User Manual

Original Instructions

Allen-Bradley

# Guard Locking with Time-Delay (GLT) Safety Relay

Catalog Number 440R-GL2S2T

## 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). |

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

- Who should use this manual
- The purpose of this manual
- Related documentation
- Conventions that are used in this manual

## Summary of Changes

This manual contains the following new and updated information:

- The section Single Wire Safety (SWS) on page 21 was added.
- In the section Status Indicators During Diagnostics on page 30, the descriptions of Green with Flashing Red 3 Times and Green with Flashing Red 4 Times were updated.

## Who Should Use This Manual

Use this manual if you design, install, program, or troubleshoot control systems that use the GLT safety relay.

You must 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 GLT time delay safety relay and accessories. It describes the procedures that you use to install, wire, and troubleshoot your controller. This manual:

- Explains how to install and wire your safety relay
- Gives an overview of the GLT safety relay performance

## Additional Resources

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

| Resource | Description |
|---|---|
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 | Provides general guidelines for installing a Rockwell Automation® industrial system. |
| Product Certifications website, http://www.ab.com | Provides declarations of conformity, certificates, and other certification details. |
| Allen-Bradley® Industrial Automation Glossary, AG-7.1 | A glossary of industrial automation terms and abbreviations. |

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

## Definitions

The Industrial Automation Glossary (publication AG-7.1) contains a glossary of terms and abbreviations that are used by Rockwell Automation to describe industrial automation systems. The following list of specific terms and abbreviations that are used in this manual:

- **N.C. (Normally Closed)** – An electrical contact whose normal state (that is, no pressure or electrical potential applied) is in the closed position.
- **N.O. (Normally Open)** – An electrical contact whose normal state (that is, no pressure or electrical potential applied) is in the open position.
- **Reaction Time** - Describes the time between the true states of one input to the ON state of the output.
- **Recovery Time** - Describes the time that is required for the input to be in the LO state before returning to the HI state.
- **Response Time** - Describes the time between the trigger of one input to the OFF state of the output.
- **OSSD (Output Signal Switching Device)** – A pair of solid-state signals that are pulled up to the DC source supply. The signals are tested for short circuits to the DC power supply, short circuits to the DC common and shorts circuits between the two signals.
- **Single Wire Safety (SWS)** - A unique, safety rated signal that is sent over one wire to indicate a safety status. The SWS can be used in Category 4.

# Overview

## Hardware Features

**Figure 1 - GLT Relay**


The GLT is a **G**uard **L**ocking with **T**ime-delay safety relay. This safety relay is designed to use time-delayed outputs for use in Stop Category 1 and to unlock a safety gate when the time expires. It also provides a lock command to lock a safety gate before the starting of the hazard.

The GLT safety relay can be operated with other safety relays in the GSR family, by use of the single wire safety (SWS) connection. When GLT safety relay receives an SWS signal from other GSR relays, the GLT safety relay issues an Unlock command. When the GLT safety relay turns ON its safety output, it also turns ON its SWS output for use by other GSR safety relays.

## Functions

The GLT safety relay can be configured to operate in one of two types of safety functions, both of which involve time-delayed safety signals.

### Function 1 - Guard Locking

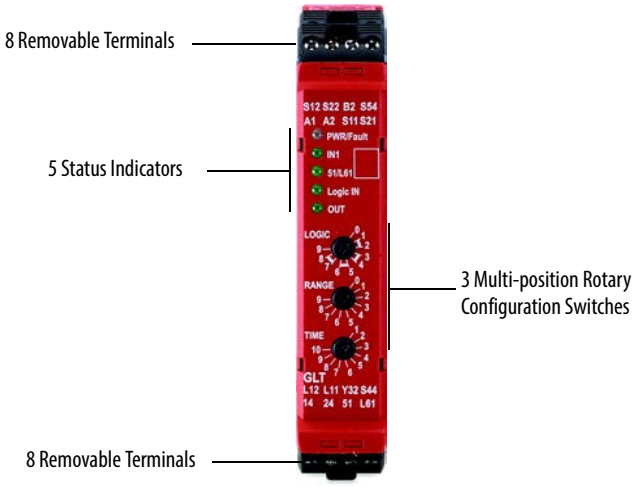
Function 1 is used for guard locking applications. During production, the safety gate is locked in the closed position by a guard locking interlock. To request access through the safety gate, the operator presses the Unlock Request button. The GLT safety relay initiates a stop and unlocks the safety gate after the time expires.

## Function 2 - E-stop

Function 2 is used for E-stop applications. The production process requires an orderly shutdown. Some processes must be stopped immediately and some must be stopped shortly thereafter. To initiate the stop, you press an E-stop button. The GLT safety relay initiates an immediate stop command followed by a delayed stop command.

Figure 2 shows some of the key hardware features of the GLT safety relay.

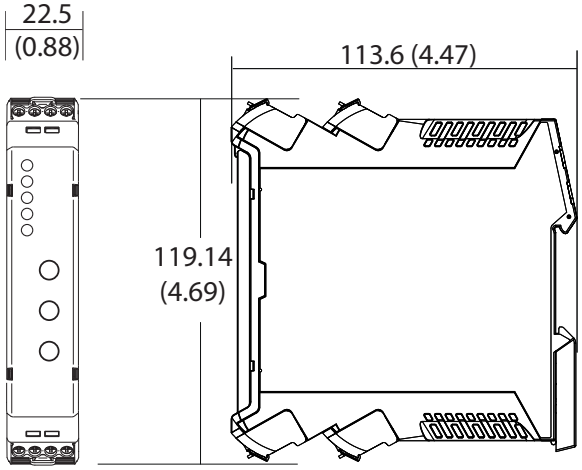
**Figure 2 - GLT Hardware Details**



# Installation

## Mounting Dimensions

**Figure 3 - Approximate Dimensions [mm (in.)]**

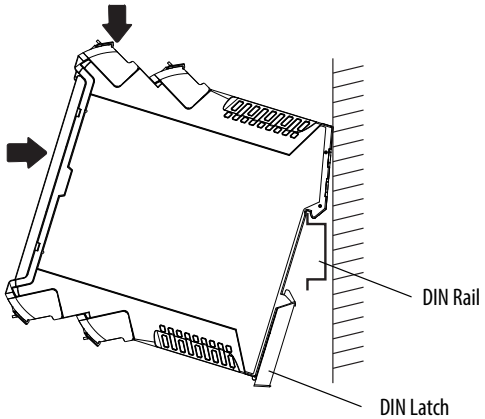



### DIN Rail Mounting and Dismounting

The GLT safety relay easily mounts onto 35 mm DIN Rails: 35x7.5x1 mm (EN 50022 - 35x7.5).

1. Hold the top at an angle
2. Slide down until the housing catches the rail.
3. Swing the bottom down and give a little push until the latch clips onto the rail.

**Figure 4 - DIN Rail Mounting**



**Removal** - To remove the GLT safety relay, use a screwdriver to pry the DIN rail latch downwards until it is in the unlatched position. Then, swing the module up.

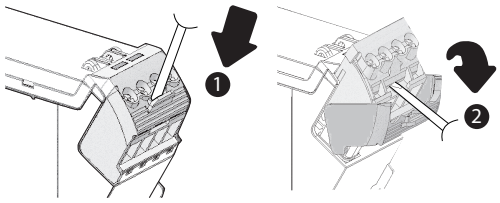
**Spacing** - The GLT safety relay can be mounted directly next to other GSR safety relays. When the GSR Ethernet Module is used, the GSR must be mounted with 10 mm (0.4 in.) of its neighboring module to maintain effective communication.

Maintain 50.8 mm (2 in.) of space above and below the relay for adequate ventilation.

### Removable Terminals

The GLT safety relay has removable terminals to ease wiring and replacement.

**Figure 5 - Removable Terminals**




1. Insert the tip of a small screwdriver into the slot near the terminal screws.
2. Rotate the screwdriver to unlock the terminal block.

The terminal block can then be removed from the housing.

## Enclosure Considerations

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference and environmental exposure. Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that condensation occasionally causes temporary conductivity. Overvoltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating. This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that are present and appropriately designed to help prevent personal injury that results from accessibility to live parts. The enclosure must have suitable flame-retardant properties to help prevent, or minimize, the spread of flame, and comply with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication contain additional information regarding specific enclosure-type ratings that are required to comply with certain product safety certifications.

For additional information, see:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional installation requirements.
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection that is provided by different types of enclosure.

## Prevent Excessive Heat

For most applications, normal convective cooling keeps the relay within the specified operating range. Verify that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, other equipment inside or outside the enclosure produce a substantial amount of heat. In this case, place blower fans inside the enclosure to help with air circulation and to reduce “hot spots” near the controller.

Additional cooling provisions could be necessary when high ambient temperatures are encountered. Do not bring in unfiltered outside air. Place the controller in an enclosure to help protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to help protect against heat buildup within the enclosure.

## Notes:

# Power, Ground, and Wire

## Wiring Requirements and Recommendation

**WARNING:** Before you install and wire any device, disconnect power to the system.

**WARNING:** Calculate the maximum possible current in each power and common wire. Observe all electrical codes that dictate the maximum current allowable for each wire size. Current above the maximum ratings cause wiring to overheat, which can cause damage.

- Allow for at least 50 mm (2 in.) between I/O wire ducts or terminal strips and the relay.
- Route incoming power to the relay by a path separate from the device wiring. Where paths must cross, their intersection must be perpendicular.
- Do not run signal or communications wiring and power wiring in the same conduit. Route wires with different signal characteristics by separate paths.
- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other means for to label wires. Colored insulation can also be used to identify wiring by signal characteristics. For example, use blue for DC wiring and red for AC wiring.

### Wire Size

Each terminal can accommodate copper wire with size from 0.2...2.5 $mm^2$ (24...14 AWG). Use copper that withstands 60/75 °C.

### Terminal Torque

Terminals must be torqued to 0.4 N•m (4 lb•in).

## Terminal Assignments

Some terminals are designed to have one specific function. Some terminals can perform multiple functions; these terminals must be configured during a power-up routine.

**Figure 6 - Terminal Identification**

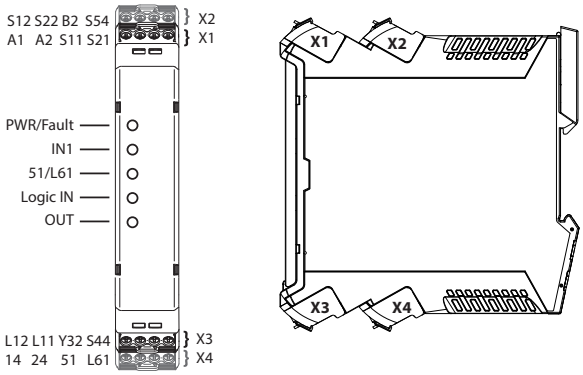



**Table 1 - Terminal Function**

| Terminal | Function |
|---|---|
| A1 | +24V Supply |
| A2 | 24V Common |
| S11 | Safety Test Pulse Output for Channel 1 |
| S21 | Safety Test Pulse Output for Channel 2 |
| S12 | Safety Input for Channel 1 |
| S22 | Safety Input for Channel 2 |
| S44 | Reset and Lock Request Input |
| S54 | Guard Locking Unlock Request Input |
| Y32 | Auxiliary Nonsafety Output |
| L11 | Single Wire Safety Output |
| L12 | Single Wire Safety Input |
| B2 | Retriggerable Input |
| 51 | Guard Locking Solenoid or Delayed Safety Output Channel 1 |
| L61 | Guard Locking Solenoid or Delayed Safety Output Channel 2 |
| 14 | Immediate Safety Output Channel 1 - Logic Setting 1, 2, 5, 6, 7, 8<br>Delayed Safety Output Channel 1 – Logic Setting 3, 4 |
| 24 | Immediate Safety Output Channel 2 - Logic Setting 1, 2, 5, 6, 7, 8<br>Delayed Safety Output Channel 2 – Logic Setting 3, 4 |

## Grounding the Controller

There are no special grounding requirements. Terminal A2 must be connected to the common of a 24V supply.

## Connecting a Power Supply

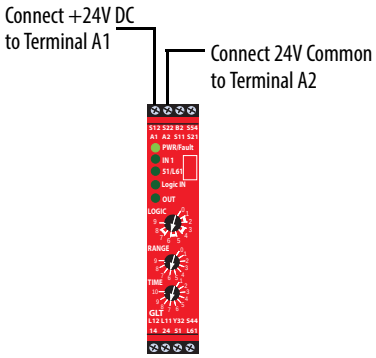
Power for the GLT safety relay is provided by an external 24V DC power supply source.

To comply with the CE Low Voltage Directive (LVD), power for the GLT safety relay must come from a DC source compliant with safety extra low voltage (SELV) or protected extra low voltage (PELV).

The following Rockwell Automation Bulletin 1606 power supply catalog numbers are SELV- and PELV-compliant.

- 1606-XLP30E
- 1606-XLP50E
- 1606-XLP50EZ
- 1606-XLP72E
- 1606-XLP95E
- 1606-XLDNET4
- 1606-XLSDNET4

**Figure 7 - Power Supply Connections**



# Safety Devices

## Safety Devices with Mechanical Contacts

Input devices with mechanical contact outputs, such as emergency stop buttons and tongue interlock switches, use both a safety input terminal and a test pulse output terminal.

When safety devices are connected via test outputs to an input circuit on the GLT safety relay, wire length must be 100 m (300 ft) or less.

For the lowest risk levels, the input device uses one channel. As shown in Figure 8, one side of the contact is connected to S11 (or S21). The other side of the contact must be connected to both S12 and S22. The GLT safety relay detects short circuits from the inputs (S12 and S22) to 24V DC and to 24V common.

**Figure 8 - Connecting a Single-channel Mechanical Contact**

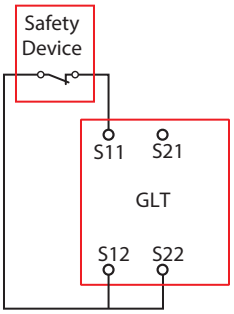
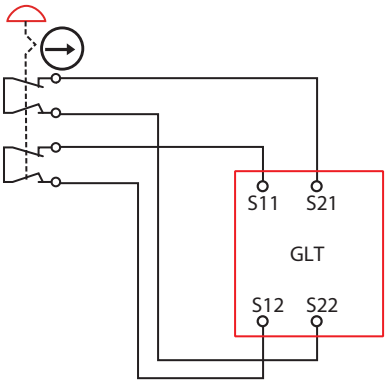
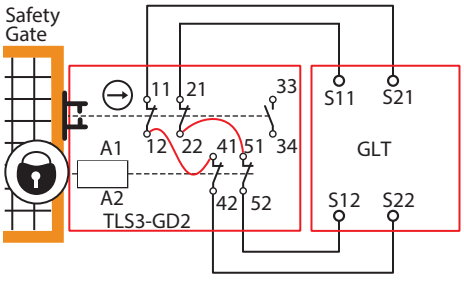



**Figure 9 - Connecting Mechanical Contacts of a Dual-channel E-stop**




When only one dual-channel E-stop button is used, the maximum safety performance rating is Cat 4 PLe and SIL CL3.

**Figure 10 - Connecting Mechanical Contacts of a TLS3-GD2 Interlock Switch**



Since the TLS3-GD2 interlock switch has multiple contacts in series, the maximum safety performance rating is Cat 3 PLd and SIL CL2.

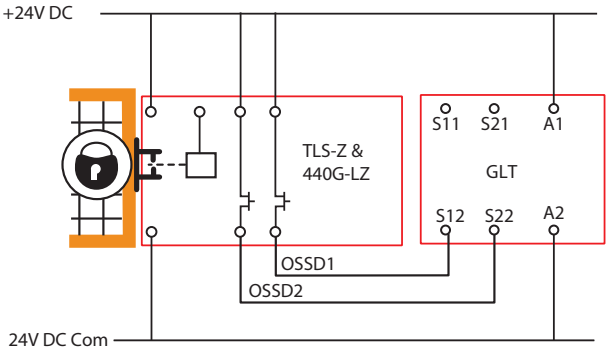
**TIP** Pulse test output S11 can be connected to either S12 or S22. Pulse test output S21 can be connected to either S12 or S22.

Regardless of how these switches are wired, performance remains the same. The GLT safety relay successfully recognizes when one or both channels open, and the GLT safety relay detects cross channel faults and single channel faults to +24V and to 24V common.

## Safety Devices with OSSD Outputs

Devices, such as light curtains, laser scanners, and solid-state interlocks have current-sourcing PNP semiconductor outputs (OSSD), which send safety signals to the GLT safety input terminal and do not use the pulse test outputs. These devices must have a common power supply reference with the GLT safety relay.

**Figure 11 - Connections to Device with OSSD Outputs**




**IMPORTANT** Both devices must have the same power supply reference.

**TIP** OSSD1 can be connected to either S12 or S22 and OSSD2 can be connected to either S12 or S22.

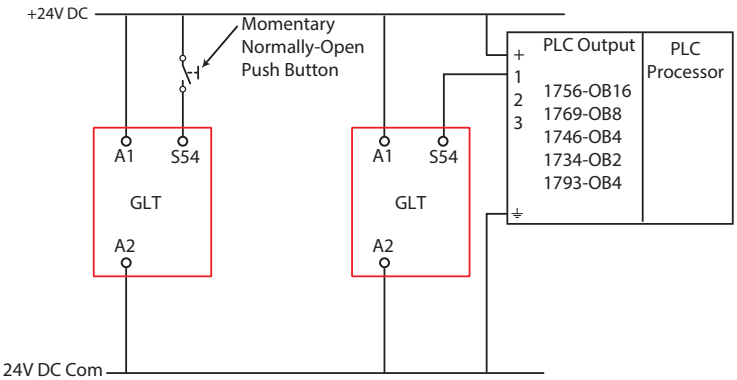
When using the TLS-ZR and 440G-LZ guard locking switches, the maximum safety performance rating is Cat 4 PLe and SIL CL3.

## Unlock Request Input

The Unlock Request Input can be connected to the 24V supply through a momentary, normally open push button switch or to a 24V sourcing output of a programmable logic controller (PLC), where the PLC turns the request ON or OFF. Some examples of Rockwell Automation PLC output modules are shown in Figure 12.

The unlock request is connected to Terminal S54.

**Figure 12 - Unlock Request Wiring**



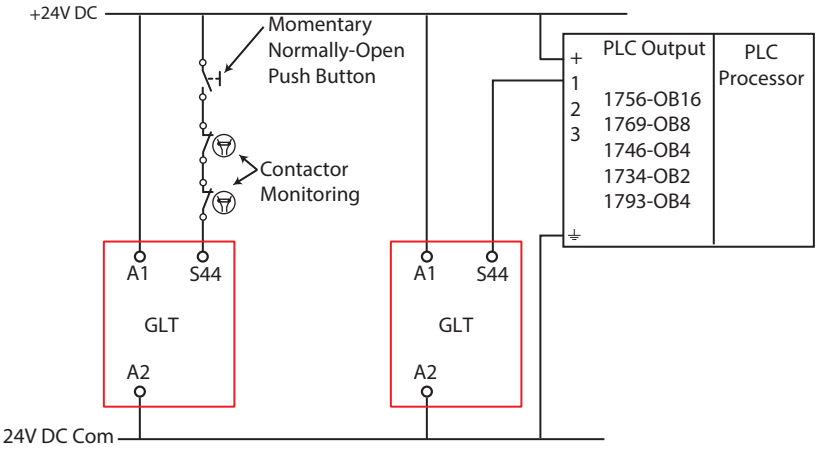

## Lock and Reset Request Input

The Lock and Reset Input can be connected to the 24V supply through a momentary, normally open push button switch or to a 24V sourcing output of a PLC where the PLC turns the request ON or OFF. Some examples of Rockwell Automation PLC output modules are shown in Figure 13.

In some safety system applications, the reset signal also serves as a monitoring function. For example, when the safety outputs are driving safety contactors, the normally closed contacts of the safety contactors should be connected in series with lock and reset circuit.

The lock and reset request is connected to Terminal S44.

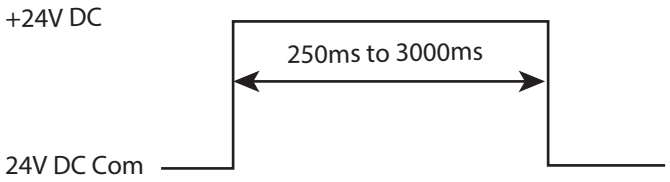
**Figure 13 - Lock Request Wiring**



## Lock and Unlock Signals

The GLT safety relay is designed to ignore incidental actuations or stuck conditions on the Lock and Unlock inputs. The lock and unlock signals must be actuated for a duration of 0.25...3 seconds. The GLT safety relay ignores signals durations that are too short or too long.

**Figure 14 - Required Signal Duration**




## Retriggerable Input

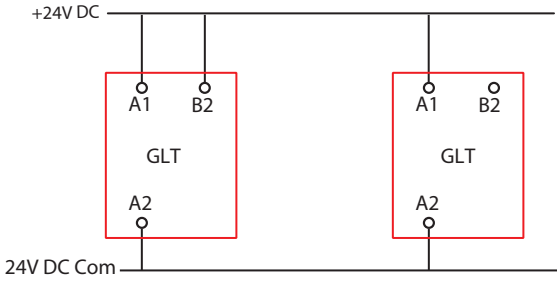
The retriggerable input is either left open for non-retriggerable operation or connected directly to the +24V DC supply for retriggerable operation. During configuration, the GLT safety relay reads the status of the input to determine whether to apply the function to the safeguarding input. The retriggerable input only works with Logic Setting 5, 6, 7, and 8. Retriggerable operation is often used when long delay times are configured in the GLT safety relay.

When terminal B2 is not connected to +24V DC, the safeguarding input device must be held open for the full duration of the timed delay cycle. If the input device is reclosed during the timing cycle, the PWR/Fault indicator is green with five red flashes. To clear the fault indication, cycle the input device (OFF then ON) after the completion of the timing cycle.

When terminal B2 is connected to +24V DC, the safeguarding input device can be closed before the full duration of the timed delay cycle, and this action resets the timer. When the input is reclosed during the timing cycle, the immediate outputs turn back ON immediately

**WARNING:** You must confirm that the reclosing or resetting of an interlocking safeguard or E-stop device does not initiate hazardous machine operation.

**Figure 15 - Retriggerable Input Wiring**



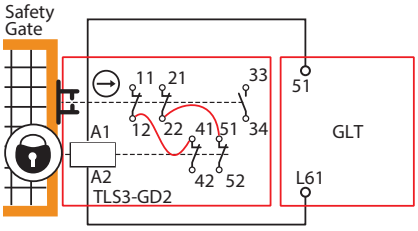
## Outputs

Terminals 51 and L61 are the time-delayed safety outputs. They can be configured for two different functions:

1. Direct connection to the solenoid of a guard locking interlock, or
2. Direct connection to other time-delayed safeguarding devices.

The function is determined during the configuration process.

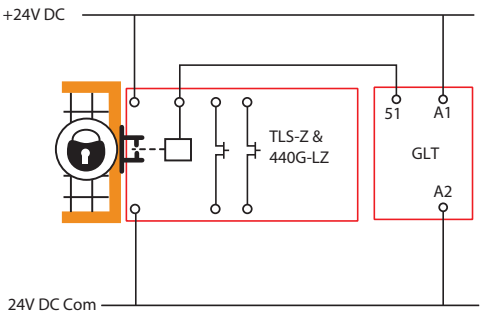
**Figure 16 - TLS1, 2, and 3 Solenoid Connections**




When using the TLS1, 2, or 3, the solenoid connections can be reversed, A1 can be connected to 51 or L61 and A2 can be connected to either 51 or L61.

> **Note:** The 440G-MT solenoid cannot be connected directly to the GLT safety relay as it draws too much current; an interposing relay is required.

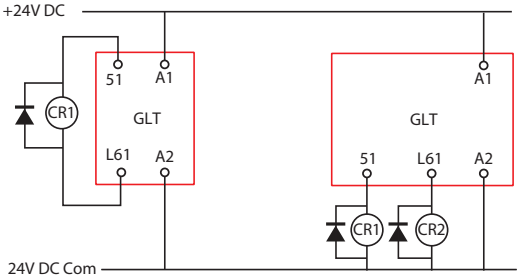
**Figure 17 - TLS-Z and 440G-LZ Solenoid Connections**




When connecting to the TLS-Z or 440G-LZ guard locking switch, the solenoid signal must be connected to terminal 51. Terminal L61 can also be used to drive a relay.

When multiple guards (solenoids) must be unlocked simultaneously, a safety control relay can be connected between terminal 51 and L61 or two separate safety control relays can be connected to 51 and L61. A diode suppressor should be connected in parallel across the coil.

**Figure 18 - Interposing Relay Connections**

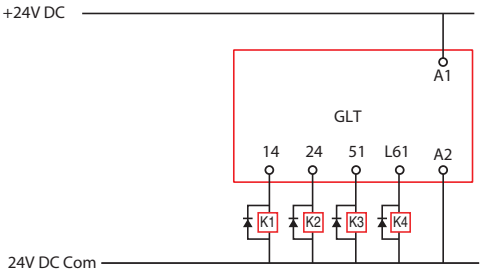


## Use Surge Suppressors

Because of the potentially high current surges that occur when switching inductive load devices, such as motor starters and solenoids, the use of some type of surge suppression to help protect and extend the operating life of the controllers output is required. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the outputs. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device. Since the outputs are 24V DC, we recommend 1N4001 (50V reverse voltage) to 1N4007(1000V reverse voltage) diodes for surge suppression for the OSSD safety outputs, as shown in Figure 19. The diode must be connected as close as possible to the load coil.

**Figure 19 - Surge Suppression**




Example suppressors include:

- Catalog number 100-FSD250 for legacy Bulletin 100S Contactors
- Catalog number 100S-C**EJ contactors have built in suppression
- Catalog number 1492-LD4DF terminal block with built-in 1N4007 diode
- Catalog number 700-ADL1R is diode for catalog number 700-HPSXZ24 positive-guided relay

## Single Wire Safety (SWS)

The GLT safety relay has two single wire safety connections:

- Terminal L12 (input)
- Terminal L11 (output)

These terminals can only be connected to other devices that support single wire safety. When the SWS input is ON, the Logic IN indicator turns ON.

## SWS Function

The configured Logic switch setting determines the function of the SWS input.

- Logic 1 and 3
  The Logic IN bypasses the IN1 signals. If the safety gate is unlocked (IN1 is OFF), the SWS input turns on the 14/24/L11/Y32 outputs.
- Logic 2 and 4
  The SWS input must be ON to turn on the 14/24/L11/Y32 outputs. Turning off the SWS input is similar to pressing the Unlock request.
- Logic 5
  The SWS input bypasses the IN1 signals. If the safety gate is unlocked (IN1 is OFF), the SWS input sets the GLT safety relay ready for reset (the OUT indicator is blinking).
- Logic 6
  The SWS input must be ON to turn on the outputs.
  If IN1 is ON, and the SWS input turns off; then 14, 24, L11, and Y32 turn off immediately and 51 and L61 turn off after a delay.
  If IN1 is ON and the SWS input turns on, the GLT safety relay is ready for reset (the OUT indicator is blinking).
- Logic 7
  The SWS input bypasses the IN1 signals. If the safety gate is unlocked (IN1 is off), the SWS input turns on all outputs immediately.
- Logic 8
  The SWS input must be ON to turn on the outputs.
  If IN1 is ON and the SWS IN turns off, then 14, 24, L11, and Y32 turn off immediately and 51 and L61 turn off after a delay.
  If IN1 is ON and the SWS input turns on all outputs immediately.

## SWS Connections

There can be many variations and combinations of series and parallel connections of the SWS. Each L11 terminal can be connected to up to ten L12 terminals.

**ATTENTION:** Do not connect two or more L11 terminals together.

Figure 20 shows an example wiring diagram with SWS input from a GSR DI safety relay and SWS output connection to a GSR EM expansion in parallel with a GSR DIS relay. The safety relays must have a common power reference (24V common).

**ATTENTION:** Do not use machine ground as the 24V common; connect the commons of multiple power supplies using direct wire connections.

**Figure 20 - Single Wire Safety Connections**

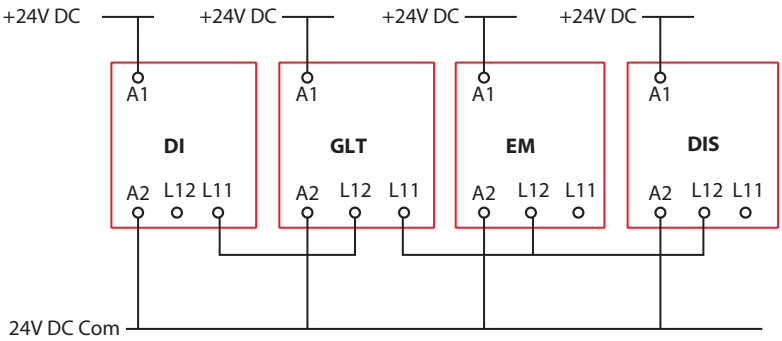
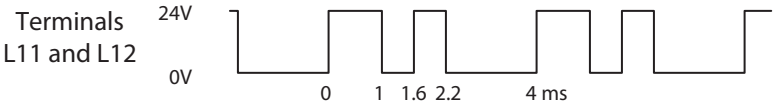



Figure 21 shows the characteristics of SWS signal when it is active. It starts with a 1 ms pulse, followed 600 µs later by a 600 µs pulse. This waveform is repeated every 4 ms. When inactive, the SWS is 0V.

**Figure 21 - SWS Waveform**



## Notes:

# Configuration

## Logic Switch Setting

The Logic switch determines the operating function of the GLT safety relay and is used to set the configuration. If only the Range or Time setting must be changed, the configuration process must start by setting the Logic switch to 0 or 9 when power is off.

**Table 2 - Logic Switch Setting**

| Switch 1 Setting | Lock/ Unlock Demand Configuration | Delay Configuration | Safety Inputs |
|---|---|---|---|
| 0 | Program mode (Pulse testing is activated on terminals 14, 24, 51, and L61 | | |
| 9 | Program mode (Pulse testing is deactivated on terminals 14, 24, 51, and L61 | | |
| **Function 1 - Guard Locking Applications** | | | |
| 1 | Manual monitored | Cat. 0 Stop.<br>14, 24, L11, Y32 immediate OFF<br>51, L61 delayed ON | Logic IN OR IN1 |
| 2 | | | Logic IN AND IN1 |
| 3 | | Cat. 1 Stop<br>14, 24, L11 delayed OFF<br>51, L61 delayed ON<br>Y32 immediate OFF | Logic IN OR IN1 |
| 4 | | | Logic IN AND IN1 |
| **Function 2 - E-stop Applications** | | | |
| 5 | Manual monitored | 14, 24, L11, Y32 immediate OFF<br>51, L61 delayed OFF | Logic IN OFF OR IN1 |
| 6 | | | Logic IN AND IN1 |
| 7 | Auto reset | 14, 24, L11, Y32 immediate OFF<br>51, L61 delayed OFF | Logic IN OFF OR IN1 |
| 8 | | | Logic IN AND IN1 |

**ATTENTION:** When the GLT safety relay is configured for settings 5 or 7 and an E-stop device is connected to IN1, there must be no connection to the Logic IN (terminal L12). E-stops must always be available and cannot be bypassed or muted with 'OR' logic.

## Range Switch Setting

The Range switch sets the maximum time for the delay. The Time switch setting adjusts the range.

**Table 3 - Range Switch Setting**

| Range Switch Setting | Maximum Delay Time |
|---|---|
| 0 | 0.5 s without 10% (1) |
| 1 | 1 s |
| 2 | 3 s |
| 3 | 5 s |
| 4 | 10 s |
| 5 | 30 s |
| 6 | 1 min |
| 7 | 3 min |
| 8 | 10 min |
| 9 | 30 min |

(1) To use the Range setting of zero, the Time setting must be set to something other than 1.

## Time Switch Setting

The Time switch sets the adjustment to the Range switch.

**Table 4 - Time Switch Setting**

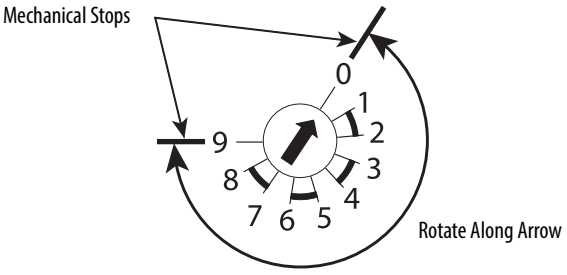
| Time Switch Setting | Delay Adjustment (%) |
|---|---|
| 1 | 10 |
| 2 | 20 |
| 3 | 30 |
| 4 | 40 |
| 5 | 50 |
| 6 | 60 |
| 7 | 70 |
| 8 | 80 |
| 9 | 90 |
| 10 | 100 |

**EXAMPLE** With the Range and Time set to 4, the delay is:
10 seconds x 40% / 100 = 4 seconds

## Configuration Switches

Use a small slotted screwdriver to set the switches to the desired setting. The configuration switches are multi-position switches with a limited rotation.

**Figure 22 - Configuration Switch Adjustment**




**IMPORTANT** Adjust the switches gently and do not turn past the mechanical stops.

# Configuration Process

Configuration is a five-step process. The process requires the wiring to the GLT safety relay to be completed. During the configuration process, the GLT safety relay sends out test pulses to determine how it is wired and then configures the internal parameters to match the application.

## Five Step Configuration

The GLT safety relay is configured in five steps:

1. With the power OFF, set the Logic switch to either 0 or 9.
2. Apply power.
3. Adjust the Logic, Range, and Time switches.
4. Verify the settings by counting the blink rates of the status indicators.
5. Cycle the power to store the settings.

## Configuration Details

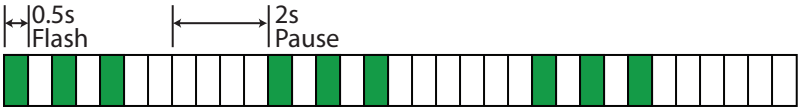
1. The GLT safety relay sends out signals during the configuration process, so the wiring must be complete.
   Set the Logic switch to:
   - 0 if you want to activate pulse testing on terminals 14 and 24
   - 9 if you want to deactivate pulse testing.
2. Power up the module.
   The PWR/Fault status indicator flashes red continuously. The prior configuration in the EEPROM is erased and the device now prepared for a new configuration.
3. Set the Logic, Range, and Time switch settings for your application.
   After 500 ms, the new configuration parameters are acknowledged.
   After 300 ms, the new parameter is stored in the EEPROM, the Power status indicator is solid green.

   **TIP** You can change (or readjust) the switch settings during Step 3 and 4. The Power status indicator flashes red again, momentarily.

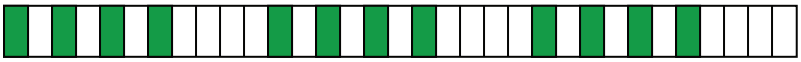
4. Verify the settings
   The status indicators flash for 0.5 seconds to indicate the switch setting. The number of flashes is equal to the switch setting. The flashing repeats after a 2 second pause.

**Figure 23 - Example of the Status Indicators Flashing During Configuration Mode:**

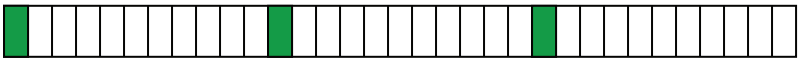
IN1 – Indicates that the LOGIC Switch is set to 3



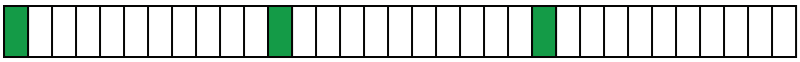

51/L61 – Indicates that the RANGE Switch is set to 4



Logic IN – Indicates that the TIME switch is set to 1



OUT – Indicates the solenoid connection to guard locking switch with OSSD outputs



5. Cycle the power to the GLT safety relay. After power-up, the current switch settings are compared to the values in the EEPROM, and the input and output circuits are checked. Upon successful completion of the internal checks, the GLT safety relay is ready for operation.

The OUT status indicator indicates the type of connection that is made to terminals 51 and L61. Table 5 shows the conditions for the OUT status indicator blink rates.

**Table 5 - OUT Status Indicator Blink Rates**

| OUT Status Indicator Blinks | Guard Locking Switch | 51 | L61 | Guard Locking Function | E-stop Function |
|---|---|---|---|---|---|
| 1 time | OSSD guard locking switch (for example, TLS-ZR or 440G-LZ) or E-stop function | High Side | High Side | Yes | Yes |
| 2 times | Standard guard locking switch (for example, TLS3-GD2) | High Side | Low Side | Yes | No |
| 3 times | Next generation guard locking switch | No Function | Logic Link | Yes | No |

# Diagnostic Status Indicators and Troubleshooting

The GLT safety relay has five status indicators to provide operating status and diagnostic information.

## Status Indicators During Powerup

During powerup, the status indicators turn ON and OFF during their self-check process. The self-check takes about 3 seconds.

## Status Indicators During Normal Operation

**Table 6 - Normal Operation Status Indicators**

| Status Indicator | State | Description |
|---|---|---|
| PWR/FAULT | Solid Green | Normal operation |
| | Blinking Red | See Status Indicators During Diagnostics for possible faults. Correct fault and cycle power |
| | Green with Blinking Red | See Status Indicators During Diagnostics for possible faults. Correct fault and press reset |
| IN | ON | Input circuits at S12 and S22 are closed |
| | OFF | Input circuits at S12 and S22 are open |
| 51/L61 | ON | Gate is locked |
| | OFF | Gate is unlocked |
| | Blinking | Timing cycle has started |
| LOGIC IN | ON | Logic IN signal at L12 is active |
| | OFF | Logic IN signal at L12 is OFF |
| OUT | ON | L11 is active and 14/24 are ON<br>Y32 is ON |
| | OFF | Outputs are OFF |
| | Blinking | Waiting for reset signal or timing cycle has started |

## Status Indicators During Diagnostics

The flashing of the status indicators indicate diagnostics. The PWR/Fault status indicator shows the major fault. The IN1 status indicator shows more detail.

The flashing rate pauses and then repeats itself.

**IMPORTANT** For accurate diagnostics, always start counting after the first pause. The first cycle is not accurate.

**Table 7 - Diagnostic Status Indicators**

| Power/Status Status Indicator | Status/Faults |
|---|---|
| Solid red | An undeclared fault has occurred.<br>Cycle power to clear the fault and return the GLT to an operational state. |
| Flashing red 1 time | The GLT safety relay is in configuration mode.<br>When the Logic Switch is set to 0 or 9 and the power is cycled, the PWR/Fault status indicator blinks at a 1X rate. The GLT safety relay is in configuration mode. Rotate the switches to the desired positions and cycle power. |
| Green with flashing red 2 times | The configuration does not agree with the EPROM.<br>One or more of the rotary switches have changed during operation. The GLT safety relay continues to operate, and the switches can be returned to their original position. If the outputs are ON, turn the outputs OFF and press reset to clear the fault. |
| Green with flashing red 3 times | A lock/reset request was made, but the safety gate is still open.<br>Close the gate. Press the Unlock button to clear the fault. Then, press the Lock/Reset button to turn on the output.<br>The connection to terminal B2 has changed.<br>The GLT safety relay continues to operate, and the connection can return to its original status. If the outputs are ON, turn the outputs OFF and press reset to clear the fault. |
| Green with flashing red 4 times | The safety inputs, or the SWS input, were closed before the delay time expired.<br>Open the safety input for the entire time cycle. Or connect B2 to 24V and reconfigure the GLT safety relay for retriggerable inputs. |
| Green with flashing red 5 times | The gate appears open when it supposed to be closed and locked.<br>The IN1 indicator is OFF - input signals are corrupt.<br>The 51/L61 indicator is ON - gate should be locked.<br>Possible fault conditions:<br>• Gate is open<br>• Open circuit on S12<br>• Open circuit on S22<br>• Short from S12 to S22<br>• Short from S12 or S22 to +24V DC<br>• Short from S12 or S22 to 24V Common.<br>Check the voltage at terminals S12 and S22. Both should have 24V DC.<br>Correct the fault. Press Reset to clear the flashing red indication. Press Reset again to turn the outputs ON. Cycle both input signals (or cycle power) to return the GLT safety relay to an operational state. |
| Flashing red 2 times | Upon power-up, one or more of the rotary switch settings do not agree the value that is stored in the EEPROM.<br>Return the switches to their originally configured settings and cycle power or reconfigure the GLT safety relay. |
| Flashing red 5 times | IN1 is flashing 12 times.<br>• Short circuit fault on terminal L11 to 24V.<br>• Short circuit fault on terminal L11 to ground.<br>• With OSSD guard locking or E-stop function…<br>• Short circuit fault on terminal 51 to ground.<br>Correct the fault and cycle power to the GLT safety relay. |

| Power/Status Status Indicator | Status/Faults |
|---|---|
| Flashing red 6 times | IN1 is flashing 7 times<br>• Short circuit fault on terminal 14 to ground or<br>• Short circuit fault on terminal 24 to 24V with pulse testing<br>IN1 is flashing 8 times<br>• Short circuit fault on terminal 24 to ground or<br>• Short circuit fault on terminal 24 to 24V with pulse testing or<br>• Short circuit fault from terminal 14 to terminal 24 with pulse testing.<br>Correct the fault and cycle power to the GLT safety relay. |
| Flashing red 9 times | IN1 is flashing 9 times<br>• Short circuit from terminal 51 to L61<br>• Open circuit on terminal 51 or L61<br>IN1 is flashing 10 times<br>• Short circuit fault on terminal 51 or L61 to ground or<br>• Short circuit fault on terminal 51 or L61 to 24V.<br>Correct the fault and cycle the power to the GLT safety relay. |
| Flashing red 10 times | IN1 is flashing 33 times<br>• The supply voltage exceeded 26.4V DC - Overvoltage<br>Correct the power supply and cycle the power. |

## Additional Diagnostics

The IN1 status indicator flashes additional information regarding faults that the GLT safety relay detects. Table 8 provides a description of the fault for each of the flash rates. You must inspect wiring, measure the voltages/waveforms at the respective terminals, check the configuration switches, and if necessary, report the fault to the factory.

**Table 8 - Flash Rate Fault Description**

| Flashes | Description |
|---|---|
| 0 | No fault |
| 5 | S11 pulse test fault |
| 6 | S21 pulse test fault |
| 7 | OSSD1 fault (terminal 14) |
| 8 | OSSD2 fault (terminal 24) |
| 9 | Terminal L61 |
| 10 | Terminal 51 |
| 11 | SPI fault |
| 12 | L11 fault |
| 13 | Guard locking system differs from EPROM |
| 14 | Configuration switches differ from EPROM |
| 15 | EPROM fault |
| 17 | Compare state fault |
| 22 | Cross fault |
| 23 | Wiring at B2 differs from EPROM |
| 24 | Input is open when gate is locked |
| 25 | Switch overflow |
| 30 | S12 fault |
| 31 | S22 fault |
| 32 | Main transistor fault |
| 33 | Overvoltage |
| 34 | S44 or S54 fault |

## Notes:

# Pulse Testing Functions

## Pulse Testing for Inputs

Pulse testing for the inputs is always active. The pulses are generated at terminals S11 and S21. These test pulses must be used with devices that have mechanical contacts.

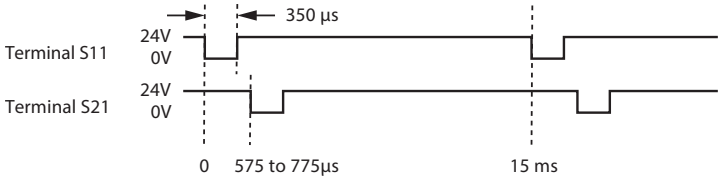
S11 is typically connected to one contact and the other side of the contact is connected to S12. S21 is typically connected to the second contact, and the other side of the second contact is connected to S22.

The test pulses are used by the GLT safety relay to detect three short circuit conditions:

1. Between the input terminals and +24V
2. Between the input terminals and 24V common
3. Between the two input terminals

Figure 24 shows the timings of the two test pulses. The pulse on S21 occurs shortly after S11. The pulses are repeated every 15 ms.

**Figure 24 - Pulse Test Signals**

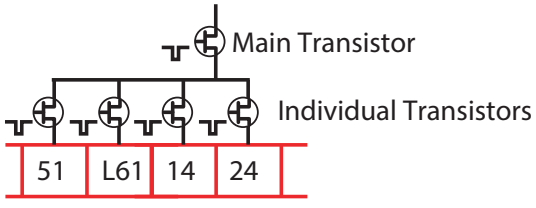



## Pulse Testing of Outputs

When the GLT safety relay configuration process starts from Logic Switch setting 0, the 14, 24, 51, and L61 outputs are pulse tested. The purpose of the pulse testing is to detect short circuits to 24V, to 24V common, and short circuits between the output terminals. The use of pulse testing allows the GLT safety relay to be used in PLe and SIL 3 applications. Without pulse testing, the GLT safety relay can only be used in applications up to PLd and SIL 2.

The outputs have built in redundancy. A main transistor supplies power to individual transistors for each output terminal as shown in Figure 25.

**Figure 25 - Output Transistor Arrangement**



When pulse testing is configured (start with Logic Setting 0), the main transistor tests the outputs, which are then tested individually. The main transistor test pulse is 50 µs wide. The pulse width on terminals 14 and 24 is 350 µs wide, and the pulse width on terminals 51 and L61 is 200 µs wide.

**Figure 26 - Output Pulse Test Width**

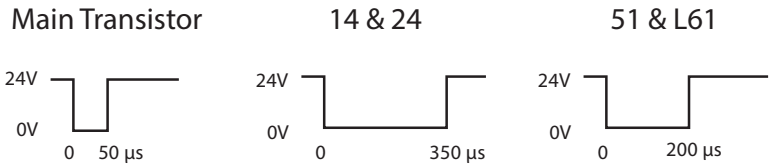



Figure 27...Figure 29 show the pulse test pattern. This pattern depends on the GLT safety relay configuration and its state. Figure 27 shows the pulse pattern for E-stop configurations. The pattern is repeated every 3750 ms.

**Figure 27 - Output Pulse Test Pattern for E-stop Functions**

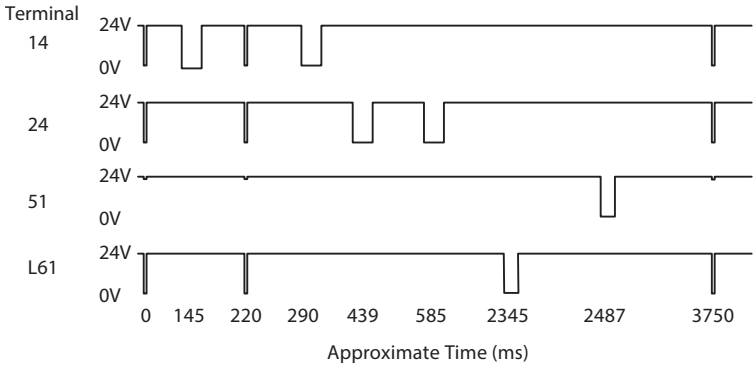



Figure 28 shows the pulse test pattern on 51 and L61 when the GLT safety relay is configured as two high side outputs. The pattern is repeated every 2639 ms.

**Figure 28 - Output Pulse Test Pattern for Two High Side Guard Locking**

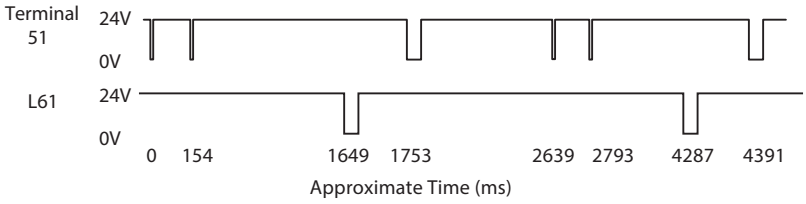
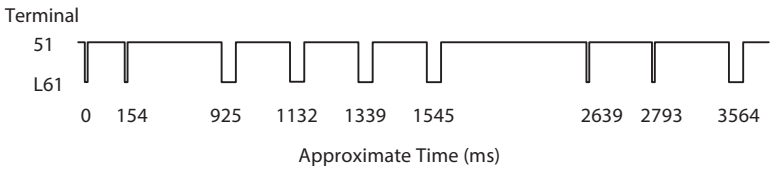



Figure 29 shows the pulse test pattern on 51 and L61 when the GLT safety relay is configured as a high side/low side outputs. Terminal 51 is referenced to L61, not 24V common. The pattern is repeated every 2639 ms.

**Figure 29 - Output Pulse Test Pattern for High/Low Side Guard Locking**



# Specifications

## General

| Attribute | 440R-GL2S2T |
|---|---|
| Dimensions, W x H x D | 22.5 x 119.14 x 113.6 mm (0.88 x 4.69 x 4.47 in.) |
| Shipping Weight, approx. | 150 g (0.33 lb) |
| Wire Size | 0.2…2.5 $mm^2$ (24…14 AWG) |
| Wiring Category | Copper that withstands 75 °C (167 °F) |
| Terminal Screw Torque | 0.4 N•m (4 lb•in) |
| Power Supply Voltage Range | 24V DC PELV/SELV<br>0.85…1.1 x rated voltage |
| Power Consumption | 2 W |
| Fuse | 4 A gG (slow blow) |
| Case Material | Polyamide PA 6.6 |
| Terminal Protection | IP20 |
| Enclosure Protection | IP40 (NEMA 1) |

## Environmental

| Attribute | 440R-GL2S2T |
|---|---|
| Operating Temperature | -5…+55 °C (23…131 °F) |
| Relative Humidity | 90% |
| Vibration | 10…55 Hz, 0.35 mm |
| Shock | 10 g, 16 ms |
| Pollution Level | 2 |

## Inputs IN1

| Attribute | 440R-GL2S2T |
|---|---|
| Input Signals (Active High) | S12, S22 |
| Input Simultaneity | Infinite |
| ON Voltage, Max | 26.4V |
| ON Voltage, Min | 11V |
| OFF Voltage, Max | 5V |
| OFF Current, Max | 2 mA |
| ON Current at 24V DC, Max | 11 mA |
| ON Current at 26.4V DC, Max | 11.1 mA |
| Galvanic Isolation: I/O from Logic | No |
| Overvoltage Protection | Yes |
| Test Out Pulse Duration | 700 µs |
| Test Out Pulse Period | 17 ms |
| Off Pulse accepted for OSSD setting without declaring the input as OFF | Min = 0 µs<br>Max = 700 µs |
| Reverse Voltage Protection | Yes |
| Input Capacitance | 10 nF |

## Lock Unlock Request

| Attribute | 440R-GL2S2T |
|---|---|
| Input Signals (Active High) | S44, S54 |
| ON Voltage, Max | 26.4V |
| ON Voltage, Min | 11V |
| OFF Voltage, Max | 5V |
| OFF Current, Max | 2 mA |
| ON Current at 24V DC, Max | 11 mA |
| ON Current at 26.4V DC, Max | 11.1 mA |
| Galvanic Isolation: I/O from Logic | No |
| Overvoltage Protection | Yes |
| Input Capacitance | 10 nF |
| Duration | 0.5…3.0 s |

## Retrigger

| Attribute | 440R-GL2S2T |
|---|---|
| Input Signal (Active High) | B2 |
| ON Voltage, Max | 26.4V |
| ON Voltage, Min | 11V |
| OFF Voltage, Max | 5V |
| OFF Current, Max | 2 mA |
| ON Current at 24V DC, Max | 11 mA |
| ON Current at 26.4V DC, Max | 11.1 mA |
| Galvanic Isolation: I/O from Logic | No |
| Overvoltage Protection | Yes |
| Input Capacitance | 10 nF |

## Outputs

| Attribute | 440R-GL2S2T |
|---|---|
| Number of Outputs | 4 |
| Output Signals (Active High) | S11, S21, 14, and 24 |
| Continuous Output Current | 0.5 A |
| Aggregate Current of Outputs per Module, Max | 1.8 A |
| Surge Output Current, Max | 1.5 A |
| Surge Output Current Duration, Max | 5 ms |
| Residual Voltage (Drop from Power Supply), Max | 0.2V |
| Max Load Capacitance | 1 µF |
| Off State Leakage Current, Max | < 0.1 mA |
| Short Circuit Protection | Yes |
| Galvanic Isolation: I/O from Logic | No |
| Pulse Test Duration | ≤700 µs |
| Pulse Test Period | ≤13000 ms (less than 15 s) |
| Maximum Resistance for the Auto Detection of a Coil | 10k |
| Maximum Resistance for the Auto Detection of an LL Device | 10k |

## Lock Unlock Signals

| Attribute | 440R-GL2S2T |
|---|---|
| Output Signals | 51 & L61 |
| Continuous Output Current, Max | 0.3 A |
| High Side Voltage, Max | 26.4V |
| High Side Voltage, Min | 15V |
| Low Side Voltage, Max | 3V |
| Surge Output Current, Max | 3 A |
| Surge Output Current Duration, Max | 10 µs |
| Load Capacitance, Max | 1 µF |
| Off State Leakage Current, Max | < 0.1 mA |
| Short Circuit Protection | Yes |

## Auxiliary Signal

| Attribute | 440R-GL2S2T |
|---|---|
| Output Signals | Y32 |
| Continuous Output Current, Max | 50 mA |
| ON State Voltage Drop (P/S to +), Max | 0.2V |
| Surge Output Current, Max | 700 mA |
| Surge Output Current Duration, Max | 5 ms |
| Load Capacitance, Max | — |
| Off State Leakage Current, Max | < 0.1 mA |
| Short Circuit Detection | No |
| Short Circuit Protection | Yes |
| Galvanic Isolation: I/O from Logic | No |

## Single Wire Safety Input Signal

| Attribute | 440R-GL2S2T |
|---|---|
| Input Signals | L12 |
| ON Voltage, Max | 26.4V |
| ON Voltage, Min | 11V |
| OFF Voltage, Max | 5V |
| OFF Current, Max | 2 mA |
| ON Current at 24V DC, Max | 11 mA |
| ON Current at 26.4V DC, Max | 11.1 mA |
| Galvanic Isolation: I/O from Logic | No |
| Overvoltage Protection | Yes |
| Reverse Voltage Protection | Yes |
| Input Capacitance | 10 nF |

## Single Wire Safety Output Signal

| Attribute | 440R-GL2S2T |
|---|---|
| Output Signals | L11 |
| Continuous Output Current, Max | 50 mA |
| ON State Voltage Drop (P/S to +), Max | 0.2V |
| Surge Output Current, Max | 700 mA |
| Surge Output Current Duration, Max | 5 ms |
| Max Load Capacitance | 1 µF |
| Off State Leakage Current, Max | < 0.1 mA |
| Short Circuit Detection | No |
| Short Circuit Protection | Yes |
| Galvanic Isolation: I/O from Logic | No |

## Recovery Times

| | Logic 1…4 | | | Logic 5…8 | | |
|---|---|---|---|---|---|---|
| | 14, 24 | L11 | Cat 1 Y32 | 14, 4 | L11 | Cat1 Y32 |
| **Reset (S44)** | 26 ms | 26 ms | 23 ms | 27 ms | 28 ms | 25 ms |

## Response Times

| | Logic 1…4 | | | Logic 5…8 | | |
|---|---|---|---|---|---|---|
| | 14, 24 | L11 | Cat 1 Y32 | 14, 4 | L11 | Cat1 Y32 |
| **Unlock Request (S54)** | 32 ms | 27 ms | 32 ms | — | — | — |
| **Single Wire Safety Input, L12** | 48 ms | 48 ms | 49 ms | 37 ms | 35 ms | 38 ms |
| **Safety Inputs (S12, S22)** | 68 ms | 61 ms | 70 ms | 55 ms | 51 ms | 57 ms |

## Notes:

# Regulatory Approvals

## Agency Certifications

- UL Listed Industrial Control Equipment, which is certified for US and Canada.
- CE marked for all applicable directives
- C-Tick marked for all applicable acts
- CCC Mark
- S-Mark

## Compliance to European Union Directives

This product has the CE marking and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

### Machine Safety Directive

This product is designed and tested to meet the European Council Directive 2006/42/EC on machinery and the following standards.

- IEC/EN 61508 - Functional safety of electrical/electronic/ programmable electronic safety-related systems
- IEC/EN 62061 - Safety of machinery - Functional safety of safety-related electrical, electronic, and programmable electronic control systems
- EN ISO 13849-1 - Safety of machinery -- Safety-related parts of control systems -- Part 1: General principles for design.

This product is intended for use in an industrial environment.

The performance of the safety function is dependent on the structure of all devices that comprise the safety function. The following two tables provide the data that must be used to represent the GLT when calculating the safety integrity level (SIL) or the Performance Level (PL).

## SIL Rating

The GLT safety relay can be used in applications up to SIL 3 in accordance with IEC 61508 and IEC 62061.

| | |
|---|---|
| **Safety Integrity Level Claim Limit** | 3 |
| **PFD** | 1.43 E-3 |
| **PFH** | 8.11 E-9 |
| **Mode of Operation** | High demand |
| **Hardware Fault Tolerance** | 1 |
| **Safe Failure Fraction** | 99% |

## Performance Level/Category

The GLT safety relay can be used in safety systems that meet up to Category 4 and Performance Level PLe in accordance with ISO 13849-1.

| | |
|---|---|
| **Category** | Up to 4 |
| **Performance Level** | Up to e |
| **MTTFd** | 352 |
| **DC Avg** | 99% |
| **Mission Time (a)** | 20 |
| **Days of Operation (d)** | 365 |
| **Hours of Operation (h)** | 24 |
| **t Cycle (h/s)** | 8/28.8 |

## EMC Directive

This product is designed and tested to meet the European Council Directive 2004/108/EC on Electromagnetic Compatibility (EMC) and the following standards:

- EN 61000-6-4: Generic Standards - Emission Standard for Industrial Environments
- EN 61000-6-2: Generic Standards - Immunity for Industrial Environments

This product is intended for use in an industrial environment.

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## 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. | https://rockwellautomation.custhelp.com/ |
| **Local Technical Support Phone Numbers** | Locate the phone number for your country. | http://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. | http://www.rockwellautomation.com/global/support/direct-dial.page |
| **Literature Library** | Installation Instructions, Manuals, Brochures, and Technical Data. | http://www.rockwellautomation.com/global/literature-library/overview.page |
| **Product Compatibility and Download Center (PCDC)** | Get help determining how products interact, check features and capabilities, and find associated firmware. | http://www.rockwellautomation.com/global/support/pcdc.page |

## Documentation Feedback

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