



# MSR42 Safety Module

Bulletin Number 440R



**Allen-Bradley**

by ROCKWELL AUTOMATION

Guardmaster®

User Manual

Original Instructions

## Important User Information

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

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

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

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

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

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



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



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

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

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



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



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



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

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



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

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## About This Publication

This manual covers the installation and operation of the Guardmaster® MSR42 Safety Module.



**ATTENTION:** MSR42 safety modules can only achieve functionality if the instructions and additional documentation that are given in this instruction manual are exactly followed. You must also consult the valid laws and regulations at the time of installation. Serious injury or death can occur if you do not follow these instructions carefully. The installer or system integrator is fully responsible for a safe integration of this product. This instruction manual is part of the MSR45E extension module. This instruction must be accessible together with the other machine documentation during its entire lifecycle for all personnel responsible for assembly, installation, operation, and maintenance.

## Summary of Changes

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

Topic	Page
Added UKCA Approvals to <a href="#">Table 2</a>	15
Updated <a href="#">Figure 13</a>	31
Updated Declaration of Conformity	32

## Additional Resources

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

Resource	Description
Light Curtains Configuration and Diagnostic Software Tool User Manual, publication <a href="#">SAFETY-UM001</a>	Provides information to configure and diagnose GuardShield™ safety light curtains and MSR42 safety module products.
System Security Design Guidelines Reference Manual, <a href="#">SECURE-RM001</a>	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
UL Standards Listing for Industrial Control Products, publication <a href="#">CMPNTS-SR002</a>	Assists original equipment manufacturers (OEMs) with construction of panels, to help confirm that they conform to the requirements of Underwriters Laboratories.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication <a href="#">IC-TD002</a>	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication <a href="#">SGI-1.1</a>	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication <a href="#">1770-4.1</a>	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, <a href="http://rok.auto/certifications">rok.auto/certifications</a> .	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at [rok.auto/literature](http://rok.auto/literature).

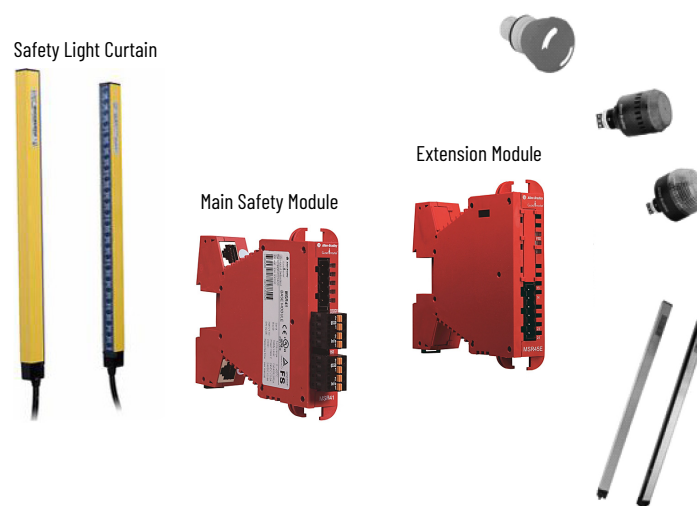
**Notes:**

## Introduction

### General Description

The MSR4x is a family of compact safety control modules. This main controlling module allows the connection and the control of the compact Allen-Bradley® GuardShield™ Micro400 Safety Light Curtain systems. Depending on the configuration, other safety components can also be connected and monitored simultaneously.

**Figure 1 - MSR42 Safety Module and Safety Components**



The MSR41 safety module or MSR42 safety module offer two safety PNP outputs (OSSD). Additional MSR45E extension modules can be applied, which require relay contact outputs.

You can attach up to three extension modules, which the base module controls.

We also offer models in special configurations, which are described in [Interrupt Ignore Time on page 36](#).

### Special Features

The characteristics of the MSR42 safety module:

- Category 4, PLe according to EN ISO 13849-1
- Type 4 according to EN 61496-1/-2
- SIL 3 according to IEC 61508
- SIL CL 3 according to EN 62061
- Short response times
- Expandable
- Up to three extension modules per main safety module
- Adjustable stop delay time
- Different safety components suitable for connection

- Blanking
- Muting
- Single scan selectable

## Customer Configurations

The configuration of an MSR42 safety module can adapt to the customer requirements of an individual application with the use of the USB/optical interface and the Allen-Bradley Guardmaster® software Configuration and Diagnostic Tool. More information is in publication [SAFETY-UM001](#). The software generates a configuration control document that lists the configurations and specifications of the controller and safety light curtain.



**WARNING:** The resolution and the response time can increase due to the download of other configuration settings for the Micro400 safety light curtain and other safety sensors that are connected to an MSR42 safety module. Consider the relevant resolution and the maximum response time when you evaluate the safety distance. See [Response Time on page 13](#). All relevant data of the actual configuration are described in the configuration control document for that controller. Always store the document near to the control unit.

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## Typical Applications

Typical MSR42 safety module applications are:

- Presses
- Robotic cells with automatic insertion
- Assembly lines
- Indexing tables
- Conveyor systems
- Automatic storage facilities

## Application Restrictions

MSR42 safety modules are not intended for application in explosive (EX) or in radioactive environments.



# System Configuration

## Wiring Diagrams

### Basic Configurations

Figure 2...Figure 6 on page 11 show the connection possibilities for the MSR42 safety module with basic configuration. The logic of this basic version is exemplified in the configuration control document. See [Blanking Teach-In on page 23](#).

Table 1 - Connection Configurations

Figure	Safety Component	Start Mode	Start Release
<a href="#">Figure 2</a>	Micro400 safety light curtain	Manual	No
<a href="#">Figure 3 on page 10</a>	Micro400 safety light curtain	Manual	Yes
<a href="#">Figure 4 on page 10</a>	Micro400 safety light curtain	Automatic	No
<a href="#">Figure 5 on page 11</a>	Micro400 safety light curtain	Automatic	Yes

Figure 2 - Basic Configuration, Manual Start

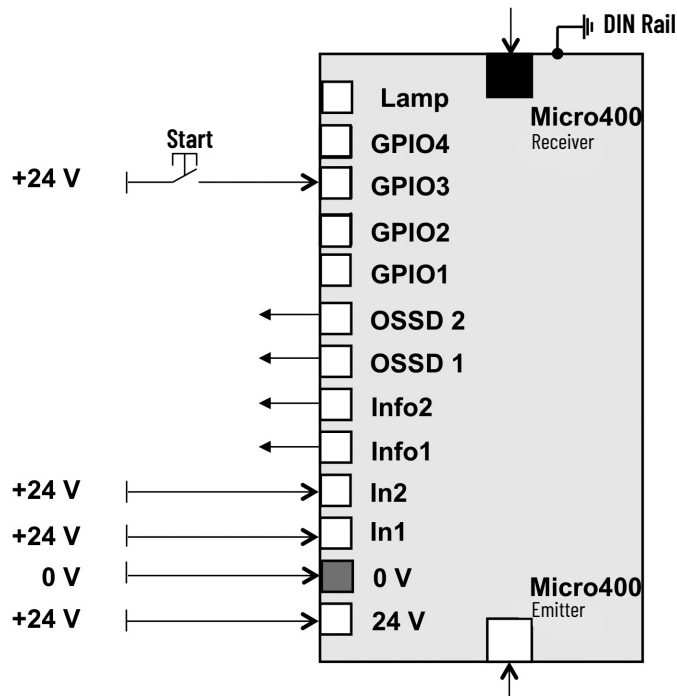


Figure 3 - Basic Configuration, Manual Start, with Start Release

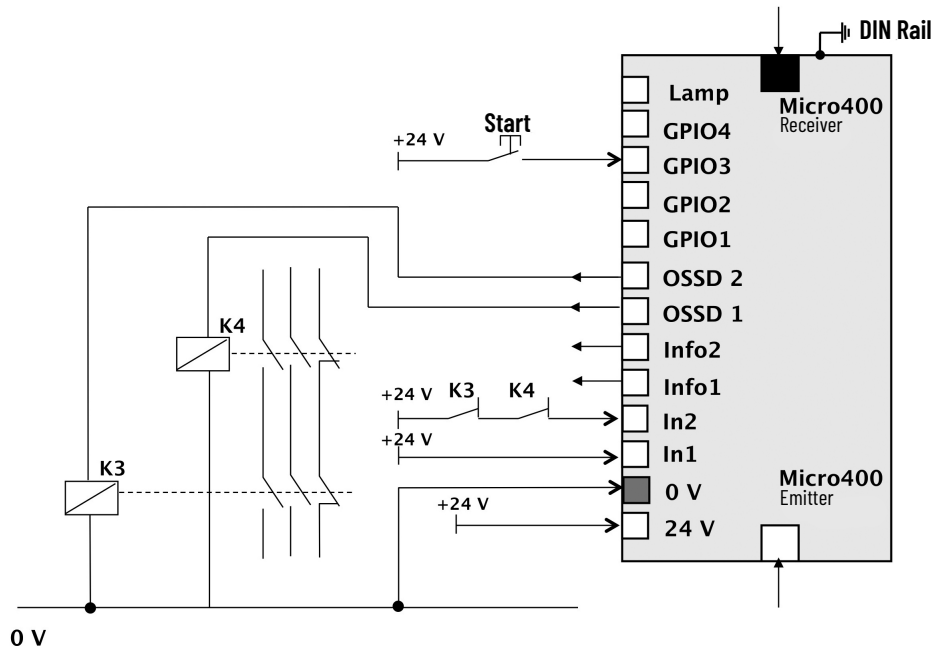


Figure 4 - Basic Configuration, Automatic Start

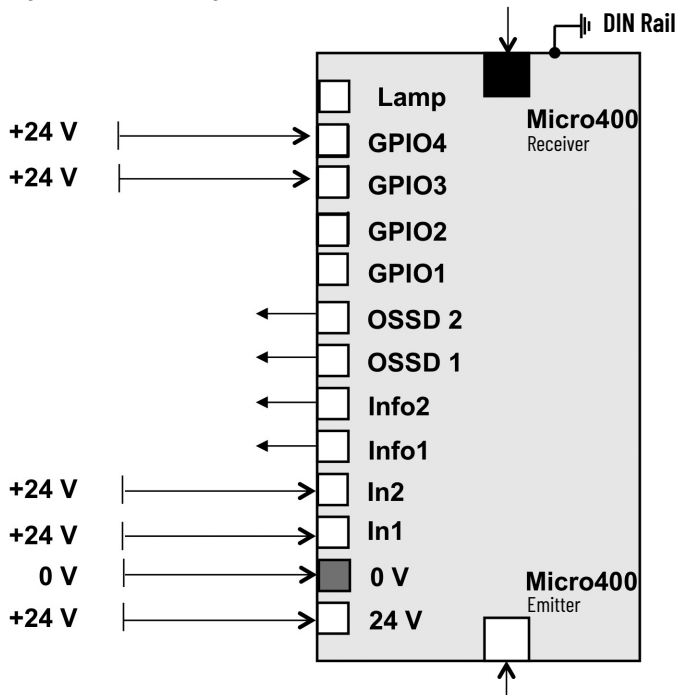


Figure 5 - Basic Configuration, Automatic Start, with Start Release

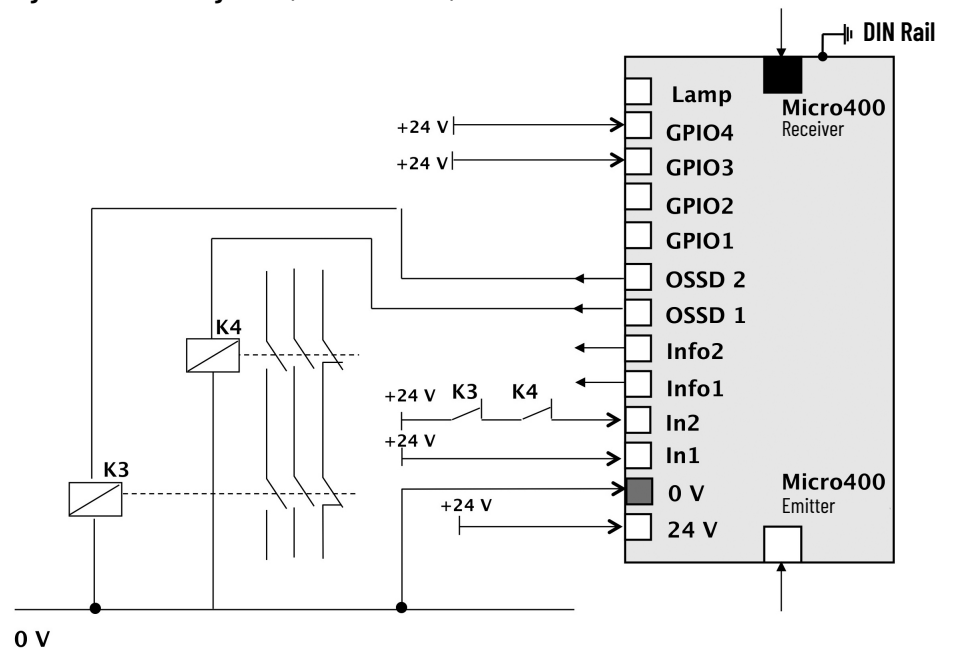
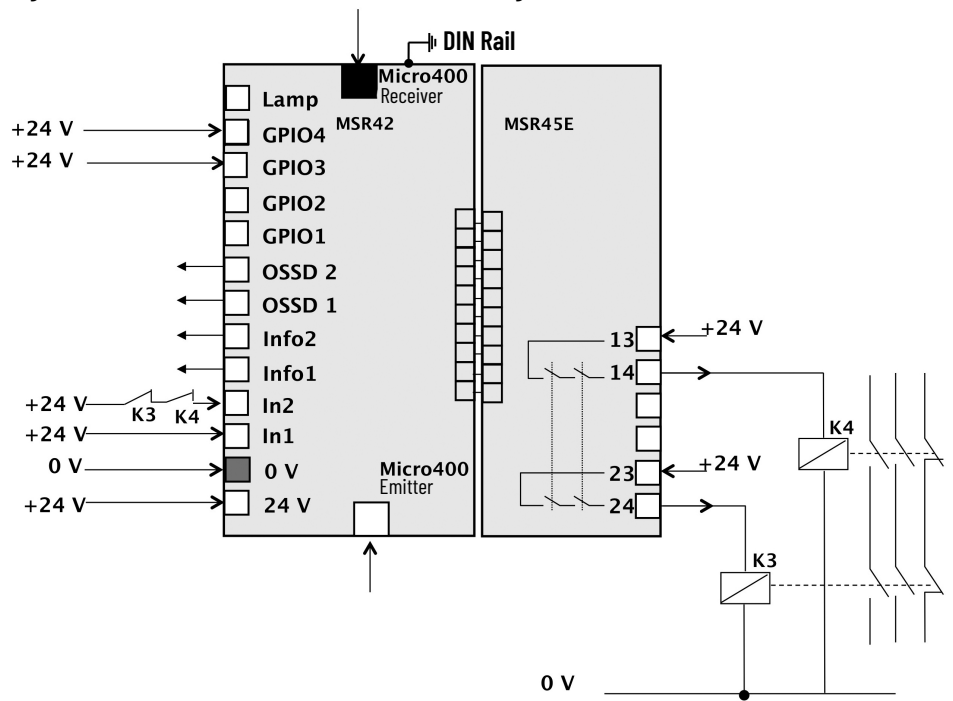


Figure 6 - With MSR45E Extension Module, Basic Configuration, Automatic Start, with Start Release



## Customer Configurations

The configuration of an MSR42 safety module is configured via of the USB/optical interface and the Allen-Bradley® GuardShield™ software Configuration and Diagnostic Tool. The configuration procedure is in publication [SAFETY-UM001](#). Configuration details are in the specific configuration control document for the MSR42 safety module.

The following features are selectable:

- Stop delay
- Single scan for faster response times
- Configuring GPIO terminals for one or two safety inputs
- Configuring GPIO terminals for E-stop or door switch
- Safety override
- Muting
- Blanking

Authorized personnel must use the USB/optical interface (catalog number 445L-AF6150) to download a new configuration to the MSR42 safety module.



**WARNING:** If authorized personnel reconfigure the safety module with the USB/optical interface, the response time or the stop delay time  $t(\text{delay})$  can increase, depending on the configuration. Execute the following steps for every new configuration.

1. Place the configuration change label (see [Figure 14 on page 31](#)) on the control module.
2. Confirm that the new response time is within the limits that are given by the risk analysis of the machine.
3. All relevant data of the actual configuration are described in the configuration control document for that controller. Always store the document near to the control unit.
4. The use of the Blanking mode reduces the resolution of the Micro400 safety light curtain. Label the Micro400 safety light curtain with the new resolution. A label is supplied with the Micro400 safety light curtain mounting kit.

## Status Outputs

The MSR42 safety module has two status outputs (Info1 and Info2). The logic of these two outputs depends on the configuration. A description of these outputs is given in the configuration control document.

[Table 2](#) shows the logic of the two status outputs for the basic configuration. Status indicators, which are visible on the front side of the main module, show the state of the status outputs.

**Table 2 - Status Outputs**

Terminal (Status Indicator)	Output High (+24V)	Output Low (0V)
Info1	Green: Start OK	Red: No start possible
Info2	Green: System OK	Red: Error (lock out)



**ATTENTION:** These outputs cannot perform any safety relevant functions. They serve only to communicate the status to a machine controller.

## Status Indicator Display Elements

[Table 3](#) shows information about the status indicator on the front side of an MSR42 safety module with basic configuration.

**Table 3 - Status Indicator Description**

Status Indicator	Description			Description		
	Signal	Color	Status	Signal	Color	Status
Lamp	-	Orange	Muting or blanking activated	-	Off	Muting or blanking not activated
GPI04	+24V	Green	Automatic start	0V	Off	Manual start
GPI03	+24V	Green	Manual start signal high or automatic start	0V	Off	Manual start
GPI02	+24V	Green	Teach-in blanking active	0V	Off	Teach-in blanking inactive
GPI01	+24V	Green	Teach-in blanking active	0V	Off	Teach-in blanking inactive
OSSD2	+24V	Green	Safety light curtain not activated	0V	Red	Safety light curtain activated (interrupted)
OSSD1	+24V	Green	Safety light curtain not activated	0V	Red	Safety light curtain activated (interrupted)
Info2	See <a href="#">Table 2 on page 12</a>			See <a href="#">Table 2 on page 12</a>		
Info1	See <a href="#">Table 2 on page 12</a>			See <a href="#">Table 2 on page 12</a>		
IN2	+24V	Green	Start release OK	0V	Red	No start release signal
IN1	+24V	Green	No test	0V	Red	Test
0V	-			-		
+24V	+24V	Green	Power connected	0V	Off	No power connected



## Response Time

### General

The response time of an MSR42 safety module depends on the configuration.

Use the following formulas to calculate the relevant maximum response times for the MSR42 safety module, concerning a specific Micro400 safety light curtain, MSR45E extension module, and a specific safety component.

The response time can increase if a stop delay time  $t(\text{delay})$  is configured for a safety component or a Micro400 safety light curtain. During this delay, all start impulses are ignored. The safety outputs switch off at the end of this delay period.

The safety module ships with the double scan filter. You can select the single scan filter to reduce the response time. The relevant times are in the corresponding configuration control document (see the configuration software manual).

**Table 4 - Response Time Calculation Terminology**

Symbol	Description
t(C)	Response time for the MSR42 safety module (evaluation time), without safety light curtain evaluation time
t(LC)	Response time of the safety light curtain (on its label)
t(delay)	Stop delay time for the outputs
t(em)	Response time for the MSR45E extension module
t(GPIO)	Evaluation time for the safety component (GPIO filter time)
t(SCext)	Response time of the external safety component (Safe4)
t(totLCOSSD)	Max OSSD response time triggered by the safety light curtain
t(totLCEXT)	Max relay extension module response time for the safety light curtain
t(totSCOSSD)	Maximum OSSD response time for the safety components on GPIO
t(totSCEXT)	Maximum relay extension module response time for the safety components on GPIO

## Micro400 Safety Light Curtain

The safety light curtain response time t(LC) is a part of the response time for the OSSD outputs. The label of the Micro400 safety light curtain shows the worst case response time, which occurs when the MSR42 safety module runs the active double scan filter (default). Single scan yields a faster response time, but makes the safety light curtain more vulnerable to ambient light. The safety light curtain response time t(LC) with the double scan filter is in the Micro400 safety light curtain manual, and with/without the double scan filter in the configuration control document (see the configuration software manual). The configuration control document is generated by the MSR42 safety module software Configuration and Diagnostic Tool (see publication [SAFETY-UM001](#)). You must enter the safety light curtain resolution and protective field height.

The response time for the MSR42 safety module (OSSD safety outputs) concerning the Micro400 safety light curtain t(totLCOSSD) is the sum of the controller response time t(C), the response time of the safety light curtain t(LC), and the stop delay time t(delay) (if a delay is configured and selected for the Micro400 safety light curtain).

### *Output OSSD*

$$t(\text{totLCOSSD}) = t(C) + t(LC) + t(\text{delay})$$

### *Output Relay Extension Module*

The response time for the MSR45E extension module (relay safety output) concerning the Micro400 safety light curtain is the sum of the OSSD response time and the response time of the extension module.

$$t(\text{totLCEXT}) = t(\text{totLCOSSD}) + t(\text{em})$$

## Other Safety Components Connected to GPIO Terminals

The response time of the MSR42 safety module OSSD safety outputs concerning the safety components that are connected to the GPIO terminals is the sum of the controller response time, the response time of the Micro400 safety light curtain, the safety component evaluation time, the response time of the external connected safety components, and the stop delay time (if delay is configured and selected for the safety components).

$$t(\text{totSCOSSD}) = t(\text{C}) + t(\text{LC}) + t(\text{GPIO}) + t(\text{SCext}) + t(\text{delay})$$

## MSR45E Extension Module

The response time for the MSR45E extension module (safety relay output) concerning the safety components that are connected on the GPIO terminals  $t(\text{totSCEXT})$  is the sum of the main module response time  $t(\text{totSCOSSD})$  and the response time of the extension module  $t(\text{em})$ .

$$t(\text{totSCEXT}) = t(\text{totSCOSSD}) + t(\text{em})$$

## Basic Configuration

The maximum controller response time  $t(\text{C})$  for the MSR42 safety module is given in [Response Time on page 13](#). However, depending on the connected Micro400 safety light curtain, the response time can be shorter. The exact value is in the configuration control document that is created with the Configuration and Diagnostic Tool software (see publication [SAFETY-UM001](#)).

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**IMPORTANT** The response can increase when authorized personnel use the USB/optical interface (catalog number 445L-AF6150) to reconfigure the controller, depending on the configuration. After every new configuration, proceed according to [Customer Configurations on page 12](#).

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**Notes:**



## Installation

For professional installation and connection, consult the relevant laws and regulations, the safety officer of the manufacturing facilities, and the local authorities (OSHA in USA, HSE in Great Britain) or the respective industry associations are available for any safety-related queries.

Consider the requirements of the safety regulations of electrical engineering, the liability insurance association of the local employer, and the international standard IEC 60204. This chapter describes the installation of all possible safety components that can generally connect to an MSR42 safety module. The corresponding configuration control document for the MSR42 safety module informs which safety component must connect to deliver faultless functionality.

### Mounting Location

Mount MSR42 safety modules in a control cabinet that is sealed to at least IP54. Snap the units onto a grounded 35 mm (1.38 in.) mounting rail. If you use the unit outside of a control cabinet, we recommend you use a housing with a protection category of IP54 and a mounting rail.

### Cable and Wires

Securely separate the wires from the MSR42 safety module and guide the wires away from the wires of the relay section (MSR45E extension modules).

### Supply Voltage

To safeguard the controller, protect the +24V terminal with an external 5 A fuse. The controller and the machine must be offline before you begin the installation.

The supply voltage must conform to the requirements of EN 60204-1 and must bridge a 20 ms interruption of the supply network. The supply voltage must be one of the following, in accordance with IEC 364-4-41:

- SELV (safety extra low voltage)
- PELV (protective extra low voltage)

### Earth Connection

The earth of each MSR42 safety module connects to the mounting rail. Confirm that the mounting rail has a good earth connection.

### Micro400 Safety Light Curtain Connection

The two RJ45 sockets on the lower portion of the safety module are for the connection of an Allen-Bradley® GuardShield™ Micro400 safety light curtain (white = E = emitter; blue = R = receiver). To protect the RJ45 connectors, snap the cables into the provided cable holders at the MSR42safety relay housing.

## Start Mode

The MSR42 safety module can be configured to have the following start modes:

- Automatic start
- Manual start

With basic configuration, you can configure the start mode without the configuration software. Automatic reset enables when you connect +24V to GPIO3 and GPIO4 (see [Wiring Diagrams on page 9](#)).

### Manual Start

When all inputs of the safety system have a safe signal, pressing the Start button causes the two safety OSSD outputs to change from low to high and, if the MSR45E extension module is connected, the modules close.

If multiple safety components are configured, then all components must have safe signals to all inputs before a start is allowed. The Start button is monitored to help prevent an unintentional start. Pulse length must be 50 ms...5 s. If the start impulse is longer or shorter, the device ignores the start input. The configuration control document identifies which terminal the Start button connects to. If the Start button connects to IN1 or IN2, a red status indicator shows that a start signal is present, a green status indicator shows that no signal is present.

**Table 5 - Status Indicator Description**

Status Indicator	Description		Description	
	Color	Status	Color	Status
IN 1 or IN 2	Green	No start signal present	Red	Start signal present (button pressed)



**ATTENTION:** Mount the Start button so the dangerous area is clearly visible. That is, confirm that when you press the Start button, no one is detained within the dangerous area.

### Automatic Start

If the MSR42 safety module is configured for automatic start, after the activation and the deactivation of the safety component, the two OSSD outputs change automatically from low to high again. Also, if connected, the MSR45E extension module contacts automatically reclose.



**ATTENTION:** According to EN 60204 article 9.2.4.4.2, a system cannot automatically restart, even after the cause of the shutdown is eliminated. Therefore, another danger can still exist to the operator. If the MSR42 safety module is configured with an automatic start, take further measures to fulfill this requirement.

## Minimum Off Time

According to the standard IEC 61496-2, a safety light curtain must have a minimum safety output off time of 80 ms. This specification means that even if a short safety light curtain interruption occurs, the safety outputs stay low (relays are open) for a minimum of 80 ms. A start signal is only recognized after the 80 ms duration.

## EDM or Start Release

If an MSR42 safety module is used with external relays or contactors, the contacts of that device must be monitored. An example category 4 application has two external contactors, each with force guided contacts that must be inserted. For monitoring the function of these contactors, each relay block must have at least one NC contact that is fed back in series to IN2 (or IN1 depending on configuration) of the MSR42 safety module (see [Figure 3 on page 10](#)).

Two monitoring options are possible:

1. Start release: The signal at the corresponding input terminal must be high before the Start button is pressed. This option means the NC contacts of the external relays must close before allowing a start. The optional start release is pre-configured in the MSR42 safety module (catalog number 440R-P226AGS-NNR) (see [Figure 3 on page 10](#)).
2. EDM (external device monitoring): The input signal of the EDM terminal is always monitored. This option means that the signal must be correct, not only at the beginning before a start. A signal change must also happen after startup, otherwise an emergency stop occurs. If a high signal is present for longer than 5 seconds, a lockout occurs.

If the configuration control document shows that EDM or start release must attach to terminal IN 1 or IN 2, then the meaning of the respective status indicator is shown in [Table 6](#).

**Table 6 - Status Indicator Description**

Status Indicator	Description		Description	
	Color	Status	Color	Status
EDM at IN 1 or IN 2	Green	EDM signal okay	Red	EDM signal wrong
Start release at IN 1 or IN 2	Green	Start release signal okay	Red	Start release signal wrong

The start release or EDM input is not cross fault monitored and therefore not a safety input.

- IMPORTANT**
- In cases where you install the MSR42 safety module without extension modules, always use the external device monitoring (EDM) or start release, unless the PNP outputs connect with another safety module or a safety PLC.
  - Use start release or EDM to switch external power contactors within the safety circuit. Such contactors often deal with large inductive loads, which during the switching-off phase can create large potential peaks. For this reason, we highly recommend surge suppressors. Surge suppressors must connect parallel to the external contactors (see [Figure 2 on page 9](#)). Do not connect surge suppressors parallel to the contacts of a MSR45E extension module.

Surge suppressors can drastically increase the off-delay time of the contactors. For this reason, do not use diodes as surge suppressors.

**Table 7 - Recommended Surge Suppressors**

Supply voltage [V]	Resistor R [ $\Omega$ ]	Condenser C [ $\mu$ F]
24	100	2.2
115...230	220	0.2

## Safety Components

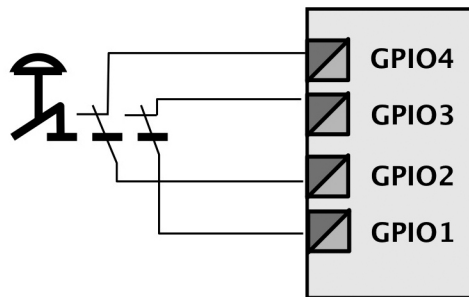
The connected safety components (for example, safety switches, position switch, E-stop buttons, cable pull safety switches) must satisfy the requirements of the safety analysis and the relevant standards for application within safety areas:

- E-stop button: EN 418
- Safety switch: EN 60947-5-1
- Safety light curtains: EN 61496-1/-2

The components must contain two force-guided, normally closed NC contacts (see [Figure 7](#)) that are approved for the relevant safety level or category.

As a basic rule to increase reliability, we recommend that you use safety components with integrated gold contacts. Safety components, can be connected to GPIO1 through GPIO4, as shown in [Figure 7](#). The inputs are short-circuit and cross fault monitored.

**Figure 7 - E-stop Connection**



In general, the two circuits of dual-channel safety components are cross fault monitored. A short of these two circuits would lead to an emergency stop of the MSR42 safety module. The two circuits are also time-monitored, meaning if, for example, one circuit of an emergency stop changes, the second circuit must follow within 5 seconds. If the second circuit does not follow in the allotted time, the MSR42 safety module interprets this action as a fault and the controller switches off the safety circuit.

Depending on the configuration and the application, there can be more terminals than the components need. The unused ports can be bridged. We recommend shielded cables for bridging to reduce the input of EMC.

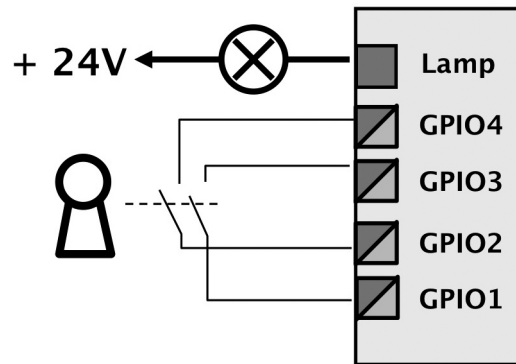
**Table 8 - Status Indicator Description**

Status Indicator	Description		Description	
	Color	Status	Color	Status
GPIO3	Green	Contact GPIO1/GPIO3 closed	Off	Contact GPIO1/GPIO3 open
GPIO4	Green	Contact GPIO2/GPIO4 closed	Off	Contact GPIO2/GPIO4 open

## Safety Override

[Figure 8 on page 21](#) shows a safety override keyswitch and a safety override lamp. With the safety override keyswitch, you can override the safety function of the Micro400 safety light curtain. This action means that if the override keyswitch is activated, the safety outputs stay high even if, for example, the protective field is interrupted.

Figure 8 - Safety Override Keyswitch and Associated Lamp Connection



Depending on the risk evaluation, when you use a safety override key-operated keyswitch, you must also connect a corresponding indicator lamp. The connection for this safety override lamp is configured to be current-controlled (see [Technical Specifications on page 29](#)). This configuration means that the current (I) of the individual lamp must remain between  $I_{min} < I < I_{max}$ . If the monitored current is not within these limits, the safety light curtain is not overridden although the safety override keyswitch is active.

The safety override lamp that is used must fulfill the requirements of EN 61496 and must mount close to the protective field and be clearly visible to the machine operator. Safety override only takes place when both circuits close. Likewise, safety override only takes place when both circuits open before becoming closed. A cross fault is detected and stops the safety override function from activating. After one of the circuits opens, the amount of time until the safety function of a safety component activates again is the maximum response time of the MSR42 safety module.

If an application does not require a safety override lamp (only allowed after a safety evaluation corresponding to EN 12100), you can deactivate the monitoring of the lamp in the configuration.

The lamp still indicates the override function, but is no longer monitored. Instead of a safety override keyswitch, an enabling switch or two independent, safety position sensors can be used, depending on the application and the risk assessment.

Table 9 - Status Indicator Description

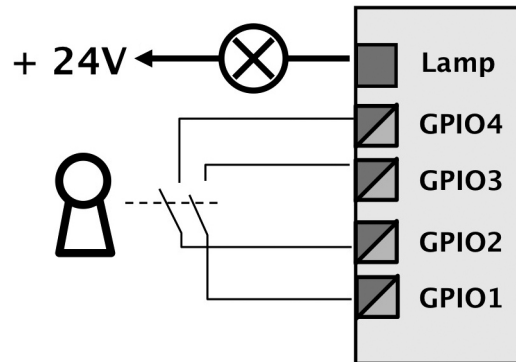
Status Indicator	Description		Description	
	Color	Status	Color	Status
GPIO3	Green	Contact GPIO1/GPIO3 closed	None flashing	Contact GPIO1/GPIO3 open
GPIO4	Green	Contact GPIO2/GPIO4 closed	None flashing	Contact GPIO2/GPIO4 open
Lamp	Off	Safety override circuits opened	Orange	Safety override circuits closed

- IMPORTANT**
- The use of the safety override function is only allowed in applications for which the risk analysis (EN ISO 12100-1 and EN14121) permits for the override of a safety component. Generally, E-stop buttons can never be overridden. Store the safety override key for this switch securely so that only authorized personnel have access to this key.
  - The function safety override cannot be understood as the function muting, which is specified as the temporary automatic suspension of a safety function in the standard IEC 61496-1 A.7 or IEC 62046. You must fulfill additional requirements (not described in this publication) to realize the muting function.

## OSSD Connections

The overall response time of a system is the sum of the response time of the OSSD outputs of the connected safety component (for example, safety light curtains or laser scanners), the response time of the MSR42 safety module, and, if used, the MSR45E extension modules (see the configuration control document).

Figure 9 - Connection of Up to Two OSSD Safety Components <sup>(a)</sup>




---

**IMPORTANT** SensaGuard™ safety switch OSSD outputs cannot be connected to the GPIO1...GPIO4.

---

## Muting

Muting is the temporary automatic suspension of a safety function. Use the USB/optical interface and the Configuration and Diagnostic Software to configure different types of muting. There are several muting option settings for safety light curtain systems. Details about the different types of muting and their characteristics are in the software MSR42 safety module software Configuration and Diagnostic Tool (see publication [SAFETY-UM001](#)), and the configured muting parameters are listed in the corresponding configuration control document.

## Blanking

Blanking is typically used to allow a material to pass through the safety light curtain during normal operation without causing a fault or stop condition. This material can include a sheet of metal passing through the safety light curtain before an operation is performed to form the material. The safety light curtain permits the material at a specific thickness, but nothing more without causing the safety outputs to turn off.

The MSR42 safety module supports teach-in fixed blanking via the basic configuration. There are two types of blanking available through the MSR42 safety module:

- Fixed blanking
- Floating blanking

A display or a lamp indicates when blanking is active. The MSR42 safety module has only one monitored output available for muting or blanking lamps. Therefore, muting and blanking cannot be configured simultaneously.

---

**IMPORTANT** After configuring one of the blanking functions, the safety light curtain resolution can change. Therefore, you must attach an updated label to the safety light curtain that notes the changed resolution.

---

(a) For example, GuardShield Safe4 safety light curtain systems.

On cascaded safety light curtains, check especially for the beams in the area of the end of the protective fields. If faulty settings are present, the blanking range can be unintentionally on the wrong stick.

Fixed blanking with monitoring requires the material to be present always to help prevent a fault condition. In many applications, the material can shift slightly during normal operation. This shift can cause blockage of one additional beam. Since this blockage can occur during normal operation, the MSR42 safety module is configured to permit one additional beam to be blocked without causing a fault (beam tolerance: -1 beam). As a result of adding one more beam to the configured blanked area, the resolution of the safety light curtain increases. [Table 10](#) shows the new resolution.

**Table 10 - One-beam Tolerance Safety Light Curtain Resolutions**

Resolution	Standard [mm (in.)]	Blanking Area [mm (in.)]
Finger	14 (0.55)	24 (0.94)
Hand	30 (1.18)	55 (2.17)

If you adjoin two blanking areas with fixed or floating blanking with monitoring, the resolution in this area increases for two beams in the standard adjoining blanking area.

**Table 11 - Two-beam Tolerance Safety Light Curtain Resolutions**

Resolution	Standard [mm (in.)]	Blanking Area [mm (in.)]
Finger	14 (0.55)	34 (1.34)
Hand	30 (1.18)	80 (3.15)

Activate blanking by:

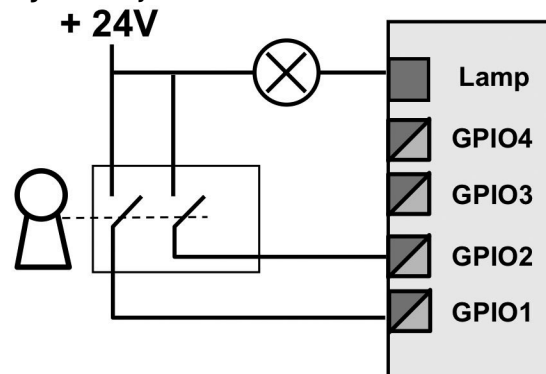
- Downloading a customer configuration
- Using the teach-in blanking function

For additional information on blanking configuration, see the description of the software Configuration and Diagnostic Tool (see publication [SAFETY-UM001](#)).

## Blanking Teach-In

Blanking teach-in is a function that allows the ability to set one or two fixed blanking areas without the use of the configuration tool or configuration software. You must connect a keyswitch to a pair of GPIO-inputs according to [Figure 10](#). The keyswitch must have two channels to select this mode.

**Figure 10 - Keyswitch with Two Activation Channels**



When the two channels are closed, the Teach-in Blanking mode is active and the lamp blinks. The safety outputs turn off and the interrupted beams are stored as the fixed blanking areas. We recommend teaching the MSR42 safety module blanking areas in the application to verify that the proper beams are blanked. You can configure up to two different fixed blanking zones via the external teach-in selector switch.

- 
- IMPORTANT** Only an authorized person can access the key to do a teach-in. If the configuration allows for a teach-in of fixed blanking, the following process takes place:
1. One or more blanked objects must be in the safety light curtain during the whole teach-in process.
  2. The authorized person must set the keyswitch.
  3. The teach-in process starts. The teach-in function is shown when the connected lamp blinks. If the teach-in function finishes and stored in the MSR42 safety module, the lamp is on. Otherwise the lamp is off and the configuration is unchanged.
  4. If the teach-in blanking function is finishes successfully, the authorized person must reset the keyswitch so the contacts open and no longer connect to 24V DC.
- 

## Single Scan Filter

By default the MSR42 safety module is operating in a Double Scan mode. This mode is robust against electrical or optical disturbances. The controller scans the safety light curtain optical elements two times to evaluate the state of the safety light curtain.

Activate the single scan filter by deselecting the Double Scan mode in the Micro400 safety light curtain window of the MSR42 safety module Configuration and Diagnostic Tool software (see publication [SAFETY-UM001](#)).



**WARNING:** Double Scan mode causes a longer response time than Single Scan mode. Consider the relevant maximum response time when you evaluate the safety distance.

---

## Test the MSR42 Safety Module

- 
- IMPORTANT** The MSR42 safety module complies with safety Category 4, PLe Per EN ISO 13849-1. Test the execution of the security function at regular intervals via higher-level controllers. The frequency of this check is based on the results of threat and risk analysis of the machine (EN ISO 12100-1 and EN14121). Furthermore, the MSR42 safety module is certified according to SIL 3 of IEC 61508. Normally the test input at the main module is connected to +24V. If an external test is desired according to the risk analysis, a contact can connect to IN 1. For operation in a Self-test mode, both OSSD outputs must connect separately to the safety circuit of the machine.
- 

[Figure 11](#) connections can be used for test inputs.

Figure 11 - Test Input Connection Possibilities

+24 V Input (In1)

+24 V Input (In1)

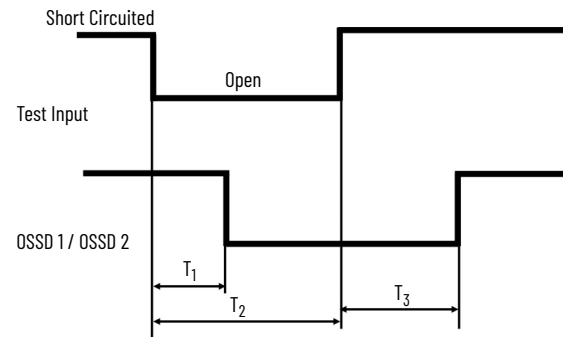


[Table 12](#) shows the timing of test inputs.

**Table 12 - Timing During Testing**

Test	Time	Value [ms]
Response time to test signal	$t_1$	$\leq t_R$
Time to test	$t_2$	$\leq t_1$
Restart time after test	$t_3$	$\geq t_R$

**Figure 12 - Test Timing Diagram (a)**



$t_R$  means the max response time of the total system (see [Response Time on page 13](#)). The machine controller checks the output of the OSSD during such a test. If the machine controller detects an error, the machine controller does not allow the machine to restart and stops the machine immediately.

In a test failure, the status output Info2 provides a failure signal.

**Table 13 - Status Indicator Description**

Status Indicator	Description		Description	
	Color	Status	Color	Status
IN 1 or IN 2	Green	External test signal high	Red	External test signal low (test running)

(a) See the configuration control document for the minimum off time.

**Notes:**

## Maintenance

### Diagnostic

The following indicate a fault condition:

1. The red status indicators of a connected GuardShield™ Micro400 safety light curtain blink
2. The blue OptiLink status indicator (on the side of an MSR42 safety module) is off
3. One of the info outputs (if configured)

In this situation, both safety outputs are low and the relays of the extension modules are open, and the controller unit is now in the Lockout mode.

Two options exist to leave the Lockout mode:

- Power up. If the fault is still present, the controller shows the Lockout mode.
- A start impulse longer than 10 s acts like a power-up.

You can obtain more detailed lockout information with the USB/optical interface (catalog number 445L-AF6150) and the software Configuration and Diagnostic Tool (see publication [SAFETY-UM001](#)).

### External Faults

The following external faults apply to the out-of-box configurations only.

**Table 14 - External Faults**

Fault No.	Fault profile	Fault Description	Measures and Instructions
1	No power status indicator	No Power Connection to +24V DC 0V	Check power connections and power supply
2	Safety light curtain status indicators flash red	Safety light curtain Rx/Tx are swapped	Reverse Rx/Tx connections and retry
		Open/missing safety light curtain cable	Replace the extension cable on the safety light curtain that does not flash
3	OSSD1 and OSSD2 status indicators are red No relay outputs	Anomaly in the safety light curtain	Replace the safety light curtain
		Missing reset switch for manual reset	Add rest switch with N.O. contact
		Missing 24V DC to GPIO3 and GPIO4 for automate reset	Add 24V DC jumper to GPIO3 and GPIO4
		Missing 24V DC to IN1 and IN2	Add 24V DC jumper to IN1 and IN2
		No start release signal from external contactors	Check wiring and function of external contacts

You can obtain programmed configuration diagnostics with the USB/optical interface (catalog number 445L-AF6150) and the software Configuration and Diagnostic Tool (see publication [SAFETY-UM001](#)).

## Internal Faults

The following internal faults apply to the out-of-box configurations only.

**Table 15 - Internal Faults**

Fault No.	Fault profile	Fault Description	Measures and Instructions
1	No power status indicator	Power supply is ok but MSR42 safety module does not power up	Replace the MSR42 safety module and retry
2	Relay is in Lockout mode Will not initialize	All input and reset status indicators are ok. No external faults were detected. Relay locks upon power-up and will not release	Replace the MSR42 safety module and retry

The Lockout mode of an MSR42 safety module can reset by one of two methods:

1. Power down, then power up. If the fault is still present, the module enters lockout.
2. A start signal longer than 10 seconds acts like a power-up.

Further diagnosis possibilities are possible with the software Configuration and Diagnostic Tool in combination with the USB/optical interface (see publication [SAFETY-UM001](#)). If the MSR42 safety module has a lockout, the exact fault description can be determined with these tools. An exact description is available at any time after a lockout, as long as the MSR42 safety module is still in the lockout condition.

## Service

MSR42 safety modules are built electronically and do not need preventive maintenance.

## Inspection

Qualified and trained personnel must periodically test the MSR42 safety module, in accordance with valid regulations, to discover prohibited manipulations or unauthorized modifications.

## Decommission

Only remove the MSR42 safety module when the machine or the equipment is shut down completely and can no longer operate without tools. Dismantle a controller if disposal is necessary. The separated materials can be recycled according to state-of-the-art technology and the corresponding regulations of the country where the unit is used.

## Specifications

### Technical Specifications

Table 16 - Technical Specifications




Attribute	Value
Average frequency of a dangerous failure per hour PFH	6.0 E-9 1/h: MSR42 safety module, MSR45E extension module, and Micro400 safety light curtain
	9.0 E-10 1/h: MSR42 and MSR41 safety module
	3.0 E-10 1/h: MSR45E extension module
	4.0 E-9 1/h: Micro400 safety light curtain
Performance Level PL	PLe, Cat. 4 (EN ISO 13849-1)
Safety Integrity Level	SIL CL 3 (IEC 61508/IEC 62061)
Approvals	CE Marked for all applicable EU directives, UKCA marked for all applicable regulations, cULus Listed, TÜV Certified <a href="http://rok.auto/certifications">rok.auto/certifications</a>
General	
Nominal working mode	Continuous process
Temperature	<ul style="list-style-type: none"> <li>Operating: 0...55 °C (32...131 °F)</li> <li>Environmental: 0...55 °C (32...131 °F)</li> <li>Storage: -25...+70 °C (-13...+158 °F)</li> </ul>
Enclosure rating (EN 60529)	<ul style="list-style-type: none"> <li>Housing: IP20</li> <li>Terminals: IP20</li> </ul>
Conductor connection, max	4-pin, terminal strip (plug-in) Wire cross section: 1 x 2.5 mm <sup>2</sup> (14 AWG) stranded, spring clamping technology
Mounting	<ul style="list-style-type: none"> <li>Standard: 35mm (1.38 in.) DIN Rail</li> <li>Quick mount: 35 mm (1.38 in.) top hat rail (EN 50022) 6</li> </ul>
Weight	130 g (0.29 lb)
Housing dimensions	111 mm x 22.5 mm x 125 mm (4.37 in. x 0.89 in. x 4.92 in.) (including plugs), see <a href="#">Approximate Dimensions on page 32</a>
Enclosure protection rating	IP20
Housing material	Polyamide
Vibration (EN60068-2-6)	<ul style="list-style-type: none"> <li>Amplitude: 0.35 mm (0.1 in.)</li> <li>Frequency: 10...55 Hz</li> </ul>
Shock resistant (EN 60068-2-29)	<ul style="list-style-type: none"> <li>Acceleration: 100 ms<sup>-2</sup></li> <li>Impulse length: 16 ms</li> <li>Number of shocks: 1000 per direction</li> </ul>
Interfaces	Optical (OptiLink)
Shipping	
Packaging	280 mm x 200 mm x 70 mm (11.02 in. x 7.87 in. x 2.76 in.)
Shipping weight	Net + 220 g (8.66 in.)
Inputs	
Safety inputs (software configurable)	1 x 2 NC or 2x 2 OSSD, and 1 Micro400 safety light curtain
Power supply (U <sub>N</sub> )	+24V DC (EN 60204-1), see <a href="#">Supply Voltage on page 13</a> at 5% residual ripple 0.85...1.15 U <sub>N</sub>
Current consumption	Current max 70 mA + 70 mA per relay extension module (semiconductor outputs unloaded) maximal: 1.7 A depending on attached load
Max power consumption at max supply voltage	2.1 W (semiconductor outputs unloaded)
Controller protection (external)	5 A slow
Control current into IN 1, IN 2	2 mA each (min) (in accordance with EN 61131-2)
Minimum voltage at IN 1, IN 2	11V DC at activated controller (EN 61131-2)
Start pulse duration	Min: 50 ms Max: 5 s (see <a href="#">Safety Components on page 20</a> )

**Table 16 - Technical Specifications (Continued)**

Attribute	Value
Test pulse duration, min	Response time x 2
Control current	Into GPIO1...GPIO4: 7 mA each at U <sub>N</sub> (coded)
Safety override lamp, min	0.9 A (at lamp, switched on)
Reset mode	Automatic / manual or manual monitored
Cable length, max	Safety switches: 50 m (164.04 ft) out and back [total 100 m (328.08 ft)]
Outputs	
Voltage	<ul style="list-style-type: none"> <li>GPIO1...GPIO4 (to safety components): U<sub>N</sub> - 2V (coded) (short circuit protected)</li> <li>Info 1, Info 2 status outputs (PNP): U<sub>N</sub> - 2V</li> <li>2 x OSSD semi conductor outputs (PNP): U<sub>N</sub> - 2V</li> </ul>
Current, max	<ul style="list-style-type: none"> <li>GPIO1...GPIO4 (to safety components): 100 mA (short-circuit protected)</li> <li>Info 1, Info 2 Status Outputs (PNP): 100 mA (short-circuit protected)</li> <li>2 x OSSD semi conductor outputs (PNP): 400 mA short-circuit protected and with cross fault detection</li> </ul>
Leakage current	<ul style="list-style-type: none"> <li>GPIO1...GPIO4 (to safety components): I<sub>MAX Off</sub> = 0.5 mA (C<sub>LOAD</sub> = 100 µF)</li> <li>Info 1, Info 2 Status Outputs (PNP): I<sub>MAX Off</sub> = 0.5 mA (C<sub>LOAD</sub> = 4.7 µF)</li> <li>OSSD semi conductor outputs (PNP): I<sub>MAX Off</sub> = 0.1 mA (C<sub>LOAD</sub> = 3.3 µF)</li> </ul>
Response time, max	<ul style="list-style-type: none"> <li>2 x OSSD semi conductor outputs (PNP)</li> <li>t(C) with U<sub>N</sub> protective mode (see <a href="#">Supply Voltage on page 13</a>): ≤ 15 ms</li> <li>t(GPIO) with U<sub>N</sub> protective mode (see <a href="#">Supply Voltage on page 13</a>): ≤ 130 ms</li> </ul>
Minimal off time	2 x OSSD semi conductor outputs (PNP): 82 ms

## Catalog Numbers

**Table 17 - Catalog Numbers**

	Cat. No. <sup>(1)</sup>	Description
	440R-P221AGS	MSR41 On/Off Safety Module <ul style="list-style-type: none"> <li>Mounting: 35 mm (1.34 in.) DIN Rail</li> <li>Size: 22.5 mm (0.98 in.)</li> </ul>
	440R-P226AGS-NNR	MSR42 Start/Restart Safety Relay <ul style="list-style-type: none"> <li>Mounting: 35 mm (1.34 in.) DIN Rail</li> <li>Size: 22.5 mm (0.98 in.)</li> </ul>
	445L-104794-Bxxx <sup>(2)</sup>	
	440-P4NANS	MSR45E Safety Relay Extension Module (optional) <ul style="list-style-type: none"> <li>Input voltage: Supplied by MSR41 or MSR42 safety module</li> <li>Reset: Determined by MSR41 or MSR42 safety module</li> <li>Outputs: Two N.O.</li> </ul>
	445L-1xxxx <sup>(2)</sup>	

(1) All series.

(2) x = Customer configurable options that do not impact the standards or directives cited in [Declaration of Conformity on page 32](#).

## Product Labels

The necessary safety information is on the product label, which is on every MSR42 safety module.

Figure 13 - Example Product Label



Table 18 - Product Label Explanation

Symbol	Description
HW	Hardware version
Safety Level Cat.	Safety category according to EN ISO 13849-1
Safety Level SIL	Safety integrity level according to EN 61508
Safety Level PLe	Performance level according to EN ISO 13849-1
Power class	Power supply
Temperature range	Operating temperature range
OSSD	Maximum current available per OSSD output, at the listed voltage

All configuration information is on the configuration control document, which is included with the delivery of each MSR42 safety module.

If authorized personnel uses the USB/optical interface to reconfigure an MSR42 safety module, fill out a new configuration control label and apply it next to the existing label (see [Figure 14 on page 31](#)). Details of the new configuration are in the configuration control document. Position the new special configuration identification next to the existing label.

Figure 14 - Configuration Changed Label

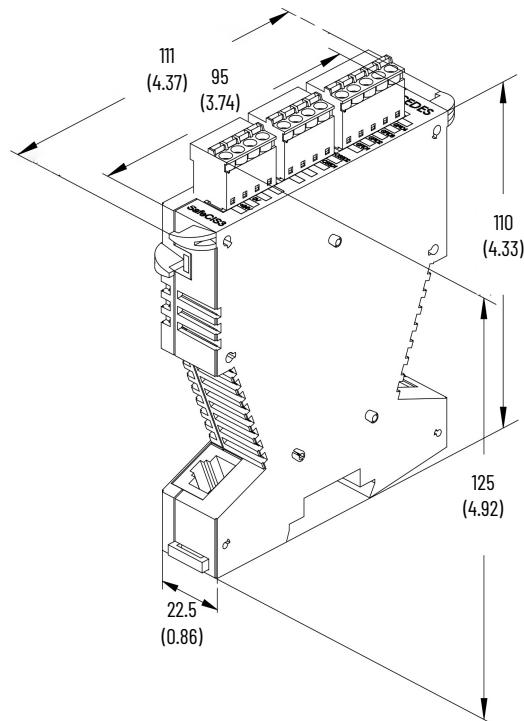
**! Configuration changed !**  
**see Configuration**  
**Control Document**

Date: \_\_\_\_\_ Name: \_\_\_\_\_

Configuration Designation: \_\_\_\_\_

## Approximate Dimensions

Figure 15 - MSR42 Safety Module and Extension Modules [mm (in.)]



## Declaration of Conformity

### CE Conformity

Rockwell Automation declares that the products that are shown in this document conform with the Essential Health and Safety Requirements (EHSRs) of the European Machinery Directive (2006/42/EC) and EMC Directive (2014/30/EU).

- EN 61496-1:2012 Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests
- IEC 61496-2:2013 Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)
- EN ISO 13849-1:2015 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- EN 61508 Parts 1-7:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 954-1:1997 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- EN 50178:1997 Electronic equipment for use in power installations
- EN 62061:2005 Safety of machinery – Functional safety of safety-related electrical, electronic, and programmable electronic control systems
- EN 60204-1:2006 Safety of machinery – Electrical equipment of machines – General requirements
- EN 61000-6-4:2007 Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments (Class A)
- EN 61000-6-2:2005 Electromagnetic Compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments

For a comprehensive CE certificate visit: [rok.auto/certifications](http://rok.auto/certifications).



## UKCA Conformity

Rockwell Automation declares that the products that are shown in this document are in compliance with the Supply of Machinery (Safety) Regulations (2008 No. 1597) and Electromagnetic Compatibility Regulations (2016 No. 1091).

- EN 61496-1:2013 Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests
- IEC 61496-2:2013 Safety of machinery – Electro-sensitive protective equipment – Part 2:
- Particular requirements for equipment using active opto-electronic protective devices (AOPDs)
- EN ISO 13849-1:2015 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- EN 61508 Parts 1-7:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 62061:2005 Safety of machinery – Functional safety of safety-related electrical, electronic, and programmable electronic control systems
- EN 60204-1:2006 Safety of machinery – Electrical equipment of machines – General requirements
- EN 61000-6-4:2007 Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments (Class A)
- EN 61000-6-2:2005 Electromagnetic Compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments

For a comprehensive UKCA certificate visit: [rok.auto/certifications](http://rok.auto/certifications).

**Notes:**

## Accessories

### Additional Components

Table 19 - Catalog Numbers

	Cat. No.	Description
	440R-ACABL1	Ribbon cable - two modules
	440R-ACABL2	Ribbon cable - three modules
	440R-ACABL3	Ribbon cable - four modules
	440R-ATERM1P	Terminal block kit for MSR41 safety module replacement
	440R-ATERM2P	Terminal block kit for MSR42 safety module replacement
	440R-ATERM2C	Terminal block kit for MSR45E extension module
	445L-AF6150	USB/optical Interface
	<a href="http://rok.auto/pcdc">rok.auto/pcdc</a>	Software configuration tool

## Interrupt Ignore Time

This function for existing customers is a MSR42 safety module special feature not included in the standard version.

The interrupt ignore time function is a limited time that a safety light curtain interruption is ignored. Use this feature when parts must move through the safety light curtain at high speed without interruption, but a human can interrupt the safety light curtain for longer than the configured time.

---

**IMPORTANT** The interrupt ignore time function increases the response time. The response time is given in the corresponding configuration control document. Recalculate the safety distance.

---

You must activate the interrupt ignore time function with the MSR42 safety module Configuration and Diagnostic Tool software (see publication [SAFETY-UM001](#)). Then use the USB/optical interface (catalog number 445LAF6150) to download the function to the MSR42 safety module.

## Notes:

**Notes:**



# Rockwell Automation Support

Use these resources to access support information.

<b>Technical Support Center</b>	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	<a href="http://rok.auto/support">rok.auto/support</a>
<b>Knowledgebase</b>	Access Knowledgebase articles.	<a href="http://rok.auto/knowledgebase">rok.auto/knowledgebase</a>
<b>Local Technical Support Phone Numbers</b>	Locate the telephone number for your country.	<a href="http://rok.auto/phonesupport">rok.auto/phonesupport</a>
<b>Literature Library</b>	Find installation instructions, manuals, brochures, and technical data publications.	<a href="http://rok.auto/literature">rok.auto/literature</a>
<b>Product Compatibility and Download Center (PCDC)</b>	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	<a href="http://rok.auto/pcdc">rok.auto/pcdc</a>

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## Waste Electrical and Electronic Equipment (WEEE)







At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at [rok.auto/pec](http://rok.auto/pec).

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