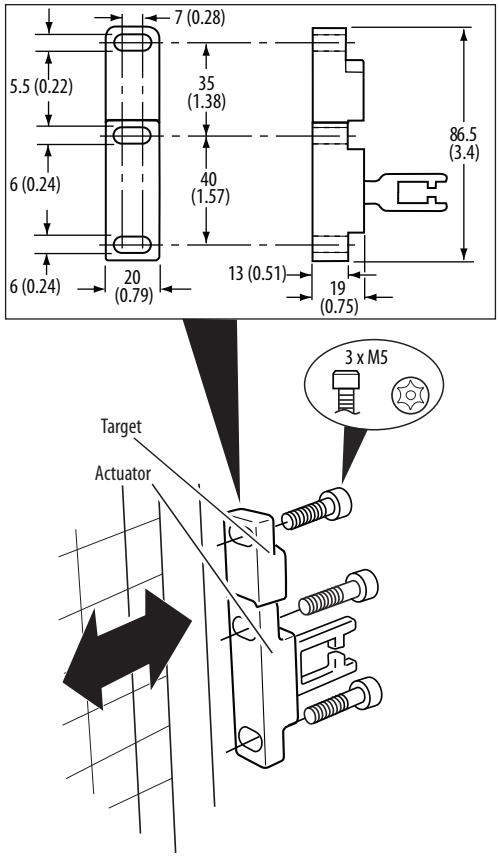


Figure 13 on page 18 shows the dimensions for mounting the target that is next to the actuator.

Figure 13 - Actuator/Target Mounting Dimensions [mm (in.)]



Wiring

Connections

The TLSZ is only available with an 8-pin DC Micro M12 quick-disconnect connector. Figure 14 and Table 3 show the pin assignments and their functions and typical mating cordsets. Other cordsets are available at DC Micro Cordsets and Patchcords.

Figure 14 - 8-pin Micro Quick Disconnect Cables

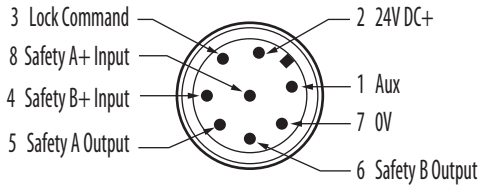


Table 3 - TLSZ Quick Disconnect Pin Assignments

Typical Mating Cordsets	Color	Function	Pin
889D-F8NB-x [1] (Red, PVC)	White	Aux	1
	Brown	24V DC Supply	2
889D-F8AB-x [1] (Black, PVC)	Green	Lock Command	3
	Yellow	Safety B+ Input	4
	Grey	Safety A Output (OSSD A)	5
	Pink	Safety B Output (OSSD B)	6
	Blue	Ground (0V)	7
	Red	Safety A+ Input	8

[1] Replace symbol with 2 [2 m (6.56 ft)], 5 [5 m (16.4 ft)], 10 [10 m (32.8 ft)], 15 [15 m (49.2 ft)] 20 [20 m [65.62 ft)] or 30 [30 m (98.4 ft)] for standard cable lengths. The TLSZ has been tested to operate with up to 120 m (393.7 ft) of the mating cables.

OSSD Inputs

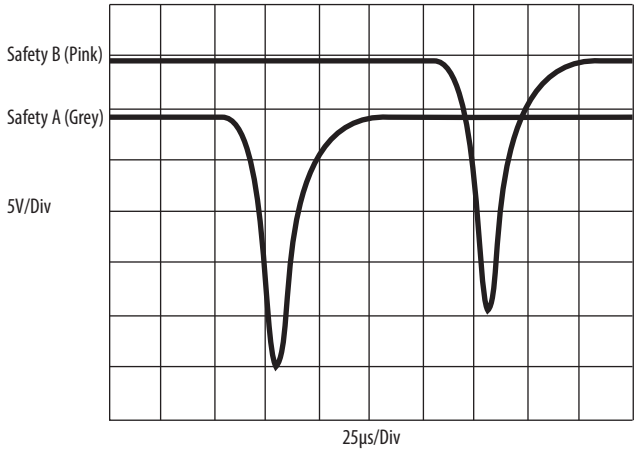
The OSSD inputs are Safety A+ and Safety B+. These inputs can be pure 24V DC, or they can contain test pulses. The OSSD inputs allow the TLSZ switches to be connected in-series while maintaining a high level of safety performance.

OSSD Outputs

The OSSD outputs are Safety A and Safety B. These outputs are 24V signals that contain test pulses. The test pulses are used to detect short circuits to 24V, to 0V and cross faults (from Safety A to Safety B). This description of the test pulses is provided for informational purposes; you cannot modify them.

Figure 15 shows the safety output test pulses when connected to a 1K resistive load for hardware (HW) revisions A and B, and for firmware (FW) revisions A through C. The pulses are 25 µs wide and repeat every 20 ms. The exact shape of the pulses depends on the nature of the load. The capacitive and resistive effects of the load are determined with the combination of cabling, cable routing, and connected devices.

Figure 15 - Output Test Pulses



Auxiliary Output

Table 4 shows the auxiliary output functions. The auxiliary output is a 24V DC logic signal, whose function is dependent on the catalog number selected. The auxiliary signal responds independently of the OSSD safety outputs. The auxiliary output is not a safety-rated signal and must only be used to indicate the status of the switch.

Table 4 - Auxiliary Output Function

Catalog Number	Function	Value
440G-TZS21U**P**RH 440G-TZS21U**P**LH	Lock Status	24V when actuator is unlocked 0V when actuator is unlocked
440G-TZS21U**T**RH 440G-TZS21U**T**LH	Actuator Status	24V when actuator inserted (gate closed) 0V when actuator removed (gate open)

Lock Command

Table 5 shows the lock command function. The lock command is a 24V logic signal, with a current of less than 5 mA. The function of the logic signal is dependent on the catalog number. The 24V power supply connection provides the power to operate the locking solenoid.

Table 5 - Lock Command Function

Catalog Number	Switch Type	Function
440G-TZS21UP**R**H 440G-TZS21UT**R**H	Power to Release	24V unlocks the actuator 0V locks the actuator
440G-TZS21UP**L**H 440G-TZS21UT**L**H	Power to Lock	24V locks the actuator 0V unlocks the actuator

Commissioning

Before use, the switch must first “learn” a new RFID target. This step is not done at the factory.

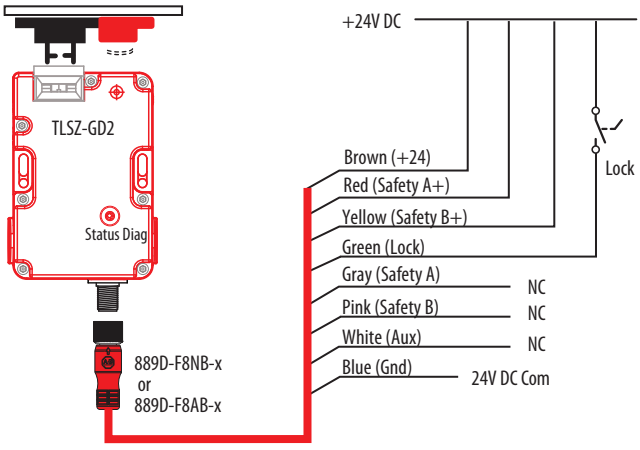
The switch can learn up to eight targets consecutively. Use this process if there is a potential for the target to become damaged, inoperable, or lost. When a new target is learned, the switch no longer recognizes the older target.

Preparation

Wire up the switch with at least the functionality shown in Figure 16.

- Power — connect brown wire to +24V.
- Gnd — connect blue wire to 0V.
- Lock — Leave the green wire ‘open’ when learning the first target. Connect the green wire to 24V to teach a TLSZR switch subsequent targets. The TLSZL switch ignores the Lock command during learning.
- Safety A+ and Safety B+ — connect red and yellow wires to 24V during commissioning. If 24V is not applied to the A+ and B+ inputs, then the indicator flashes green after commissioning if the switch is locked.
- Safety A and Safety B — optional, no connection required for commissioning.
- Aux — optional, no connection required for commissioning.

Figure 16 - Commissioning Wiring



First Time Power-up

Turn on the 24V DC power without the actuator and target.

The Status/Diagnostic indicator blinks green 3 times, pauses 2 seconds, and then blinks green 8 times. Eight is the number of times a new target can be learned. The switch continuously repeats the two-second pause followed by the eight blink sequence.

Learn First Target

Table 6 shows the events that take place when the first target is learned. The lock command is ignored until after the switch learns its first target, therefore, the lock command can be 24V or 0V during the first-time learning sequence.

Table 6 - First Target Learning Events

Step	Event	Indicator Color	Blink Rate	Duration
1	Apply power to switch	Red	Solid	—
2	Present actuator/target	Red	Solid	—
3	Detect target	Red	Solid	2…25 s
4	Verifying target	Green/Red	1 Hz	15 s
5	Report commissioning error (see Table 8) or continue	—	—	—
6	Programming switch	Green/Red	4 Hz	15 s
7	Finalizing	Red	Solid	2 s
8	Number of learns remaining	Green	# of learns	15 s
9	Learn completed PTR PTL	 Green Red	Solid	Continuous

Learning Additional Targets

Table 7 shows the steps that take place when teaching the switch to recognize an additional target. For PTR switches, the lock command must connect to +24V to learn additional targets. The PTL switch ignores the lock command during learning.

Table 7 - Additional Target Learning Steps

Step	Event	Indicator Color	Blink Rate	Duration
1	Apply power to switch PTR: Apply 24V to lock command PTL: Ignores lock command	Red	Solid	—
2	Present new actuator/target	Red	Sold	—
4	Detect target	Red	Solid	3…25 s
5	PTR: Solenoid automatically locks PTL: No action	Red	Solid	05.s
6	Verifying target	Green/Red	1 Hz	15 s
7	Report commissioning error (see Table 8) or continue	—	—	—
8	Programming switch	Green/Red	4 Hz	15 s

Step	Event	Indicator Color	Blink Rate	Duration
9	Finalizing	Red	Solid	2 s
10	Number of learns remaining	Green	# of learns	15 s
11	PTR: Solenoid unlocks then locks PTL: no action	—	—	0.5 s
12	Learn completed PTR PTL	 Red Red	 4 Hz Solid	 Continuous
13	PTR: Cycle power PTL: Ready for use	—	—	—

Commissioning Errors

During commissioning, the switch performs certain checks. If an error is detected, the Status/Diagnostic indicator reports the error. Table 8 lists the commissioning error codes. The error code is generated after the switch verifies the target. If an error code is generated, the switch must be power cycled before further learning is started.

Table 8 - Commissioning Error Codes

Indicator Flashes (4 Hz)	Code
Red-Red-Red-Green-Green	Target already learned
Red-Red-Red-Green-Green-Green	Bad RFID Target that is removed while programming PTL
Red-Red-Red-Green-Green-Green-Green	Exceeded learning eight targets

Power-up Self-check

Upon power-up, the TLSZ performs an internal self-check, which takes approximately three seconds. Whether the actuator/target is inserted and the lock command is present; the indicator remains red or turns green after the self-check. Table 9 shows the indicator sequence during self-check with the actuator/target inserted. The self-check sequence occurs only once.

Table 9 - Self-check Indicator Sequence

Model	Lock Signal	Indicator Sequence	OSSD Outputs
TLSZR	OFF	Green-Green-Green-Red-Green	ON
	ON	Green-Green-Green-Red	OFF
TLSZL	OFF	Green-Green-Green-Red	OFF
	ON	Green-Green-Green-Red-Green	ON

Notes:

Functional Testing

A manual functional electric test must be made:

- After installation
- After any maintenance or change of component
- If the guard is used infrequently
  - Less than once per month for SIL 3/PLe
  - Less than once per year for SIL 2/PLd

Testing Procedure

ATTENTION: During the functional test, confirm that there are no persons in the danger area and that the machine startup causes no hazard.

1. Confirm that the guard door is open.
2. Connect the 24V DC power to pin 2 and ground (0V) to pin 7. The switch conducts a self-testing routine at the end of which the diagnostic indicator shows solid red.
3. Test to confirm that the machine cannot start.
4. Confirm the lock command at pin 3 is set to 0V for PTR and 24V for PTL types.
5. Test again to confirm that the machine cannot start.
6. Close the guard door and then confirm that the guard is mechanically locked and the diagnostic indicator shows solid green.
7. Test to confirm that the machine can now start.
8. Change the lock command at pin 3. Set it to 24V for PTR and 0V for PTL types.
9. Confirm the machine stops, the guard door is mechanically unlocked, and the machine cannot restart.

Notes:

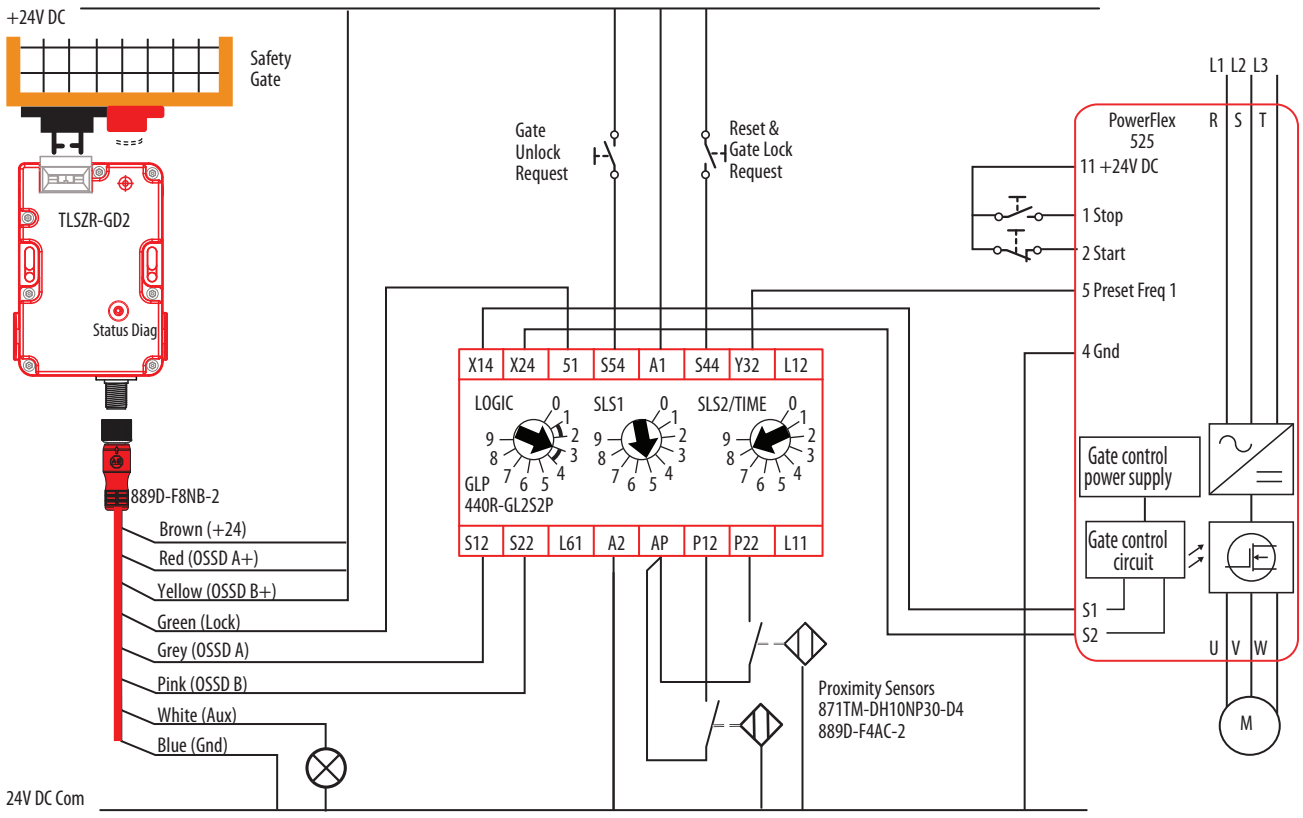
Application and Wiring Examples

The following application and wiring examples are intended to show how the TLSZ products can be applied. If you are the user or the designer, you may require variations to these examples in order to meet their specific requirements.

Wiring to GLP Relay

The GLP safety relay is designed to operate with PTR switches. To use a PTL switch, you must use an interposing relay on the lock command at GLP terminal 51. In the example shown in Figure 17, the GLP allows the gate to be unlocked when the motor is running at a Safely-limited Speed.

Figure 17 - GLP and TLSZR Schematic



Circuit Status as Shown

The gate is open and unlocked. The motor is off. The GLP is ready for reset. The GLP has a Logic setting of 3: (Safely-limited Speed with Logic IN OFF), a Safely-limited Speed (SLS1) setting of 5 (5 Hz) and a maximum (SLS2) speed setting of 8 (2000 Hz). The safety outputs (X14 & X24), the single wire safety output (L11), and the auxiliary output (Y32) are OFF.

IMPORTANT Start the GLP logic configuration from "0" to configure X14 and X24 for use as safety outputs.

Starting

Close the gate and press Reset to lock the gate and turn on the GLP safety outputs. Press Start to turn the motor ON.

Safely-limited Speed

A normal production stop is performed by pressing Stop. Access through the safety gate is initiated by pressing Gate Unlock Request. The Y32 output of the GLP turns ON and commands the PowerFlex® drive to bring the motor to a safe slow speed (Preset Freq 1). When the proximity sensors detect the speed has dropped below the Safely-limited Speed (5 Hz), the gate becomes unlocked. The operator can enter the machine cell, as the motor continues to run at the safe slow speed. After you leave the cell and close the gate, press Reset to lock the gate and return the machine to production speeds.

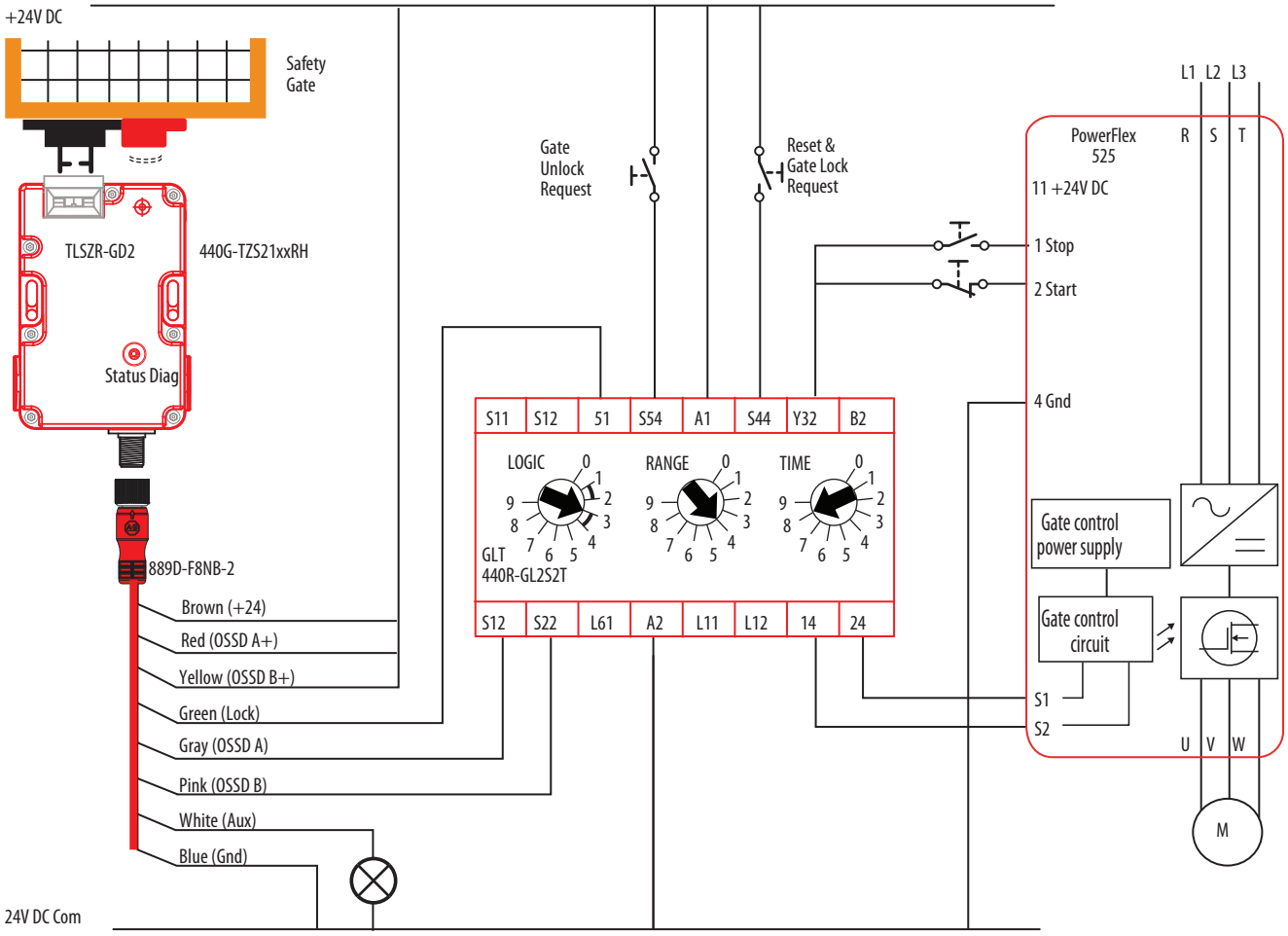
The circuit meets the safety requirements up to Category 3, Performance Level d in accordance with ISO 13849-1 and SIL CL 2 in accordance with IEC 62061.

Wiring to GLT Relay

The GLT safety relay is designed to operate with PTR switches. To use a PTL switch, you must use an interposing relay on the lock command at terminal 51 of the GLP.

In this example shown in Figure 18 on page 29, the GLT sends an immediate command to the drive to turn OFF. After eight seconds, the GLT turns off its safety outputs and unlocks the gate. The risk assessment must determine adequate time delay for the machine to achieve a safe state before unlocking the gate.

Figure 18 - GLT and TLSZR Schematic



Circuit status as shown: The gate is open and unlocked. The motor is off. The GLT is ready for reset. The GLT has a Logic setting of 3: (Category 1 Stop), a Range setting of 4 (10 seconds) and a Time setting of 8 (80%). The Y32 output turns OFF immediately; 8 seconds later, the safety outputs turn OFF.

The safety outputs (14 and 24) and the single wire safety output (L11) are OFF and the auxiliary output (Y32) is ON.

IMPORTANT Start the GLT logic configuration from "0" to configure 14 and 24 for use with pulse testing; the PF525 can operate with pulse tested inputs to S1 and S2.

Starting

Close the gate. Press Reset and Gate Lock Request to lock the gate and turn on the GLT safety outputs. Press Start to turn the motor ON.

Stopping

Normal production stops are performed by pressing Stop. Access through the safety gate is initiated by pressing the Gate Unlock Request. The Y32 output of the GLP turns OFF, which commands the PowerFlex drive to bring the motor to a stop. After the configured time delay (eight seconds) expires, the GLT safety outputs turn off, and the gate becomes unlocked. After you leave the cell and close the gate, press Reset to lock the gate and return the machine to a production state.

The circuit meets the safety requirements up to Category 3, Performance Level d in accordance with ISO 13849-1 and SIL CL 2 in accordance with IEC 62061.

Wiring to DI and EMD Relay

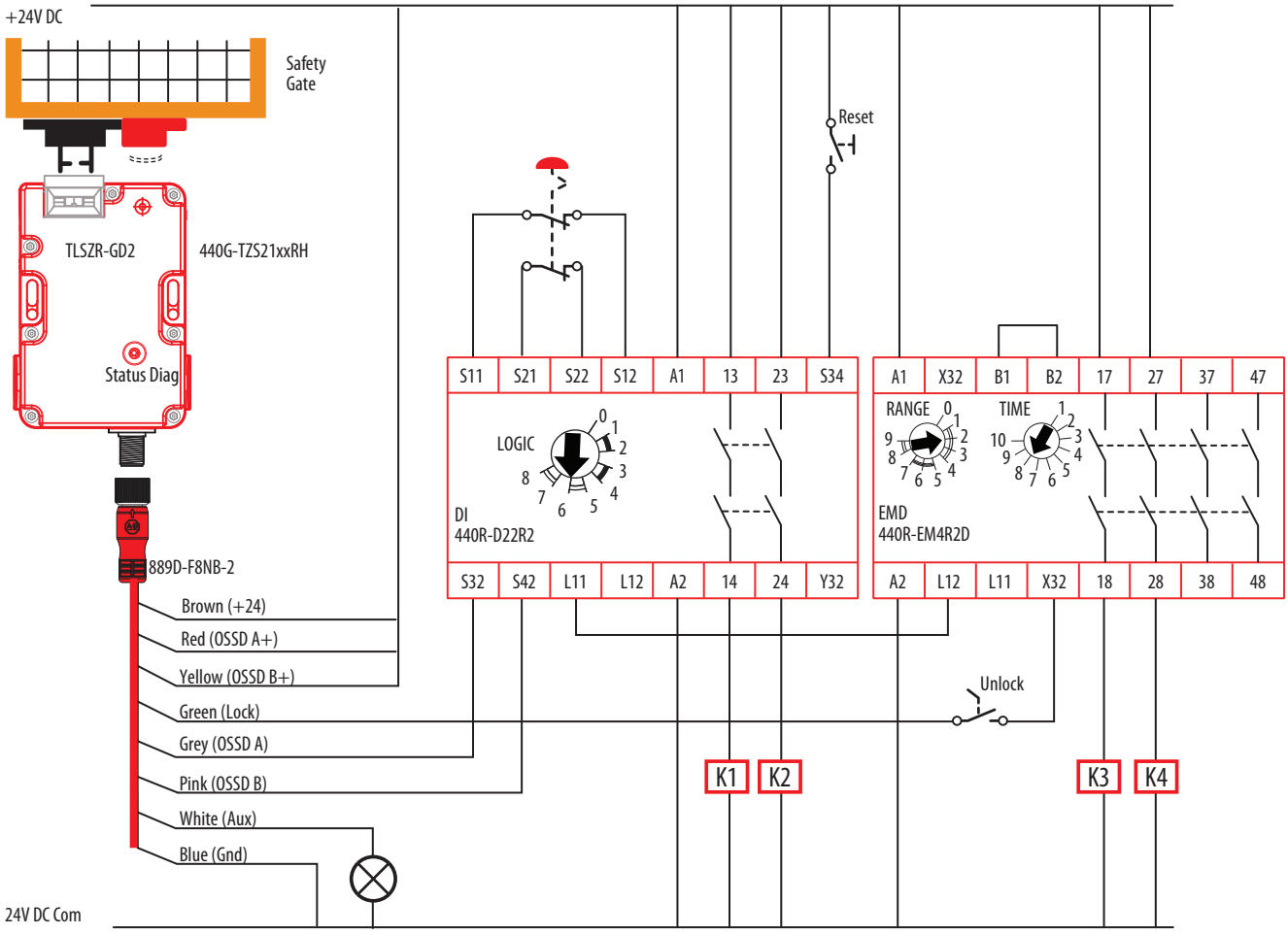
The TLZ can be connected to the DI and EMD safety relays. The DI monitors the safety outputs of the TLZR and the EMD enables the gate to be unlocked after a configured delay time expires.

B1 is connected to B2 to allow for retriggering. If you open and close the E-stop and press Reset before the delay expires, the EMD timer resets.

Upon initial power-up, the TLSZ must be cycled for the DI to recognize the TLSZ OSSD signals.

In the example shown in Figure 19 on page 31, an E-stop initiates the machine shutdown. After an eight-second delay, the TLZR is allowed to be unlocked and the hazards that remain are turned OFF. A selector switch is required to maintain the gate in an unlock state. The risk assessment must determine adequate time delay for the machine to achieve a safe state before unlocking the gate.

Figure 19 - DI with EMD and TLSZR Schematic



Circuit Status as Shown

The E-stop is released. The gate is open and unlocked. K1, K2, K3, and K4 are OFF. The DI is configured for two inputs with monitored manual reset. The EMD is configured for 8-second off-delay; Range setting of 2 is 10 s, Time setting of 8 is 80% of the range. The X32 terminal is ON because the EMD safety outputs are OFF.

Starting

With the Unlock switch open, close the gate. Press Reset to lock the gate and turn on the K1...K4 safety contactors.

Stopping

Stopping is initiated by pressing the E-stop. K1 and K2 contactors turn off immediately. The single wire safety signal from the DI (L11) to the EMD (L12) also turns off immediately, and the EMD starts the off-delay timer. After 8 seconds, contactors K3 and K4 turn OFF and X32 goes to 24V. The unlock switch is enabled, and the gate can be unlocked. While the gate is unlocked, the

DI cannot turn the safety outputs back ON. After you leave the cell and close the gate, open the unlock switch to lock the gate, and release the E-stop.

The circuit can meet the safety requirements up to Category 4, Performance Level e in accordance with ISO 13849-1 and SIL CL 3 in accordance with IEC 62061.

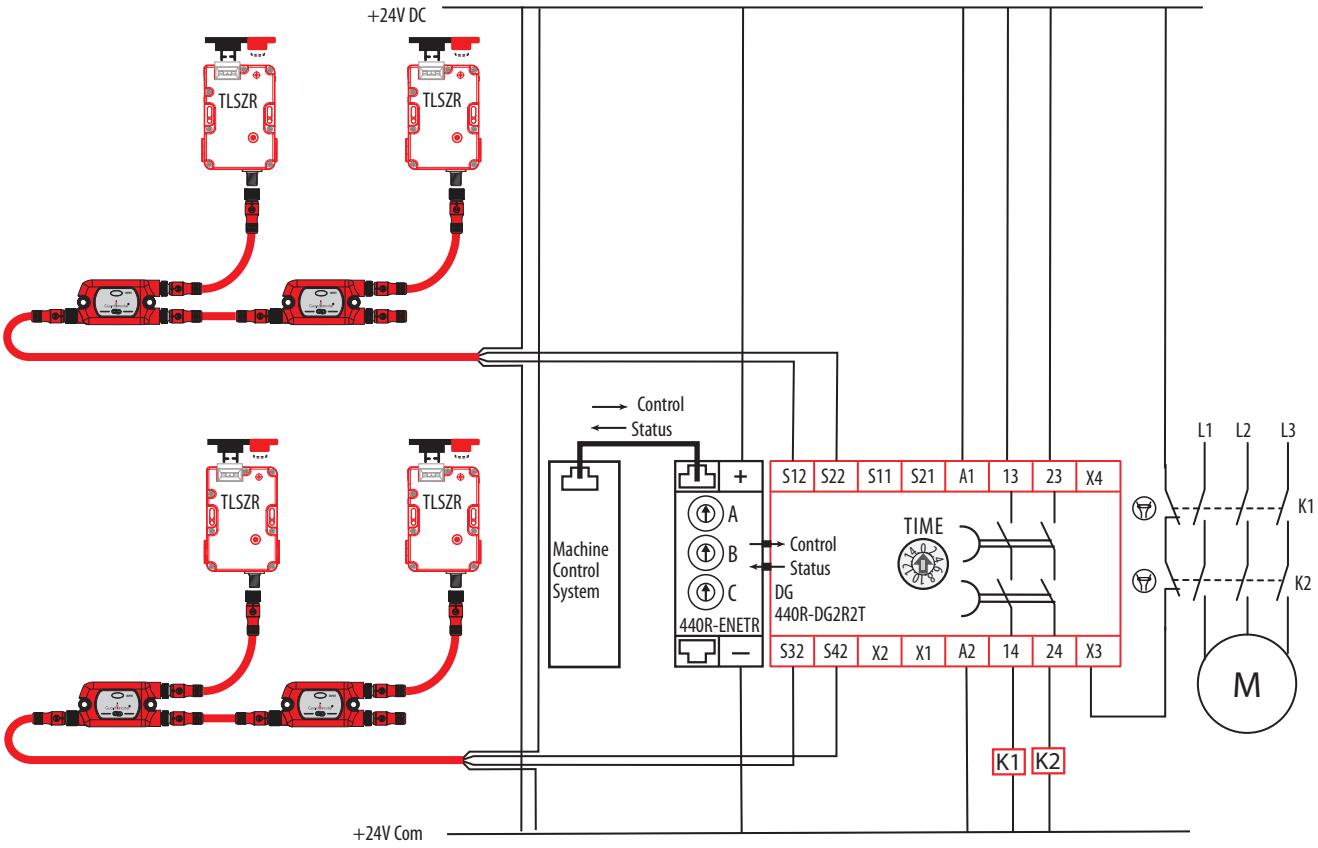
Wiring to DG Relay

The TLSZR can be used in GuardLink® applications; the TLSZL cannot be used in GuardLink applications. The GuardLink system uses taps to connect a series of devices to one relay. The GuardLink system provides control and status information between the machine control system and the safety system.

Figure 20 shows four TLSZR switches that are connected on two GuardLink circuits from one DG relay. The DG relay can accommodate up to 32 devices on each input. The devices can be a mix of many different safety devices. When guard locking devices are included in the GuardLink system, the lock/unlock command must come from the machine control system through the 440R-ENETR module.

See publication 440R-UM015 for further details.

Figure 20 - DG with TLSZR Schematic



Wiring to CR30 Relay

The CR30 is a software configurable relay that can easily interface with the TLSZ guard locking switch. Version 10 and later of Connected Components Workbench™ has a locking function that is useful for guard locking applications.

Figure 21 shows an example schematic. The CR30 monitors the motor running signal from the PowerFlex® 525. When the motor is not running, the safety gate can be unlocked, and the PowerFlex 525 goes to a Safe Torque Off state.

Figure 21 - CR30 Schematic

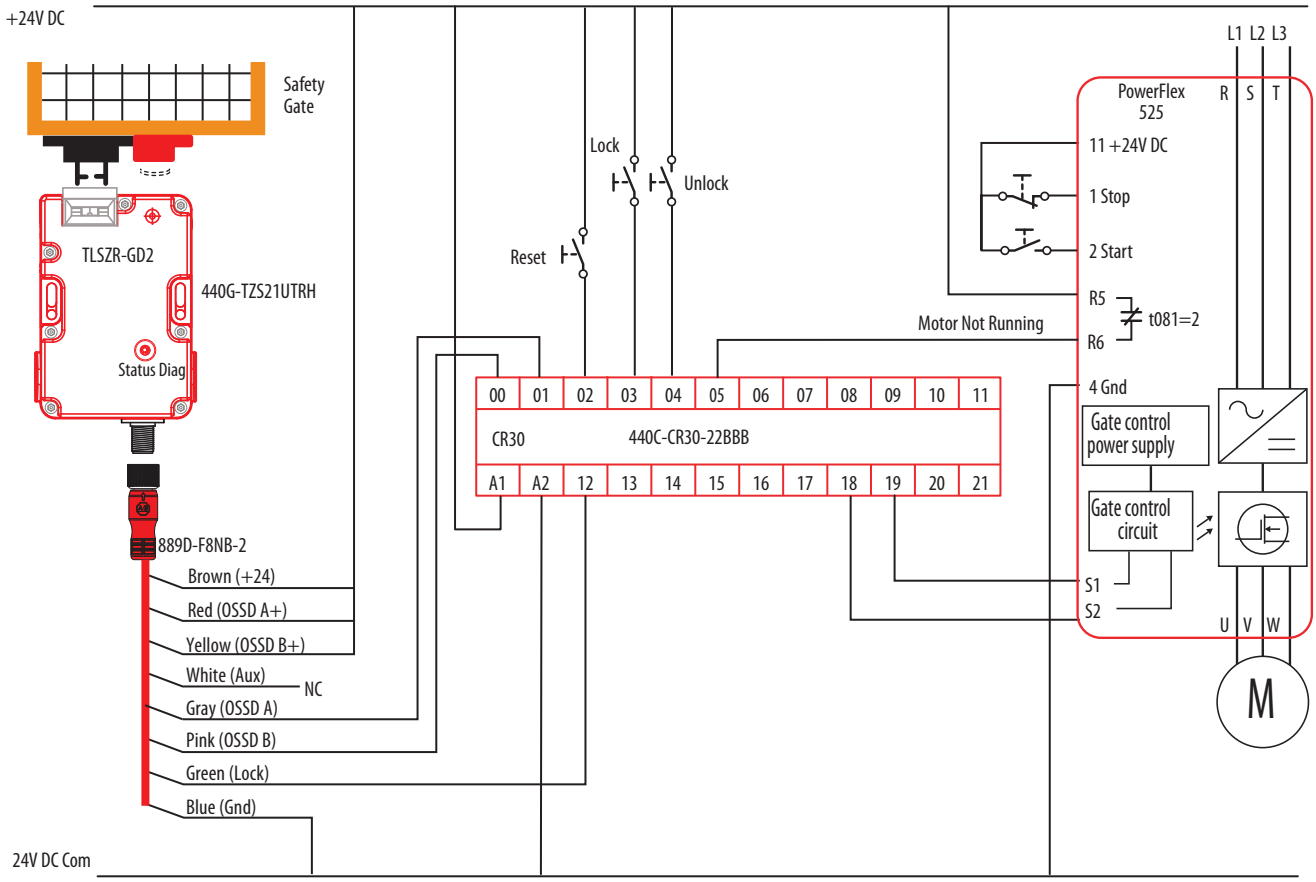
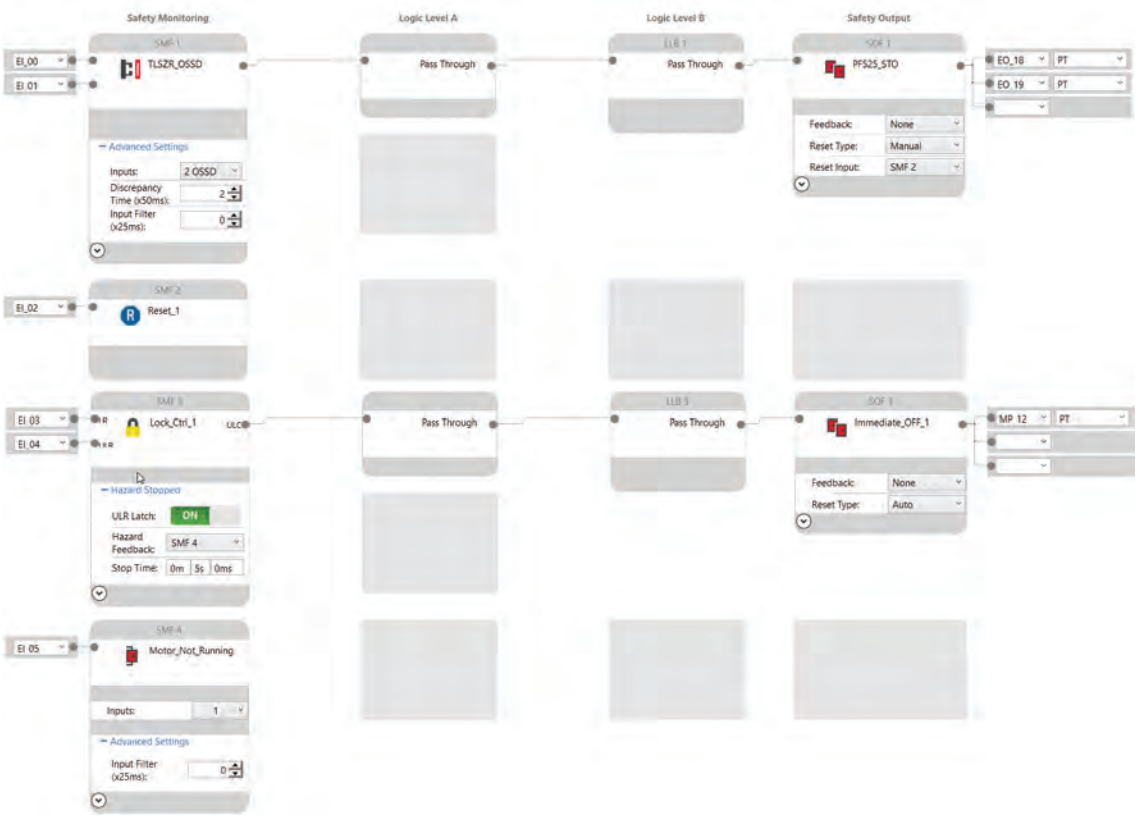


Figure 22 on page 34 shows an example CR30 configuration that works with the schematic in Figure 21.

The TLSZR OSSD outputs drive the Safe Torque Off (STO) signals of the PF525. The STO is enabled after the gate is locked and the Reset is pressed. The PF525 STO inputs can tolerate the pulse test that is generated by the CR30 outputs.

The Lock_Ctrl_1 block controls the unlock command to the TLSZR. The unlock Stop Time delay is set to five seconds, and the ULR Latch (Unlock Request) is set to ON. When an unlock request is made, the command is issued five seconds after the motor stops running, and the unlock request is latched ON.

Figure 22 - CR30 Configuration in CCW



Wiring to 1734 Guard Point I/O

The TLSZ can be connected to a 1734 Guard POINT I/O™. The catalog number 889D-F8NB cordset has 24-AWG wires; which allows three wires that are connected to one terminal. This wiring example shows a Power to Lock switch with a Door Status auxiliary signal. The PLC logic checks to see if the door is closed before issuing a lock command. The schematic for this example is shown in Figure 23 on page 35.

Figure 23 - 1734 and TLSZL Schematic

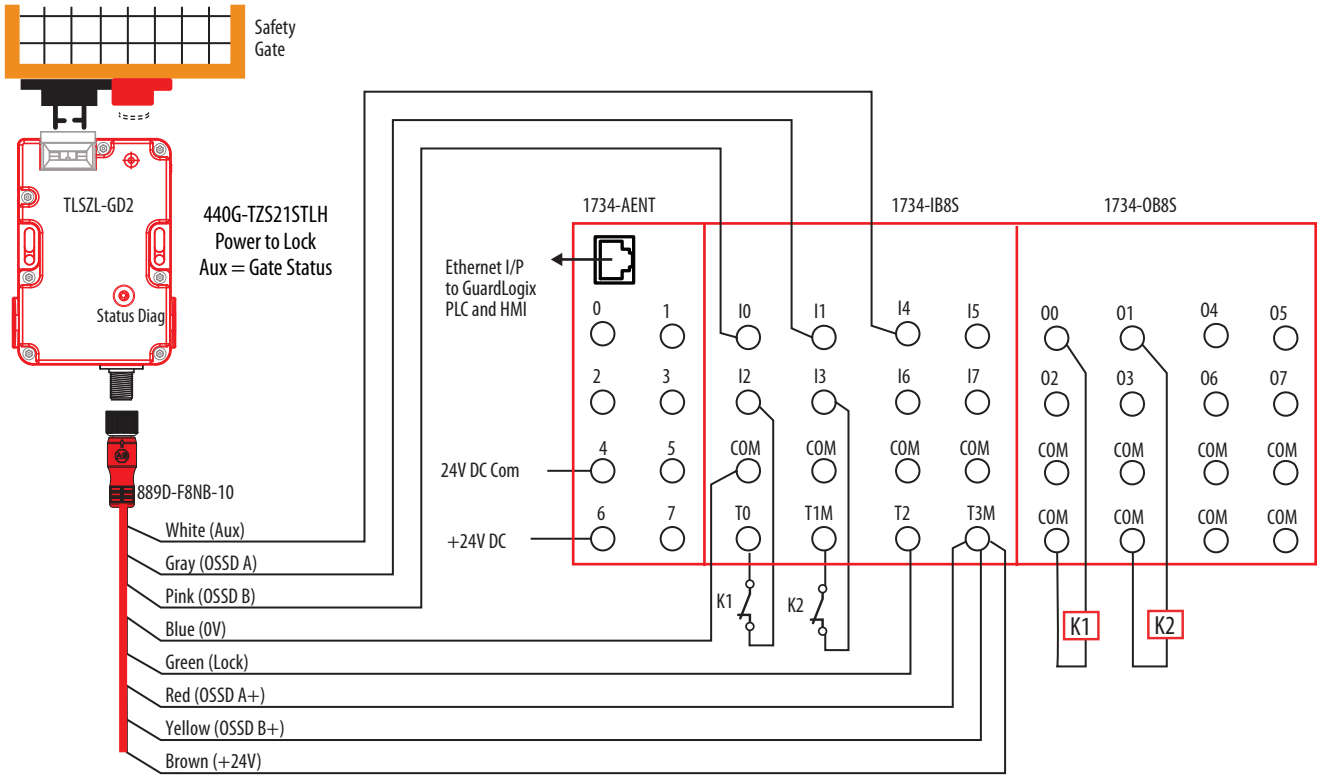


Figure 24 shows the General Tab of the 1734-IB8S Module Properties. The Input Status must be set to "Combined Status – Muting" as this setting is used by the Dual Channel Input Stop logic block to verify that 1734-IB8S is operational. The Output Data must be set to "Test," as the test outputs are used to generate test pulses for the output contactors.

Figure 24 - 1734-IB8S Module Properties – General

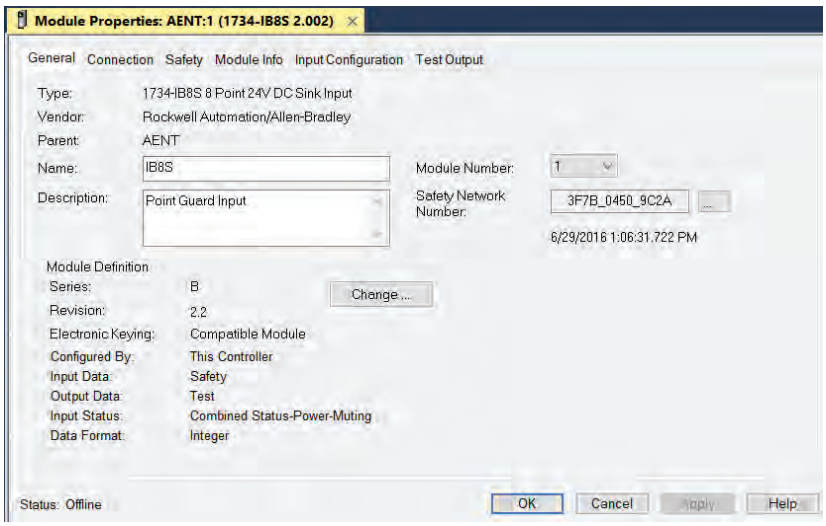


Figure 25 on page 36 shows the Input Configuration tab of the 1734-IB8S Module Properties. In this example, Points 0 and 1 monitor the OSSD outputs of the TLSZL. The Type is set to Single (to allow the Logix program to detect

potential faults) and Mode must be set to Safety. Points 2 and 3 monitor the status of the output contactors K1 and K2. Set the Type to Single (to allow the program to detect potential faults). Safety pulse testing detects potential faults in the monitoring circuit. The TLSZ can operate with the Input Delay Time set to zero.

Figure 25 - 1734-IB8S Module Properties – Input Configuration

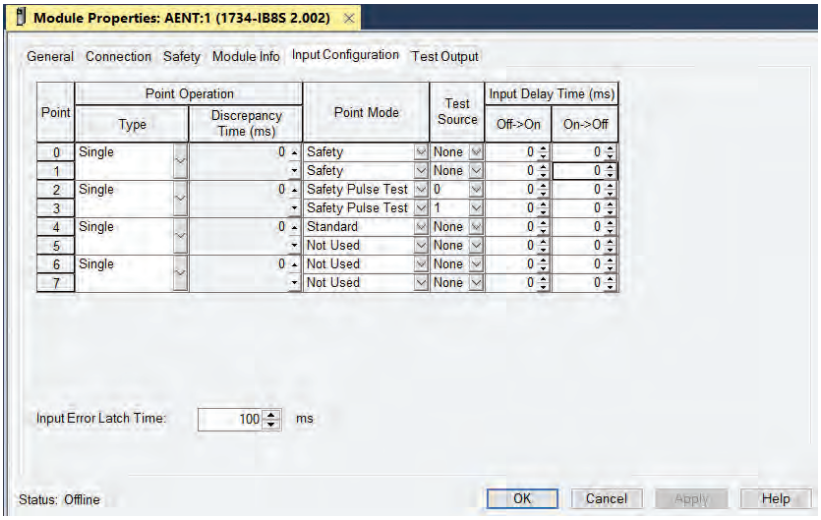


Figure 26 shows the Test Output tab of the 1734-IB8S Module Properties. In this example, Points 0 and 1 are set to pulse test as these points help check the integrity of contactors K1 and K2. Points 2 and 3 are set to "Standard." Point 2 is the lock command, and Point 3 applies power to the TLSZL and supplies power to the OSSD inputs. By setting it to standard, you can programmatically turn Points 2 and 3 off and on.

Figure 26 - 1734-IB8S Module Properties –Test Output

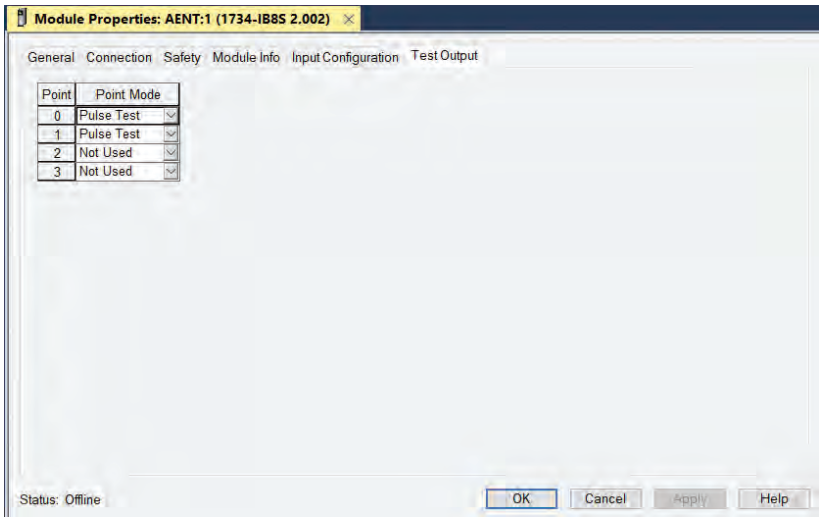


Figure 27 shows the General Tab of the 1734-OB8S Module Properties. The Output Data must be set to "Safety," as it is controlling the output safety contactors.

Figure 27 - 1734-OB8S Module Properties – General

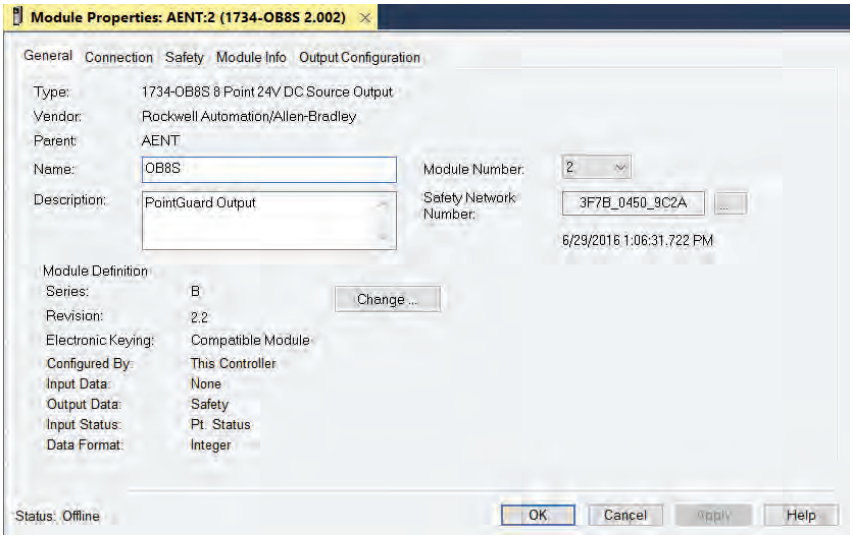


Figure 28 shows the Output Configuration tab of the 1734-OB8S Module Properties. Points 0 and 1 drive the output contactors K1 and K2. The point Types are set to Dual, and the Modes are set to Safety.

Figure 28 - 1734-OB8S Module Properties – Output Configuration

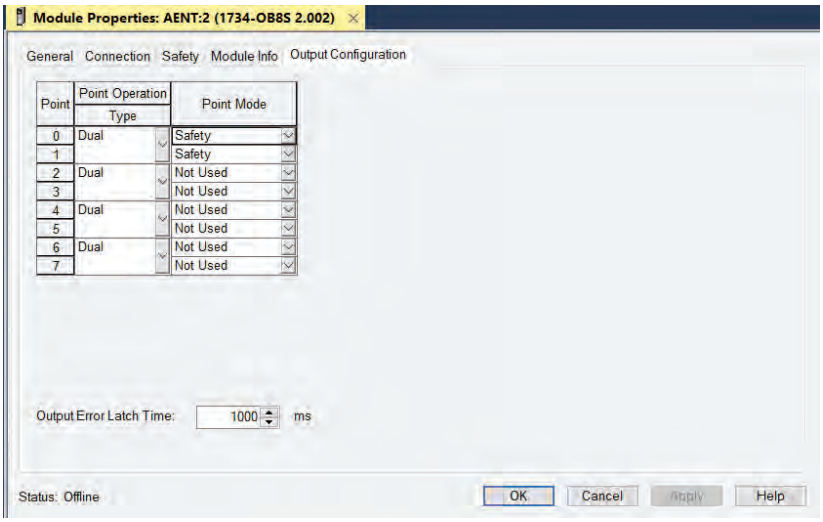
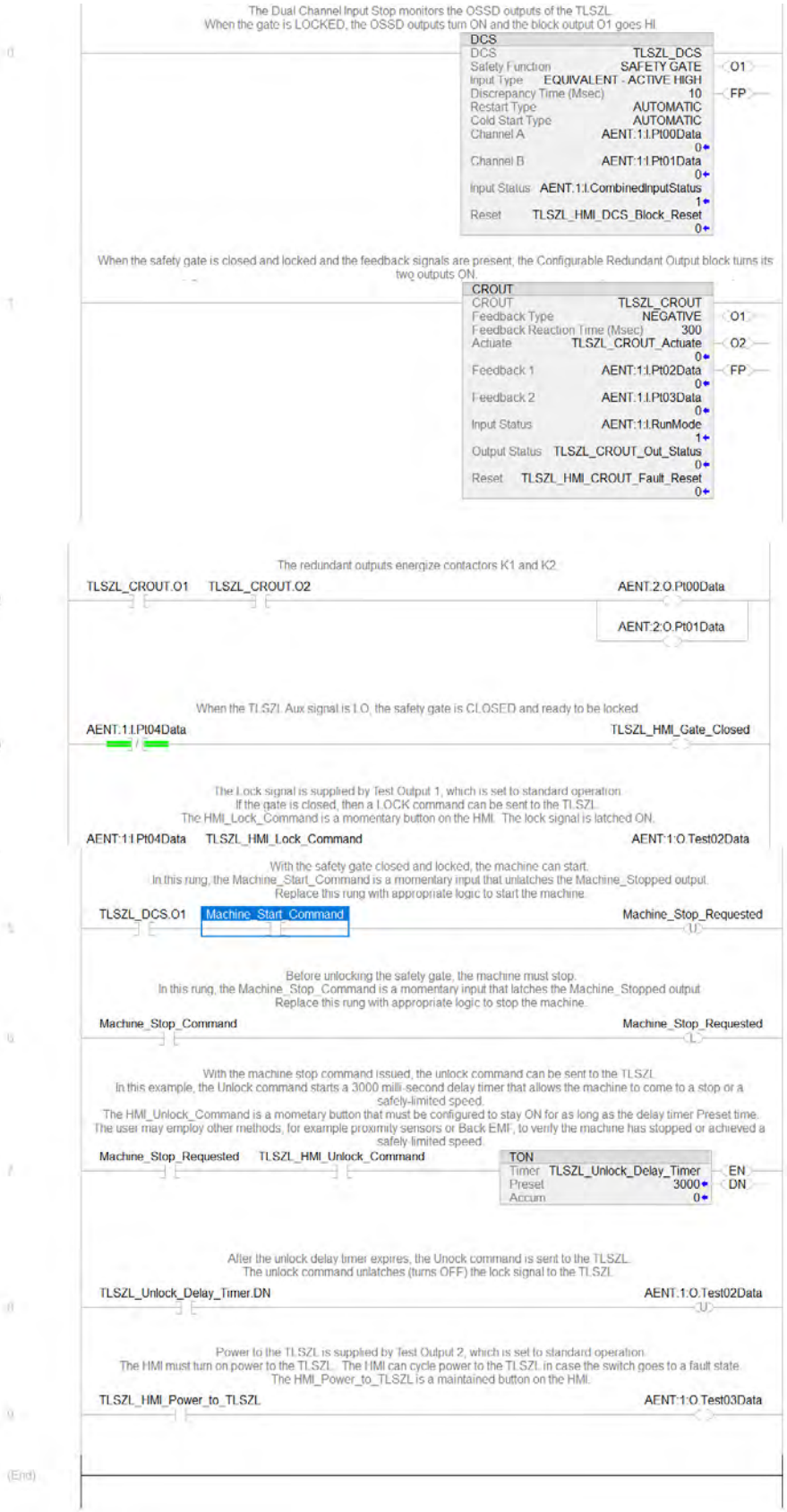


Figure 29 on page 38 shows an example logic program. A Dual Channel Input Stop function block monitors the TLSZL and a Configurable Redundant Output function block controls two contactors. This example can be used as a starting point for implementation; you must incorporate additional logic that is based on the risk assessment for the machine.

Figure 29 - Studio 5000® Example Logic Program



Wiring to 1732 ArmorBlock

The TLSZ can be connected to a 1732ES or 1732DS ArmorBlock® by using an 871A-TS5-DM1 field attachable connector. The cordset 889D-F8NB has 24-AWG wires that connect to one pin. An example schematic is shown in Figure 30.

As an alternative, you can use an 871A-TS8-D1 field attachable connector at the TLSZ and a 5-wire cordset (889D-M5NC-x).

Figure 30 - ArmorBlock Schematic

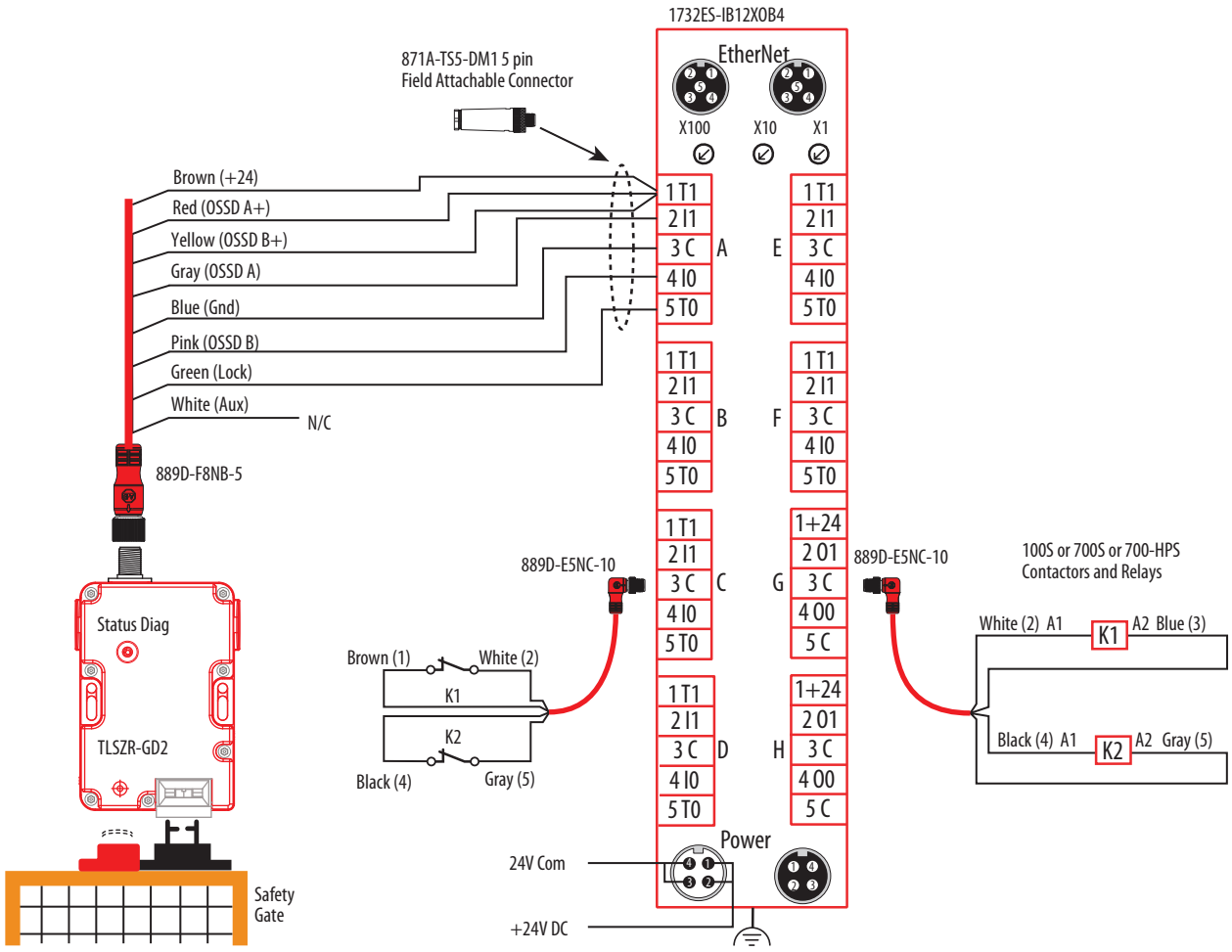


Figure 31 on page 40 shows the General Tab of the ArmorBlock Module Properties. The Input Status must be set to "Combined Status — Muting" and the Output Data must be set to "Combined."

Figure 31 - Module Properties - General

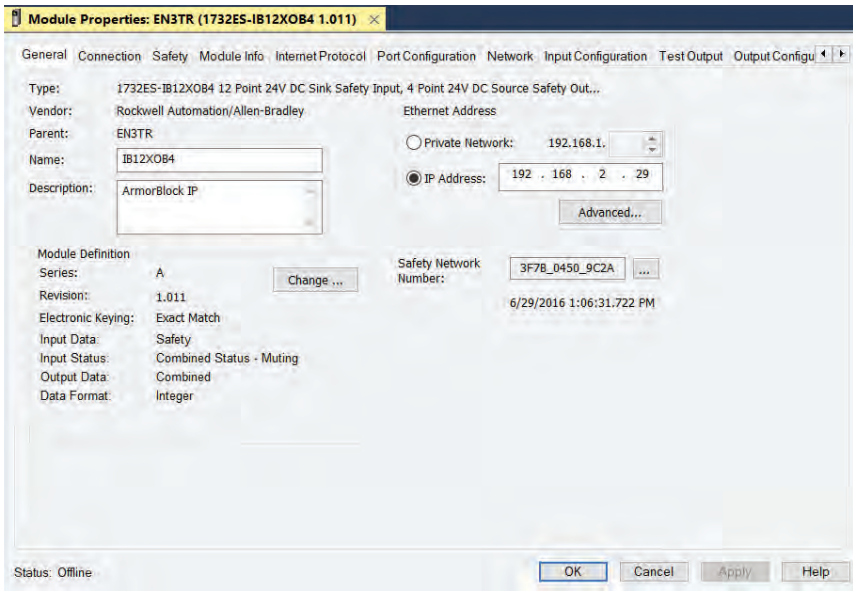


Figure 32 shows the Input Configuration tab of the ArmorBlock Module Properties. In this example, Points 0 and 1 monitor the OSSD outputs of the TLSZR. The Type is set to Single (to allow the Logix program to detect potential faults), and Mode must be set to Safety. Points 4 and 5 monitor the status of the output contactors K1 and K2. Set the Type to Single to allow the Logix program to detect potential faults. The safety pulse test is used to detect potential faults in the monitoring circuit.

Figure 32 - Module Properties – Input Configuration

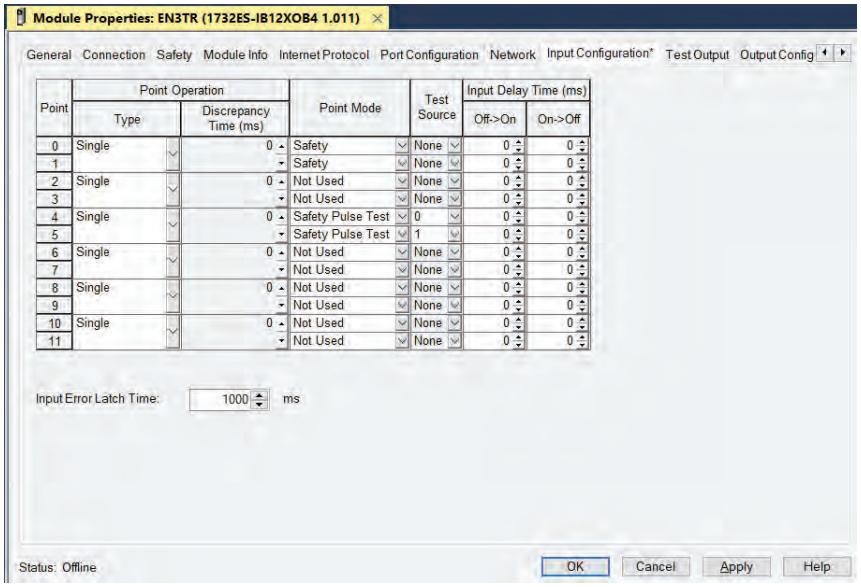


Figure 33 on page 41 shows the Test Output tab of the ArmorBlock Module Properties. In this example, Points 0 and 1 are set to Standard. The Standard setting allows these two points to be controlled by the program. Point 0 applies power to the TLSZR. By setting it to Standard, you can programmatically turn

this point off and on if the TLSZ switch has a fault condition. Point 1 is the lock/unlock command. In this example, the TLSZ is a PTR type, so 24V unlocks the switch. Use Points 4 and 5 to monitor the contactor outputs and are set to pulse test.

Figure 33 - Module Properties – Test Output

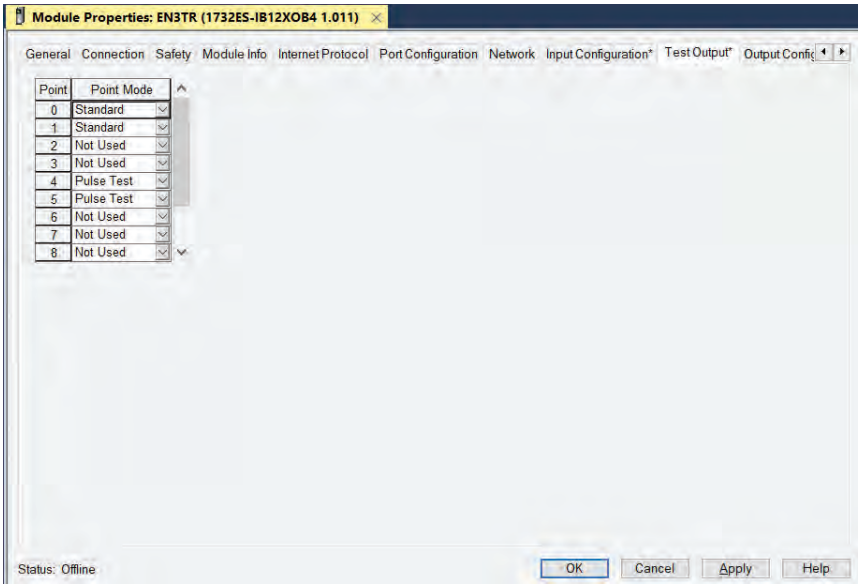


Figure 34 shows the Output Configuration tab of the ArmorBlock Module Properties. Points 0 and 1 drive the output contactors K1 and K2. The point Types are set to Dual, and the Modes are set to Safety.

Figure 34 - Module Properties – Output Configuration

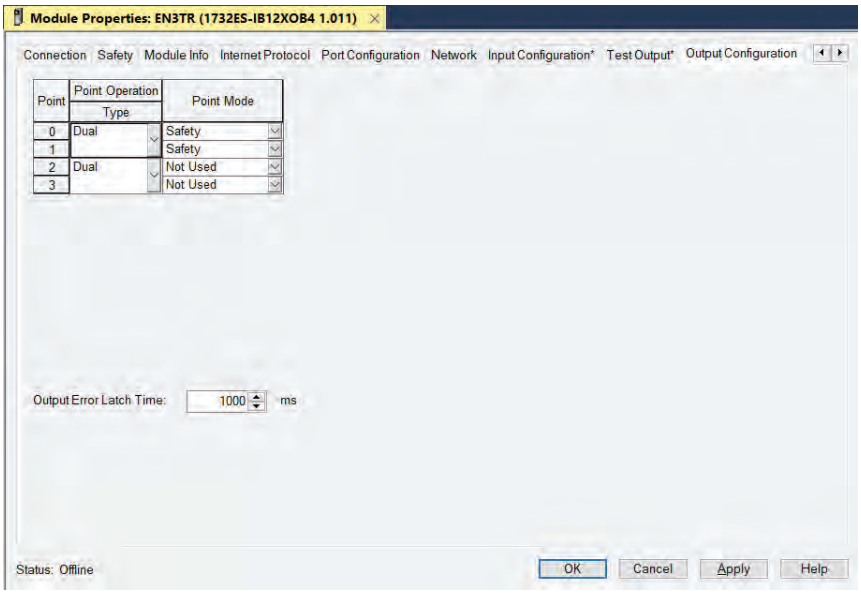
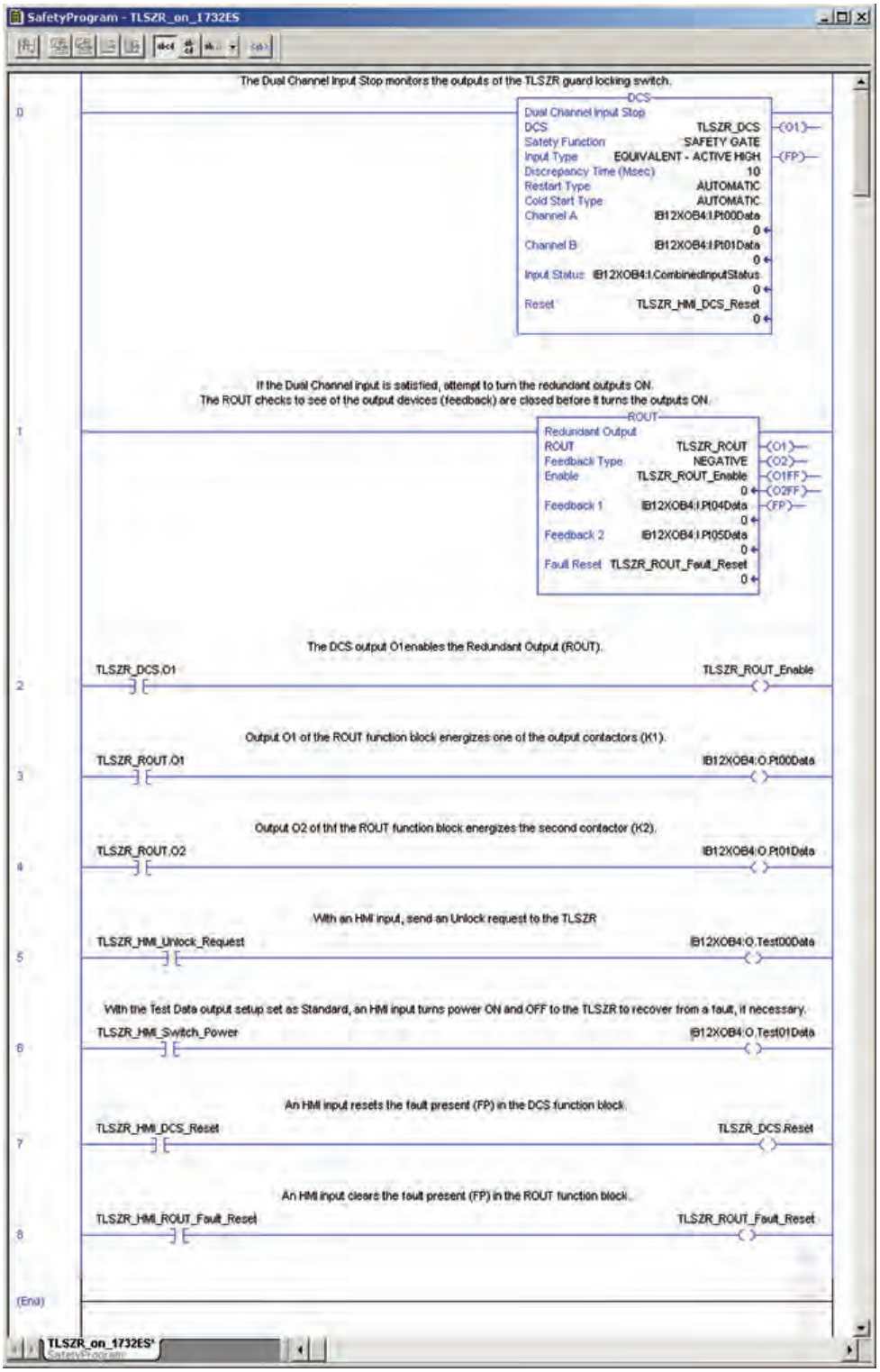


Figure 35 shows an example program. A Dual Channel Input Stop function block monitors the TLSZR and a Configurable Redundant Output function block controls two contactors. This example can be used as a starting point for implementation; based on the risk assessment for the machine, you can incorporate additional logic.

Figure 35 - Example Studio 5000 Program



Diagnostics and Troubleshooting

Most importantly, persons who are trained in the safety of machine systems must conduct troubleshooting procedures. This training includes knowledge of all sources of energy (for example electrical, pneumatic, safety, thermal, others).

The best approach to troubleshooting the TLSZ guard locking switches is to observe the status indicator on the switch and follow the flow diagram that is shown in Figure 36 on page 44.

Tools Needed

Required Tools

1. T20 security-Torx screwdriver bit. Notice that the security Torx has a hollowed center. You need this bit to remove the cover of the TLSZ.
2. You need a medium-sized flat screwdriver for terminal screws, to remove terminal blocks, and to configure the switches on the front face of the relays.
3. Digital Multi-meter (DMM) — to measure signal levels and resistance.

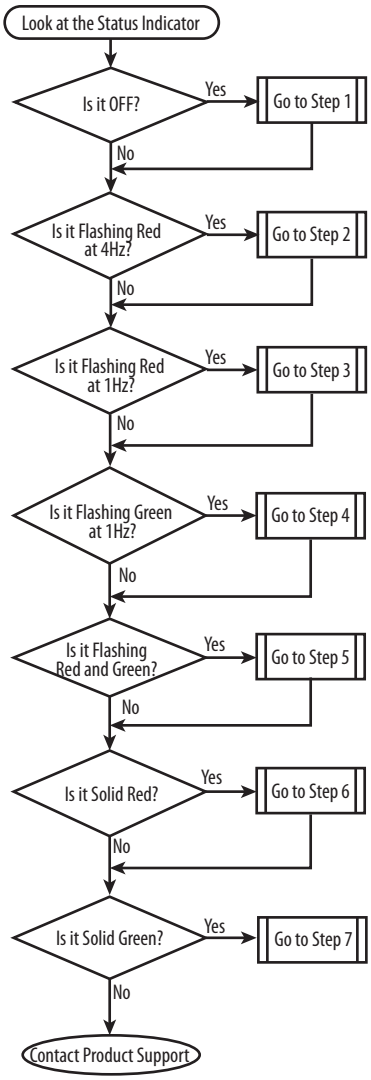
Optional Tools

1. Oscilloscope — dual or four channel storage scope to view input and output signals and to capture signals and noise transients.
2. Metal paper clips — to insert into the terminals and allow connection of scope probes to terminals.

Flowchart

Figure 36 shows a flow diagram to help diagnose the condition of the TLSZ switch.

Figure 36 - Troubleshooting Flow Diagram



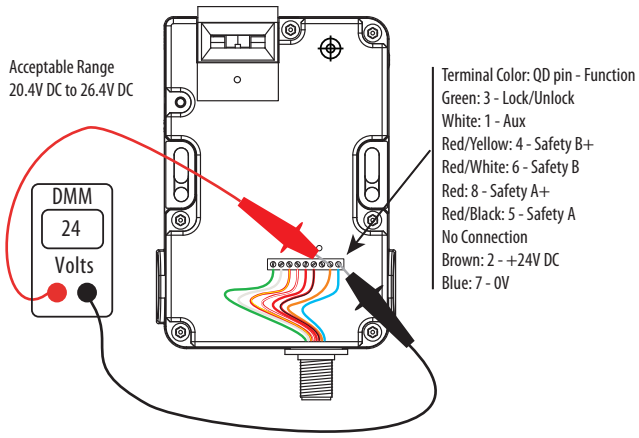
Step 1 — Status Indicator OFF

When the status indicator is OFF, the TLSZ is not connected properly to either the 24V power supply or ground.

1. Use the Torx screwdriver to remove the TLSZ cover.
2. Use a digital multi-meter (DMM) to measure the voltage at the power supply terminals (blue wire is 0V and brown wire is plus), as shown in Figure 37 on page 45.

The voltage must measure between 20.4V and 26.4V DC.

Figure 37 - Measure the Voltage at the Power Supply Terminals



If 24V is present at the wiring terminals, then check that the wires are stripped and the terminal screws are tight. If the wires are okay, then replace the switch.

If 24V is not present at the terminals, then check the power supply and the wiring up to the TLSZ switch.

Step 2 — Status Indicator Flashing Red at 4 Hz

The status indicator flashes red at a 4-Hz rate when an inconsistency is detected with the RFID sensor. A number of scenarios can cause this fault indication.

Wrong Target

The TLSZ is configured to detect a specific target. If a non-configured target is presented to the TLSZ, the TLSZ goes into fault mode and its status indicator flashes red at 4 Hz.

To correct this condition:

1. Replace the incorrect target with a correct target.
2. Cycle the power to clear the fault.

When received from the factory, the TLSZ is not configured to detect any target. You must configure the TLSZ to detect a target. The configuration can be a one-time event, or the TLSZ can be configured to be able to learn up to eight different targets. The TLSZ can only recognize one target. If the target gets damaged, the TLSZ can be configured to learn another target, if initial configuration is set to multi-time learning, see Commissioning Errors on page 23.

Missing Target

If the actuator is inserted into the TLSZR without the target present, the status indicator flashes red at 4 Hz.

To correct this condition:

1. Remove the actuator from the switch.
2. Cycle power to the TLSZR
3. Mount the target next to the actuator as shown in Figure 38.

Insert the actuator/target into the switch.

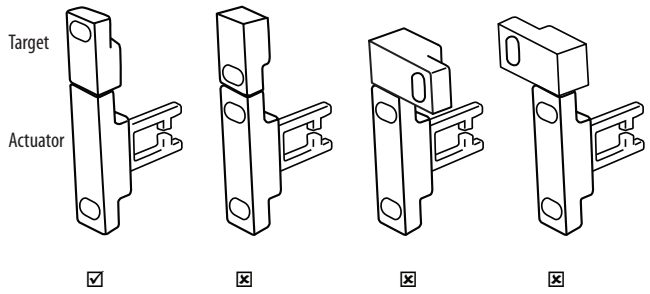
Target Not Mounted Correctly

If the actuator is mounted incorrectly, the TLSZ can operate correctly, but with reduced tolerance to misalignment of the target. The status indicator intermittently goes to a fault state with the status indicator flashing red at 4 Hz.

To correct this condition:

1. Remove the actuator/target from the switch.
2. Cycle power to the TLSZ to clear the fault.
3. Mount the target next to the actuator as shown in Figure 38.
4. Insert the actuator/target into the switch.

Figure 38 - Mounting of Target and Actuator



Pair Proximity

The RF field from a neighboring switch can cause intermittent faults. Switches with similar RF technology include the TLSZ, the SensaGuard™ switches, and the 440G-LZ guard locking switches.

To correct this condition:

1. Make sure that the neighboring switches are mounted at least 200 mm (8 in.) from any edge of the TLSZ.
2. Cycle power to the TLSZ switch to clear the fault.

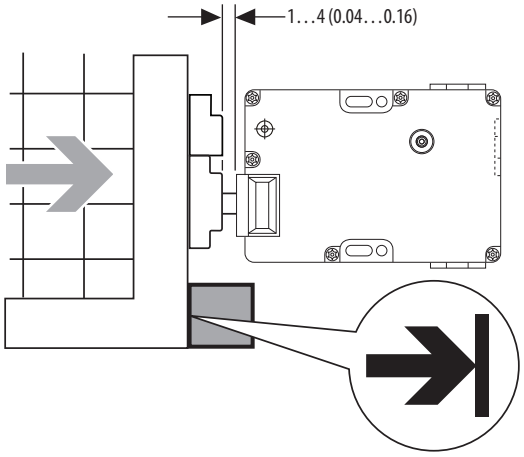
Mechanical Pressure on Safety Gate

If a mechanical load (pressure) is applied to the gate during unlocking, the TLSZR goes to a fault mode. The status indicator flashes green three times and then red once. It repeats this process for 10 seconds, and then the status indicator flashes red at 4 Hz. Firmware 1.003 and earlier have a 10-second limit. Firmware 1.004 attempts to lock for 10 minutes.

1. Check the allowable spacing between the TLS and mechanical gate stop.
2. Adjust the spacing to be between 1 mm (0.04 in.) and 4 mm (0.16 in.) between the actuator and the metal guide as shown in Figure 39.
3. Cycle power to the TLSZ switch to clear the fault.

The safety gate needs a little freedom to move when locked.

Figure 39 - Clearance in Closed Position [mm (in.)]



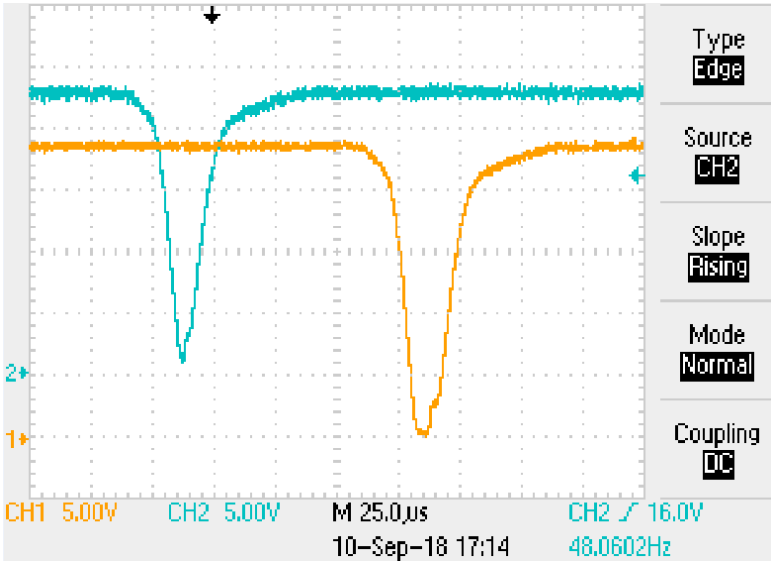
Long Wiring

Long input wiring adds resistance and decreases the supply voltage to the switch and reduces the safety OSSD outputs. The size of the wire also makes a difference; smaller wires have higher resistance.

Figure 40 shows the typical TLSZ test pulses when connected to a resistive load with short [2 m (6.56 ft) wiring. The test pulses are about 25 ms wide.

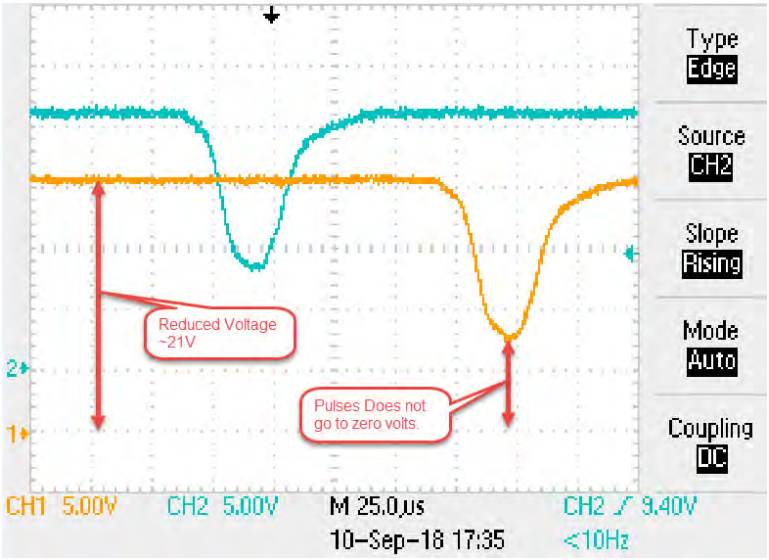
IMPORTANT The OSSD outputs are about 23V and the test pulses go to zero volts.

Figure 40 - TLSZ Test Pulses Into a 1K Resistive Load



In Figure 41 on page 49, a TLSZR and GSR-SI operate successfully with long wiring. The OSSD outputs drop to approximately 21V and the test pulses only drop to approximately 8V (not 0V).

Figure 41 - Effect of 300 ohms of Wire Resistance Going Into a GSR-SI Safety Relay



Voltage Supply Dips

When you energize the TLSZ solenoid, it causes a 350 mA in-rush current on the power supply wire. If multiple TLSZ switches are energized simultaneously, the voltage supply can dip below the 20.4V voltage specification and cause the switch to go to fault mode.

Voltage drop is by:

1. The number of switches being energized simultaneously,
2. The power supply wire size, and
3. The wire length.

IMPORTANT The lock/unlock command on the TLSZ is not like the older TLS1, TLS2, and on the TLSZ (both Power to Lock and Power to Release) is a logic level signal; about 3…5 mA. The power to energize the solenoid is provided by the 'brown' power supply wire.

To avoid the power supply dip, it is recommended that you stagger the lock/unlock command to successive switches by at least 170 ms.

Rapid Locking

The TLSZL Power to Lock switches cannot withstand rapid locking and unlocking. This action results in the indicator flashing red at 4 Hz. Although the TLSZR Power to Release switches are more tolerant to rapid unlocking/locking, they can also go to a fault state with the indicator flashing red at 4 Hz.

It is recommended you check that the locking operation frequency is no faster than 1 Hz with 50% duty cycle (500 ms lock, 500 ms unlock).

Step 3 - Status Indicator Flashes Red at 1 Hz

This status indicates that an undetermined fault has occurred.

Cycle the power. If the switch does not recover, cycle it again. If the switch does not recover, then run a separate cable directly from the power supply to the switch. This cable can run on the floor away from any extraneous signals. You can also provide a temporary selector switch to execute the lock/unlock command.

Case 1. Switch Operates OK. Check the routing of the cable from the power supply to the switch. Be sure of adequate separation of switch cabling to sources of electromagnetic noise, such as drives and motion systems.

Case 2: Switch Faults. If the switch fails with the cabling on the floor (clear of all electromechanical noise), then replace the switch.

Capacitive Loading

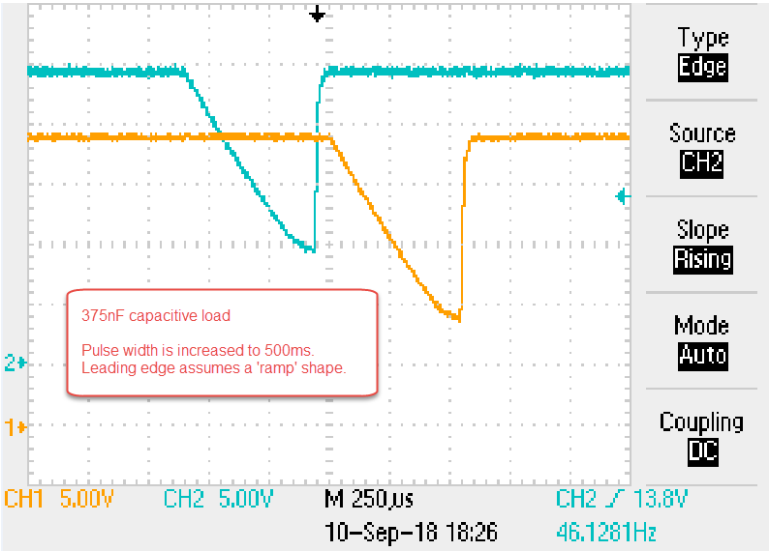
The OSSD outputs of the TLSZ uses pulse testing to detect faults. The pulse testing is subjected to the capacitive loading of the cabling (longer cabling creates additional capacitance) and capacitance from the device to which it is connected.

Cable capacitive loading is not an intermittent issue. Once resolved, the capacitance can remain unchanged until conditions, such as cabling changes, occur.

Use an oscilloscope to measure the pulse tests. Figure 42 on page 51 shows the typical effect; curved leading edge indicates capacitive loading.

The TLSZR can withstand a capacitive load up to 375 nF. Higher capacitance causes the OSSD outputs to turn OFF and the indicator flashes red at 1 Hz. Higher levels of capacitance can be tolerated by adding a 10K resistor from the OSSD signal to ground.

Figure 42 - Typical Capacitive Effect on Pulse Tests



Step 4 — Status Indicator Flashes Green at 1 Hz

When the status indicator is flashing green at 1 Hz, the switch is indicating that it is waiting for 24V to be applied to the OSSD A+ and OSSD B+ input signals.

Upon power-up, the TLSZ performs internal checks. During this time, the status indicator flashes green three times, shows solid red for about two seconds. If the OSSD A+ and OSSD B+ inputs are not connected to 24V, the status indicator then flashes green at 1 Hz.

Corrective Action:

1. If you have multiple switches that are connected in series, check the OSSD outputs of the prior switch.
   a. If the prior switch is flashing green, go to then next prior switch to determine why its OSSD outputs are OFF.
   b. If the TLS is the only switch or the first switch in a series connection of switches, check the power supply connections of OSSD A+ (red wire) and OSSD B+ (yellow wire).

Step 5 — Flashing Red and Green

The TLSZ switch was initially configured for multi-time use. The flashing red and green indicator indicates the number of configurations that can be completed, see Commissioning on page 21.

Step 6 — Indicator Solid Red

The solid red indicator occurs when specific faults have not been detected.

1. Try to cycle power.
2. Remove the cable and reconnect the switch to a separate cable and use the existing power supply.
   a. If the switch recovers, check the existing cable routing to be sure that the switch cable is not along motor or other high–noise wiring. Also check the grounding scheme, the 0V of the switch must be very close to the safety logic device to which it interfaces.
   a. If the switch does not recover, proceed to Step 3.
3. Remove the switch from the installation and apply a bench test circuit.
   a. If the switch still exhibits solid red indicator, replace the switch.
   b. If the switch recovers, then re-examine the cable routing and the grounding scheme.

Step 7 — Other Considerations

Distribution Block

The TLZ can be connected the 898D distribution block. The block is available with either four or eight ports. An example with eight ports is shown in Figure 43 on page 53. This application requires a couple of special considerations:

1. The cable length in this example, are all 30 m (98.4 ft) long. The cable length causes a 1.5V drop in power at the switch.
2. If the power supply is set to 24V, the voltage at the terminals inside each switch is 22.5V.

Common Lock Signal

The lock/unlock command is simultaneously applied to all eight switches. Each switch has a 300 mA nominal (350 mA max) inrush current that lasts about 110 ms (see Figure 44 on page 53). With all 8 switches locked/unlocked at the same, the inrush current is 2.4 A. The power supply must be able to accommodate this inrush.

Figure 43 - TLSZ with 898D Distribution Block

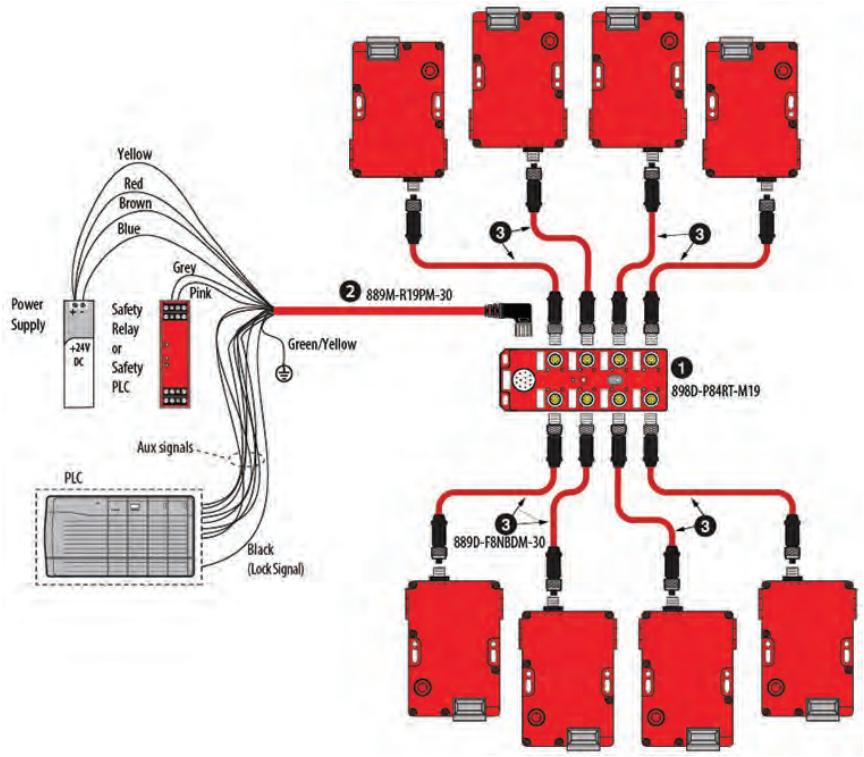
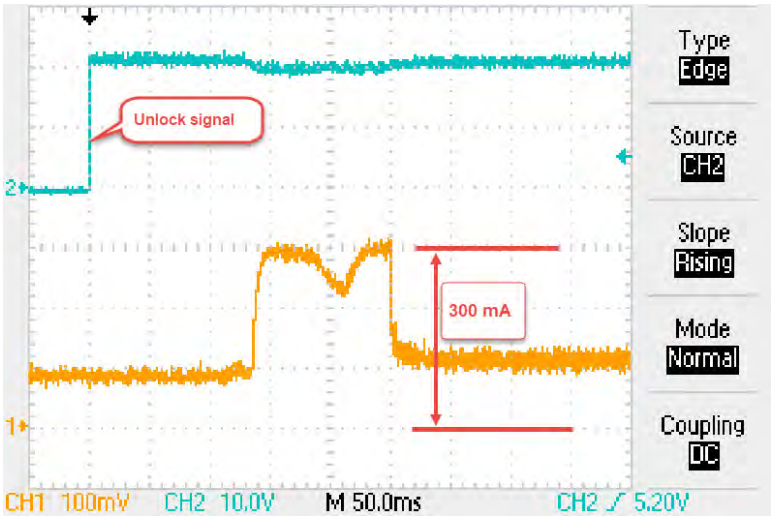


Figure 44 - In-rush Current on the Power Supply at the Switch



GSR Relays on Power-up

Upon power-up, the Guardmaster safety relays (GSR) input does not recognize the status of the TLSZ outputs; the IN1 indicator remains OFF. The TLSZR must be unlocked and then locked. Then the GSR relay recognizes the OSSD outputs of the TLS. This sequence only occurs on power-up and is a function of the GSR (not the TLSZ).

Notes:

Specifications and Safety Ratings

Specifications

Attribute	440G-TZS21UPRH, 440G-TZS21UPLH, 440G-TZS21UTRH, 440G-TZS21UTLH Cat. Nos.
Operating Characteristics	
TLSZR-GD2	Power to Release
TLSZL-GD2	Power to Lock
Assured Locking Distance	13 mm (0.51 in.) Maximum target distance 4 mm (0.16 in.) Maximum clearance between actuator base and switch in the door closed position
Torque for M5 Mounting	1.4 N•m (12.39 lb•in)
Torque for Cover Mounting	1.2 N•m (10.62 lb•in)
Locking Force Fmax	Plastic pins: 1950 N (488 lb) Steel bolts: 2600 N (585 lb)
Locking Force Fzh per EN/ISO 14119	Plastic pins: 1500 N (337 lb) Steel bolts: 2000 N (450 lb)
Maximum Output Current (all outputs)	200 mA
Current Consumption solenoid not energized, no output load solenoid energized, no output load Inrush Current	 75 mA 120 mA 350 mA
Solenoid Duty Cycle	100%
Off-State Current	< 0.5 mA DC
Maximum number of switches connected in series	Unlimited. See Unit Response Time on page 8
Operating Voltage Ue	24V DC +10% / -15%, Class 2 Source Required
Frequency of Solenoid Operating Cycle	1 Hz, max
Actuation Speed	160 mm/s (6.29 in/s), max 100 mm/min (3.94 in/min), min
Response Time (turn Off)	75 ms first switch, 25 ms additional for each switch
Utilization Category per IEC 60947-5-2	DC-13, 24V 200 mA
Impulse Withstand Voltage Uimp	250V
Protection Class	2
Mechanical Life	1,000,000 cycles
Environmental	
Operating Temperature [C (F)]	-10…+60 °C (+14…140 °F)
Operating Humidity [% relative]	5…95
Risk Time, Max [ms] If the RFID door target moves outside of the operating distance, the safety outputs are deactivated	60
Rated Insulation Voltage Ui [V]	500
Enclosure Ingress Rating	NEMA 3, 4X, 12, 13, IP66, IP67, IP69K
Shock per IEC 68-2-27 [g, ms]	30, 11

Attribute	440G-TZS21UPRH, 440G-TZS21UPLH, 440G-TZS21UTRH, 440G-TZS21UTLH Cat. Nos.
Vibration IEC 68-2-6 [Hz, mm]	10…55, 0.35
Radio frequency	IEC 61000-4-3 IEC 61000-4-6
Pollution Degree	3
Altitude, Max [m(ft)]	2000 (6562)
General	
Housing Material	UL Approved glass-filled PBT
Actuator Material	Stainless steel
Target Material	UL Approved glass-filled PBT
Connection	M12 8-pin connector
Protection	
Short Circuit Protection	Incorporated

Safety Ratings

Attribute	440G-TZS21UPRH, 440G-TZS21UPLH, 440G-TZS21UTRH, 440G-TZS21UTLH Cat. Nos.
Standards	IEC 60947-5-3, IEC 60947-5-1, IEC 62061, IEC 61508, ISO 13849-1, ISO 14119
Category per ISO 13849-1	4
Performance Level per ISO 13849-1	PLe, includes guard door position and lock monitoring
SIL Claim Limit per IEC 62061	3
PFHd [1/h]	1.70E-09
Proof test Interval [years]	20
Certifications	CE Marked for all applicable EU directives, c-UL-us (UL 508), and TÜV

Notes:

Notes:

Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	www.rockwellautomation.com/knowledgebase
Local Technical Support Phone Numbers	Locate the phone number for your country.	www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	www.rockwellautomation.com/literature
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	www.rockwellautomation.com/global/support/pcdc.page

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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 information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

www.rockwellautomation.com

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