Safety Update 2017
What is a Risk Assessment and Why should I do one?
WHY?

Under the OSHA law, employers have a responsibility to provide a safe working environment for their employees.
Follow the Safety Life Cycle!

1. Assessment
   - Identifies Task & Hazards Pairs

2. Functional Safety System Requirements
   - Outlines functional requirements of the safety system

3. Design and Verification
   - Circuit & Component Selection
   - Safety System Design
   - Design Verification
   - Guarding design

4. Installation and Validation
   - Final site assembly
   - Commissioning
   - Validation
   - Final Assessment Validation

5. Operate, Maintain and Improve
   - Detailed operational specification
   - Required maintenance schedule
   - Preventive maintenance schedule

Steps 1 & 2 help to define system requirements prior to the selection & design process!
Step 1 in the Machinery Safety Lifecycle is the Assessment!

Proper safety system development starts here!

1. Assessment
2. Functional Requirements
3. Selection, Design & Verification
4. Installation & Validation
5. Operate, Maintain & Improve
The assessment is used to identify the risk associated with operating a machine/system!

What is an assessment and how do I do it?

Risk Assessment Process according to ISO12100 & ANSI B11.0

1. Machine Characteristics/Limits
2. Task & Hazard Identification
3. Risk Estimation
4. Risk Evaluation
   - OK
   - Too High
5. Risk Reduction
   - Risk Tolerable
The Proper Approach: A standards based methodology.

- Both US and International standards require a systematic approach for safety system development which starts with a risk assessment!
- So which method is right for you?

ANSI/RIA TR15.306 Method

ISO 13849 Method

Either is OK as long as you are following a risk assessment and risk reduction method!
Step 2 is the safety requirements specification!

The SRS defines the functional requirements of the machine/system!
The main reason for developing a SRS

- It identifies how the machine is to operate in each mode of operation for each person that interacts with the machine.

- It identifies special needs like: (Safe-speed/Safe-direction/Zone control/Etc.)

- It also identifies any special operational characteristics that are needed.

The SRS defines the solution!
Step 3 is the selection, design & design verification phase.

This step focuses on safety system design, product selection, circuit selection and design verification!
Mitigation Technique Selection

Hierarchy of Protective Measures

1. Design it out
2. Fixed enclosing guard
3. Monitoring Access / Interlocked Gates
4. Awareness Means, Training and Procedures (Administrative)
5. Personal protective equipment

Most Effective

Least Effective
We do design verification by selecting a structure, calculating reliability and diagnostic coverage to ensure it meets the desired PL!

How do I verify my design!

Design verification considerations:
- What do I need to do to verify the design?
- Select the stem structure
- Component reliability data/MTTFd or B10d
- Diagnostic capability/DC.
- Design verification method/tool.
This requires a lot of math unless you use a tool!

**MTTFd Mean Time to Dangerous Failure**
- Low: 0 - 10 Years
- Medium: 10 - 30 Years
- High: 30 - 100 Years

**DC Diagnostic Coverage** = Detected Dangerous Failures / All Dangerous Failures
- None: DC < 60%
- Low: 60 < DC < 90%
- Medium: 90 < DC < 99%
- High: DC > 99%

Do the math or use tools like SISTEMA or Safety Automation Builder.
Step 4 ensures that the system was installed properly and that the system functions as intended!

This requires a documented installation plan and a documented process for verifying and validation that the system operates as intended.
The installation plan should address specific instructions for the installation of the safety system.

- **Installation considerations:**
  - There should be specific instructions regarding physical barrier installation!
  - There should be specific instructions regarding safety product installation and wiring!
  - There should be specific instructions regarding wiring methods and grounding!
  - There should be specific instructions regarding panel fabrication and wiring!
  - There should be specific instructions regarding signage installation and location!
  - There should be specific layout drawings showing a routing, mounting and installation instructions!
  - There should be specific electrical schematics regarding terminations & connections.
There should also be a defined Verification & Validation Process that includes fault injection.

How do I validate my safety system?
Step 5: Operate, maintain and improve ensures that the system is operated properly and that the system is maintained. Step 5 focuses on ensuring that the safety system remains effective.

Tools and Downloads

- Safety Automation Builder
- Pre-engineered Safety Functions
- Download SISTEMA Software
- Safety Maturity Index Tool
- Safeguard 4 – A Guide to Machine Safety
- Whitepapers
- Safety Webinar
- Safety ROI Tool
- Palletizer Application Guide

Quick links:
- Download Safety Automation Builder NOW!
- Download Safety Functions
- Request a Risk Assessment Service
- Book a TÜV Certified Training Course
- Get Machinery Safeguard 4

Discover more:
- Safety Products
- Services & Training
- Industry Solutions

Tools and Downloads

Complex machinery, safety standards, and contemporary equipment require a deep understanding of each to implement safety solutions that protect workers, improve productivity, and achieve compliance.

Below, we’ve provided you with a variety of tools to help you achieve these goals.

Safety Automation Builder
Irresistible software designed to help simplify machine safety system design and validation.

Pre-engineered safety functions for machines
Machine safety can be developed by combining blocks of safety functions to produce a complete safety solution.

Download SISTEMA Software
Calculate the Performance Level from the safety-related parts of a control system to EN ISO 13849-1.

Safety Maturity Index
The Safety Maturity Index is an invaluable tool that offers visibility into safety processes.

Safeguard 4 – A Guide to Machine Safety
Practical guide to the principles of machine safety, legislation, theory and practice.

Whitepapers
Exploring a range of topics related to safety systems, practices, performance and productivity.

Safety Webinar
Watch this safety webinar from one of our Rockwell Automation safety engineers.

Safety ROI Tool
The evidence is clear: safety is good business. Find out how you quantify the savings and productivity gains from safety investments.

Read more

Read more

Read more

Read more

Read more

Read more

Read more
Safety Component Update
Features and Benefits

- Combines multiple functions – door handle, guard interlock, guard locking, control panel and escape release – for a complete machine guarding solution with safety over Ethernet/IP
- EtherNet/IP connection saves time and money compared to wiring the standard device
- Easy integration using an add-on profile in Studio 5000 Logix Designer™
- Rated PLe, Cat 4 for interlocking, guard lock monitoring and control of guard locking
- Unique RFID coded bolt actuator achieves the highest level of tamper-resistance in accordance with ISO 14119
- Meets the new ISO 14119:2013 requirements
- Suitable for hinged or sliding guards
- Optional escape release
- Door handle rotates in 90° increments to suit the installation
- Up to 4 controls and indicators including an E-stop push button
Allen-Bradley® Guardmaster® 442G Multifunctional Access Box with Safety over Ethernet/IP

Ideal for Full Body Access

- High Holding Force
- Wide Misalignment Tolerance
- Escape Release Available
- Integrated Door Stop

Secure

- Rated Performance Level e Category 4 EN ISO 13849-1 for door position monitoring and lock monitoring
- Meets ISO 14119 Requirements
- RFID Uniquely Coded Actuator

Application Flexibility

- Available in PTR or PTL
- Choice of Controls
- Left or Right-Hand Opening
- Sliding or Hinged Doors
- Optional Escape Release

- Optimized for Profile Mounting
- 4 Status/Diagnostic Indicators
- Supports Reset without Power Cycle
- Integrated Bolt Locking Mechanisms
- CIP Safety over E/IP Interface with Add-on Profile for Studio 5000 Logix Designer®
CR30 Software Configurable Safety for machine safety applications
- PLe and SIL 3
- 22 Safety I/O
- Supports expanded standard I/O via plug-in
- Configured using free Connected Components Workbench™ software
- Intuitive software simplifies configuration
Allen-Bradley® Guardmaster® 440C-CR30
Software Configurable Safety Relay

- Configurable LED Indicators
- RS232 Serial Port (non-isolated)
- USB Programming Port
- 6 Configurable Safety Terminals (N.C. Inputs, N.O. Inputs, Test Sources, or Outputs)
- 2 Single-Wire Safety or Safety N.C. Inputs
- Two Plug-in Slots
- DIN Rail or Panel Mount
- 2 Safety Outputs
- 2 Single-Wire Safety or Safety Outputs
Allen-Bradley® Guardmaster®
SC300 Hand Detection Safety Sensor

- Compact die-cast aluminum housing is designed to be mounted to the inside of, or to the side of a frame
- Angular field of view of 110°
- No software required to program monitored opening area
- PLd (EN ISO 13849), SIL2 (IEC 61508), Type 3 (IEC 61496), Category 3 (EN ISO 13849)
- Horizontal or vertical mounting
- Integrated EDM, ReStart/Reset and Teach-in
800F-1YMD51 E-Stop Station

- Factory assembled with M12 QD For use with 5 pin Patchcord
- Illuminated when activated
- 2 NC Circuits (safety)
- 1 NO Circuit (illumination)
- 24V AC/DC
- External panel mounting holes
800F-1YMD51 Wiring Diagram

**Safety Relays**
- Ch.2 (S22/X2)
- Ch.1 (S12/T12)
- Ch.1 (S11/T11)(24 V)
- 0 V DC
- Ch.2 (S21/X1)(0 V)

**OnMachine I/O**
- In n+1
- In n (no test pulse)
- 24 V DC Power
- 0 V
- Test Source n+1

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**E-Stop**

- Dual Circuit
- SMCB
- Pin 4
- Pin 2
- Pin 1
- Pin 3
- Pin 5

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GSR - Guardmaster Safety Relays
RA Safety Relays

- MSR – Minotaur Safety Relay
- MSR6 – Rockwell Automation’s first electromechanical safety relay series
- MSR100 – 2nd generation of electromechanical relays
- MSR30 – Rockwell Automation’s first solid state safety relay family
- MSR200 – modular safety relay series
- MSR300 – modular configurable relay series
- Next Gen Guardmaster Safety Relay – Compact family of Logic Configured Compatible Relays *(Fewer part numbers can replace a broader range of legacy products)*
AB Safety Relay Family Positioning Overview

Price

Single Function

Configurable/Modular

Specialty

MSR57

MSR22LM / MSR42
(Light Curtain Muting)

MSR125
(2 Hand Control)

Next Generation Guardmaster Safety Relays

MSR100 Relays

MSR200 Relays

MSR300 Relays

MSR127

MSR126

Safedge Controller
Next Generation Safety Relays

Concept & Innovations

Universal Input – automatic input type detection
- A single catalog number to support all types of safety components
  - e-stops
  - switches
  - mats
  - light curtains
- 6 part numbers will cover a majority of safety applications with consistent wiring.

Single-Wire Safety Connection – maintains PL e, SIL 3
- (Single Channel Safety Input) TÜV approved concept of one-wire connection to expand and cascade safety functions to SIL3
  - Simplifies wiring
  - Increases number of I/O on terminal
  - Maintains PLe, SIL3 rating
  - Dynamic signal

Dual Input = 2 safety inputs each two channels
- Twice the functionality of a single input dual channel relay in a 22.5mm housing. Reduced wiring for commissioning and multiple inputs can have logic configured simply in a single relay.

Single Rotary Switch – setting of Logic Functions, Reset, Timing
- TÜV approved concept to eliminate double switches.
- Unique validation method.
- Expedites configuration
- Single device can address a broader range of reset modes, time delays, etc.

Scalable platform to address single- and multi-zone applications for a variety of standard and special functional requirements
Universal Inputs

Universal Input

- All sensor types go to same terminals
- Automatic cross-loop monitoring – no configuration by switch setting or hardwired-jumper required
- Supports both single-channel and two dual-channel safety inputs
- Two dual-channel inputs on DI models configured by logic switch
- All Faults including Cross-Loop are detected by test outputs S11 and S21

Cable Pull Switches  E-Stop  Light Curtains  Laser Scanners  Contact Interlocks  Hinge Switches  Non Contact Interlocks  Grip Switches  Safety Mats
A single wire safety connection is used to expand and cascade multiple relays while maintaining a PLe / SIL3 rating.

A dynamic signal with specific test patterns is transmitted through a single wire which is the only signal the input will recognize. (Any other signal will be a fault)

- Terminal L11 – sends the Logic signal (output)
- Terminal L12 – receives the Logic signal (input)

Single Wire Safety input (L12) can be configured with safety inputs of device using AND/OR logic

- Safety functions can be cascaded through multiple zones
- Expansion modules are easily added to a base relay while leaving all safety outputs of base module available for use
The relationship between the two safety inputs & the Single Wire Safety (SWS) Input (L12) can be configured with AND/OR logic.

Hence 4 logic combinations are available:

1. L12 OR (IN1 OR IN2)
2. L12 OR (IN1 AND IN2)
3. L12 AND (IN1 OR IN2)
4. L12 AND (IN1 AND IN2)

Safety outputs and single wire safety (SWS) output (L11) become active after valid reset (S34).

A HIGH signal on IN1, IN2 and a valid SWS signal on L12 is considered to be true in this logic. So if an input is to be ignored or muted, OR logic should be used.
Configuration

Selectable functions

- 4 Logic conditions for safety inputs and the Single Wire Safety input (L12)
- Reset modes – automatic/manual and manual monitored reset
- Timing configuration (EMD) – Time needs to be configured before operation.
- Easy to configure:
  1. Set Device to "0"
  2. Power Up device. Relay is now in configuration mode
  3. Turn rotary switch to desired logic & reset value (see table). Power LED will glow green and Input 1 LED will provide feedback of position.
  4. Cycle power to lock in configuration.
  5. Relay maintains setting until configuration process is repeated.

Single input devices only need reset mode configured

Dual input devices configure logic between inputs and reset mode.

Time delay expansion modules configure output type and time delay.
Single Input Dual Channel Devices

**Single Input Dual Channel (SI)**

- Same terminal layout as DI (but only has one set of safety inputs)
- One dual channel input
- Single Wire Safety Output
- Configurable for reset
- 24V DC supply voltage
- 2 N/O safety outputs and 1 PNP aux. Output

**Compatible Input Dual Channel (CI)**

- Compatible to MSR127
- One dual channel input
- Configurable for Reset
- 24V DC supply voltage
- Single wire link output only
  - configurable as aux. PNP output
- 3 N/O safety outputs, 1 N/C aux.
Dual Input Dual Channel Devices

**DI**
- 2 safety inputs
- Configurable for Reset and logic
- 24V DC supply voltage
- Full single wire cascading capability
- 2 N/O safety outputs, 1 PNP aux.

**DIS**
- 2 safety inputs
- Configurable for Reset and logic
- 24V DC supply voltage
- Full single wire cascading capability
- 4 PNP safety outputs (most applications use one pair or the other), 1 PNP aux.
  - 14, 24 up to 1.5A
  - 34, 44 up to 500mA - special filters on output to prevent false trips in applications with high capacitive loads (eg. Drives)
Expansion Modules

EM
- 24V DC supply voltage
- Full single wire cascading capability
- 4 N/O safety outputs, 1 PNP aux.

EMD
- 24V DC supply voltage
- Full single wire cascading capability
- Timer functions (TM, EMD):
  - delay-on energization,
  - delay-on de-energization,
  - jogging (single pulse for teach-in)
- Selectable time delays
  - Time x Factor = 0...300s
- 4 N/O delayed safety outputs, 1 PNP aux.
Diverse Inputs

Application Example: Light Curtain & E-stop

- Simple system where breaking a light curtain beam or hitting an e-stop stops a machine

• Universal input allows various types of safety devices to be connected to the relay
• Dual input relay can handle 2 dual-channel devices, simplifying wiring and commissioning
• Rotary switch on front of device configures reset mode and logic between two devices (“AND” logic shown)

Legacy Solution

Next Gen. Solution

The new generation relay’s ability to communicate with a broad range of safety devices reduces hardware and simplifies wiring needed to configure systems.
Global e-stop

- The SI relay controls the global e-stop which distributes its signal over the single-wire safety output which is wired to all zones in parallel, maintaining PL e, SIL3
- Multiple devices dedicated to one zone through dual input relays.
- Each DI relay is dedicated to a zone which is supporting multiple devices through "AND/OR" configuration (here single wire input is "AND" with safety inputs which are also "AND")

Application Example: Printing Machine
- Global E-Stop through multiple zones

Single wire safety connection wired in parallel provides fast integration of a global e-stop to multiple zones
Guardmaster® Safety Relays
GLT – Guardlocking with time delay

440R-GL2S2T – GLT

- 2-ch safety inputs with test pulse evaluation
- 2 inputs for lock and unlock request
- 2 pairs of OSSD outputs
- Catalog Number: 440R-GLTS2T, PGC: 28A, Discount code: E8
  - Same as all other GSR
- Compatible with 440R-ENETR and available in RS Studio 5000 AOP
- Supports 2-Channel unlock-signal achieving PLe
- Two functions

Guard Locking with time delay
Immediate and delayed stop upon

[Diagram showing speed over time with guard locking]
GuardMaster Safety Relays
GLP - Guard Locking with Speed Monitoring

Line Extension to the new family of Guardmaster Safety Relays GSR for application with guard locking functions

Case 1: Unlock door as soon as motor has stopped
Machine must be stopped e.g. to change workpieces or to adjust machine settings

Case 2: Operate machine at safe speed
The machine must sometimes be operated for irregular operations, such as maintenance.

GLP – Guard Locking with Prox.
Input
440R-GL2S2P
Lifeline™ 5 Safety Cable-Pull Switches
Product Overview

- Same mounting as the Lifeline™ 4 Cable-Pull Switches
- Quick disconnect version
- Optional emergency stop button
- Uses standard installation kits
Features:

- Solid-state operation – the first in the industry
- Enhanced safety and productivity with microprocessor-based
- Performs at the highest safety ratings, even in series connection
- TÜV Approved
  - PLe Cat 4 according to EN ISO 13849-1
  - SIL CL3 per IEC 62061 and IEC 61508
  - EN ISO 13850 and IEC 60947-5-5
- 100 m (328 ft) maximum cable span
- Electronic rope monitoring system monitors the cable span and compensates for thermal expansion
- Built in margin indication helps reduce downtime
- Wide operating temperature range -20°C to 75°C (-4°F to 167°F)
- 270-degree visible LED indicators offer diagnostic for switch and tensioning setup
- Rugged stainless steel (IP69K) or die cast aluminum (IP66) housings with optional e-stop
- Available with a 5- or 8-pin Micro M12 connector
- OSSD outputs
  - 2 OSSDs for safety
  - 1 Auxiliary
  - 1 Tension/margin (8-pin model only)

A significant technology advantage over the competition
<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
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<tr>
<td>Plant availability – no shut downs</td>
<td>Increase productivity</td>
</tr>
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</table>

- Random trips due to cable expansion
- Frequent re-adjustment of cable tension
- Operator leaning on cable
- Therma Expansion

- Electronic monitoring of the cable to reduce false trips from thermal changes or operator leaning on cable
- Solid-state safety outputs
- Tension indication
Built in margin indication to monitor rope tension:
If the status indicators are green and the tension indicator is flashing amber, the rope/cable requires maintenance/adjustment before the machine shuts down.

5x better than traditional cable-pull switches at maximum cable span
Customer Values – Time to Market

**Problem**

Commissioning and Installation

- Lack of visual indication of cable tension and status

**Solution**

Easy to Operate and Install

- Flexible mounting helps reduce installation time
- 270-degree visible LED indicators
- Easy to set up cable tension with bright indicators
## Problem

**Product Damaged**
- Bent nose assembly

**Environmental**
- Corrosion inside the unit

## Solution

### Application Flexibility

- Rugged die cast aluminum or stainless steel housing
- Long cable span
- Optional emergency stop button
- Large operating temperature range

[Image of different types of pushbuttons: Stainless Steel, Die Cast Aluminum, Optional Integrated E-stop pushbutton.]
Typical Applications

- Material handling equipment
- Distribution centers
- Food and beverage
# Ordering Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
<th>Outputs</th>
<th>Connection</th>
<th>Connection Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifeline 5 with e-stop</td>
<td>440E-LL55E5</td>
<td>2 OSSD Outputs, 1 Aux Output</td>
<td>5-Pin Micro (M12)</td>
<td>889D-FSAC-2</td>
</tr>
<tr>
<td></td>
<td>440E-LL55E8</td>
<td>2 OSSD Inputs, 2 OSSD Outputs, 1 Aux Output, Tension Output</td>
<td>5-Pin Micro (M12) Connect to ArmorBlock Guard I/O</td>
<td>889D-F4ACDM-2</td>
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Accessories

Lifeline™ Rope Tensioner System (LRTS)

Inside Corner Pulley

Outside Corner Pulley

Stainless Steel Turn Buckle

P Bolt and Eye Bolt

Lifeline™ Stainless Steel Installation Kit – Polypropylene and UV Resistant Polypropylene Cable

Lifeline 5 Tensioner Spring
Wiring Examples

T-port system with no Enunciation

- Lifeline 5 With E-Stop
- Lifeline 5 Without E-Stop
- Lifeline 5 Stainless Steel
- Device Cordset
- Device Patchcord (Typical)
- Safety-Wired Splitter/T-Port
- Shorting Plug

100 M

5000 M
Wiring Examples

4 and 8 port safety distribution box with enunciation

- Lifeline 5 With E-Stop
- Device Patchcord (Typical)
- Lifeline 5 Stainless Steel
- Shorting Plug
- Lifeline 5 Without E-Stop
- Tower Light
- Safety-Wired Distribution Box
- Enclosure
- PLC
- Safety Relay or Safety PLC
**Wiring Examples**

**Guard I/O EtherNet/IP Safety Module**

**Important:** For Lifeline™ 5 Connected to ArmorBlock® Guard Safety I/O, the recommended patchcord is 889D-F4NBDM-2. For additional lengths replace the -2 (6.5 ft) with -5 [for -5 m (16.4 ft)] or with -10 [for -10 m (32.8 ft)] for other standard cable lengths.
GuardShield™ 450L
Most advanced Safety Light Curtain in the Market
450L-B Safety Light Curtain

Features

- Slim design
- Finger or hand Resolution
- Indicators Provide Status and Diagnostics
- Optical Interface for Diagnostics
- Easy Top/Bottom mounting
- Unique stick architecture
- Advanced plug-in technology
GuardShield 450L POC

Platform Overview

- **Modern Compact** design
  - 30 mm x 30 mm (1.2” x 1.2”) IP65 profile
  - Available in lengths of 150 mm (5.9”) increments up to 1.95 m (6.4’)
  - IP65 rated

- Patented Universal Transceiver design **Reduces Inventory**

- **Ease of Use** with unique Plug-in System
  - Plug-in module provides application specific functionality

- Active sensing over entire length allows for **Flexible Mounting**
  - Top/bottom or side mount with no loss of resolution

- Advanced Safety Light Curtain **Platform**
  - Two models provide functionality based on application requirements

- **Highest Safety**: Type4 (IEC 61496), PL e (EN 13894), SiL 3 (IEC 61508)
GuardShield 450L Architecture
Unique Transceiver Design

- Traditional Safety Light Curtain Architecture
  - Two different sticks (a Transmitter [Tx] and a Receiver [Rx]) build one system.

- Unique GuardShield 450L Architecture
  - Two identical sticks (two Transceiver T/Rx) build one system and the plug-in defines functionality.

Identical stick design reduces inventory, efforts for logistics & maintenance
(“Stock only one stick type instead of two types!”)
GuardShield 450L-B
Supported functionalities

- Broad application support
  - Finger resolution (14 mm): 0.5 … 4 m (1.64 … 13.12 ft)
  - Hand resolution (30 mm): 0.9 … 6.5 m (2.95…21.33 ft)

- Bottom plug-ins support
  - OSSD Output
  - Reset
  - EDM
  - Operating Range

Advanced technology that reduces total cost of ownership
GuardShield 450L-B
Plug-Ins

- Transmitter
  - M12, 5-Pin: 450L-APT-PW-5
  - M12, 8-Pin: 450L-APT-PW-8

- Receiver: On/Off
  - M12, 5-Pin: 450L-APT-ON-5

- Receiver: EDM, Start, Range
  - M12, 8-Pin: 450L-APT-ED-8

- Universal Plug-in
  - Acts as Transceiver or Receiver depending on wiring
  - M12, 8-Pin: 450L-APT-UN-8
GuardShield 450L-E
Enhanced Functionality

- Patented Integrated Laser Alignment
  - Provides for quick installation
- Solve more complex applications
  - Supports L or U shape cascading
  - 2 and 4 sensor Integrated Muting
  - Blanking
- Extended working range
  - Finger resolution (14 mm) up to 7m (23 ft)
  - Hand resolution (30 mm) up to 16m (53 ft)

Capable of solving the most Complex Applications
GuardShield 450L
Status and Diagnostic

450L-B

Cascading
Blanking
Muting
Reset
Regional intensity
OSSD
Tx/Rx
Fault
Optical Communication Interface (for diagnostic with CCW)
Laser alignment

450L-E
GuardShield 450L
450L Mounting Accessories

- Mounting Brackets
  - Top and Bottom (included)

- Optional 450L-AM-SM Side Mount

- Existing 445L-AF6140 and 445L-AF6141 are also supported
GuardShield 450L

450L Accessories

- OID 450L-AD-OID
  - Optical interface device with USB connection
  - Enables use with CCW

- Laser alignment tool adapter 450L-ALAT-C
  - (use together with 440L-ALAT)

- Weld shield 450L-AW-xxxx
  - xxxx = 0150 … 1950 mm (0.5 … 6.4 ft) in increments of 150 mm (0.5 ft)
GuardShield 450L
450L-B Selection Guide

1. Select Required Protection
   • Resolution and Size
     • For a system you will need 2 of these (a Stick on each side of the protected area)

   \[
   450L-B4 \times N \times \times \times YD
   \]
   - Resolution
   - Hand: H
   - Finger: F
   - 0150 mm (5.91 in.)
   - 0300 mm (11.82 in.)
   - 0450 mm (17.73 in.)
   - 0600 mm (23.64 in.)
   - 0750 mm (29.55 in.)
   - 0900 mm (35.46 in.)
   - 1050 mm (41.37 in.)
   - 1200 mm (47.28 in.)
   - 1350 mm (53.19 in.)
   - 1500 mm (59.1 in.)
   - 1650 mm (65.01 in.)
   - 1800 mm (70.92 in.)
   - 1950 mm (76.83 in.)

2. Select Functionality
   • Transmitter and Receiver or 2 Universal Plug-ins

<table>
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<tr>
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<th>Receiver (Rx)</th>
<th>Universal (Tx or Rx)</th>
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<td>5-Pin 450L-APT-PW-5</td>
<td>On/Off 450L-APR-ON-5</td>
<td>450L-APU-UN-8</td>
</tr>
<tr>
<td>8-Pin 450L-APT-PW-8</td>
<td>EMD 450L-APR-ED-8</td>
<td></td>
</tr>
</tbody>
</table>
450L-B Safety Light Curtain
FAQs

- What exactly do I have to buy to set up a complete system?
  Two identical sticks. Then you need a plug-in for each stick. You can order transmitter and receiver plug-ins (one of each) or two universal plug-ins.

- What is the universal plug-in for?
  The universal plug-in can be used for either the transmitter or the receiver and requires an 8-pin connection cable. Depending on the wiring it acts like a transmitter or as a receiver plug-in. This plug-in also provides for simplified logistics as a single plug-in part number can be used for every transmitter or receiver stick.

- How are the different functionalities set?
  The receiver plug-ins are outfitted with DIP switches to select the requested functionality. No software is required.

- Can I use the 450L-B in an application where the device is mounted horizontally?
  Yes, it is possible to mount a 450L-B stick in any orientation, as long as the proper safety distance is maintained.

- What is the response time of the new safety light curtain system?
  The response time of a 450L-B system depends on length and resolution. As a rule of thumb, more beams cause a longer response time. The time varies between 15 ms and 25 ms.
Safety Light Curtain Applications

Typical Types

Point of Operation (POC)
- Allows frequent and easy access to point of operation hazard
- Light Curtain may automatically reset when operator removes hand or arm from hazard
- Safety Light Curtain Resolutions;
  - 14 mm Finger Protection
  - 30 mm Hand Protection

Perimeter Access (PAC)
- Opto electronic fence with multiple sided protection
- Allows easy Perimeter Access.
- Must be manually reset, external to work cell
- Typically 2, 3 or 4 beams for Whole Body detection

Area Access (AAC)
- Allows easy access.
- Must be manually reset external to work cell
- Single Beam
- Short (20M) or Long (70M) range
- Whole Body Detection

450L-B & 450L-E
## Applications
### Point of Operation Control (POC)

<table>
<thead>
<tr>
<th>Application Types and Examples for POC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On / Off</strong></td>
</tr>
<tr>
<td>• Basic assembly equipment</td>
</tr>
<tr>
<td>• Light curtain at load / unload point</td>
</tr>
<tr>
<td>and operator uses two-hand control or</td>
</tr>
<tr>
<td>foot switch for actuation</td>
</tr>
<tr>
<td>• Pick and place machine on in-feed</td>
</tr>
<tr>
<td>• Frequent maintenance access</td>
</tr>
<tr>
<td><strong>Advanced Function</strong></td>
</tr>
<tr>
<td>• Blanking – Conveyor or product in</td>
</tr>
<tr>
<td>sensing area (Many Mechanical Power</td>
</tr>
<tr>
<td>Press Applications)</td>
</tr>
<tr>
<td>• Cascading – Two or Three light</td>
</tr>
<tr>
<td>curtains interconnected</td>
</tr>
<tr>
<td>- Prevents reach-over or pass through</td>
</tr>
<tr>
<td>- Larger detection area</td>
</tr>
<tr>
<td>- 2 protective areas, e.g. front &amp; sides</td>
</tr>
<tr>
<td><strong>Specialty</strong></td>
</tr>
<tr>
<td>• Press - Shock and Vibration Isolators</td>
</tr>
<tr>
<td>• Food &amp; Beverage – Wash down enclosures</td>
</tr>
</tbody>
</table>

![Image of POC devices: 450L-B and 450L-E]
New Safety Light Curtain Platform
POC Positioning Overview

SC300 Hand Detection Safety Sensor

Micro400 with MSR41 Controller

450L-B

Safe 4 ON/OFF

Micro 400 with MSR42 Controller

Micro 400 IP69K

GuardShield Type 4

450L-E

Price

Functionality

(ON/OFF)

(Advanced)
Upcoming New Product

- SafeZone 3
  - Ethernet

- GuardLink
  - Smart Tap, GSR DG, Gateway and AOP
Machine Safety with GuardLogix

GuardLogix & Compact GuardLogix and Safety IO for machine safety
The Safety Life Cycle

5. Operate, Maintain and Improve
   Detailed operational specification
   Required maintenance schedule
   Preventive maintenance schedule

Follow the Safety Life Cycle!

4. Installation and Validation
   Final site assembly
   Commissioning
   Validation
   Final Assessment Validation

3. Design and Verification
   Circuit & Component Selection
   Safety System Design
   Design Verification
   Guarding design

2. Functional Safety System Requirements
   Outlines functional requirements of the safety system

1. Assessment
   Identifies Task & Hazards Pairs

Steps 1 & 2 help to define system requirements prior to the selection & design process!
**Safety Control Positioning**

### Compact GuardLogix
- High performance integrated safety
- Standard, Safety, and Motion control
- CIP Safety on EtherNet/IP
- Superior ease-of-use for SIL2, SIL3, PLe safety functions
- High Integrity AOIs

### GuardLogix
- High performance integrated safety
- Standard, Safety, and Motion control
- CIP Safety on DeviceNet, ControlNet, Ethernet
- Superior ease-of-use for SIL2, SIL3, PLe safety functions
- High Integrity AOIs

### Armor GuardLogix
- Full capabilities of GuardLogix
- SIL3, PLe, CAT 4 safety control
- IP67 wash-down protection
- 2 independent dual EtherNet/IP ports w/ DLR support
- 24VDC pass-through power

---

**GSR & MSR Safety Relays**
- Cover most safety functions
- Modular expansion
- Configurable

**CR30 Guardmaster® CR30**
- Software Configurable Safety Relay
- Supports up to 10 safety input circuits and up to 5 safety output zones
- 22 Safety I/O; expandable by up to 16 standard I/O
- One software supports Guardmaster CR30, Micro800®, PowerFlex®, and PanelView™ Component

**SmartGuard 600**
- Dedicated safety controller with EtherNet/IP connectivity
- 16 safety inputs / 8 safety outputs / 4 std outputs
- Networked safety I/O expansion (CIP Safety on DeviceNet)

---

**Safety System Complexity / Functionality**
Safety Relay/Safety Controller/Safety PLC Selection Matrix

**Safety Relays**
- 1 Zone
- Local/Hardwired I/O
- Simple Safety Logic
- 1 to 2 dual channel Inputs
- 2 to 3 outputs

**Safety Controllers & Expandable / Configurable Relays**
- 1 to 3 Zones
- Local & Distributed I/O
- Simple & Semi-complex Safety Logic
- 1 to 10 dual channel Inputs
- 1 to 10 outputs
- Basic Diagnostics thru PLC

**Safety Controllers - GuardLogix**
- More Than 3 Zones
- Distributed I/O
- Simple & Complex Safety & Standard Logic
- 1 to 200 dual channel Inputs
- 1 to 200 outputs
- Advanced HMI Diagnostics
GuardLogix Benefits

- **Single controller** for Standard Motion and Safety Control
  - No Extra Time For Data Integration
  - Better diagnostics, Easy data sharing up to HMI

- **Single network** for Standard, Motion & Safety Control
  - No special network or gateways for IOs
  - Ability to mix and match with standard IOs

- **Single Software** for Standard and Safety Control
  - Same look & feel, Speeds up application building
  - Design Flexibility saves time

- **Built-in Safety Functions** for ease of use
  - Certified Safety instructions (More than 100)
  - Also facilitates to create your own (AOI)
GuardLogix Controllers

- **GuardLogix - Integrated Safety**
  - Dual Processor Solution (1oo2 Architecture)
  - Up to Cat 4, SIL 3 Certification per IEC 61508
  - ISO 13849 Performance Level e (Category 4)
  - Certified Safety Application Instructions
  - CIP Safety over DeviceNet and EtherNet/IP

1002 Architecture
SIL3 (IEC61508)
PLe (ISO13849)

Compact GuardLogix
1766-L30ERMS
1769-L33ERMS
1769-L36ERMS

GuardLogix Controllers: 1756-L71S, L72S, L73S
GuardLogix Safety Partner: 1756-L7SP

Compact GuardLogix 1768-L43S & 45S
## Compact Guardlogix 5370

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Standard Memory</th>
<th>Safety Memory</th>
<th>Total Memory</th>
<th>Integrated Motion over Ethernet/IP</th>
<th>Ethernet/IP Nodes</th>
<th>Local 1769 Compact I/O modules supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>1769 - L30ERMS</td>
<td>1.0MB</td>
<td>0.5MB</td>
<td>1.5MB</td>
<td>4 Axis</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>1769 - L33ERMS</td>
<td>2.0MB</td>
<td>1.0MB</td>
<td>3.0MB</td>
<td>8 Axis</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>1769 - L36ERMS</td>
<td>3.0MB</td>
<td>1.5MB</td>
<td>4.5MB</td>
<td>16 Axis</td>
<td>48</td>
<td>30</td>
</tr>
</tbody>
</table>

Version 28 of Logix is Required
Next generation Compact Safety Controller with
Built-In Embedded switch for discrete, motion & Safety
Armor™ Compact GuardLogix® & Armor™ CompactLogix™ - On-Machine™ Programmable Automation Controller (PAC)

<table>
<thead>
<tr>
<th>Armor™ Compact GuardLogix®</th>
<th>IP rating</th>
<th>Memory</th>
<th>Network</th>
<th>EtherNet/IP Nodes</th>
<th>Controller Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1769-L33ERMOS</td>
<td>IP 67</td>
<td>2 MB standard + 1.0 MB Safety</td>
<td>Single IP address, DLR</td>
<td>32</td>
<td>256</td>
</tr>
<tr>
<td>1769-L36ERMOS</td>
<td>IP 67</td>
<td>3 MB standard + 1.5 MB Safety</td>
<td>Single IP address, DLR</td>
<td>48</td>
<td>256</td>
</tr>
<tr>
<td>1769-L37ERMOS</td>
<td>IP 67</td>
<td>3 MB standard + 1.5 MB Safety</td>
<td>Single IP address, DLR</td>
<td>64</td>
<td>256</td>
</tr>
</tbody>
</table>
Full 1oo2 Architecture

- GuardLogix safety system provides complete dual channel operation
  - CIP Safety I/O devices have full dual channel behavior
  - GuardLogix 1oo2 design provides full independent dual channel behavior
  - No single point of failure
  - Superior diagnostic coverage due to two independent processor designs in critical components

- Two controllers are used to obtain high integrity
  - Primary contains and executes both standard control and safety logic
    - Safety isolated from standard
  - Partner contains and executes only safety logic

Data redundancy
Safety CRC redundancy
End-to-end Safety CRCs – individual CRCs for data and for overall message
Every packet is time stamped
Guard I/O

- Guard I/O is the safety rated I/O for GuardLogix
- Three versions:
  - Point Guard I/O (IP20)
  - CompactBlock Guard I/O (IP20)
  - ArmorBlock Guard I/O (IP67)
- Common benefits of all Guard I/O
  - Reduce engineering requirements
  - Use existing network infrastructures
  - Flexibility
  - SIL3 / PLe rated and TÜV certified
# Guard I/O Family Comparison

<table>
<thead>
<tr>
<th>Guard I/O Platforms</th>
<th>Point</th>
<th>CompactBlock</th>
<th>ArmorBlock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Networks</td>
<td>EtherNet/IP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>DeviceNet</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Input</td>
<td>Discrete</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Analog</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed Monitor</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>Solid State, Count</td>
<td>8 single per slice</td>
<td>4 dual or 8 single</td>
</tr>
<tr>
<td></td>
<td>Solid State, Power</td>
<td>1 A per point</td>
<td>Up to 2 A or 0.5 A</td>
</tr>
<tr>
<td></td>
<td>Relay</td>
<td></td>
<td>4 single, 2 A per</td>
</tr>
<tr>
<td>Environment</td>
<td>IP20</td>
<td>IP20</td>
<td>IP67</td>
</tr>
</tbody>
</table>
GuardLogix - Multidiscipline Controller

Safety & Standard IO can use the same Point IO adapter
Safety IO can leverage standard Ethernet network
Integrated Safety on EtherNet/IP

SIL3 / Ple Safe Torque Off with EtherNet/IP. GuardLogix issues Safe Torque Off command to the drives over EtherNet/IP network based on safety IO.

GuardLogix Integrated Safety Controller

Point IO with Safety IO

Stratix 5700

Kinetix 5500 or Kinetix 5700

PowerFlex 527

Integrated Safety Enhances Machine Performance and Flexibility
Document provides information that any GuardLogix user should find helpful. Topics include:

- Safety Signature
- Lock/Unlock
- Configuration Signature
- Connection Reaction Time limit
- What makes CIP Safety safe
- Safety Network Number
- Explicit Messaging of 1791 modules
- Safety I/O module replacement
- Wiring Diagrams
Safety Application Technotes

Search with keyword Safety-AT

Safety Application Example

Safety Mat Control Using CompactBlock Guard I/O and GuardLogix Integrated Safety Controller

Safety Network-enabled Example
Safety Rating: Category 3, according to EN6954-1
Thank You!