MSR42 Control Module
User Manual

Allen-Bradley









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Allen Bradley 440R-P226AGS-NNR | gesrepair.com

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in the guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control (available from your local Rockwell Automation sales office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual 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.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
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 consequences.
SHOCK HAZARD 	Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.

It is recommended that you save this user manual for future use.

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Approvals and Conformity

The CE-declaration as well as the safety approval, performed by TÜV Rheinland GmbH are available online at www.ab.com. The actual list of relevant safety data and applied standards is given in these documents.

WARNING 	MSR42 units can only achieve their function as a safety control module, if the instructions in these manual and accompanying documents are followed and all laws and regulations are observed at the time of installation. Should these instructions not be carefully followed, serious injury or death may occur. The installer or system integrator has full responsibility for a safe integration of this product. This instruction manual is part of the MSR45E expander module. It must be kept accessible together with the other machine documentation during its entire life cycle for all personnel responsible for assembly, installation, operation and maintenance.

Introduction

The MSR4x is a family of extremely compact safety controller modules. The main controlling module allows for the connection and control of the compact Allen-Bradley GuardShield Micro400 safety light curtain. Depending on the configuration, other safety components can also be connected and monitored simultaneously.



Figure 1: MSR42 controller with some safety components which can be connected (depending on individual configuration)

Either the MSR41 or 42 offers two safety PNP outputs. Extension modules are available for applications which need relay contact outputs.

Up to three expander modules can be easy attached & controlled by the base module.

In addition to the multifunction controllers, models are offered in special configurations which are described in the appendix at the end of this manual.

Special features

The characteristics of the MSR42 base module:

- Category 4, PLe according to EN ISO 13849-1
- Type 4 according to EN61496-1 / -2
- SIL CL3 according to EN62061
- SIL3 based on IEC 61508
- Short response times
- Expandable
- Up to 3 safety relay expander modules per base module
- Adjustable stop delay time
- Different safety components suitable for connection
- Blanking
- Muting
- Single scan selectable

Customer Configurations

The configuration of a MSR42 base module may very easily be adapted to the customer requirements of an individual application with the help of the USB/optical interface and the Allen-Bradley Guardmaster Software "Configuration & Diagnostic Tool". More information can be found in the Software Technical Manual. The software is capable of generating a configuration control document which lists configurations and specifications of the controller and light curtain (Figure 16).

WARNING 	The resolution and the response time may increase due downloading other configuration settings for the Micro 400 and other safety sensors connected to MSR42. Consider the relevant resolution and the maximum response time when evaluating the safety distance. See Chapter 7. All relevant data of the actual configuration are always described in the actual configuration control document for that controller. Make sure that the actual document is always stored near to the control unit.

Applications

Typical applications

Typical MSR42 base module applications are:

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

Application restrictions

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

Dimensions

The dimensions of the MSR42 housing are illustrated in Figure 2.

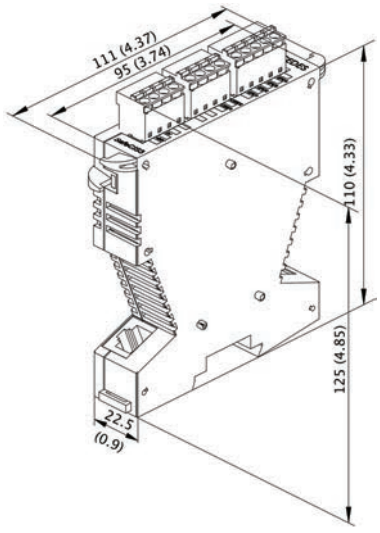


Figure 2: Base module dimensions are the same for expansion modules

Wiring diagrams

Basic configuration

The following figures show the connection possibilities for the MSR42 base module with the basic configuration. The logic of this basic version is exemplified in the accompanying configuration control document:

Figure	Safety component	Start mode	Start release
Figure 3	Micro400	manual	no
Figure 4	Micro400	manual	yes
Figure 5	Micro400	automatic	no
Figure 6	Micro400	automatic	yes

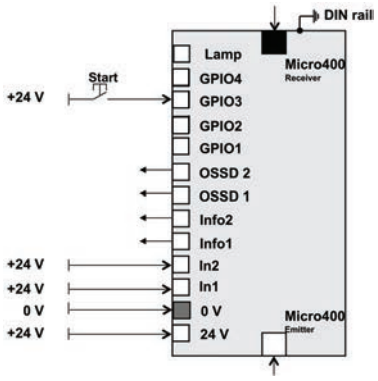


Figure 3: MSR42 base module (basic configuration, manual start)). For teach-in see page 8

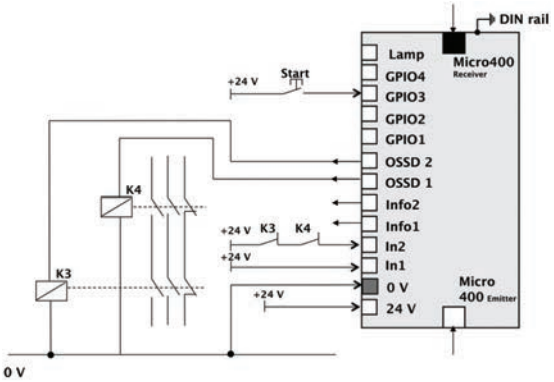


Figure 4: MSR42 base module (basic configuration, manual start, with start release). For teach-in see page 8

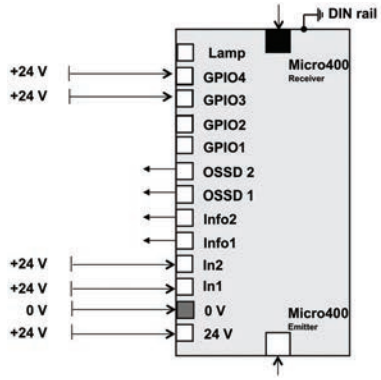


Figure 5: MSR42 base module (basic configuration, automatic start). For teach-in see page 8

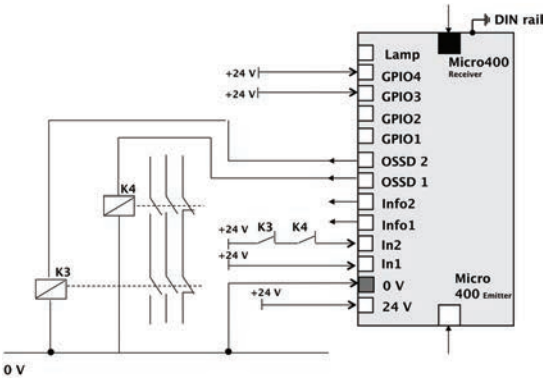


Figure 6: MSR42 base module (basic configuration, automatic start, with start release). For teach-in see page 8

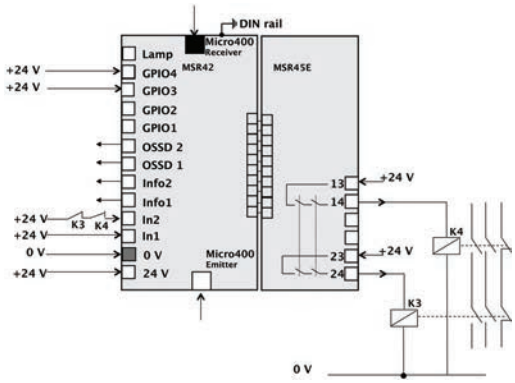


Figure 7: MSR42 base module and MSR45E expander module (basic configuration, automatic start, with start release). For teach-in see page 8

Customer Configurations

The configuration of a MSR42 control module is set up via of the USB/optical interface and the Allen-Bradley GuardShield Software "Configuration & Diagnostic Tool". The configuration procedure can be found in the Technical Description Manual. Configuration details can be found in the specific configuration control document for the MSR42.

The following features may be selected:

- 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

A new configuration has to be downloaded to the MSR42 controller by authorized personnel using the USB/optical interface (445L-AF6150).

WARNING

If authorized personnel reconfigure the control module using the USB/optical interface, then depending on the configuration the response time or the stop delay time t(delay) may increase. So it is very important that after every new configuration.

a. the configuration change label (page 13) is placed on the control module and
b. the new response time is confirmed to be within the limits given by the risk analysis of the machine and
c. All relevant data of the actual configuration are always described in the actual configuration control document for that controller. Make sure that the actual document is always stored near to the control unit.
d. Using the blanking mode, the resolution of the Micro 400 will be reduced. Label the Micro 400 with the new resolution. A label is supplied with the Micro 400 light curtain mounting kit.

Status outputs

The MSR42 base 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. The following table shows the logic of the two status outputs for the basic configuration. The state of the status outputs will also be displayed through LED, visible on the front side of the main module.

Terminal (LED)	Output "high" (+24 V)	Output "low" (0 V)
Info1 (LED)	Start ok (green)	No start possible (red)
Info2 (LED)	System okay (green)	Error (Lock out) (red)

Table 1

WARNING

These outputs may not perform any safety relevant functions. They are diagnostic outputs which provide status to a machine controller.

LED display elements

Table 2 gives information about the LED on the front side of a MSR42 control unit with the basic configuration:



	LED	Signal / Color /Status	Signal / Color /Status
	Lamp	Orange / muting or blanking activated	Off / muting or blanking not activated
	GPIO4	+24 V / green / automatic start	0 V / off / manual start
	GPIO3	+24 V / green / manual start signal high or automatic start	0 V / off / manual start
	GPIO2	+24 V / green / Teach-in Blanking active	0 V / off / Teach-in Blanking inactive
	GPIO1	+24 V / green / Teach-in Blanking active	0 V / off / Teach-in Blanking inactive
	OSSD2	+24 V / green / Micro 400 not Activated	0 V / red / Micro 400 activated (e.g. interrupted)
	OSSD1	+24 V / green / Micro 400 not Activated	0 V / red / Micro 400 activated (e.g. interrupted)
	Info2 (LED)	See page 4	See page 4
	Info1 (LED)	See page 4	See page 4
	IN2	+24 V / green / start release okay	0 V / red / no start release signal
	IN 1	+24 V / green / no test	0 V / red / test
	0 V	-	-
	+24 V	+24 V / green / power connected	0 V / off / no power connected

Table 2

Response time

General

The response time of a MSR42 main module depends on the configuration.

The relevant maximum response times for the MSR42 control module, with respect to a specific Micro 400 light curtain and MSR45E expander module, as well as a specific safety component may be calculated using the formulas below.

The response time may be increased if a stop delay time t(delay) is configured for a safety component or a Micro 400 light curtain. During this delay, all start impulses are ignored. The safety outputs will switch off at the end of this delay period.

The controller is shipped with the double scan filter. Single scan filter can be selected to reduce the response time. The relevant times may be found in the corresponding configuration control document (e.g. see configuration software manual).

Terminology	
t(C)	Response time for the MSR42 control module (evaluation time), without light curtain evaluation time
t(LC)	Response time of the light curtain
t(delay)	Stop delay time for the outputs
t(em)	Response time for the MSR45E expansion module
t(GPIO)	Evaluation time for the safety component (GPIO filter time)
t(SCext)	Response time of the external safety component (e.g. Safe4)
t(totLCOSSD)	Maximum OSSD response time triggered by the light curtain
t(totLCEXT)	Maximum relay extension module response time for the light curtain
t(totSCOSSD)	Maximum OSSD response time for the safety components on GPIO

Terminology	
t(totSCEXT)	Maximum relay extension module response time for the safety components on GPIO

Table 3

The response time of the device under a specific configuration can be found in the configuration control document (see configuration software manual)

Micro 400 safety light curtain

The light curtain response time t(LC) is a part of the response time for the OSSD outputs. The label of the Micro 400 shows the worst case response time which occurs when the MSR42 runs active double scan filter (default). Using a single scan yields a faster response time but this makes the light curtain more vulnerable to ambient light. The light curtain response time t(LC) with the double scan filter can be found in the Micro 400 manual and with/without double scan filter in the configuration control document (see configuration software manual). The configuration control document gets generated by the MSR42 Software "Configuration & Diagnostic Tool". Therefore the light curtain resolution and protective field height has to be entered.

The response time for the MSR42 main module (OSSD safety outputs) with respect to the Micro 400 light curtain t(totLCOSSD) is the sum of the controller response time t(C) + the response time of the light curtain t(LC) + ,the stop delay time t(delay) (if a delay is configured and selected for the Micro 400).

Output OSSD

t(totLCOSSD) = t(C) + t(LC) + t(delay)

Output relay extension module

The response time for the MSR45E expansion module (relay safety output) with respect to the Micro 400 light curtain is the sum of the OSSD response time and the response time of the extension module.

t(totLCEXT) = t(totLCOSSD) + t(em)

Other safety components connected to GPIO terminals

The response time of the MSR42 control module OSSD safety outputs with respect to the safety components connected to the GPIO terminals is the sum of the controller response time and the response time of the Micro 400 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(totSCOSSD) = t(C) + t(LC) + t(GPIO) + t(SCext) + t(delay)

MSR45E relay expansion module

The response time for the MSR45E extension module (safety relay output) with respect to the safety components connected on the GPIO terminals t(totSCEXT) is the sum of the main module response time t(totSCOSSD) + and the response time of the extension module t(em).

t(totSCEXT) = t(totSCOSSD) + t(em)

Basic configuration

The maximum controller response time t(C) for the MSR42 control module is given in chapter 14 However, depending from the connected Micro 400 light curtain, the response time may be faster. The exact value can be read out from the configuration control document, created with the Configuration & Diagnostic Tool software.

IMPORTANT	If authorized personnel reconfigure the controller using the USB/optical Interface (445L-AF6150), then depending on the configuration the response times may be increased. So it is very important that after every new configuration to proceed according chapter "Customer Configurations" on page 3.

Installation

For proper installation and connection, please consult the relevant laws and regulations. The safety officer of the manufacturing facilities, the local authorities (OSHA in USA, HSE in GB) or the respective industry associations are available for any safety related queries. The requirements of the safety regulations of electrical engineering, the local employer's liability insurance association and the international standard IEC 60204 are to be taken into full consideration. In the following chapters the installation of all possible safety components, which can in general be connected to a MSR42 control module, is also described. Which safety component has to be connected to guarantee a faultless function is printed in the corresponding configuration control document for the MSR42 control module.

Mounting location

The MSR42 control modules must be mounted in a control cabinet which is sealed to at least IP54. The units must be snapped onto a 35 mm mounting rail, which is grounded. If it is used outside of a control cabinet housing with a protection category of IP54 and a mounting rail capability is recommend.

Cable and wires

The wires from the MSR42 control module must be securely separated and guided away from the wires of the relay section (MSR45E expander module). In the case of high EMC levels shielded cables may be required to preserve signal integrity.

Supply voltage

To safeguard the controller, the +24 V terminal should be protected with an external 5 A fuse. The controller and the machine should be off-line before beginning the installation. The supply voltage must conform to the requirements of EN 60204-1, it must bridge a 20 ms interruption of the supply network. When considering the supply voltage, it must be one of the following: SELV (Safety-Extra-Low-Voltage) or PELV (Protective-Extra-Low-Voltage) in accordance with IEC 364-4-41.

Earth connection

The earth of each MSR42 control module is realized through the connection to the mounting rail. Consequently it is important to ensure, that the mounting rail has a good earth connection.

Micro400 light curtain

The two RJ45 sockets on the lower portion of the control module are for the connection of Allen-Bradley GuardShield Micro400 (white = E = emitter; blue = R = receiver). To help protect the RJ45 connectors the cables have to be snapped into the provided cable holders at the.MSR42 housing.

Start mode

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

- automatic start or
- manual start.

In case of the basic configuration the start mode can also be configured without the configuration software. By connecting +24V to GPI03 and GPI04, automatic reset is enabled (see wiring diagrams).

Manual start

When all of the inputs of the safety system have a safe signal, depressing the start button will cause the two safety OSSD outputs to change from low to high. If a MSR45E relay expander module is connected, it will close. If more than one safety component is configured, then all components must have safe signals to all inputs before a start is allowed. The start button is monitored to prevent an unintentional start. Pulse length must be between: 50 ms and 5 sec. If the start impulse is longer or shorter, the start input will be ignored by the device. The configuration control document identifies which terminal the start button is connected to. If the start button is connected to IN1or IN2 then a red LED indicates that a start signal is present, a green LED indicates no signal is present.

Terminal	LED green	LED red
IN 1 or IN 2	No start signal present	Start signal present (button pressed)

Table 4

WARNING



It is fundamental that the start button be mounted so that the danger area is clearly visible. That is, when pressing the start button it must be guaranteed that no one is detained within the danger area.

Warning: Important safety advice:

Automatic start

If a safety component is configured for "automatic start", then, after the activation and the deactivation of the safety component, the two OSSD outputs will change automatically from low to high again and if connected the MSR45E expander relay contacts will automatically re-close.

IMPORTANT

According to EN 60204 article 9.2.4.4.2 a system may not automatically restart, even after the cause of the shutdown has been eliminated and thereby another danger may still exist to the operator. If the MSR42 control module is configured with an "automatic start", this requirement must be fulfilled by further measures.

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 means that even in the case of a very short safety light curtain interruption, the safety outputs will stay low (Relays = open) for 80ms at minimum. A start signal will only be recognized after the 80ms duration.

EDM or start release

If an MSR42 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 must be inserted. For monitoring the function of these contactors, each relay block must have at least one normally closed contact which is fed back in series to IN2 (or IN1 depending on configuration) of the MSR42 control module (e.g. Figure 4).

Two options are possible for this monitoring:

1. Start release: The signal at the corresponding input terminal must be high before the start button is pressed (this means: the normally closed contacts of the external relays must be closed before allowing a start). The option "start release" is pre-configured in the MSR42 control module (440R-P226AGS-NNR) (e.g. Figure 4).

2. EDM (external device monitoring): The input signal of the EDM terminal is always monitored. This means: not only at the beginning before a start the signal must be correct. Also after the start a signal change must happen, otherwise an emergency stop occurs. If a high signal is present for longer than 5 seconds, a lock-out will occur.

If the configuration control document shows that EDM or start release must be attached to terminal IN 1 or IN 2, then the meaning of the respective LED is shown below.

Terminal	LED green	LED red
EDM at IN 1 or IN 2	EDM signal okay	EDM signal wrong
Start release at IN 1 or IN 2	Start release signal okay	Start release signal wrong

Table 5

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

IMPORTANT

1. In cases where the MSR42 control module is installed without expander modules the function external device monitoring (EDM) or start release must always be used, the only exceptions are if the PNP outputs are connected with another safety relay or a safety PLC.
2. Through the use of start release or EDM, it is possible 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 surge suppressors are highly recommended. Surge suppressors must be connected parallel to the external contactors (e.g. Figure 4). They may never be connected parallel to the contacts of a MSR45E expander module. Surge suppressors may drastically increase the off delay time of the contactors. Diodes are not allowed to be used as surge suppressors, for exactly this reason.

Recommended surge suppressors are:

Supply voltage [V]	Resistor R [Ω]	Condenser C [µF]
24	100	2.2
115 - 230	220	0.2

Table 6

Safety Components

The connected safety components (e.g. safety switches, position switch, emergency stop buttons, cable pull safety switches) must satisfy the relevant standards for application within safety areas:

- Emergency stop button : EN 418
- Safety switch : EN 60947-5-1
- Light curtains : EN 61496-1 / -2
- etc.

as well as the requirements of the safety analysis. It is essential that the components contain 2 force guided, normally closed (NC) contacts (Figure 8), and that they are approved for the relevant safety level or category.

As a basic rule to increase reliability, it is recommended to use safety components with integrated gold contacts. Safety components, can be connected to "GPIO1" through "GPIO4" as shown below. The inputs are short-circuit and cross fault monitored.

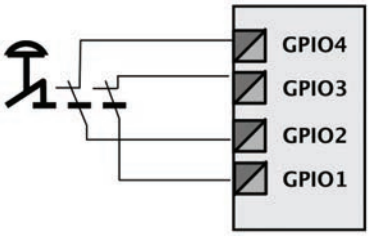


Figure 8: Connecting an emergency stop

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 control module. The two circuits are also time monitored. This means, if one circuit changes e.g. of an emergency stop, the second circuit has to follow within 5 seconds. If this is not the case, the MSR42 interprets this as a fault and the controller switches off the safety circuit.

Depending on the configuration and the application, there may be more terminals than components needed. The unused ports may be bridged. Shielded cables are recommended for bridging to reduce the input of EMC.

Terminal	LED green	LED off
GPIO3	Contact GPIO1/GPIO3 closed	Contact GPIO1/GPIO3 open
GPIO4	Contact GPIO2/GPIO4 closed	Contact GPIO2/GPIO4 open

Table 7

Safety Override

In Figure 9 a "Safety Override" key switch and a safety prevention lamp is shown. With the "Safety Override" key switch it is possible to override the safety function of the Micro400 light curtain. This means that if the override key switch is activated, the safety outputs stay high even if e.g. the protective field is interrupted.

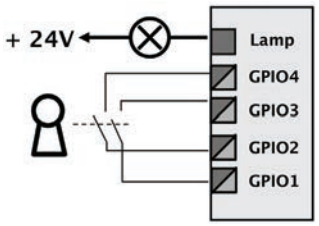


Figure 9: Connecting a Safety Override key switch and the associated lamp

Depending on the risk evaluation when using a "Safety override" key operated switch a corresponding indicator lamp must also be connected. The connection for this safety override lamp can be configured to be current controlled (see Technical Data chapter 14). This means, the current (I) of the individual lamp must remain between (Imin < I < Imax). If the monitored current is not within these limits, the light curtain will not be overridden although the safety override key switch is activated.

The safety override lamp used has to fulfil the requirements of EN 61496 and has to be mounted close to the protective field and be clearly visible to the machine operator. Safety override only takes place when both circuits are closed. Likewise safety override only takes place when both circuits were opened before becoming closed. A cross-fault will be

detected and stop the Safety override function from becoming activated. After one of the circuits is opened, the amount of time until the safety function of a safety component is active again is maximum the response time of the MSR42 module.

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

Note that the lamp still will indicate the override function, but is no longer monitored. Instead of a safety prevention key switch, an enabling switch or two independent, safety position sensors may be used, depending on the application and the risk assessment.

Terminal	LED green	No LED flashing
GPIO3	Contact GPIO1/GPIO3 closed	Contact GPIO1/GPIO3 open
GPIO4	Contact GPIO2/GPIO4 closed	Contact GPIO2/GPIO4 open

Table 8

Terminal	LED off	LED orange
Lamp	Safety override circuits opened	Safety override circuits closed

Table 9

IMPORTANT

1. 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. As a general rule, emergency stop buttons may never be overridden! The safety override key for this switch has to be stored securely, so that only authorized personnel have access to this key.
2. The function "Safety override" can not 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! Additional requirements have to be fulfilled to realize the "Muting" function which are not described here.

OSSD connections

Overall response time of a system is the sum of the response time of the OSSD outputs of the connected safety component (e.g. light curtains or laser scanners) and the response time of the MSR42 and if used the MSR45E modules (see Configuration Control Document).

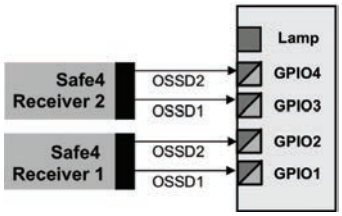


Figure 10: Connection of up to two OSSD safety components (e.g. GuardShield Safe4 light curtain systems)

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

Muting

Muting is the temporary automatic suspension of a safety function. Using the USB/optical interface and the "Configuration & Diagnostic Software" different types of muting can be configured. There are several muting option settings for light curtain systems. Details about different types of muting and their characteristics can be found in the software MSR42 Software "Configuration & Diagnostic Tool" 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 light curtain during normal operation without causing a fault or stop condition. This can include a sheet of metal passing through the light curtain before an operation is performed to form the material. The Light curtain will permit the material at a specific thickness but nothing more without causing the safety outputs to turn off.

The MSR42 already supports teach-in fixed blanking via the basic configuration.

There are two types of blanking available through the MSR42:

- Fixed blanking
- Floating blanking

When blanking is activated this has to be clearly indicated by a display or a lamp. The MSR42 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 light curtain resolution may be changed. Therefore it is necessary to attach an updated label to the Light Curtain noting the changed resolution has changed.

On cascaded light curtains check especially for the beams in the area of the end of the protective fields. In case of faulty settings the blanking range may be unintentionally on the wrong stick.

Fixed blanking with monitoring requires the material to be present at all times to prevent a fault condition. In many applications, the material may shift slightly during normal operation. This can cause up to one more beam to be blocked. Since this can occur during normal operation, the MSR42 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, it increases the resolution of the light curtain. The table below shows the new resolution.

	standard	Blanking area
Finger resolution	14mm	24mm
Hand resolution	30mm	55mm

Table 10

Adjoining of two blanking areas with fixed blanking or floating blanking with monitoring the resolution in this area rises up for 2 beams. standard adjoining blanking area

	standard	Blanking area
Finger resolution	14mm	34mm
Hand resolution	30mm	80mm

Table 11

Blanking can be activated with

- downloading a customer configuration or
- using the teach-in blanking function.

For configuring blanking and obtaining additional information surrounding the subject see the description of the software "Configuration & Diagnostic Tool".

Blanking Teach-In

Blanking Teach-in is a function, which allows the ability to set one or two fixed blanking area(s) without the use of the configuration tool or configuration software. The customer has to connect a key switch to a pair of GPIO-inputs according Figure 11. The key switch must have two channels to select this mode.

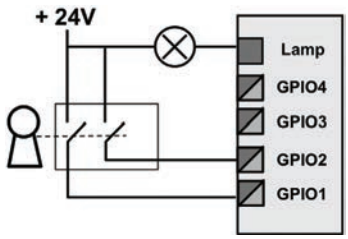


Figure 11: Key switch with two channels for activating

When the two channels are closed, the teach-in blanking mode is active and the lamp is blinking. The safety outputs turn off and the beams interrupted will be stored as the fixed blanking areas. It is recommended to teach the MSR42 blanking areas in the application to ensure the proper beams are blanked. Up to two different fixed blanking zones can be configured via the external "teach-in" selector switch.

IMPORTANT

- Only an authorized person may have the key to do a teach-in. If the configuration allows for a teach-in of fixed blanking the following process takes place:
- The blanked object(s) has to be in the light curtain during the whole teach-in process.
- The authorized person has to set the key switch.
- After that the teach-in process starts. The teach-in function is shown when the connected lamp is blinking. If the teach-in function is finished and stored in the MSR42 the lamp will be on, otherwise the lamp will be off and the configuration is unchanged.
- If the teach-in blanking function is successfully finished the authorized person has to reset the key switch so the contacts are open, no longer connected to 24VDC.

Single Scan Filter

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

The single Scan Filter can be activated by deselecting the double scan mode in the Micro 400 window of the MSR42 "Configuration & Diagnostic Tool" software,

(see "Double Scan Filter" in Software Configuration Tool Manual)

WARNING



Double scan mode causes a longer response time than single scan mode. Consider the relevant maximum response time when evaluating the safety distance.

Testing the MSR42

IMPORTANT

The MSR42 control module complies with safety Category 4, PLe Per EN ISO 13849-1. The execution of the security function must be tested 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 control module is certified according to SIL3 of IEC 61508. Normally the test input at the main module is connected to +24 V. If an external test is desired according to the risk analysis, a contact can be connected to IN 1. In case of operation in a "self test mode" both OSSD outputs have to be connected separately to the safety circuit of the machine.

Following connections may be used for test inputs.

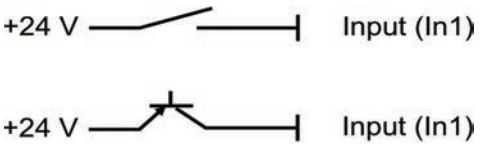


Figure 12: Connection possibilities for the input

The timing of test input is as follows (Figure 13):

	Time	Value in ms
Response time to test signal	t_1	$\leq t_R$
ime to test	t_2	$\leq t_1$
Restart time after test	t_3	$\geq t_R$

Table 12: Timing during testing

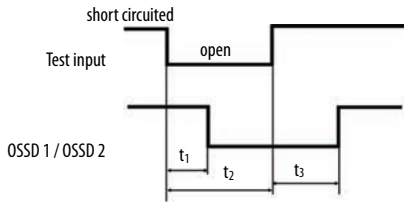


Figure 13: Test timing diagram (minimum off time = see configuration control document)

t_R means the max response time of the total system (see page 4). The machine controller has to check the output of the OSSD during such a test. If the machine controller detects an error, then the machine controller should not allow the machine to restart, respectively must stop the machine immediately.

In case of a test failure the status output "Info2" will also provide a failure signal.

Terminal	LED green	LED red
IN 1 or IN 2	External test signal high	External test signal low (test running)

Table 13

Diagnostic

In the event of a fault condition, it will be indicated by

1. the red LED of a connected GuardShield Micro 400 safety light curtain are blinking
2. can be visually noticed in that the blue OptiLink LED (located on the side of a MSR42 unit) 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 so-called lock-out mode.

Two options exist to leave the lock-out mode:

- Power up. If the fault is still present the controller will again show the lock-out mode.
- A start impulse longer than 10 s acts like a power up.

More detailed lock out information can be obtained with help of the USB/optical interface (445L-AF6150) and the software "Configuration & Diagnostic Tool".

External faults

The following external faults apply to the "Out of Box" configurations only. Reference Table 14 for detailed information.

No	Fault profile	Fault description	Measures & instructions
1	No power LED	No Power Connection to +24 VDC OV	Check power connections and power supply
2	Light curtain LED(s) are flashing red	Light curtain Rx / Tx are swapped	Reverse Rx / Tx connections and retry
		Open / missing light curtain cable	Replace expansion cable on the light curtain that is not flashing
		Defect in light curtain	Replace light curtain
3	OSSD1 & OSSD2 LEDs are red No relay outputs	Missing reset switch for manual reset	Add rest switch with N/O contact
		Missing 24 VDC to GPIO3 and GPIO4 for automate reset.	Add 24VDC jumper to GPIO3 and GPIO4
		Missing 24VDC to IN1 and IN2	Add 24VDC jumper to IN1 and IN2
		No start release signal from external contactors	Check wiring and function of external contacts

Table 14

Programmed Configuration Diagnostics can be obtained with the use of USB / Optical Interface (445l-AF6150) and the software "Configuration and Diagnostic Tool"

Internal faults

The following internal faults apply to the "Out of Box" configurations only. Reference Table 15 for detailed information.

No	Fault profile	Fault description	Measures & instructions
1	No Power LED	Power supply is ok but MSR42 relay does not power up	Replace the MSR42 and retry
2	Relay is in Lockout mode Will not initialize	All input and reset LEDS are ok. No external faults were detected. Relay locks upon power up and will not release	Replace the MSR42 and retry

Table 15

The lock-out mode of a MSR42 control module may be reset by one of two methods:

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

Further diagnosis possibilities are possible with the software Configuration & Diagnostic Tool in combination with the USB/optical interface. If the MSR42 unit has a lock-out, the exact fault description can be determined with these tools. An exact description is available at any time after a lock-out, as long as the MSR42 unit is still in the lock-out condition.

Selection tables

	Mounting	Size	Cat. No.
MSR41 ON/OFF 	35 mm DIN Rail	22.5 mm	440R-P221AGS
MSR42 Multi-functional module 	35 mm DIN Rail	22.5 mm	440R-P226AGS-NNR

Optional Safety Relay Interfaces

Relay	Input Voltage	Reset	Outputs	Cat. No.
MSR45E Safety Relay Expansion Module 	Supplied by MSR41 or MSR42	Determined by MSR41 or MSR42	2 N.O.	440-P4NANS

Table 16

Accessories / Components

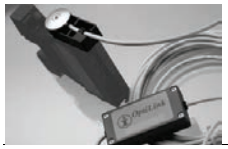
	Part number	Description
	440R-ACABL1	Ribbon Cable – Two modules
	440R-ACABL2	Ribbon Cable – Three modules
	440R-ACABL3	Ribbon Cable – Four modules
	440R-ATERM1P	Terminal Block Kit - MSR41
	440R-ATERM2P	Terminal Block Kit - MSR42
	440R-ATERM2C	Terminal Block Kit - MSR45E
	445L-AF6150	USB USB/optical Interface
	www.ab.com	Software Configuration Tool

Table 17

Inspection and service

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

Inspections

The MSR42 control modules have to be tested periodically – in accordance with valid regulations - by qualified and trained personnel to discover prohibited manipulations or unauthorized modifications.

Decommissioning

The MSR42 modules can only be removed, when the machine or the equipment is shut down completely and can no longer be operated without tools. If a controller has to be disposed, it can be simply dismantled. The separated materials can be recycled according to state of the art technology and corresponding regulations of the country it was used in.

Product labels

All the necessary safety information can be found on the product labels and the Configuration Control Label, which can be found on each controller module (example):



Figure 14: Product label MSR42 control module

Explanation of terminology	
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 PL	Performance level acc. to EN ISO 13849-1
Power class	Power supply
Temperature range	Operating temperature range
OSSD	Max. current available per OSSD output, at the listed voltage

Table 18

All of the configuration information will also be found on the configuration control document, which is included with the delivery of each MSR42 control module.

Note:

In the event that a MSR42 control module is reconfigured by authorized personnel using the USB/optical interface, a new Configuration Control Label must be filled out and applied next to the existing label (Figure 15). Details of the new configuration are given in the configuration control document.



Figure 15: The new special configuration identification "Configuration changed" must be positioned next to the existing label.

Technical Data

General data	
Nominal working mode	Continuous process
Temperature range	Environment temp.: 0 ... +55°C Stock temp.: -25 ... +70°C
Enclosure rating according EN 60529 Housing Terminals	 IP20 IP20
Conductor connection: 4-, 5-pin, terminal strip (plug-in)	Wire cross section: 1 x max 2.5 mm^2 (14 AWG) stranded spring clamping technology
Quick mounting	Top hat rail 35 mm (EN 50022)
Net weight	130 g (0.287 lbs)
Housing dimensions	111 x 22,5 x 125 mm (incl. plugs) See page 2
Housing material	Polyamide
Vibration according to EN60068-2-6	Amplitude: 0.35 mm Frequency: 10 … 55 Hz
Shock resistant according to EN 60068-2-29	Acceleration: 100 ms^{-2} Impulse length: 16 ms Number of shocks: 1'000 per direction
Mounting	35 mm DIN Rail
Approvals	TÜV, CE, cULus
Interfaces	Optical (OptiLink)

Weight and packaging	
Dispatch packaging	280 mm x 200 mm x 70 mm
Dispatch weight	Net weight + 220 g

Power Supply	
Input Power Entry	+24 VDC (EN 60204-1) See page 4
Max. power consumption at max. supply voltage	2.1 W (semiconductor outputs unloaded)
at 5 % residual ripple	0.85 ... 1.15 U_N
Current consumption	Current max. 70 mA + 70 mA per relay extension module (semi conductor outputs unloaded) maximal: 1.7 A depending on attached load
Controller protection (external)	5 A slow

Inputs	
Safety inputs (software configurable)	(1 x 2 NC or 2x 2 OSSD) and 1 Micro 400
Reset mode	Automatic / Manual or Manual monitored
Control current into: IN 1, IN 2	2 mA each (min.) (in accordance with EN 61131-2)
Minimum voltage at: IN 1, IN 2	11 VDC at activated controller (EN 61131-2)

Inputs	
Start pulse duration Min. Max.	 50 ms 5s See page 7
Test pulse duration (min.)	response time x 2
Control current into: GPIO1 – GPIO4	7 mA each at U_N (coded)
Maximum cable length for safety switches	50 m out and back (total 100 m) See page 6 or 10
Safety Prevention Lamp Minimum current at Lamp	0.9 A with lamp switched on

GPIO1 – GPIO4 Outputs to safety components	
Nominal voltage	U_N – 2 V (coded) (Short circuit protected)
Current max	100 mA (short-circuit protected)
Leakage current	$I_{MAX\ Off}$ = 0.05 mA (C_{LOAD} = 100 µF)

Info 1, Info 2 Status Outputs (PNP)	
Voltage	U_N – 2 V
Current max	100 mA (short-circuit protected)
Leakage current	$I_{MAX\ Off}$ = 0.05 mA (C_{LOAD} = 4.7 µF)

2 OSSD semi conductor outputs (PNP)	
Voltage	U_N - 2 V
Current Max	400 mA short-circuit protected and with cross-fault detection
Leakage current	$I_{MAX\ Off}$ = 0.1 mA (C_{LOAD} = 3.3 µF)
Max. response time t(C) with UN protective mode See page 4	≤ 15 ms
Max. response time t(GPIO) with UN protective mode See page 4	≤ 130 ms
Minimal off time	82 ms

Safety Related Parameter	
Probability of a dangerous failure per hour PFH_D	6.0 E-9 1/h MSR42 & MSR45E & Micro 400
	9.0 E-10 1/h MSR42 & MSR41 Control Module
	3.0 E-10 1/h MSR45E Expander Module
	4.0 E-9 1/h Micro 400 Light Curtain
Performance Level PL	PL e, Cat. 4 (EN ISO 13849-1)
Safety Integrity Level	SIL CL 3 (IEC 61508 / IEC 62061)

Appendix

Special MSR42 control module features -- for existing customers.

Interrupt Ignore Time

This function is not included in the standard version.

A limited time a light curtain interruption will be ignored. This may be used when parts move through the light curtain at high speed and the safety output should not switch, but yet a person moving through the light curtain should be detected and cause the safety output to switch off.

Activating this operating mode, a limited time a light curtain interruption will be ignored. This may be used when parts may move at a fast speed through the light curtain without interrupting, but a human will interrupt the light curtain at time longer than the configurated time.

IMPORTANT	Interrupt Ignore Time will increase the response time. The response time is given in the corresponding configuration control document. Recalculate the safety distance.

The Interrupt Ignore Time function has to be activated by the MSR42 “Configuration & Diagnostic Tool” software and downloaded to the MSR42 control module with help of the USB/optical interface (445L-AF6150)

Configuration control document

Rockwell Automation — Configuration designation AB B001 (AB B001.cfg)

The MSR42 safety control units may only be configured by authorized people. This sheet shows the actual system parameters of the configurator and has to be stored together with the manual. The device number has to correspond to the number on the control document. Old control documents have to be exchanged! To receive more information see manual or contact your local ROCKWELL AUTOMATION Partner.

User registration:

Company:	Rockwell Automation	City:	Town
First Name:	John	Country:	US
Name:	Doe	Phone:	+1 123 456 7890
Address:	Street 2	Fax:	+1 123 456 7890
Zip code:	12345	Email:	jdoe@ e-mail .com

Current set up

Installed hardware:	MSR42
Attached GuardShield Micro 400	Order Code not specified
GuardShield Micro 400: Number of beams:	not specified
GuardShield Micro 400: Response time t(LC):	see label light curtain
GuardShield Micro 400: Evaluation time t(EvalLC):	see label light curtain (only important for interrupt ignore time)
Controller response time t(C):	14.70 ms
Stop delay time t(delay):	0.00 ms
Interrupt ignore time t(ignore):	0.00 ms
Response time for safety component on GPIO t(GPIO):	0.00 ms
Response time for extension modul t(em):	6.00 ms
Maximum OSSD response time for GuardShield Micro 400 light curtain:	
t(totLCOSSD)=t(C)+t(LC)+t(delay):	14.70 ms + t(LC) (see label)
Maximum relay extension module response time for GuardShield Micro 400 light curtain:	
t(totLCEXT)=t(C)+t(LC)+t(delay)+t(em):	20.70 ms + t(LC) (see label)

Configuration

Filename (Configuration file):	AB B001.cfg
Configuration designation	AB B001
Device No.	000000

Connector / Pin	Function	Remarks
RJ45	Safety light curtain	Start Mode: manual / Stop Delay: No / Double scan2
GPIO1/2	TeachIn Blanking	
GPIO3	Start button	
GPIO4	Start mode	Depends on GPIO4: 24V = auto, 0V = manual
IN1	Test input	
IN2	Start release	OSSD (ChA) and relay outputs (ChB)
Info1	Status Output	EDM or start release/GuardShield Micro 400 light curtain
Info2	Status Output	Lockout
Safety Outputs	Contact monitoring	Start release

Additional safety information

(ChA: OSSD outputs, ChB: Relay outputs)

Safety category (EN ISO 13849):	PLe, Cat. 4
SIL level (EN/IEC 61508):	3
EDM response time:	300 ms
Minimal off time:	82 ms

14.03.2011 / Signature: _____

Configuration printout (1.0.2.61) 14.03.2011 15:30:15 Page 1 of 1

Figure 16: Configuration Control Document for the MSR42 controller with basic configuration

Rockwell Automation

EC Declaration of Conformity

The undersigned, representing the manufacturer	*and the authorised representative established within the Community*
Rockwell Automation, Inc. ***2 Executive Dr.*** ***Chelmsford, MA 01824*** ***USA***	***Rockwell Automation BV*** ***Rivium 1e Straat, 23*** ***2909 LE Capelle aan den IJssel*** ***Netherlands***
Herewith declare that the Products:	***MSR4x Safety Base / MSR4xE Expander Controller Modules***
Product identification (brand and catalogue number/part number):	***Allen-Bradley 440R-P and 445L-1 Series*** *(reference the attached list of catalogue numbers)*
Product Safety Function	***The MSR4x safety base control devices and the MSR4xE extension modules can be used in applications up to Safety Category 4 (EN 954-1)/ SIL3/SIL CL3 (EN 61508 / EN 62061) and PL e (EN ISO 13849-1).***

are in conformity with the essential requirements of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

2006/42/EC	*Machinery Directive*
2004/108/EC	*EMC Directive*

and that the standards and/or technical specifications referenced below have been applied:

EN 61496-1:2004 + A1:2008	*Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests*
IEC 61496-2:2006	*Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPD's)*
EN ISO 13849-1:2008	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN 61508 Parts 1-7:1998-2000	*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*

Manufacturer:	*Authorised Representative in the Community:*
Daniel L. Nachtigall	
Signature	***Signature***
Name: Daniel L. Nachtigall	*Name:* Viktor Schiffer
Position: Supv – Product Certification Engineering	*Position:* Engineering Manager
Date: 01-Mar-2011	*Date:* 08-Mar-2011

Document Control Number: SEN-0394-B-EN 1 / 2

Original instructions

Allen-Bradley Guardmaster®

Rockwell Automation

Catalogue number [1]	*Series* [2]	*Description*
440R-P221AGS		*MSR41 base module*
440R-P226AGS-NNR		*MSR42 base module*
445L-104794-B***		*MSR42 base module customer configuration*
440R-P4NANS		*MSR45E expander module*
445L-1****		*MSR45E expander module customer configuration*

*1) *Denotes characters representing options that do not impact the standards or directives cited on this DoC*

2) If no series number is given, then all series are covered

Technical Support / Technische Unterstützung / Assistance technique / Assistenza tecnica / Asistencia técnica	
ENGLISH	Installation of this product must not take place until the installer has obtained a copy of the manufacturer's instructions in a language which he can understand. This instruction sheet is available in multiple languages at http://rockwellautomation.com/literature.
DEUTSCH	Dieses Produkt darf erst installiert werden, wenn der Installateur eine Kopie der Instruktionen des Herstellers in der Sprache eingeholt hat, die er versteht. Diese Instruktionen sind mehrsprachig erhältlich unter: http://rockwellautomation.com/literature.
FRANÇAIS	Ce produit ne peut être installé avant l'obtention d'un duplicata des instructions du fabricant dans une langue compréhensible. La fi che d'instructions est disponible en plusieurs langues depuis le lien http://rockwellautomation.com/literature.
ITALIANO	Non si deve procedere all'installazione di questo prodotto fin quando l'installatore non abbia ottenuto una copia delle istruzioni del produttore in una lingua che l'installatore possa capire. La presente scheda di istruzioni è disponibile in linguaggi multipli sul sito web http://rockwellautomation.com/literature.
ESPAÑOL	Absténgase de instalar este producto a menos que el instalador disponga de un ejemplar de las instrucciones del fabricante en un idioma que pueda comprender. En http://rockwellautomation.com/literature puede encontrar esta hoja de instrucciones en varios idiomas.
PORTUGUÊS	A instalação deste produto não pode ser efectuada até que o montador tenha obtido uma cópia das instruções do fabricante numa língua que ele compreenda. Essa folha de instruções está disponível em diversas línguas em http://rockwellautomation.com/literature.
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SVENSKA	Denna produkt får inte installeras förrän installatören har skaff at ett exemplar av tillverkarens instruktioner på ett språk som han/hon förstår. Detta instruktionsblad fi nns på fl era språk på http://rockwellautomation.com/literature.
NEDERLANDS	Het product mag pas worden geïnstalleerd wanneer de monteur beschikt over een exemplaar van de instructies van de fabrikant in een voor hem begrijpelijke taal. Dit instructieblad is in diverse talen verkrijgbaar op http://rockwellautomation.com/literature.
繁體中文	安裝者須取得其所通曉語言之產品說明書後方可進行本產品的安裝。 各語言版本的產品說明書可透過以下連結獲取: http://rockwellautomation.com/literature 。
简体中文	安装者须取得其所通晓语言的产品说明书后方可进行本产品的安装。 各语言版本的产品说明书可通过以下链接获取: http://rockwellautomation.com/literature 。
日本語	この製品の取付けは取付け者が理解できる言語で書かれたメーカーの取扱説明書を入手するまで行わないで下さい。 この説明書は http://rockwellautomation.com/literature で複数の言語で提供されています
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EESTI	Selle toote installatsioon ei tohi toimuda enne kui installeerija on omandanud koopia tootja instruktsioonidega keeles mida ta ise valdab. Instruktsioonid erinvates keeltes on saadaval siin: http://rockwellautomation.com/literature.
SUOMI	Tämä tuote voidaan asentaa vasta kun asentaja on hankkinut valmistajan ohjeet kielellä, jota hän ymmärtää. Erikieliset ohjeet ovat ladattavissa sivustolta http://rockwellautomation.com/literature.
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MAGYAR	Ez a termék csak akkor helyezhető üzembe, ha az üzembehelyezést végző személy rendelkezésére áll a gyártó használati utasítása az általa ismert nyelven. Az utasítás több nyelven megtalálható itt: http://rockwellautomation.com/literature
ÍSLENSKA	Uppsetning á þessari vöru má ekki eiga sér stað fyrr en sá sem annast uppsetninguna hefur fengið afrit af leiðbeiningum framleiðanda á því tungumáli sem hann þekkir. Leiðbeiningarpésinn er tiltækur á mörgum tungumálum og er hægt að ná í hann hér: http://rockwellautomation.com/literature
LATVIEŠU VALODA	Šī ražojuma uzstādīšanu nedrīkst veikt, pirms uzstādītājs nav saņēmis ražotāja instrukcijas tādā valodā ko viņš saprot. Šo instrukciju lapiņu var saņemt daudzās valodās no vietnes http://rockwellautomation.com/literature
LIETUVIRŠKAI	Šito produkto įrengimas negali būti vykdomas tol, kol įrengėjas neturės gamintojo instrukcijų kopijos ta kalba, kurią jis supranta. Instrukciją galima rasti įvairiomis kalbomis tinklapyje http://rockwellautomation.com/literature
MALTI	L-installazzjoni ta' dan il-prodott mgħandux isir qabel ma l-installatur jakwista kopja tal-istruzzjonijiet tal-manifattur f'lingwa li tista' tiftiehem. Il-karta tal-istruzzjonijiet hija disponibbli f'ħafna lingwi f'http://rockwellautomation.com/literature.
NORSK	Dette produktet må ikke installeres før installatøren har bruksanvisningen på et behersket språk. Dette instruksjonsarket kan fås i fl ere språk på http://rockwellautomation.com/literature.
ROMÂNĂ	Produsul nu trebuie să fi e instalat până când cel care instalează produsul nu a obținut o copie a manualului de utilizare , în limba pe care o poate înțelege. Aceste instrucțiuni sunt valabile în mai multe limbi la adresa http://rockwellautomation.com/literature.
SLOVENSKY	Inštalácia tohto výrobku nesmie prebehnúť, dokiaľ inštalujúca osoba nedostane pokyny výrobca v jazyku ktorému rozumie. Tieto pokyny sú k dispozícii v niekoľkých jazykoch na http://rockwellautomation.com/literature.
SLOVENŠČINA	Tega izdelka se ne sme nameščati, če si oseba, ki ga namešča, ni priskrbela izvoda proizvajalčevih navodil v jeziku, ki ga razume. Ta list z navodili v številnih jezikih je na razpolago na http://rockwellautomation.com/literature.
TÜRKÇE	Bu ürünün kurulmasının, ürünü kuracak kişinin üreticinin hazırladığı talimatların bir kopyasını, ki bu talimatlar bu kişinin anlayacağı bir dilde olacaktır, elde edene kadar gerçekleşmemesi gerekir. Bu talimatlar pek çok dilde şu web-sayfasında mevcuttur: http://rockwellautomation.com/literature

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