ROBOTICS

Application manual

Scalable I/O

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Application manual

Scalable I/O

RobotWare 7.18

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Original instructions.

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Overview of this manual

About this manual

This manual describes the scalable I/O devices and contains instructions for the configuration.

> **Note**
>
> It is the responsibility of the integrator to provide safety and user guides for the robot system.

Usage

This manual should be used during installation and configuration of the scalable I/O devices.

> **Note**
>
> Before any work on or with the robot is performed, the safety information in the product manual for the controller and manipulator shall be read.

Who should read this manual?

This manual is intended for

- Personnel responsible for installations and configurations of industrial network hardware/software
- Personnel responsible for I/O system configuration
- System integrators

Prerequisites

The reader should have the required knowledge of

- Mechanical installation work
- Electrical installation work
- System parameters and how to configure them
- RobotStudio

References

Document references

Reference	Document ID
Operating manual - RobotStudio	*3HAC032104-001*
Operating manual - OmniCore	*3HAC065036-001*
Operating manual - Integrator's guide OmniCore	*3HAC065037-001*
Product manual - OmniCore C30	*3HAC060860-001*
Product manual - OmniCore C90XT	*3HAC073706-001*
Product manual - OmniCore V250XT Type B	*3HAC087112-001*

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Reference	Document ID
Product manual - OmniCore V400XT	*3HAC081697-001*
Technical reference manual - System parameters	*3HAC065041-001*
Technical reference manual - RAPID Instructions, Functions and Data types	*3HAC065038-001*
Application manual - Controller software OmniCore	*3HAC066554-001*
Product specification - OmniCore C line	*3HAC065034-001*
Product specification - OmniCore V line	*3HAC074671-001*
Application manual - EtherNet/IP Scanner/Adapter	*3HAC066565-001*
Application manual - I/O Engineering	*3HAC082346-001*

Revisions

Revision	Description
A	Released with RobotWare 7.0.
B	Released with RobotWare 7.0.1. • Updated the section *Coil neutralization on page 53*.
C	Released with RobotWare 7.0.2. • Updated the section *Connecting the EtherNet/IP network on page 57*.
D	Released with RobotWare 7.2. • Discrete I/O replaced by Scalable I/O in entire manual.
E	Released with RobotWare 7.5. • Information about safety digital base devices added in sections: *Introduction on page 11*, *Hardware overview on page 13*, "I/O device descriptions", "Status LED descriptions", "Technical data", *Information about ABB Scalable I/O devices on page 55* and "Configuring Scalable I/O devices using RobotStudio". • New section: "Setting up safety digital base devices". • Updated the section *References on page 7*. • Information about node commissioning for other EtherNet/IP scanners added in sections *Introduction on page 11*, *Installing digital base devices on page 41*, and "Reset button". • Limitation added in section *Information about ABB Scalable I/O devices on page 55* that COS is not supported for DSQC1042, safety digital base. • Section "Identifying an I/O device" updated with information that the MS LED also flashes during identification plus that for DSQC1042 only the PWR (Power) LED flashes.
F	Released with RobotWare 7.7. • Content in manual completely restructured. • New section including information about OmniCore capacity and examples of device combinations: *General system information on page 13* • Information about dimensions, weight and environmental conditions added in technical data for all devices in *Hardware overview on page 13*. • New section including information about mounting and required installation space: *General installation information on page 39*. • New section including information about configuration of Scalable I/O devices: *Software commissioning on page 55*.

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Revision	Description
	• New section including information about prerequisites, recommended work process and troubleshooting for safety digital base devices: *Configuring safety digital base devices on page 84*. • Information about status signal names for safety digital devices added in *Information about ABB Scalable I/O devices on page 55*. • Section *Installing safety digital base devices on page 45* updated with information about safe I/O dual channel connection.
G	Released with RobotWare 7.8. • Minor corrections in *Installing safety digital base devices on page 45*.
H	Released with RobotWare 7.10. • Information about connection of external outputs to safe I/O inputs updated in *Installing safety digital base devices on page 45*. • Information about process power supply added in *Safety digital base device, DSQC1042 on page 24* and *Installing safety digital base devices on page 45*. • Information about default hysteresis added in section *Analog add-on device, DSQC1032 on page 33* and in *Analog input point object on page 93*.
J	Released with RobotWare 7.13. • Safety related cautions added in *Safety digital base device, DSQC1042 on page 24*, "Configuring Scalable I/O devices using RobotStudio", *Configuring safety digital base devices on page 84*.
K	Released with RobotWare 7.15. • Information about Safety Network Number added in "Configuring an I/O device". • New section: *Configuring Scalable I/O devices using I/O Engineering on page 58*.
L	Released with RobotWare 7.16 and IOE 1.5.0. • Information about online configuration added in *Configuring Scalable I/O devices using I/O Engineering on page 58*. • Information about safety configuration added in *Reset safety configuration on page 88*. • Minor corrections in *Hardware overview on page 13*.
M	Released with RobotWare 7.17 and IOE 1.5.1. • Minor corrections in *Offline configuration on page 58* and *Verifying safety parameters on page 86*.
N	Released with RobotWare 7.18 and IOE 1.5.2. • Values for input and output RPI updated in *Configure the safe input connection properties on page 70* and *Configure the safe output connection properties on page 71*. • New appendix: *Reaction times on page 94*.

Network security

Network security

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide, and continuously ensure, a secure connection between the product and to your network or any other network (as the case may be).

You shall establish and maintain any appropriate measures (such as, but not limited to, the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its entities are not liable for damage and/or loss related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

1 Introduction

General

ABB Scalable I/O is a modular, compact, and scalable I/O system that consists of a digital base device, or a safety digital base device, which is the minimum configuration, and add-on devices.

Up to four add-on devices can be controlled by each base device with maintained performance, and any combination of add-on devices is supported.

Communication

The digital base device communicates over the EtherNet/IP communication protocol to the robot controller or to other EtherNet/IP scanners. Up to 50 devices in total can be connected to the robot controller over EtherNet/IP.

Node commissioning for other EtherNet/IP scanners

For other EtherNet/IP scanners, node commissioning needs to be done either using a dhcp server on the scanner network or setting a static IP address in the device with the help of third-party software. An initial volatile address can be obtained using the reset button. The TCP/IP Object can then be accessed for the purpose of this.

Note

The safety digital base device, DSQC1042, is not to be used with other EtherNet/IP scanners.

Options

When using the standard *Plug & Produce* interface, no additional RobotWare options or hardware options are required to connect to the robot controller.

When using the RobotWare options *3024-1 EtherNet/IP Scanner* and/or *3024-2 EtherNet/IP Adapter*, more configuration possibilities are available.

Device interfaces

The add-on devices have an optical interface and must be attached to a digital base device. The additional Ethernet port on the base device can be used to daisy chain any Ethernet based equipment on the same network, for example additional digital base devices.

Safety

The safety digital base device can be used to control and monitor machine safety equipment in a system. It uses dual channels, meaning that no undetected single fault can lead to loss of safety functions.

Note

The safety digital base device functionality is available from RobotWare 7.5.

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Note

The safety digital base device, DSQC1042, may only be used with the OmniCore controller on the Private Network.

Mounting

The I/O devices are designed to be mounted vertically on a mounting rail in an IP20 protected environment with normal air convention. Forced air is needed if the devices are mounted horizontally.

Features

The important features of the ABB Scalable I/O devices are following:

- Easy to install.
- Easy to configure in RobotWare with support of the *Plug & Produce* interface.
- Compact and scalable.
- Can be mounted inside the controller and/or distributed outside.
- Supports standard DIN-rail mounting.
- Galvanically isolated add-on devices.
- Dual port switch for daisy chaining.
- Fast signal setting with *Change of State*.

2 Hardware overview

2.1 General system information

ABB Scalable I/O devices

ABB Scalable I/O is a modular, compact, and scalable I/O system that consists of base devices (digital or safety digital base device) and a number of various add-on devices (digital, analog and relay add-ons):

Spare part no.	Description	Type
3HAC058663-001	Digital base, 16 digital inputs, 16 digital outputs	DSQC1030
3HAC058664-001	Digital add-on, 16 digital inputs, 16 digital outputs	DSQC1031
3HAC058665-001	Analog add-on, 4 analog inputs, 4 analog outputs	DSQC1032
3HAC058666-001	Relay add-on, 8 digital inputs, 8 relay outputs	DSQC1033
3HAC062908-001	Safety digital base, 12 digital safe inputs, 4 digital safe outputs **Note** The device is configured with dual channels (= 6 digital safe inputs, 2 digital safe outputs).	DSQC1042

See *Base devices on page 18* and *Add-on devices on page 30* for detailed information about the devices.

Additional parts

Spare part no.	Description
3HAC060919-001	Connectors digital base/add-on
3HAC060925-001	Connectors analog add-on
3HAC060926-001	Connectors relay add-on
3HAC069538-001	Connectors safety I/O
3HAC062073-001	DIN bracket

Note

See manufacturer (Phoenix) for recommendation on conductor connections.

Communication

The digital base device communicates over the EtherNet/IP communication protocol to the robot controller or to other EtherNet/IP scanners. [1] Up to 50 devices in total can be connected to the robot controller over EtherNet/IP.

When the digital base device is connected to logic power supply and Ethernet, it can be detected and configured by the robot controller. The process power supply powers the inputs, outputs, and the optical interface to the add-on devices.

1 For more information about communication to other scanners, see *Node commissioning for other EtherNet/IP scanners on page 11*.

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OmniCore controller capacity

The OmniCore controller has the capacity to handle the following combinations of ABB Scalable I/O devices:

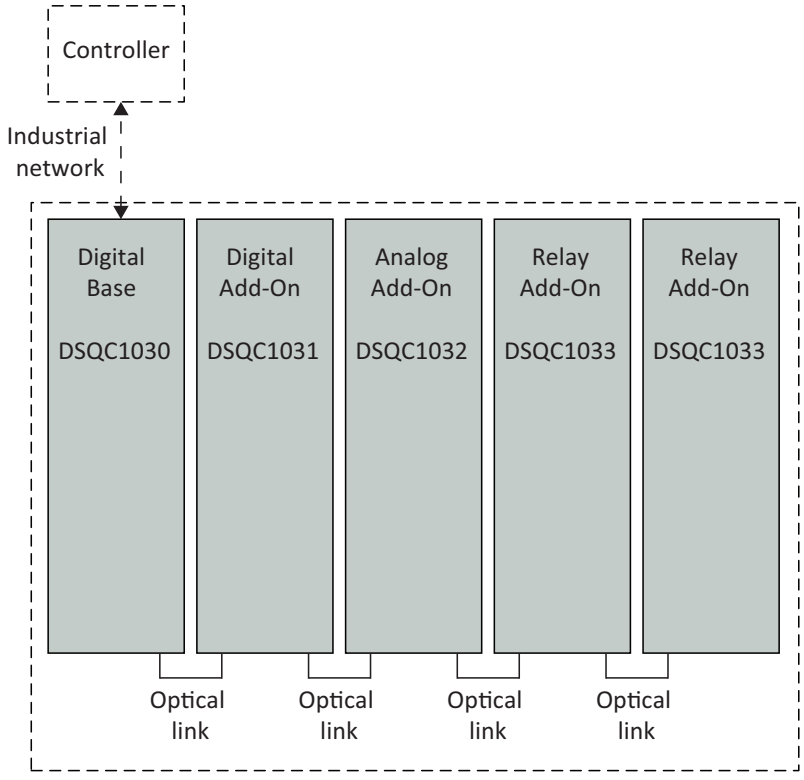
Digital base devices	Number of digital base devices per OmniCore controller	Number of add-on devices per digital base device
DSQC1030, Digital base device	30	4
DSQC1042, Safety digital base device	4	4

Up to four add-on devices can be controlled by each digital base device with maintained performance, and any combination of add-on devices is supported.

Examples of device combinations

Digital base device with add-ons

The illustration below shows a combination of a digital base device and connected add-on devices:



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Note

Up to four add-on devices can be controlled by each digital base device with maintained performance, and any combination of add-on devices is supported.

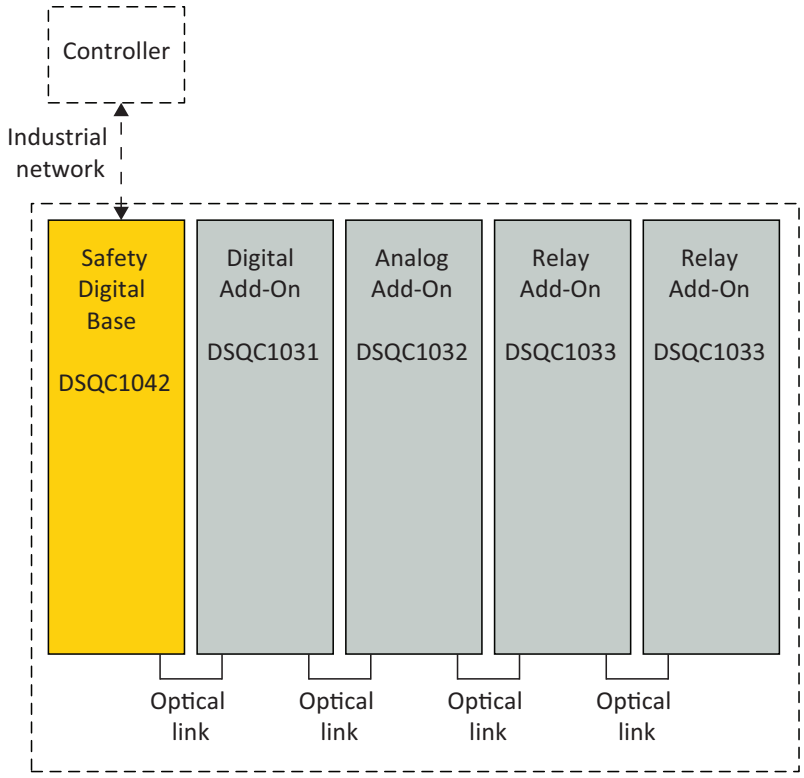
Continues on next page

Note

The optical interface on the base device must be powered by process power supply to detect add-on devices.

Safety digital base device with add-ons

The illustration below shows a combination of a safety digital base device and connected add-on devices:



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Note

Up to four add-on devices can be controlled by each safety digital base device with maintained performance, and any combination of add-on devices is supported.

Two digital base devices with add-ons

The illustration below shows a combination of two digital base devices with connected add-on devices:

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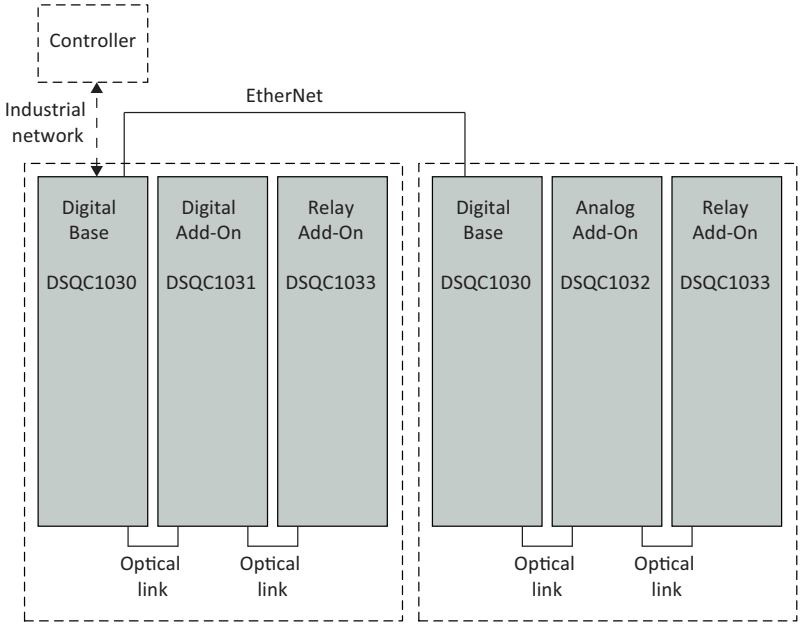
2.1 General system information
Continued



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Note

Both digital base devices communicate with their connected add-ons via an optical interface. Communication between the two digital base devices must, however, be enabled through an EtherNet cable (daisy chaining).

Two safety digital base devices with add-ons

The illustration below shows a combination of two safety digital base devices, where only the first safety digital base device has connected add-on devices.

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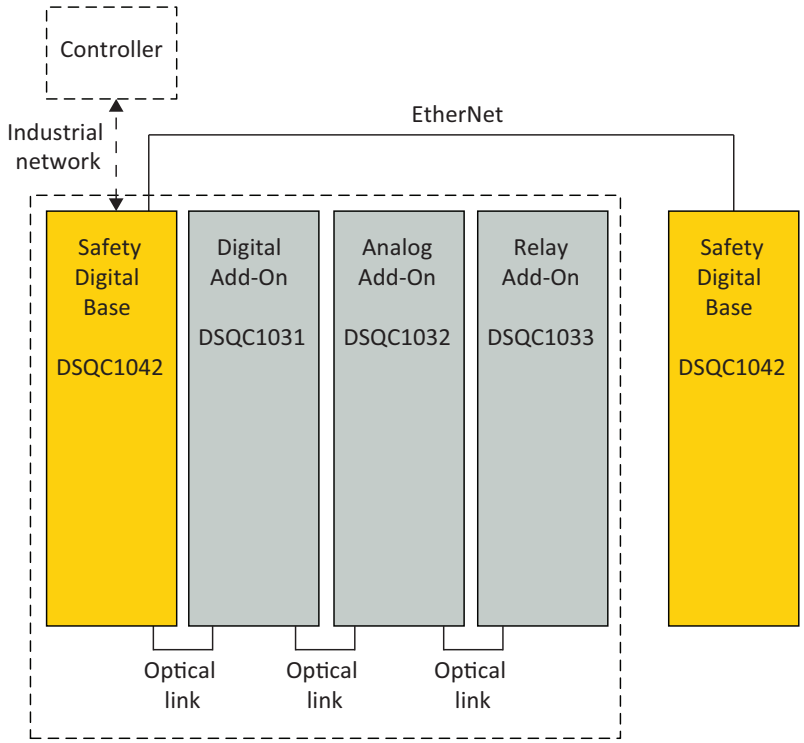

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Note

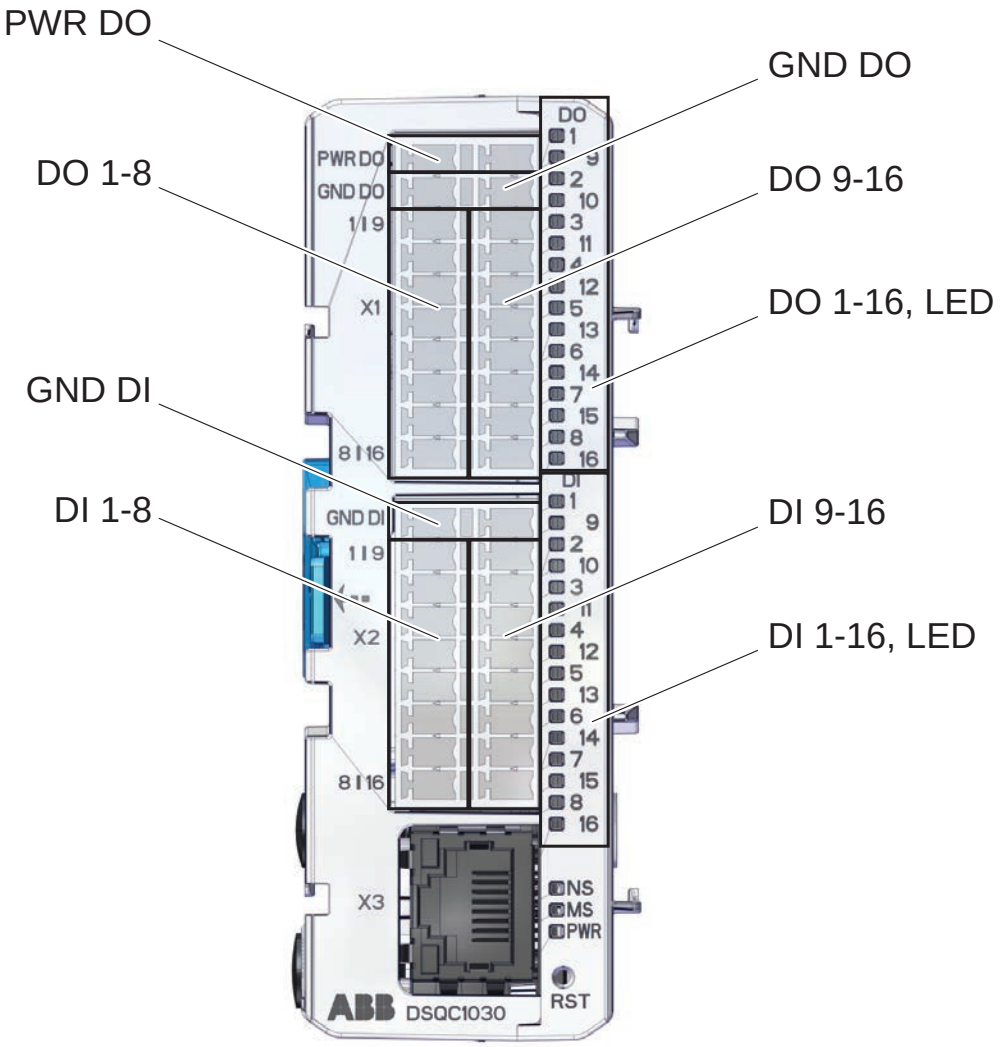
The first safety digital base device communicates with the connected add-ons via an optical interface. Communication between the two safety digital base devices must, however, be enabled through an EtherNet cable (daisy chaining).

2.2 Base devices

2.2.1 Digital base device, DSQC1030

Description

The DSQC1030 digital base device has 16 digital inputs and 16 digital outputs and can be combined with up to four additional add-on devices.



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Connector	Description
X1 [i]	Digital outputs, process power
X2 [i]	Digital inputs
X3	EtherNet
X4	Logic power

Continues on next page

Connector	Description
X5	EtherNet

i The numbers (printings) on the module only show the I/O numbers (digital input/output). It is not the pin position number for connector X1 or X2 (only I/O number).

Connectors

Location	Connector	Left side/description	Right side/description
Top	X4 Logic power	PWR	PWR
		GND	GND
Front	X1 Digital outputs, process power[i]	PWR DO	PWR DO
		GND DO	GND DO
		DO01	DO09
		DO02	DO10
		DO03	DO11
		DO04	DO12
		DO05	DO13
		DO06	DO14
		DO07	DO15
		DO08	DO16
	X2 Digital inputs[i]	GND DI	GND DI
		DI01	DI09
		DI02	DI10
		DI03	DI11
		DI04	DI12
		DI05	DI13
		DI06	DI14
		DI07	DI15
		DI08	DI16
	X3 EtherNet		
Down	X5 EtherNet		

i The numbers (printings) on the module only show the I/O numbers (digital input/output). It is not the pin position number for connector X1 or X2 (only I/O number).

Technical data

Dimensions and weight

Description	Data	Note
Dimension (Length x Width x Height)	75x33.3x101	
Weight	117 g	

Continues on next page

2.2.1 Digital base device, DSQC1030
Continued

Environmental conditions

Description	Data	Note
Operating temperature	+5…+ 65 °C	
Storage temperature	-40…+70 °C	
Permissible relative humidity	10… 95% non-condensing	
Degree of protection	IP20	

Supply voltage

Description	Data	Note
Voltage range	20.4 – 28.8 VDC	
Input current, 24V SYS	100 mA (TBC)	
Input current, 24V Process	8 A	
Plug-in current	<2 A @ 1ms	
Surge protected	Yes	
Reverse polarity protected	Yes	

Digital outputs

Description	Data	Note
Rated current	500 mA	
Max current	600 mA	
Typical short circuit current	1200 mA	
Leakage current	< 100 uA	
Rated voltage	24 VDC	
Max voltage	30 VDC	
Max voltage drop	0.5V at 500 mA	
Max inductive load	1000 mH	(max switching repetition rate: 10 sec)
Max capacitive load	10 mF	
Recommended cable area	1 mm^2	
Surge protected	Yes	
Thermal protection	Yes	
Max delay time	0.5 ms	

Digital inputs

Description	Data	Note
Input voltage level Lo	-30 - 5 V	
Input voltage level Hi	15 - 30 V	
Type switch voltage	10 V	
Input current level Lo	<0.5 mA	
Input current level Hi	>2 mA	typically 4 mA

Continues on next page

Description	Data	Note
Max voltage	30 V	
Reverse polarity protected	Yes	
Surge protected	Yes	
Internal delay time	0.5 ms	
Filter time	0 – 65 ms	Programmable. Default value 5 ms

Status LEDs

The DSQC1030 digital base device has the following status LEDs:

LED label	Description
DO 1-16	Digital outputs
DI 1-16	Digital inputs
PWR	Power
NS	Network status
MS	Module status
	Ethernet

Status LED descriptions

Power LED

The bicolor (green/red) LED indicates the status of the power. The LED is controlled by software. The following table shows the different states of the Power LED.

LED color	Description
OFF	The device has no power or is not online. The device has not completed the startup.
GREEN steady	The device is in standby state.
RED flashing (500 ms ON, 500 ms OFF)	The device is booting.
RED flashing (One flash: Red 100 ms)	IP-settings reset. The reset button has been pressed for more than 3 s.
RED/GREEN flashing (Two flashes: Red 100 ms, Green 100 ms, Red 100 ms)	Factory reset. The reset button has been pressed for more than 10 s.
RED steady	The device performs a self-test or is in error.

MS - Module status LED

The bicolor (green/red) LED indicates the status of the device. It indicates whether or not the device has power and is operating properly. The LED is controlled by software. The following table shows the different states of the MS LED.

LED color	Description
OFF	The device is booting.

Continues on next page

2.2.1 Digital base device, DSQC1030
Continued

LED color	Description
RED/GREEN flashing (Green 250 ms, Red 250 ms, Green steady)	Starting procedure.
GREEN steady	Self-test or operational.
GREEN flashing (500 ms ON, 500 ms OFF)	Standby.
RED flashing (500 ms ON, 500 ms OFF)	Recoverable fault.
RED steady	Unrecoverable fault.

NS - Network status LED

The bicolor (green/red) LED indicates the status of the communication link. The LED is controlled by software. The following table shows the different states of the NS LED.

LED color	Description
OFF	Boot, self-test, no IP address.
GREEN steady	IP address set and existing CIP connection.
GREEN flashing (500 ms ON, 500 ms OFF)	IP address set but no existing CIP connection.
RED flashing (500 ms ON, 500 ms OFF)	One or more I/O connections are in the Timed–Out state.
RED steady	Duplicate IP address detected.
GREEN/RED flashing (Green 250 ms ON, Red 250 ms ON, Both OFF)	Starting procedure.

Ethernet LEDs

The Ethernet LEDs are located on the Ethernet connectors and shows the status of Ethernet communication.

LED label	LED color	Description	Remedy/cause
Speed	OFF	Operating at 10 Mbps.	
	YELLOW steady	Operating at 100 Mbps.	

LED label	LED color	Description	Remedy/cause
Link/activity	OFF	No link is established.	
	GREEN steady	Link is established.	
	GREEN flashing	There is activity on this port.	

Continues on next page

Status LEDs at power-up

The system performs a test of the MS and NS LEDs during startup. The purpose of this test is to check that all LEDs are working properly. The test runs as follows:

Order	LED action
1	NS LED is switched Off.
2	MS LED is switched On green for approx. 0.25 seconds.
3	MS LED is switched On red for approx. 0.25 seconds.
4	MS LED is switched On green.
5	NS LED is switched On green for approx. 0.25 seconds.
6	NS LED is switched On red for approx. 0.25 seconds.
7	NS LED is switched On green.

Reset button

The DSQC1030 digital base device has a reset button located under the status LEDs. The reset button can be used in different ways to reset the device.

Function	Description	Indication
Pressed once (<3 sec)	Regular reset, same as toggling the power.	
Short press and hold (>3 sec)	Assigns volatile IP-settings of 192.168.125.254.	The Power LED flashes red once.
Long press and hold (>10 sec)	Factory reset.	The Power LED flashes red two times.

CAUTION

Use a straightened out paper clip or a similar blunt object to carefully press the reset button. Using sharp objects or pressing with force may damage the reset button.

Note

Factory reset can also be made remotely via RobotStudio, see *Removing an I/O device configuration*.

2.2.2 Safety digital base device, DSQC1042

Description

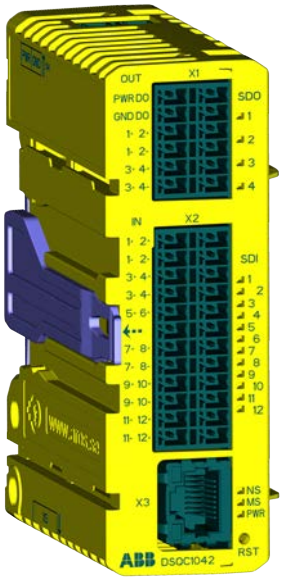
The DSQC1042 safety digital base device has 12 inputs and 4 outputs working in dual channel pairs. Due to the dual channel configuration, the device has 6 safe digital inputs and 2 safe digital outputs. The safety digital base device can be combined with up to four additional add-on devices.

Note

For information about how to set up the safety digital base device and its dual channel signals, see *Configuring safety digital base devices on page 84*.

Note

For information about how to connect safety digital base devices to process power sources, see *Installing safety digital base devices on page 45*.



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Connector	Description
X1	Digital outputs, process power
X2[i]	Digital inputs
X3	EtherNet
X4	Logic power
X5	EtherNet

Continues on next page

Connectors

Location	Connector	Left side/description	Right side/description
Top	X4 Logic power	2 - PWR	4 - PWR
		1 - GND	3 - GND
Front	X1 Digital outputs, process power	6 - PWR DO	12 - PWR DO
		5 - GND DO	11 - GND DO
		4 - SDO_1_+	10- SDO_2_+
		3 - SDO_1_-	9 - SDO_2_-
		2 - SDO_3_+	8 - SDO_4_+
		1 - SDO_3_-	7 - SDO_4_-
	X2 Digital inputs[i]	12 - SDI_1_+	24 - SDI_2_+
		11 - SDI_1_-	23 - SDI_2_-
		10 - SDI_3_+	22 - SDI_4_+
		9 - SDI_3_-	21 - SDI_4_+-
		8 - SDI_5_+	20 - SDI_6_+
		7 - SDI_5_-	19 - SDI_6_-
		6 - SDI_7_+	18 - SDI_8_+
		5 - SDI_7_-	17 - SDI_8_-
		4 - SDI_9_+	16 - SDI_10_+
		3 - SDI_9_-	15 - SDI_10_-
		2 - SDI_11_+	14 - SDI_12_+
		1 - SDI_11_-	13 - SDI_12_-
	X3 EtherNet		
Down	X5 EtherNet		

Performance level data

Type of data	Description
CAT according to ISO 13849-1	Up to Cat. 3
Performance Level. PLr according to ISO 13849-1	Up to PL e (In Cat.3 dual channel config.)
PFH_D	4,29 x 10-8 (Cat 3)
$MTTF_D$	Dual channel In: 904 years
	Dual channel Out: 928 years
DC_{AVG}	> 90%
Service lifetime	20 years

Continues on next page

2.2.2 Safety digital base device, DSQC1042
Continued

Technical data

Dimensions and weight

Description	Data	Note
Dimension (Length x Width x Height)	75x36x101	
Weight	117 g	

Environmental conditions

Description	Data	Note
Operating temperature	+5…+ 65 °C	
Storage temperature	-40…+70 °C	
Permissible relative humidity	10… 95% non-condensing	
Degree of protection	IP20	

Supply voltage

Description	Data	Note
Voltage range	20.4 – 28.8 VDC	
Input current, 24V SYS	150 mA (TBC)	
Input current, 24V Process	2 A	
Plug-in current	<2 A @ 1ms	
Surge protected	Yes	
Reverse polarity protected	Yes	

Digital outputs

Description	Data	Note
Rated current	500 mA	
Max current	600 mA	
Typical short circuit current	1200 mA	
Leakage current	< 100 uA	
Rated voltage	24 VDC	
Max voltage	30 VDC	
Max voltage drop	0.5V at 500 mA	
Max inductive load	< 700 mH	(max switching repetition rate: 10 sec)
Max capacitive load	< 3.3 mF	
Recommended cable area	1 mm^2	
Surge protected	Yes	
Thermal protection	Yes	
Max delay time	21 ms	

Continues on next page

Digital inputs

Description	Data	Note
Input voltage level Lo	-30 - 5 V	
Input voltage level Hi	15 - 30 V	
Type switch voltage	10 V	
Input current level Lo	<1 mA	
Input current level Hi	>2 mA	typically 4 mA
Max voltage	30 V	
Reverse polarity protected	Yes	
Surge protected	Yes	
Internal delay time	13 ms	
Filter time	2 ms	
Safety digital inputs	Equivalent	
Discrepancy time, dual channel	500 ms	

Status LEDs

CAUTION

LEDs are not reliable indicators and cannot be guaranteed to provide accurate information. They should only be used for general diagnostics during commissioning or troubleshooting. Do not attempt to use LEDs as operational indicators.

The DSQC1042 safety digital base device has the following status LEDs.

LED label	Description
DO 1-4	Digital outputs
DI 1-12	Digital inputs
PWR	Power
NS	Network status
MS	Module status

Status LED descriptions

Power LED

The bicolor (green/red) LED indicates the status of the power. The LED is controlled by software. The following table shows the different states of the Power LED.

LED color	Description
GREEN steady	The device is in standby state.
GREEN flashing	The device is online, but has no connections in the established state.
RED flashing (500 ms ON, 500 ms OFF)	The device is booting.

Continues on next page

2.2.2 Safety digital base device, DSQC1042
Continued

LED color	Description
RED flashing (One flash: Red 100 ms)	The reset button has been pressed for more than 3 s.
RED/GREEN flashing (Two flashes: Red 100 ms, Green 100 ms, Red 100 ms)	The reset button has been pressed for more than 10 s.
RED steady	The device performs a self-test or is in error.

MS - Module status LED

The bicolor (green/red) LED indicates the status of the device. It indicates whether or not the device has power and is operating properly. The LED is controlled by software. The following table shows the different states of the MS LED.

LED color	Description
OFF	The device has no power or is not online.
GREEN steady	The device is online and has an established connection.
GREEN flashing	The device is online but has no established connections or is not allocated to a master. Connection may be established, but the validator has not completed an initial time coordination exchange.
RED flashing	One or more I/O connections has timed–out.

NS - Network status LED

The bicolor (green/red) LED indicates the status of the communication link. The LED is controlled by software. The following table shows the different states of the NS LED.

LED color	Description
OFF	Device is not powered.
GREEN steady	The device is operating in a normal condition.
GREEN flashing	The device is idle or in standby state.
RED flashing	Abort. The device has a recoverable fault.
RED steady	The device has an unrecoverable fault, and may need replacing.
GREEN/RED flashing	The device is in self-test state, or the device needs commissioning due to configuration or UNID missing, incomplete or incorrect.

Ethernet LEDs

The Ethernet LEDs are located on the Ethernet connectors and shows the status of Ethernet communication.

LED label	LED color	Description	Remedy/cause
Speed	OFF	Operating at 10 Mbps.	
	YELLOW steady	Operating at 100 Mbps.	

Continues on next page

LED label	LED color	Description	Remedy/cause
Link/activity	OFF	No link is established.	
	GREEN steady	Link is established.	
	GREEN flashing	There is activity on this port.	

Status LEDs at power-up

The system performs a test of the MS and NS LEDs during startup. The purpose of this test is to check that all LEDs are working properly. The test runs as follows:

Order	LED action
1	NS LED is switched Off.
2	MS LED is switched On green for approx. 0.25 seconds.
3	MS LED is switched On red for approx. 0.25 seconds.
4	MS LED is switched On green.
5	NS LED is switched On green for approx. 0.25 seconds.
6	NS LED is switched On red for approx. 0.25 seconds.
7	NS LED is switched On green.

Reset button

The DSQC1042 safety digital base device has a reset button located under the status LEDs. The reset button can be used in different ways to reset the device.

Function	Description	Indication
Pressed once (<3 sec)	Regular reset, same as toggling the power.	
Short press and hold (>3 sec)	Resets the IP-settings to ABB default values.	The Power LED flashes red once.
Long press and hold (>10 sec)	Factory reset.	The Power LED flashes red two times.

CAUTION

Use a straightened out paper clip or a similar blunt object to carefully press the reset button. Using sharp objects or pressing with force may damage the reset button.

Note

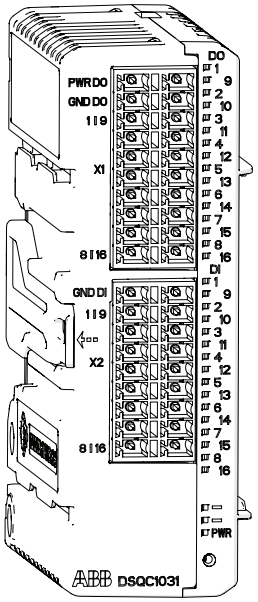
Factory reset can also be made remotely via RobotStudio, see *Removing an I/O device configuration*.

2.3 Add-on devices

2.3.1 Digital add-on device, DSQC1031

Description

The DSQC1031 digital add-on device has 16 digital inputs and 16 digital outputs and must be used together with a digital base device.



xx1600002034

Item	Description
X1	Digital outputs, logic and process power
X2	Digital inputs

Status LEDs

The DSQC1031 device has the following status LEDs.

LED label	LED description	LED color	Status
DO 1-16	Digital outputs		
DI 1-16	Digital inputs		
PWR	Power	GREEN steady	Addressed.
		GREEN flashing	Not addressed.
		RED flashing	Boot.

Continues on next page

Connectors

Location	Designation	Left	Right
Front	X1 Digital outputs, logic and process power	10 - PWR DO	20 - PWR DO
		9 - GND DO	19 - GND DO
		8 - DO01	18 - DO09
		7 - DO02	17 - DO10
		6 - DO03	16 - DO11
		5 - DO04	15 - DO12
		4 - DO05	14 - DO13
		3 - DO06	13 - DO14
		2 - DO07	12 - DO15
		1 - DO08	11 - DO16
	X2 Digital inputs	9 - GND DI	18 - GND DI
		8 - DI01	17 - DI09
		7 - DI02	16 - DI10
		6 - DI03	15 - DI11
		5 - DI04	14 - DI12
		4 - DI05	13 - DI13
		3 - DI06	12 - DI14
		2 - DI07	11 - DI15
		1 - DI08	10 - DI16

Technical data

Dimensions and weight

Description	Data	Note
Dimension (Length x Width x Height)	75x33.3x101	
Weight	105 g	

Environmental conditions

Description	Data	Note
Operating temperature	+5…+ 65 °C	
Storage temperature	-40…+70 °C	
Permissible relative humidity	10… 95% non-condensing	
Degree of protection	IP20	

Digital outputs

Description	Data	Note
Rated current	500 mA	

Continues on next page

2.3.1 Digital add-on device, DSQC1031
Continued

Description	Data	Note
Max current	600 mA	
Typical short circuit current	1200 mA	
Leakage current	< 100 uA	
Rated voltage	24 VDC	
Max voltage	30 VDC	
Max voltage drop	0.5V at 500 mA	
Max inductive load	1000 mH	(max switching repetition rate: 10 sec)
Max capacitive load	10 mF	
Recommended cable area	1 mm^2	
Surge protected	Yes	
Thermal protection	Yes	
Max delay time	0.5 ms	

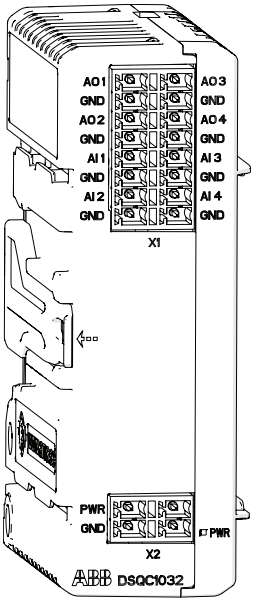
Digital inputs

Description	Data	Note
Input voltage level Lo	-30 - 5 V	
Input voltage level Hi	15 - 30 V	
Type switch voltage	10 V	
Input current level Lo	<0.5 mA	
Input current level Hi	>2 mA	typically 4 mA
Max voltage	30 V	
Reverse polarity protected	Yes	
Surge protected	Yes	
Internal delay time	0.5 ms	
Filter time	0 – 65 ms	Programmable. Default value 5 ms

2.3.2 Analog add-on device, DSQC1032

Description

The DSQC1032 analog add-on device has 4 analog inputs and 4 analog outputs and must be used together with a digital base device.



xx1600002035

Item	Description
X1	Analog inputs and outputs
X2	Logic and process power

Status LEDs

The DSQC1032 device has the following status LEDs.

LED label	LED description	LED color	Status
PWR	Power	GREEN steady	Addressed.
		GREEN flashing	Not addressed.
		RED flashing	Boot.

Continues on next page

2.3.2 Analog add-on device, DSQC1032
Continued

Connectors

Location	Designation	Left	Right
Front	X1 Analog inputs and outputs	8 - AO1	16 - AO3
		7 - GND	15 - GND
		6 - AO2	14 - AO4
		5 - GND	13 - GND
		4 - AI1	12 - AI3
		3 - GND	11 - GND
		2 - AI2	10 - AI4
		1 - GND	9 - GND
	X2 Logic and process power	2 - PWR	4 - PWR
		1 - GND	3 - GND

Technical data

Dimensions and weight

Description	Data	Note
Dimension (Length x Width x Height)	75x33.3x101	
Weight	95 g	

Environmental conditions

Description	Data	Note
Operating temperature	+5…+ 65 °C	
Storage temperature	-40…+70 °C	
Permissible relative humidity	10… 95% non-condensing	
Degree of protection	IP20	

Analog inputs

Description	Data	Note
Input range	0 – 10 V	
Resolution	12 bits, 2.44 mV	
Hysteresis	4	The default value can be changed, see *Analog input point object on page 93*.
Inaccuracy	0.5% + 25 mV	
Input impedance	100 kOhm	typically
Reverse polarity protected	Yes	
Surge protected	Yes	
Delay time	2ms	

Continues on next page

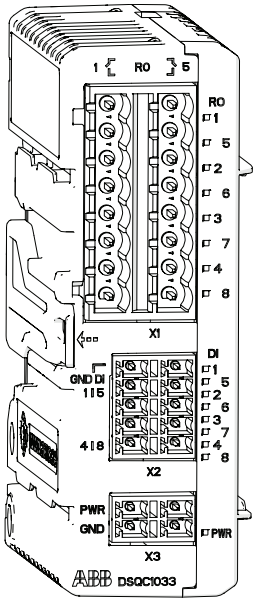
Analog outputs

Description	Data	Note
Output range	0 – 10 V	
Resolution	12 bits, 2.44 mV	
Inaccuracy	0.5% + 25 mV	
Min load impedance	1 kOhm	
Surge protected	Yes	
Short circuit protection	Yes	
Delay time	2 ms	

2.3.3 Relay add-on device, DSQC1033

Description

The DSQC1033 relay add-on device has 8 digital inputs and 8 relay outputs and must be used together with a digital base device.



xx1600002036

Item	Description
X1	Relay outputs
X2	Digital inputs
X3	Logic and process power

Status LEDs

The DSQC1031 device has the following status LEDs.

LED label	LED description	LED color	Status
RO 1-8	Relay outputs		
DI 1-8	Digital inputs		
PWR	Power	GREEN steady	Addressed.
		GREEN flashing	Not addressed.
		RED flashing	Boot.

Continues on next page

Connectors

Location	Designation	Left	Right
Front	X1 Relay outputs	8 - RLY1	16 - RLY5
		7 - RLY1	15 - RLY5
		6 - RLY2	14 - RLY6
		5 - RLY2	13 - RLY6
		4 - RLY3	12 - RLY7
		3 - RLY3	11 - RLY7
		2 - RLY4	10 - RLY8
		1 - RLY4	9 - RLY8
	X2 Digital inputs	5 - GND DI	10 - GND DI
		4 - DI1	9 - DI5
		3 - DI2	8 - DI6
		2 - DI3	7 - DI7
		1 - DI4	6 - DI8
	X3 Logic and process power	2 - PWR	4 - PWR
		1 - GND	3 - GND

Technical data

Dimensions and weight

Description	Data	Note
Dimension (Length x Width x Height)	75x33.3x101	
Weight	133 g	

Environmental conditions

Description	Data	Note
Operating temperature	+5…+ 65 °C	
Storage temperature	-40…+70 °C	
Permissible relative humidity	10… 95% non-condensing	
Degree of protection	IP20	

Relay outputs

Description	Data	Note
Max switching voltage	230 VAC	
Max switching current	2 A	
Isolation	Reinforced	

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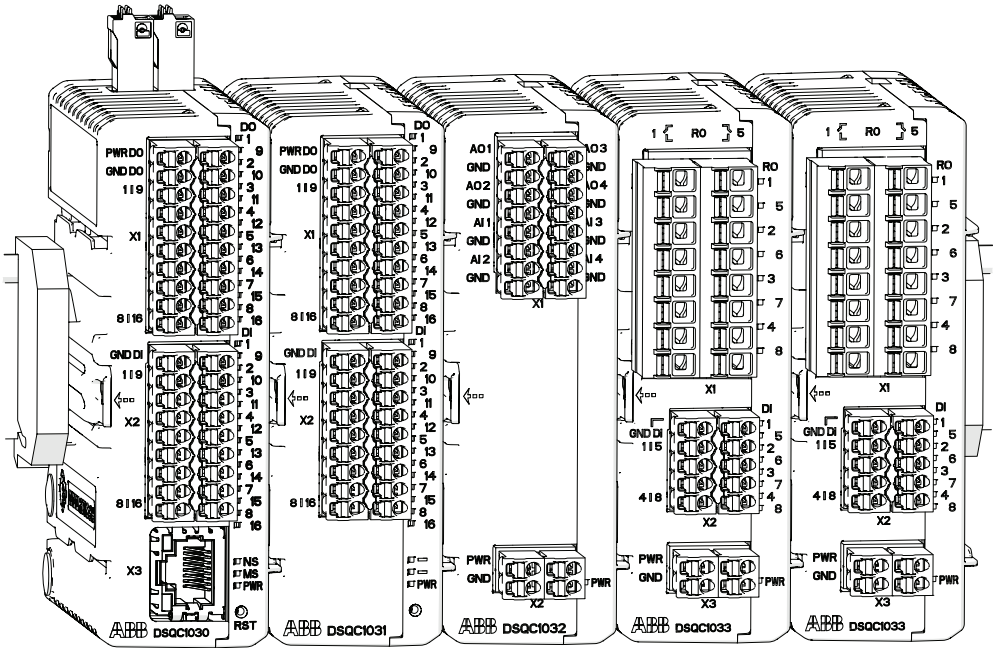
3 Hardware installation

3.1 General installation information

Mounting

The ABB Scalable I/O devices are designed to be mounted vertically on a mounting rail in an IP20 protected environment with normal air convention.

The individual devices must be mounted side by side on the DIN rail, starting with the digital base device. The add-on devices are placed to the right of the digital base device.



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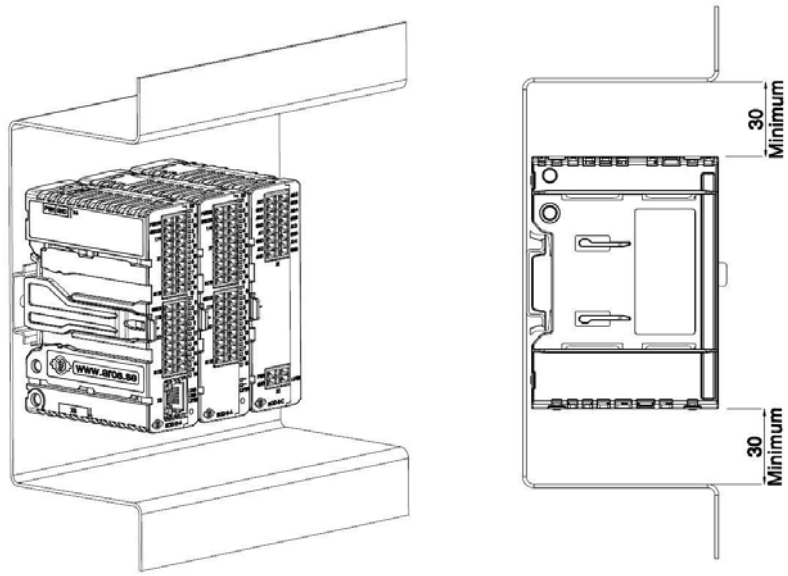
Required installation space

The Scalable I/O system is designed for normal air convention when the devices are mounted vertically. Forced air is needed if the devices are mounted horizontally.

Continues on next page



xx2200000942

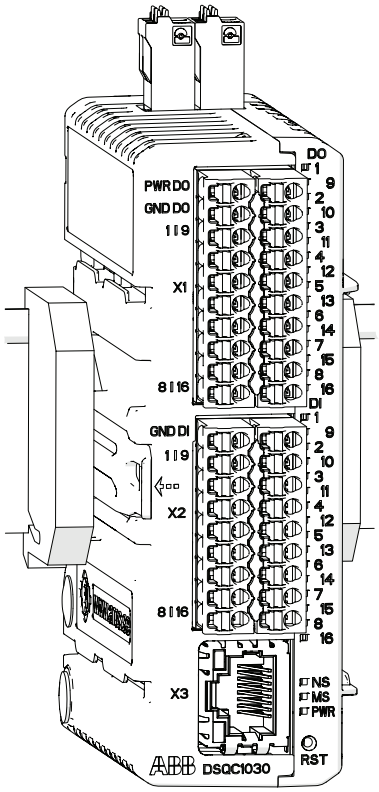
Note

To ensure that the maximum operating ambient temperature is not exceeded, a minimum of 30 mm space is recommended between the system and other components.

3.2 Installing digital base devices

Installing digital base devices

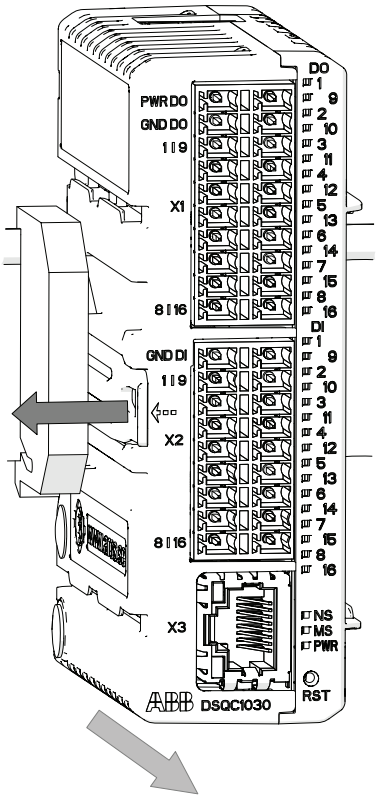
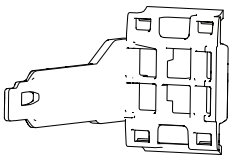
Use this procedure to install the digital base device. See also the product manual for the robot controller, listed in *References on page 7*.

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Fit the device by snapping it onto the mounting rail.	 xx1700000275
3	Connect the Ethernet cable from the robot controller, or the EtherNet/IP scanner, to any of the connectors X3 or X5.	
4	Connect the logic power supply to connector X4.	For information about the pinout see *Connectors on page 19*.
5	Connect process power supply and GND to the input and output connectors X1 and X2. **Note** The process power supply also powers the optical interface to the add-ons.	**CAUTION** The process power supply must be supplied separately. Connecting the process power supply through the logical power supply connector may damage the device.

Continues on next page

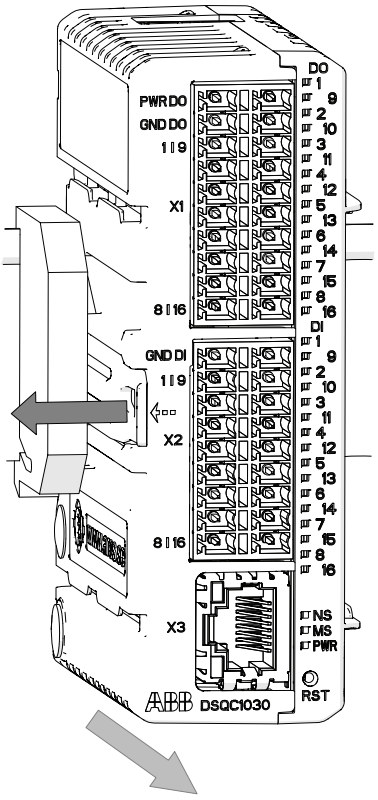
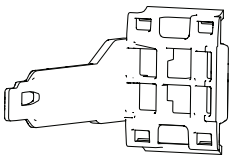
	Action	Note
6	Connect wires to the inputs and outputs as required.	
7	Configure the device, see *Configuring Scalable I/O devices using I/O Engineering on page 58*.	

Removing digital base devices

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Disconnect all connectors.	
3	Press the DIN bracket gently to the left and pull the device straight out.	 xx1700000276
4	Snap off the DIN bracket and refit it to the removed device.	 xx1600002039

Continues on next page

Replacing digital base devices

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Disconnect all connectors.	
3	Press the DIN bracket gently to the left and pull the device straight out. Leave the DIN bracket attached to the rail.	 xx1700000276
4	Remove the DIN bracket from the new device.	 xx1600002039

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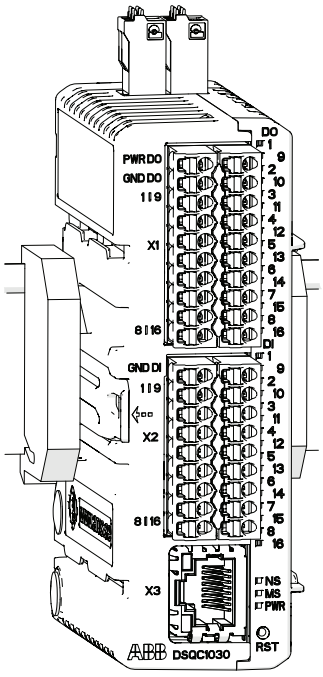
	Action	Note
5	Fit the new device by snapping it onto the rail and the DIN bracket.	 xx1700000275
6	Reconnect all connectors.	
7	Fit the spare DIN bracket to the removed device.	
8	Configure the device, see *Configuring Scalable I/O devices using I/O Engineering on page 58*.	

Installing additional (external/remote) digital base devices

Additional base devices can be used as external/remote I/O devices, and assembled together in the same way as add-on devices, but they must be connected with separate Ethernet cables. The Ethernet cable can be connected to any of the connectors X3 or X5 on the previous base device.

The logical power supply, connector X4, of up to five base devices in total can be connected in parallel if the devices are placed inside the same controller cabinet, i.e. over short distances. For all other applications, the logical power must be supplied separately to each base device.

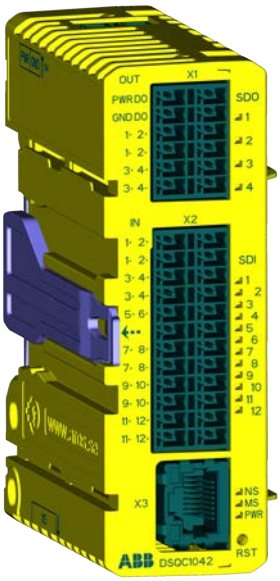
The process power supply must always be supplied separately to each base device.

CAUTION

Connecting the process power supply in parallel or through the logical power supply connector may damage the device.

3.3 Installing safety digital base devices

General



xx2100001681

The safety digital base devices, DSQC1042, are installed in the same way as the digital base devices with a few exceptions. See *Installing digital base devices on page 41* for information about the main installation process, and *Connection to process power source on page 45* and *Safe I/O dual channel connection on page 46* for specific details.

Connection to process power source

The process power input of the DSQC1042 X1 connector (PWR DO and GND DO) must be connected to DSQC609 or another internal/external 24V DC power source. The power source must have less than 4 seconds start-up delay from controller power on.

Note

The 24V DC from X19 customer I/O interface of DSQC3037 cannot be used since it has longer start-up delay.

Note

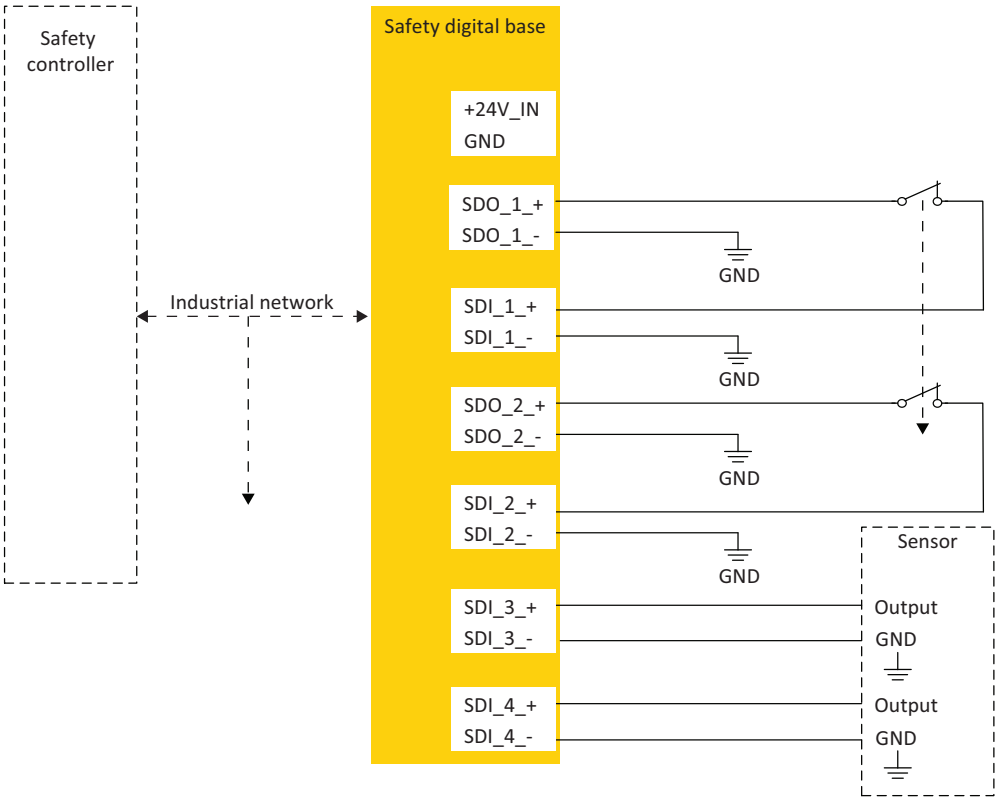
The DSQC1042 must always be set up with this type of power source connection even if Safe Digital Outputs (SDOs) are not used.

Continues on next page

Safe I/O dual channel connection

The safety digital base devices are set up with dual channels. See *Setting up dual channel signals on page 85*.

The following example shows how to connect a safe sensor to an input of the safe scalable I/O unit, and how to connect a safe switch to a safe output:



xx2200000441

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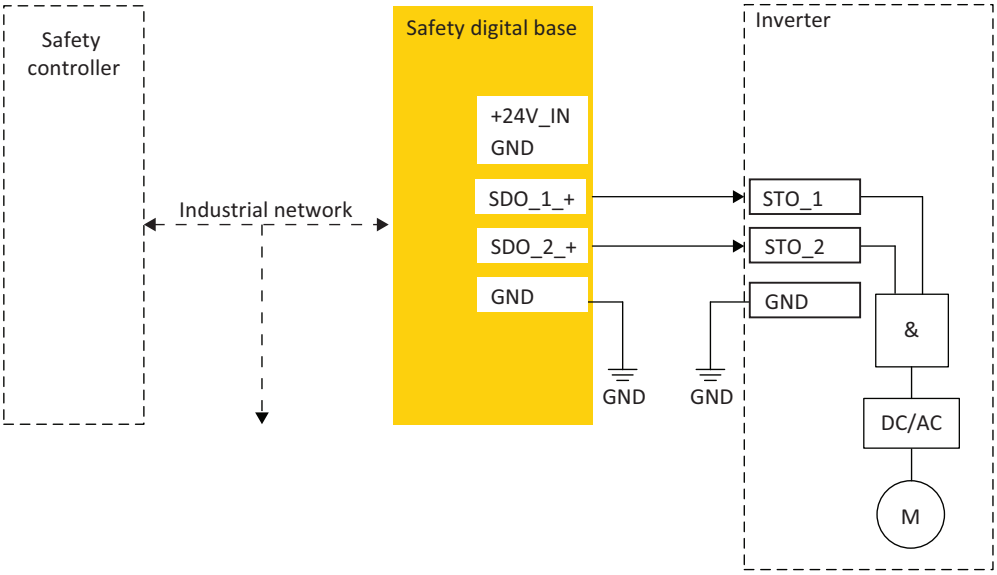
Safety digital base device used as dual channel safety output



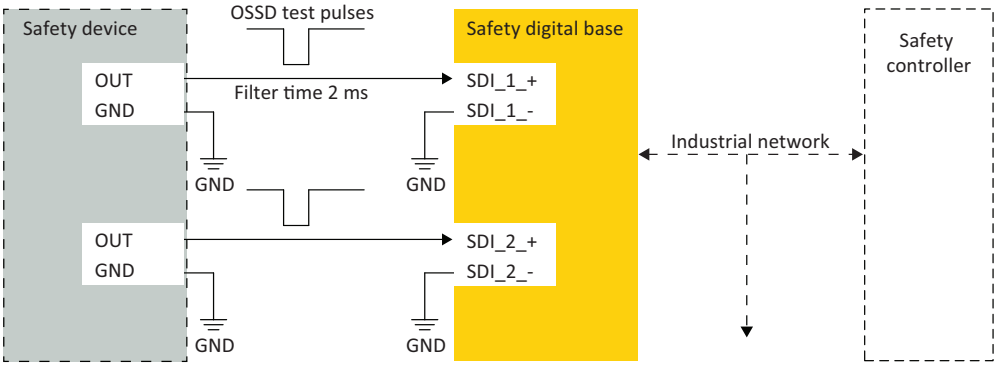
xx2200000566

External outputs connected to safe I/O inputs

This example shows how to connect an external output with test pulse to a safe I/O input.

Note

The test pulses from the output signal switching device (OSSD) must be less than 2 ms.



xx2200000938

3.4 Installing add-on devices

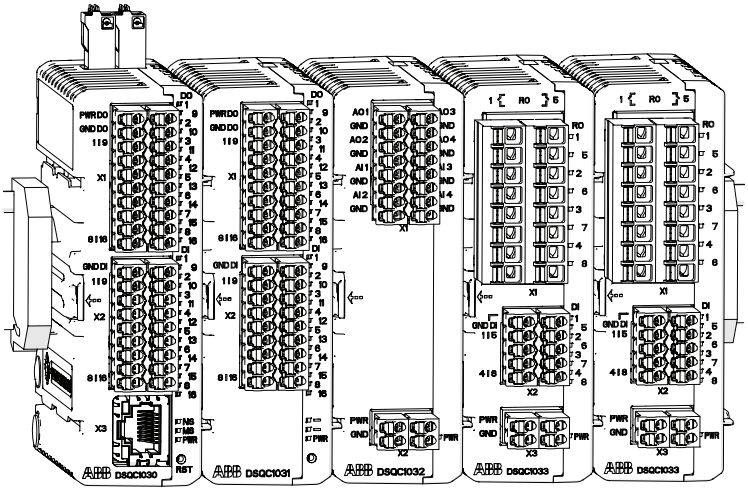
General

Add-on devices have an optical interface and must be powered and attached to a configured base device to be detected by the robot controller. Up to four add-on devices can be attached to the same base device with maintained performance.

The optical interface on the base device is powered by process power supply and must also be connected to detect the add-on device. Unpowered add-on devices shall be placed last, i.e. to the right, otherwise the optical link is broken.

Note

Add-ons can also be attached to a safety digital base. See *Examples of device combinations on page 14*.

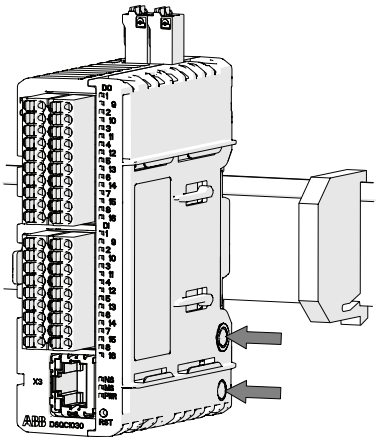
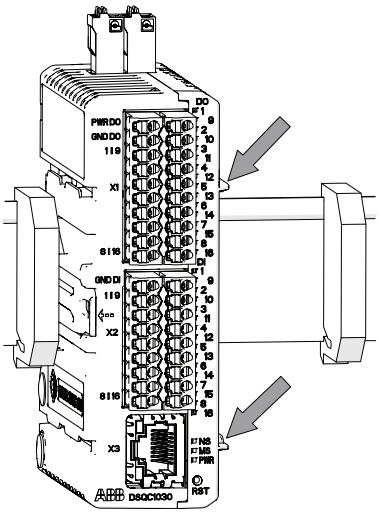


xx1600002032

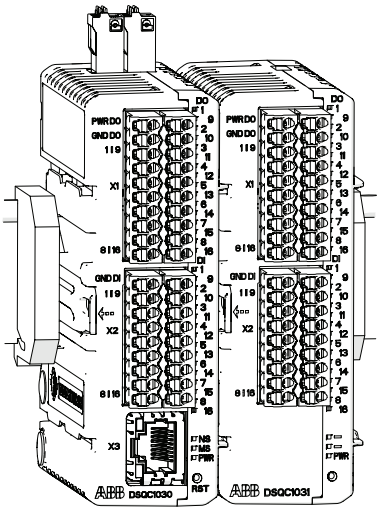
Installing add-on devices

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	

Continues on next page

	Action	Note
2	Clean the optical interface on both the base device and the add-on from dirt or dust using a soft cloth.	 xx1700000277
3	Fit the add-on device to the guide rails on the right side of the base device or the last device according to the arrows. Press the add-on device until it snaps onto the mounting rail.	 xx1700000278 **Note** If the device is not correctly inserted there is a risk that the optical communication between the devices does not work.

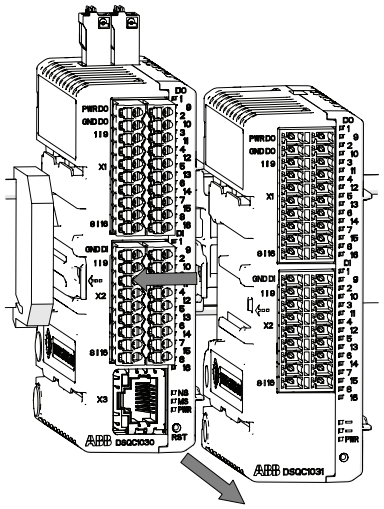
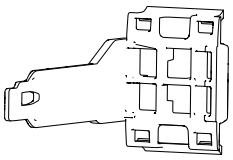
Continues on next page

	Action	Note
4	Connect the logic and process power supply. For information about the pinout see *Add-on devices on page 30*. **Note** The optical interface on the base device must also be powered by process power supply to detect add-on devices.	 xx1700000279 **CAUTION** Connecting the process power supply in parallel with another add-on may damage the devices.
5	Connect wires to the inputs and outputs as required.	
6	Configure the device, see *Configuring Scalable I/O devices using I/O Engineering on page 58*.	

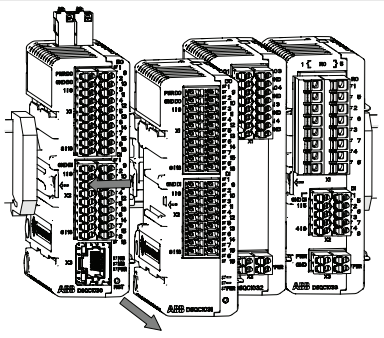
Removing add-on devices

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Disconnect all connectors.	

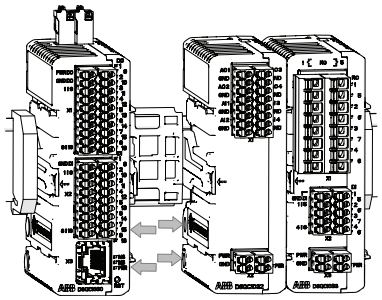
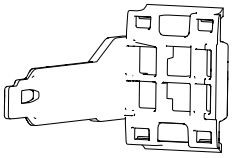
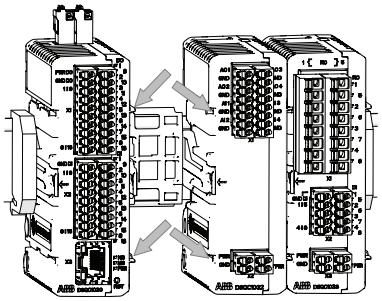
Continues on next page

	Action	Note
3	Press the DIN bracket gently to the left and pull the device straight out.	 xx1700000274
4	Snap off the DIN bracket from the rail and refit it to the removed device.	 xx1600002039

Replacing add-on devices

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Disconnect all connectors.	
3	Press the DIN bracket gently to the left and pull the device straight out. Leave the DIN bracket attached to the rail.	 xx1600002037

Continues on next page

	Action	Note
4	Clean all optical interfaces from dirt or dust using a soft cloth.	 xx1600002040
5	Remove the DIN bracket from the new device.	 xx1600002039
6	Fit the new device to the guide rails of the adjacent devices. Press the new device until it snaps onto the DIN bracket. **Note** The device must be updated if the order is changed, see *Configuring Scalable I/O devices using I/O Engineering on page 58*.	 xx1600002038 **Note** If the device is not correctly inserted there is a risk that the optical communication between the devices does not work.
7	Reconnect all connectors.	
8	Fit the spare DIN bracket to the removed device.	

3.5 Coil neutralization

External devices

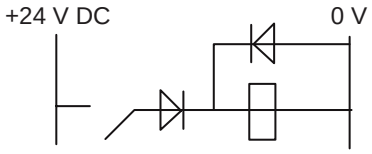
External relay coils, solenoids, and other devices that are connected to the I/O devices must be neutralized and protected with external diodes for reverse protection. The following sections describe how this can be done.

Note

The turn-off time for DC relays increases after neutralization, especially if a diode is connected across the coil. Varistors give shorter turn-off times. Neutralizing the coils lengthens the life of the switches that control them.

Clamping with a diode

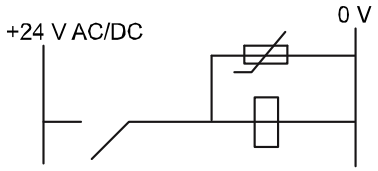
The diode should be dimensioned for the same current as the relay coil, and a voltage of twice the supply voltage.



xx0100000163

Clamping with a varistor

The varistor should be dimensioned for the same current as the relay coil, and a voltage of twice the supply voltage.

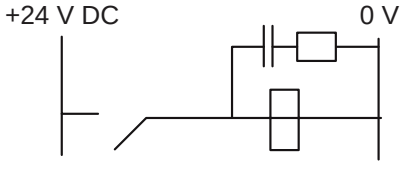


xx0100000164

Clamping with an RC circuit

R 100 ohm, 1W C 0.1 - 1 mF

>500 V max. voltage, 125 V nominal voltage.



xx0100000165

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4 Software commissioning

4.1 Information about ABB Scalable I/O devices

General

To use the Scalable I/O devices, plug in the base device and the add-on devices to the controller through the Ethernet cable. Then configure the I/O devices using I/O Engineering, RobotStudio or the FlexPendant.

Industrial network

EtherNet/IP is the industrial network that is used for communication between the I/O devices and the robot and controller.

EDS file

Electronic Data Sheet (EDS) files are required when configuring I/O devices with other scanners. The EDS file, which identifies the devices during the configuration in the network, is stored in the following controller location:

...\products\RobotControl_x.x.x-xxx\utility\service\ioconfig\EDS

Behavior

ABB Scalable I/O devices support both *Cyclic* and *Change of State* (COS) I/O connection. It is possible to set output signals with a *Change of State* connection.

Note

Change of State is used together with the parameter production inhibit timer. The parameter defines the highest frequency for which a signal change can occur with *Change of State*.

Note

The *Change of State* (COS) I/O connection is not supported for safety digital base devices (DSQC1042). It is, however, supported for the add-on devices that are connected to it.

Safety digital base devices

The safety digital base devices, DSQC1042, are configured in the same way as other digital base devices. See *Software commissioning on page 55*. After the configuration, the dual channels must be defined using CL logic. See *Setting up dual channel signals on page 85*.

When the set-up and configuration is done, see *Application manual - Functional safety and SafeMove* for instructions on how to work with the safety configuration.

Continues on next page

Note

The network reaction time is carefully set to optimal for the safety digital base device.

Signal names

Signals are generated according to the following structure:

Format	Example
Name of device_slot number_type + index	ABBIO_0_DO3 or ABBIO_0_DI5 or ABBIO_3_RO1

Status signal names

Status signal names for the safety digital base devices are generated according to the following structure:

Format	Example
Name of device_slot number_type_Status	ABBIO_0_DO_Status ABBIO_0_DI_Status

4.2 Connecting the EtherNet/IP network

Connecting the EtherNet/IP network

The I/O devices are based on the EtherNet/IP communication protocol but does not require any additional RobotWare options or hardware options to be connected to the robot controller. In this standard configuration, the devices should be connected to the *Private Network* to gain the advantages with *Plug & Produce*.

When using the RobotWare options *3024-1 EtherNet/IP Scanner* or *3024-2 EtherNet/IP Adapter* more connection configuration possibilities are available for Scalable I/O (additional network interfaces available). For more information see *Application manual - EtherNet/IP Scanner/Adapter*.

For more information about network connections on OmniCore, see *Operating manual - Integrator's guide OmniCore*.

4.3 Configuring Scalable I/O devices using I/O Engineering

4.3.1 Offline configuration

General

This section describes the recommended working procedure when installing and configuring ABB Scalable I/O devices in I/O Engineering. For general information about I/O Engineering, see *Application manual - I/O Engineering*.

For information about configuration using the FlexPendant, see *Configuring Scalable I/O devices using the FlexPendant on page 81*.

> **Note**
>
> Safety digital base devices (DSQC1042) cannot be configured using the FlexPendant.

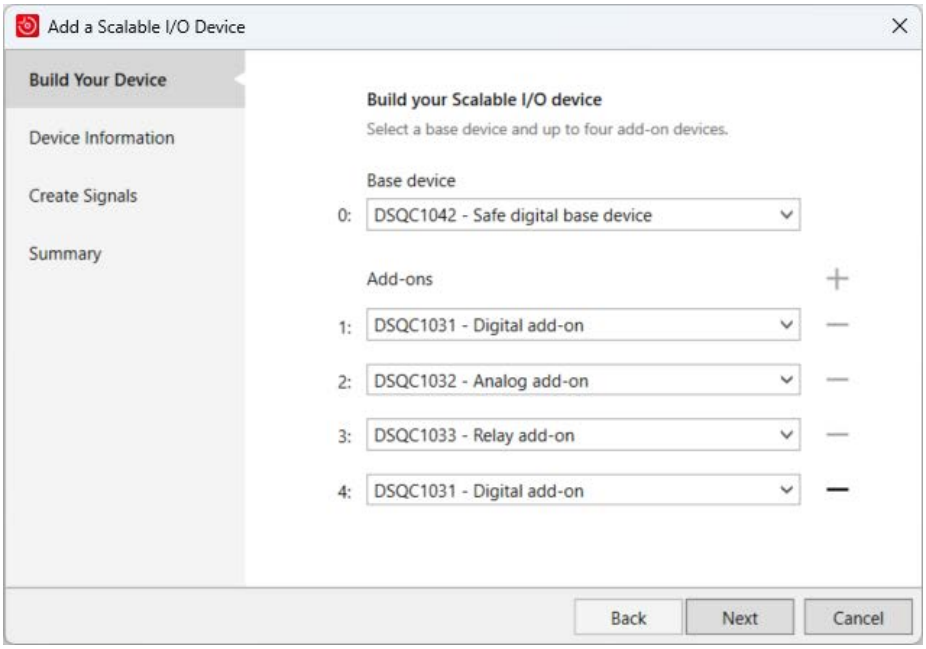
> **Note**
>
> A maximum of 4 safety digital base devices can be used at the same time with an OmniCore controller.

When the I/O device is configured using *Plug & Produce* interface, it requires minimal user interaction. Follow the working procedures to configure a new I/O device, update an existing I/O device and to replace an I/O device with another.

Adding I/O devices

1. In the **Controller** tab in RobotStudio, select **I/O Engineering**.
2. In the **I/O Engineering** tab, select **Add ABB Device** > **Scalable I/O Device**.
3. In the **Build Your Device** dialog, select a safe digital base device and up to four add-on devices:

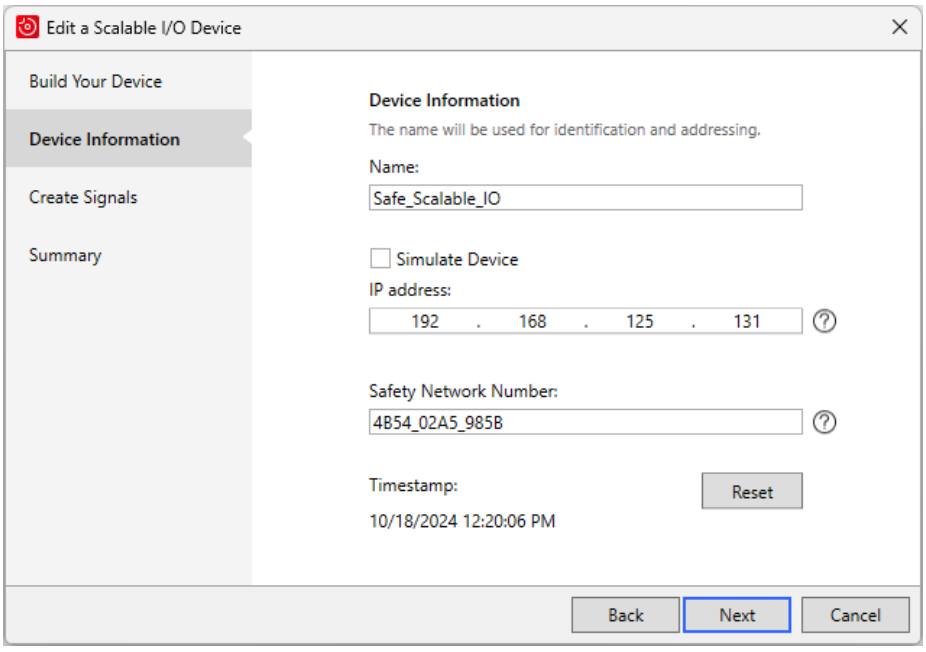
Continues on next page



xx2400000718

Select **Next**.

4 In the **Device Information** dialog, define the following:



xx2400000719

- **Name**
- **Simulate Device**

  Select if the device is simulated.
- **IP address**

  Not applicable for simulated devices.
- **Safety Network Number**

Continues on next page

Only applicable for safe Scalable I/O. Enter a unique safety network number for each safety network or safety sub-net.

Tip

Select **Reset** to reset the **Safety Network Number**.

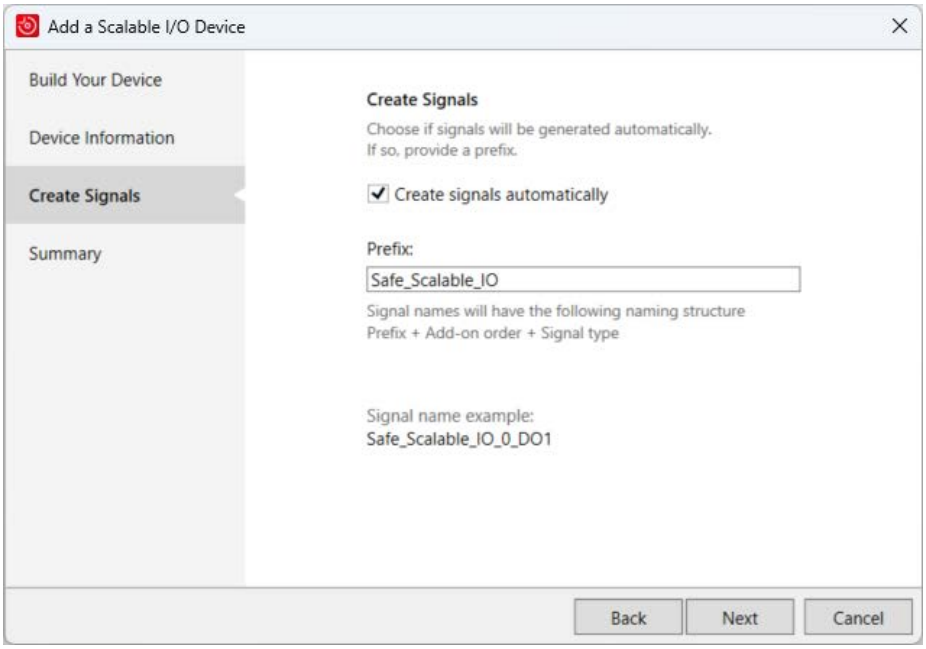
If not previously defined, the **Safety Network Number** for both device and controller will be generated using the date and time the wizard was opened.

Note

If the controller has a defined **Safety Network Number**, the device will inherit the **Safety Network Number** from the controller.

Select **Next**.

5 In the **Create Signals** dialog, define if new signals should be generated automatically and include a name prefix:

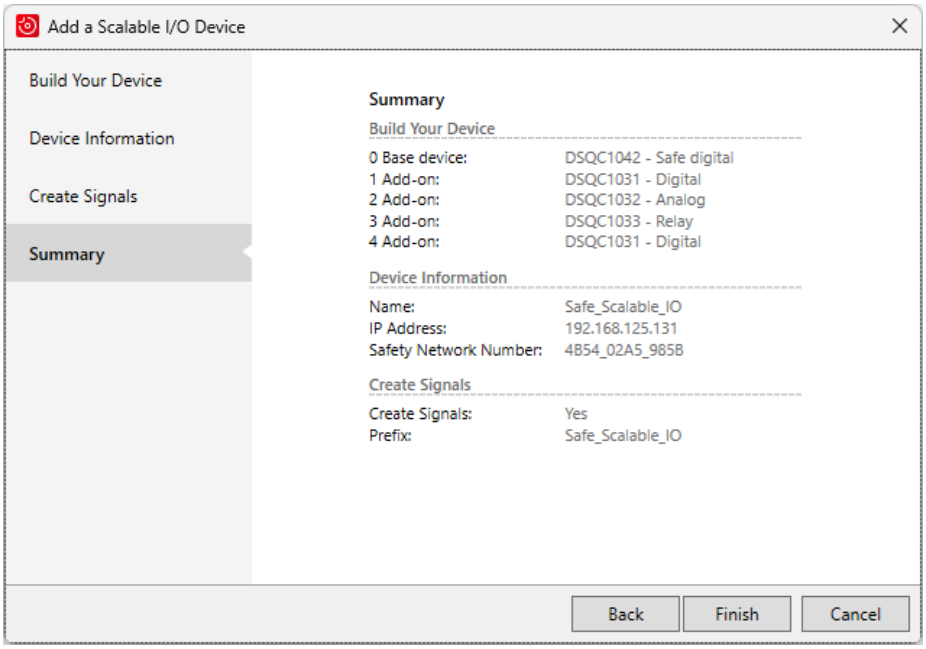


xx2400000720

Select **Next**.

6 The **Summary** is displayed:

Continues on next page



xx2400001428

Select **Finish**.

7 The I/O devices are added to the I/O project and can now be configured. See *Configuring Scalable I/O devices using I/O Engineering on page 58*.

8 Restart the controller.

Updating I/O device selections

The I/O devices that were selected at creation can be modified.

> **Note**
>
> Always attach or remove I/O devices from the right side of the base I/O device, otherwise the optical link is broken.

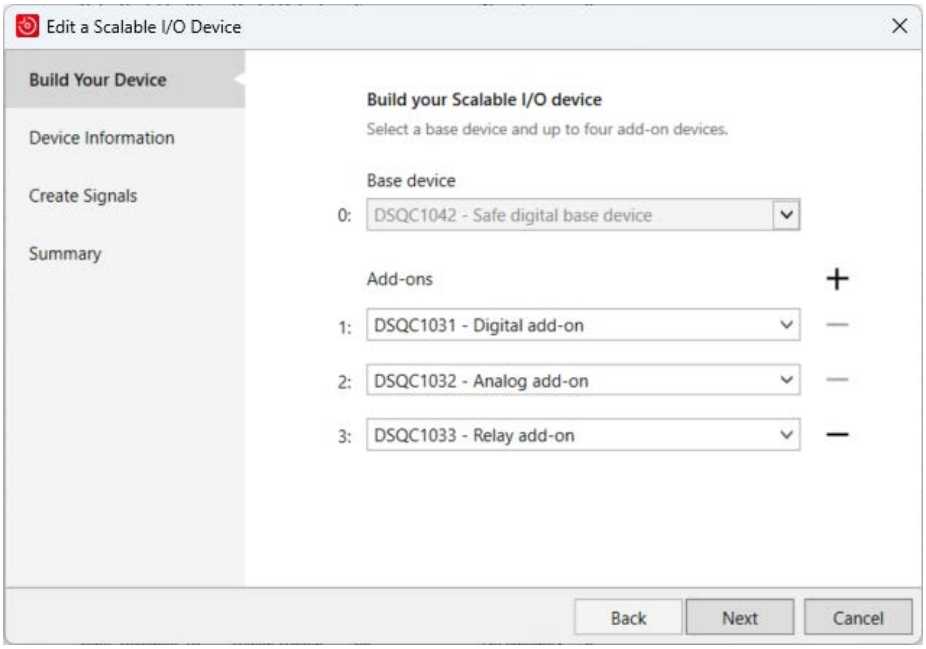
1 In the **Controller** tab in RobotStudio, select **I/O Engineering**.

2 In the **Configuration** browser, right-click **Scalable I/O** and select **Edit**.

3 In the **Build Your Device** dialog, remove or add add-on devices:

Continues on next page

4.3.1 Offline configuration
Continued



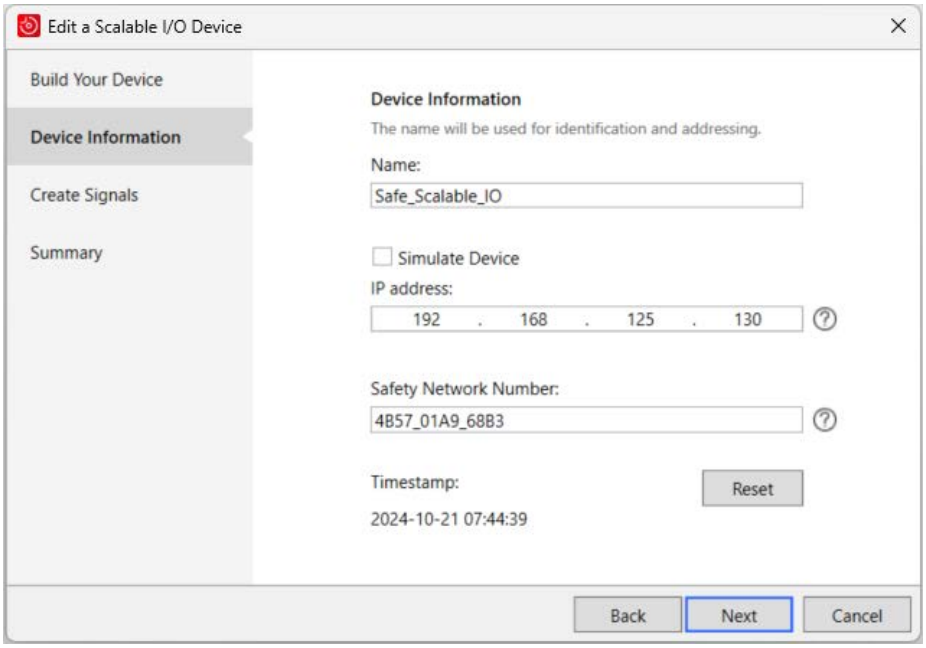
xx2400000712

Note

It is not possible to change the previously selected base device.

Select **Next**.

4 In the **Device Name and IP** dialog, update the device name and/or the IP address:

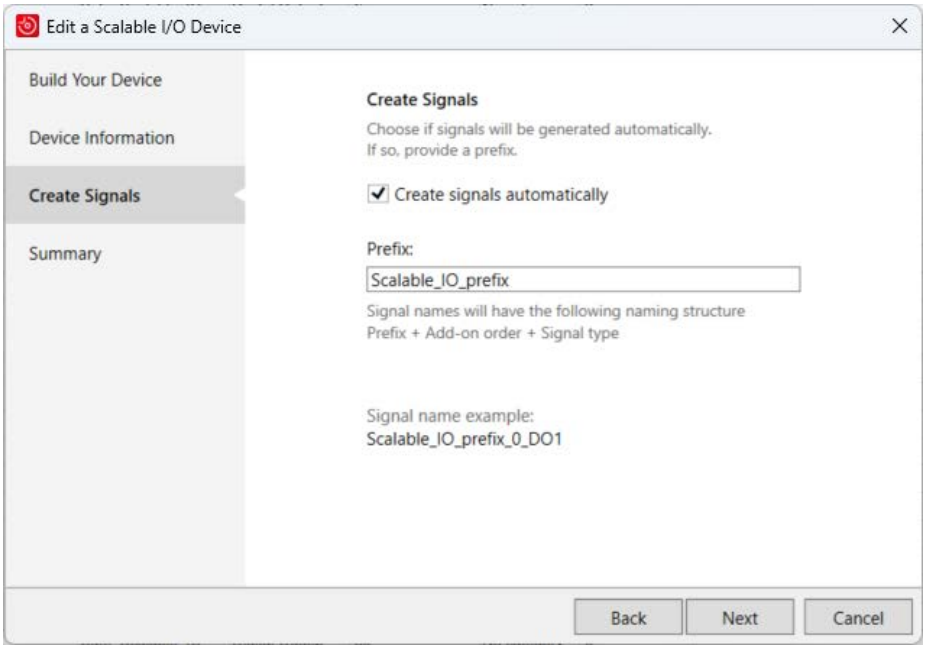


xx2400000713

Select **Next**.

5 In the **Signal Prefix** dialog, update the name prefix:

Continues on next page



xx2400000714

Note

If no name prefix is defined, no signals will be added to the configuration.

Select **Add**.

6 The I/O project is updated.

7 Restart the controller.

Configure the Scalable I/O properties

1 In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.

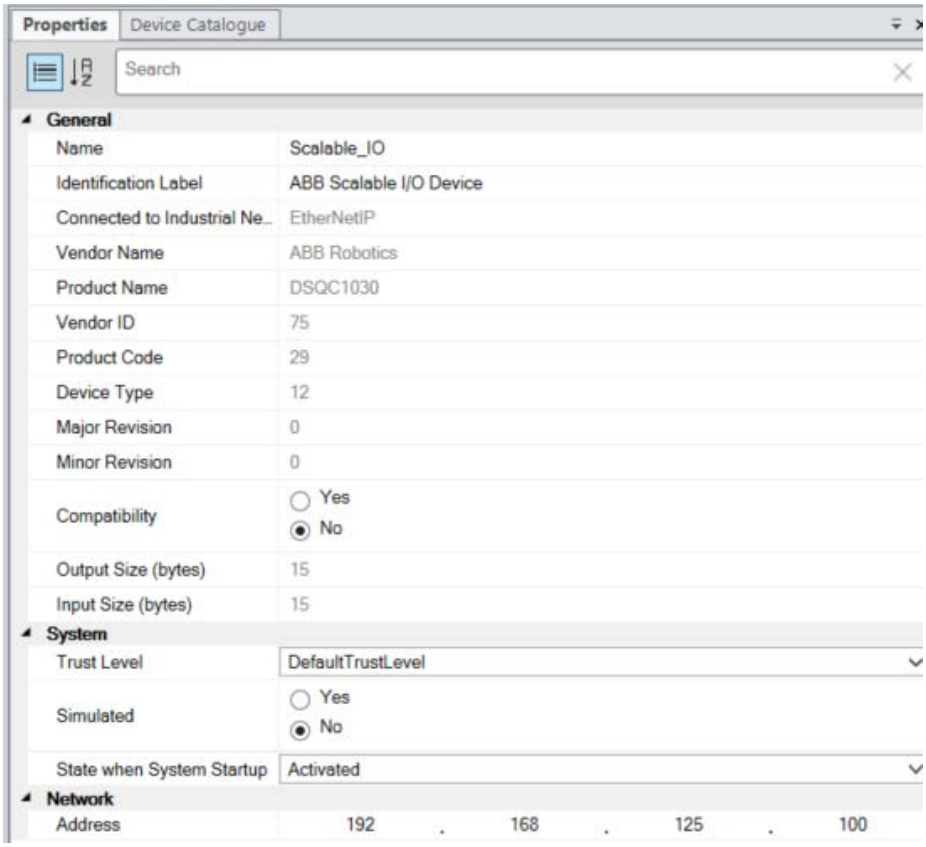
2 In the **Configuration** browser, select **Scalable_ IO**.

3 In the **Properties** browser, you can configure the following:

Continues on next page

4.3.1 Offline configuration

Continued



xx2400000715

Parameter	Description	Allowed values
Name	Enter the name to be used for the device.	A string with maximum 32 characters.
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the device.	A string with maximum 80 characters.
Compatibility	This parameter makes it possible to install devices that can emulate the exact device.	
Trust Level	Select an existing trust level that defines the behavior for external devices at different execution situations in the robot controller. See *Application manual - I/O Engineering* for more information about how to create trust levels.	
Simulated	Select **Yes** or **No**, indicating if the industrial network and all its connected I/O devices should be treated as simulated.	The default value is No.
Address	Enter the IP address for the device.	Valid range for Scalable I/O: 192.168.125.100-129 Valid range for Safe Scalable I/O: 192.168.125.130-139

Continues on next page

4 Save the configuration. See *Application manual - I/O Engineering* for more information.

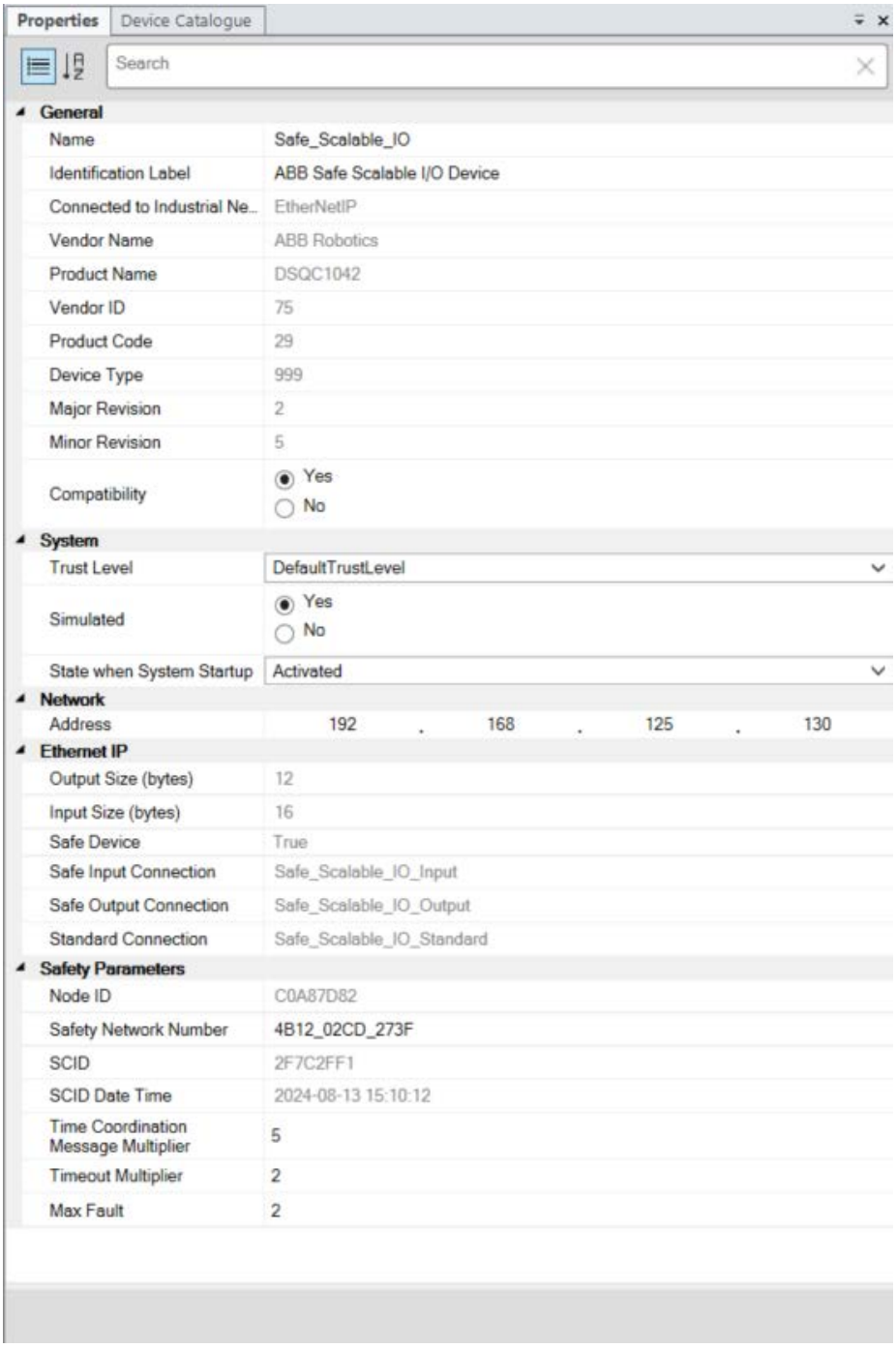
Configure the safe Scalable I/O properties

1 In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.
2 In the **Configuration** browser, select **Safe_Scalable_ IO**.
3 In the **Properties** browser, you can configure the following:

Continues on next page

4.3.1 Offline configuration

Continued



xx2400000731

Parameter	Description	Allowed values
Name	Enter the name to be used for the device.	A string with maximum 32 characters.
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the device.	A string with maximum 80 characters.
Compatibility	This parameter makes it possible to install devices that can emulate the exact device.	

Continues on next page

Parameter	Description	Allowed values
Trust Level	Select an existing trust level that defines the behavior for external devices at different execution situations in the robot controller. See *Application manual - I/O Engineering* for more information about how to create trust levels.	
Simulated	Select **Yes** or **No**, indicating if the industrial network and all its connected I/O devices should be treated as simulated.	The default value is No.
Address	Enter the IP address for the device.	
Safety network number	Enter a unique safety network number for each safety network or safety sub-net.	
Time coord msg multip	**Time coord msg multip** is the minimum number of 128 uS increments it could take for a time coordination message to traverse from the consumer to the producer.	Default: 2.
Timeout multiplier	The **Timeout multiplier** can either be used to: calculate the Network Time Expectation. determine the number of ping intervals to wait without Correction before declaring a connection fault.	Default: 2.
Max fault	Number of erroneous packets within one hour after which a connection is closed. Used by both producers and consumers.	Fixed value 2.

4 Save the configuration. See *Application manual - I/O Engineering* for more information.

Configure the standard connection properties

1 In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.

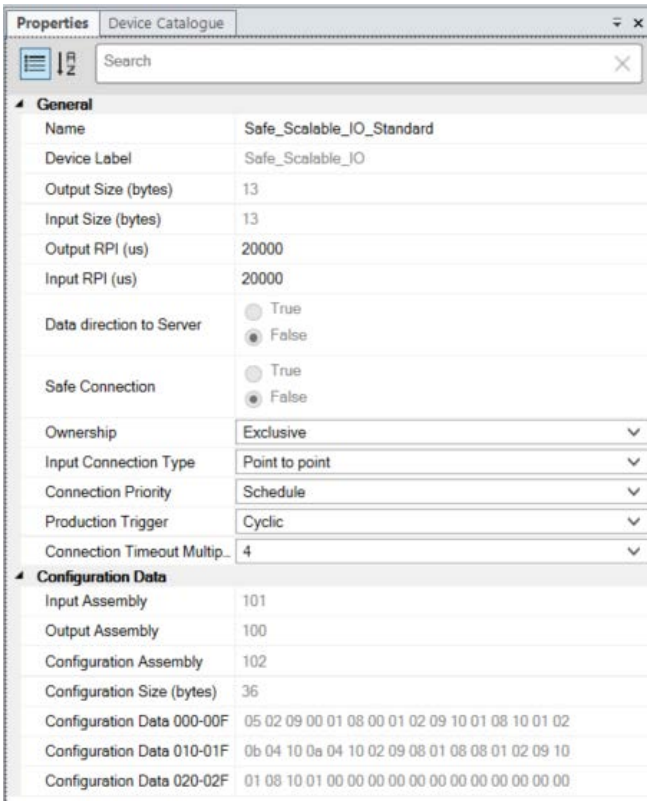
2 In the **Configuration** browser, select **Standard Connection**.

3 In the **Properties** browser, you can configure the following:

Continues on next page

4.3.1 Offline configuration

Continued



xx2400000716

Parameter	Description	Allowed values
Output RPI	*Output RPI* (Originator to Target Request Packet Interval) is the time between I/O packets from the scanner to the I/O device. Use this parameter to decide at which interval the scanner shall produce output data to the I/O device. The Request Packet Interval is specified in micro seconds. **Note** In case of connection problems, it is recommended to increase the Connection Timeout Multiplier.	The minimum limit is 2000 and maximum limit is 500000.
Input RPI	*Input RPI* (Target to Originator Request Packet Interval) is the time between I/O packets from the I/O device to the scanner. Use this parameter to decide at which interval the scanner shall consume input data from the I/O device. The Request Packet Interval is specified in micro seconds. **Note** In case of connection problems, it is recommended to increase the Connection Timeout Multiplier.	The minimum limit is 2000 and maximum limit is 500000.

Continues on next page

Parameter	Description	Allowed values
Data direction to Server	Indicates the direction of the data flow for a connection, for example input or output data.	
Safe Connection	Indicates that this connection is a safety connection.	
Ownership	The *Ownership* parameter specifies how the I/O connection shall act between the scanner and the I/O device. There are three different types of Ownership: • Exclusive Owner: An I/O connection where the data of an I/O device can be controlled only by one scanner. • Input Only: An I/O connection where only the scanner can receive input data from an I/O device. There is no output data. • Listen Only: An I/O connection where only the scanner can receive input data from an I/O device. This type of *Ownership* can only be attached to an connection of type; Exclusive Owner or Input Only. If this underlying connection closes, then the connection with Ownership of type; Listen Only will also be closed. There is no output data. **Note** Some EtherNet/IP devices might not support the Input Only connection.	Allowed values are Exclusive Owner, Input Only, or Listen Only.
Input Connection Type	The *Input Connection Type* parameter specifies how I/O data is send from the I/O device to the scanner. There are two different connection types: • **Point-to-point (Unicast)**: A connection where the data is send from one point to another point. In this case there is just one sender and one receiver. • **Multicast**: A connection where the data is send from one or more points to a set of other points. In this case there is one sender and multiple receivers. **Note** Some EtherNet/IP I/O devices might not support Point-to-point as input connection type.	
Connection Priority	The *Connection Priority* parameter specifies how I/O data is prioritized on the network. Network priority is accomplished by using Quality of Service (QoS) mechanisms in the device.	Allowed values are Low, High, Schedule, Urgent.
Production Trigger	Select **Change of State** or **Cyclic** indicating the type of I/O connection to be used.	
Connection Timeout Multiplier	The **Connection Timeout Multiplier** can either be used to: calculate the Network Time Expectation. determine the number of ping intervals to wait without Correction before declaring a connection fault.	

Continues on next page

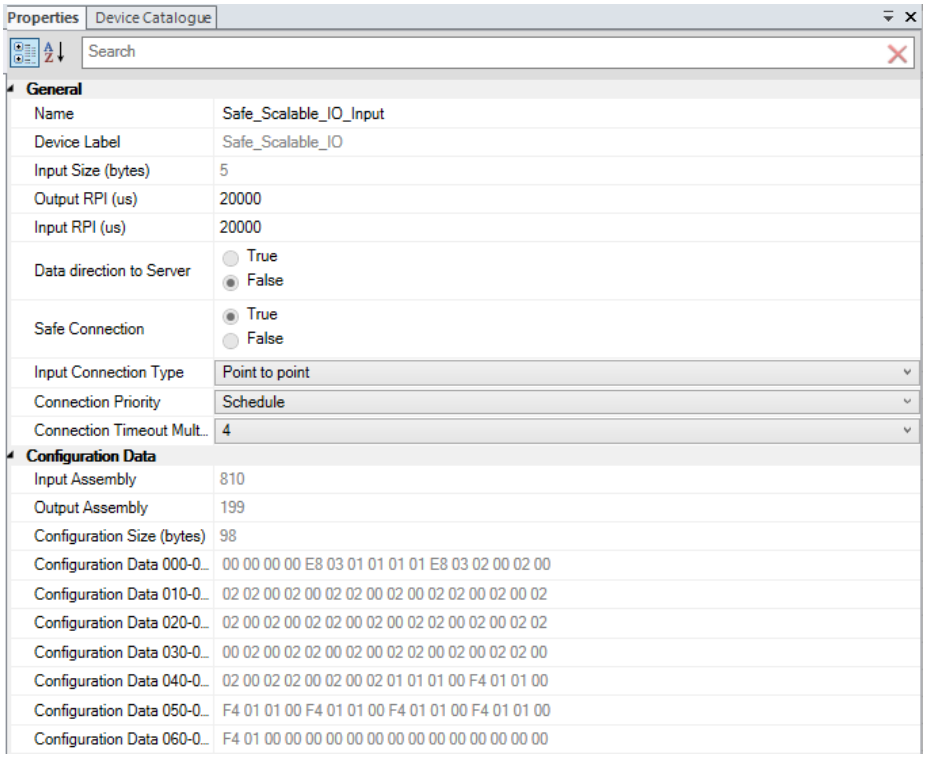
4.3.1 Offline configuration
Continued

Parameter	Description	Allowed values
Production Inhibit Time	**Production Inhibit Time** is used together with the production trigger **Change of State** indicating the frequency with which a signal change can occur. This value is calculated as Request Packet Interval (RPI) divided by 4.	

4 Save the configuration. See *Application manual - I/O Engineering* for more information.

Configure the safe input connection properties

1 In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.
2 In the **Configuration** browser, select **Safe Input Connection**.
3 In the **Properties** browser, you can configure the following:



xx2400001417

Parameter	Description	Allowed values
Name	Enter the name to be used for the device.	A string with maximum 32 characters.

Continues on next page

Parameter	Description	Allowed values
Input RPI	*Input RPI* (Target to Originator Request Packet Interval) is the time between I/O packets from the I/O device to the scanner. Use this parameter to decide at which interval the scanner shall consume input data from the I/O device. The Request Packet Interval is specified in micro seconds. **Note** In case of connection problems, it is recommended to increase the Connection Timeout Multiplier.	Valid range: 10 -100 ms.
Data direction to Server	Indicates the direction of the data flow for a connection, for example input or output data.	
Safe Connection	Indicates that this connection is a safety connection.	
Connection Priority	The *Connection Priority* parameter specifies how I/O data is prioritized on the network. Network priority is accomplished by using Quality of Service (QoS) mechanisms in the device.	Allowed values are Low, High, Schedule, Urgent.

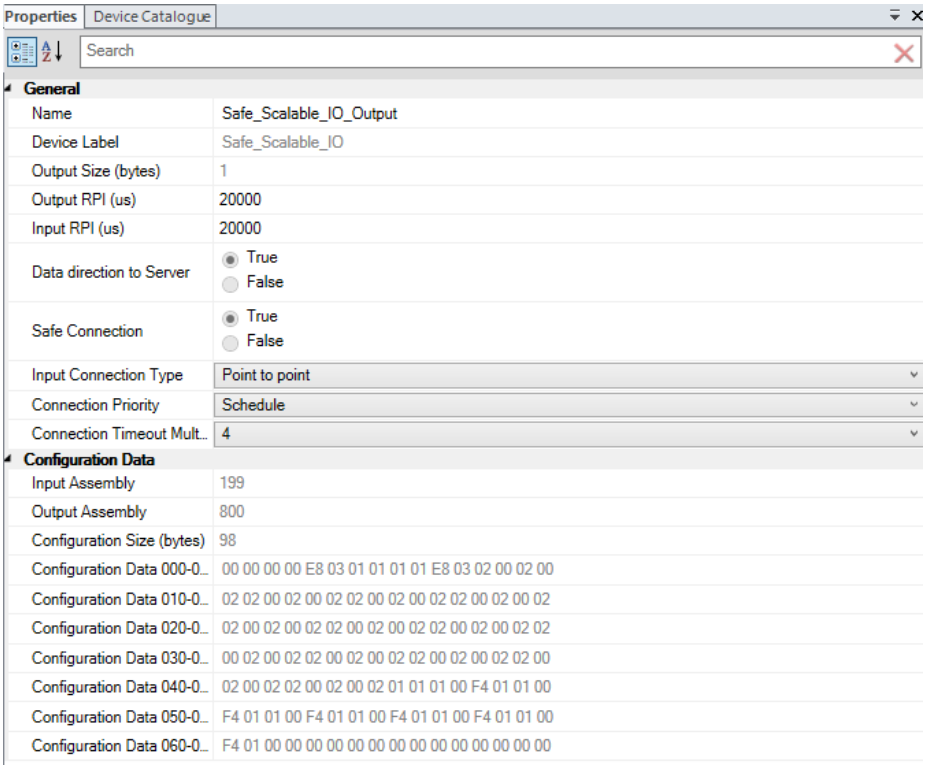
4 Save the configuration. See *Application manual - I/O Engineering* for more information.

Configure the safe output connection properties

1 In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.
2 In the **Configuration** browser, select **Safe Output Connection**.
3 In the **Properties** browser, you can configure the following:

Continues on next page

4.3.1 Offline configuration
Continued



xx2400001416

Parameter	Description	Allowed values
Name	Enter the name to be used for the device.	A string with maximum 32 characters.
Output RPI	*Output RPI* (Originator to Target Request Packet Interval) is the time between I/O packets from the scanner to the I/O device. Use this parameter to decide at which interval the scanner shall produce output data to the I/O device. The Request Packet Interval is specified in micro seconds. **Note** In case of connection problems, it is recommended to increase the Connection Timeout Multiplier.	Valid range: 10 -100 ms.
Data direction to Server	Indicates the direction of the data flow for a connection, for example input or output data.	
Safe Connection	Indicates that this connection is a safety connection.	
Connection Priority	The *Connection Priority* parameter specifies how I/O data is prioritized on the network. Network priority is accomplished by using Quality of Service (QoS) mechanisms in the device.	Allowed values are Low, High, Schedule, Urgent.

4 Save the configuration. See *Application manual - I/O Engineering* for more information.

4.3.2 Online configuration

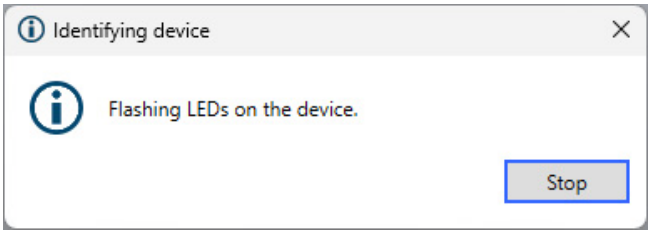
General

This section describes the working procedure when configuring devices online in I/O Engineering. For general information about I/O Engineering, see *Application manual - I/O Engineering*.

Identifying an I/O device

When there are multiple I/O devices in the controller, it is important to identify the physical I/O device for any device update, signal connection or troubleshooting.

1. Start RobotStudio and connect to the OmniCore controller. Request write access.
2. In **I/O Engineering**, select **Live** to access the **Live configuration**.
3. In the **I/O System** tree, right-click the target I/O device to be identified and select **Identify**.
4. The window **Identifying device** is displayed:



xx2400001315

The PWR (Power), MS (Module status) and NS (Network Status) LED of the physical base I/O device flashes to identify the I/O device in the controller. Select **Stop** when the device has been identified to stop the flashing LEDs.

> **Note**
>
> For DSQC1042, Safety digital base, only the PWR (Power) LED flashes to identify the I/O device in the controller.

Pairing a device with a controller

When a base I/O device is damaged, broken or faulty, it should be replaced. The new I/O device must be paired with the controller.

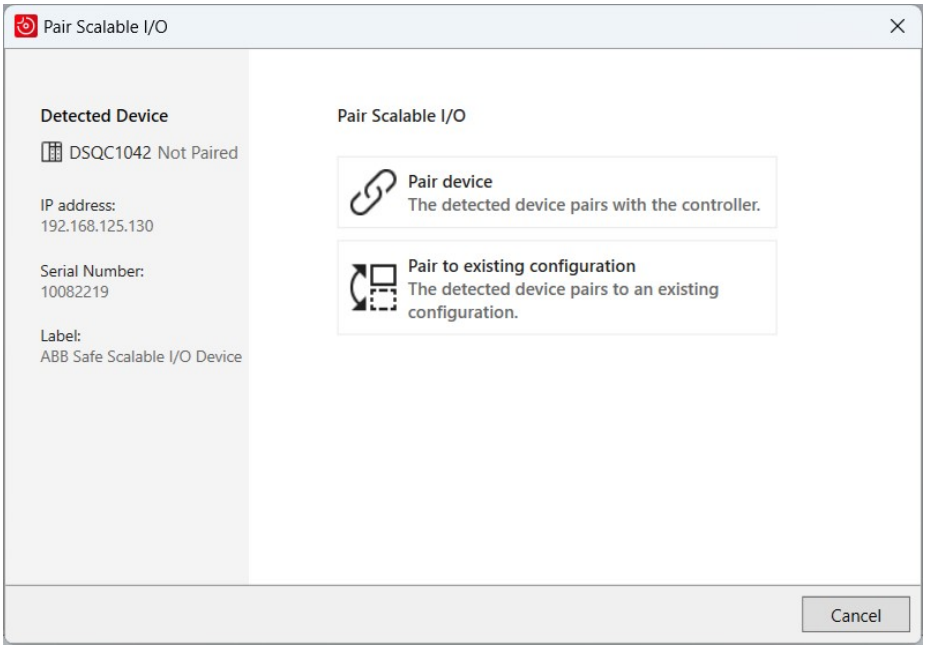
> **Note**
>
> If a faulty add-on I/O device is replaced with another add-on I/O device of the same type, there is no need to update the configuration of the base I/O device.

> **CAUTION**
>
> The replacement of safety digital base requires that the replacement device be configured properly and operation of the replacement device shall be user verified.

Continues on next page

4.3.2 Online configuration
Continued

1 Start RobotStudio and connect to the OmniCore controller.
2 In **I/O Engineering**, select **Live** to access the **Live configuration**.
3 Request write access.
4 A new device is connected to the private network. The detected device appears in the **I/O System** tree.
5 Right-click the new device and select **Pair**.
6 The **Pair Safety digital base device** dialog is displayed. Select **Pair device**.



xx2400001309

7 In the **Device Information** view, complete the following fields:

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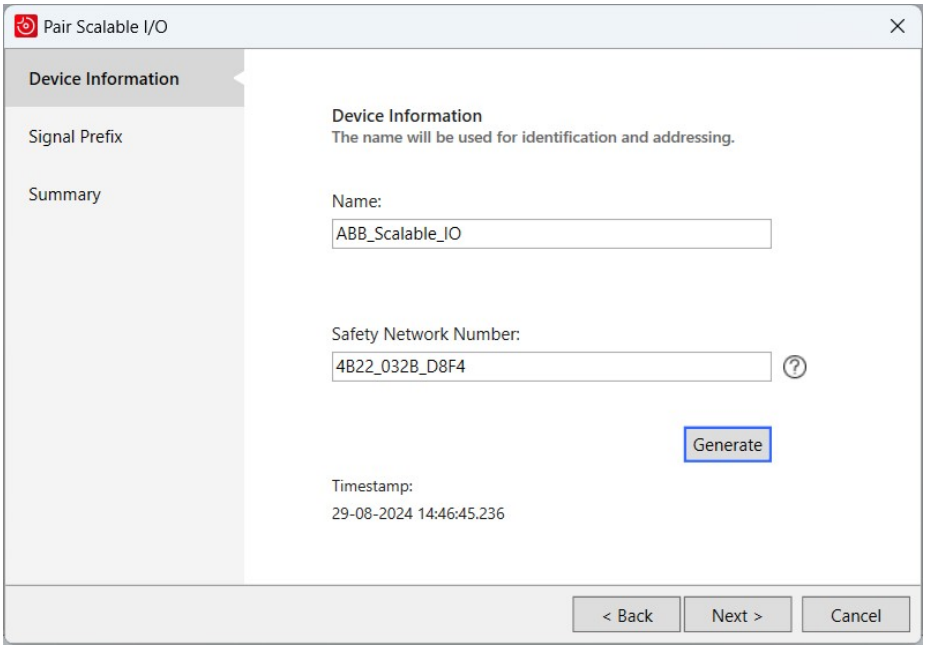

xx2400001310

- **Name**: Select a name for the new device.
- **Safety Network Number**: Enter a unique safety network number.

> **Note**
>
> Only applicable for safety digital base devices.

> **Tip**
>
> Select **Generate** to automatically retrieve a safety network number that is based on the current time stamp (displayed below).

8 In the **Signal Prefix** view, complete the following fields:
   - **Create Signals**: Select if signals should be generated automatically. If yes, also complete **Prefix**.
   - **Prefix**: Enter the signal prefix to be used in signal names. Not mandatory.
9 The **Summary** view is displayed. Select **Restart controller** and then **Apply**.

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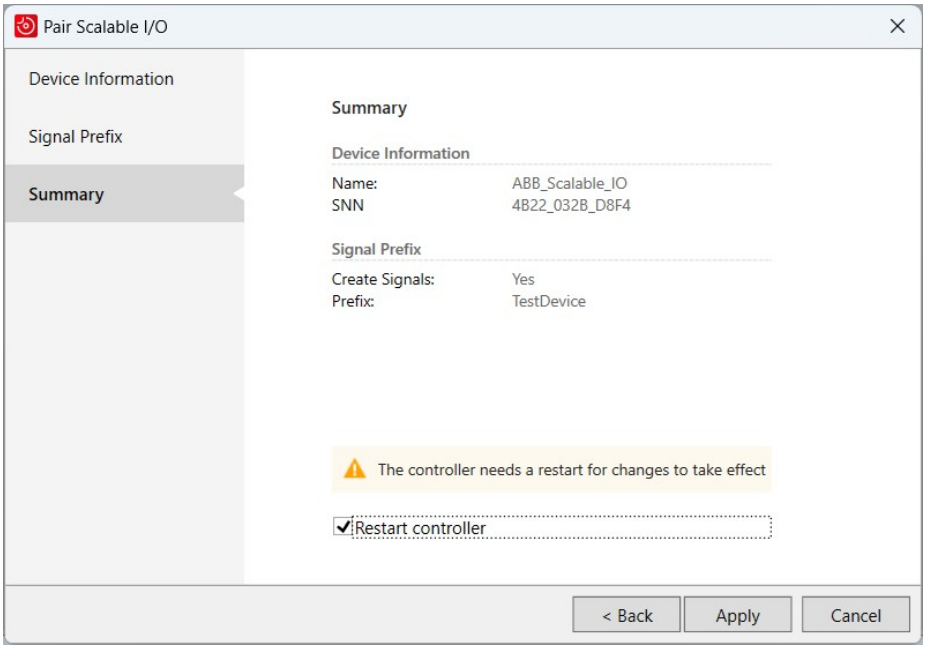
4.3.2 Online configuration
Continued



xx2400001312

10 The device is now paired, and the configuration is written to the controller.

Pairing a device with an existing configuration

Existing device configurations found on the controller can be inherited by a new device. This means that devices can be created in the controller ahead of time without access to the physical device. See *Offline configuration*. This also extends to simulated devices that also can be turned into physical devices by configuring a new Safety digital base device using the simulated device configuration.

CAUTION

Before installing a new device into the safety network, the user must ensure that any pre-existing configuration is cleared from the new device.

CAUTION

The replacement device must be configured properly and operation of the replacement device shall be user verified.

1 Start RobotStudio and connect to the OmniCore controller.
2 In **I/O Engineering**, select **Live** to access the **Live configuration**.
3 Request write access.
4 A new Safe 24V Switching Device is connected to the private network. The detected device appears in the **I/O System** tree.
5 Right-click the new I/O device and select **Pair**.
6 The **Pair Safety digital base device** dialog is displayed. Select **Pair to existing configuration**.

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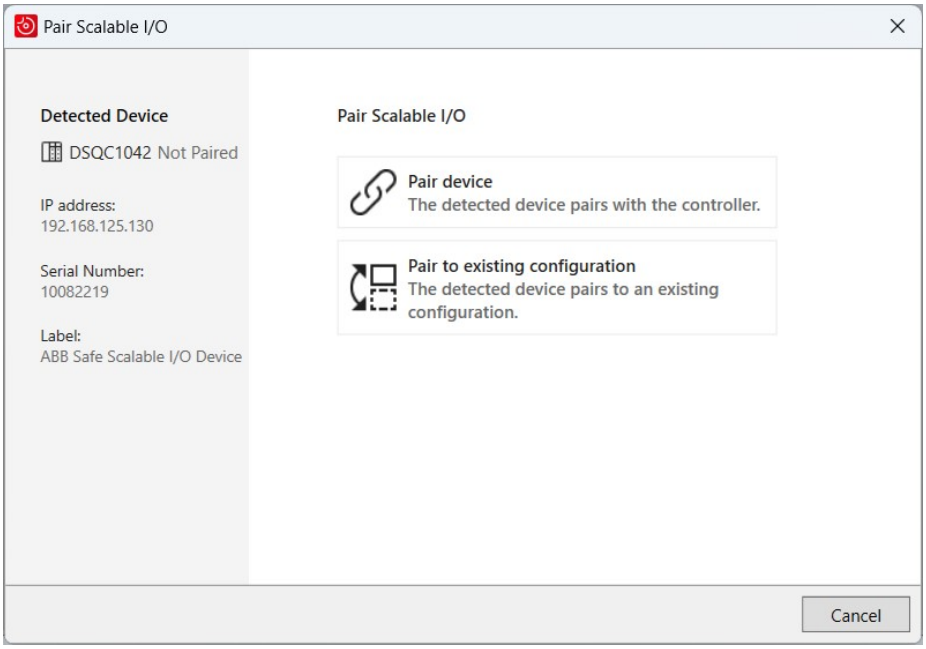
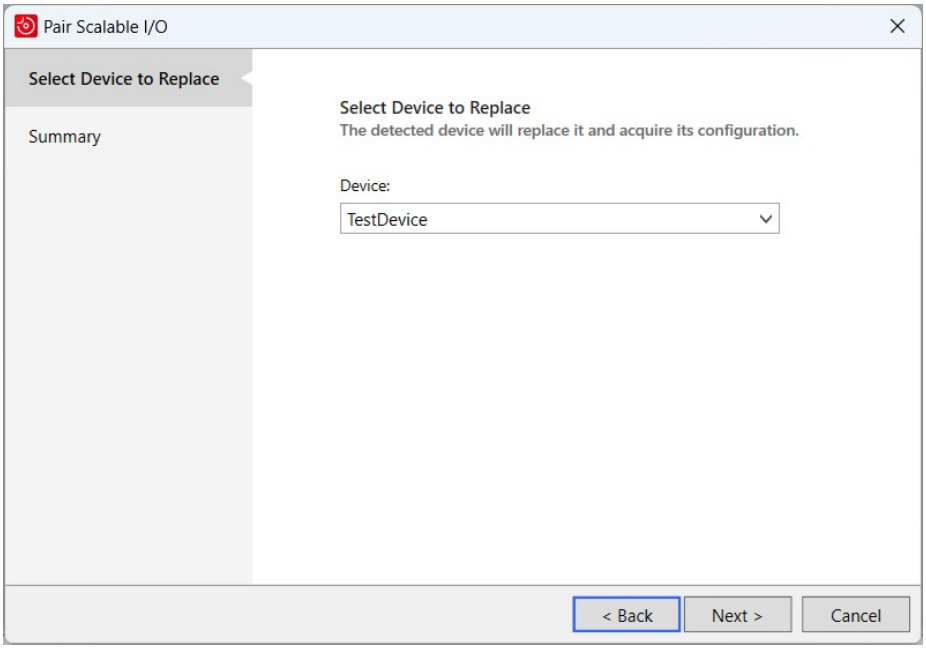


xx2400001309

7 In the **Select Device to Replace** view, select the **Device** that should be replaced and then **Next**.

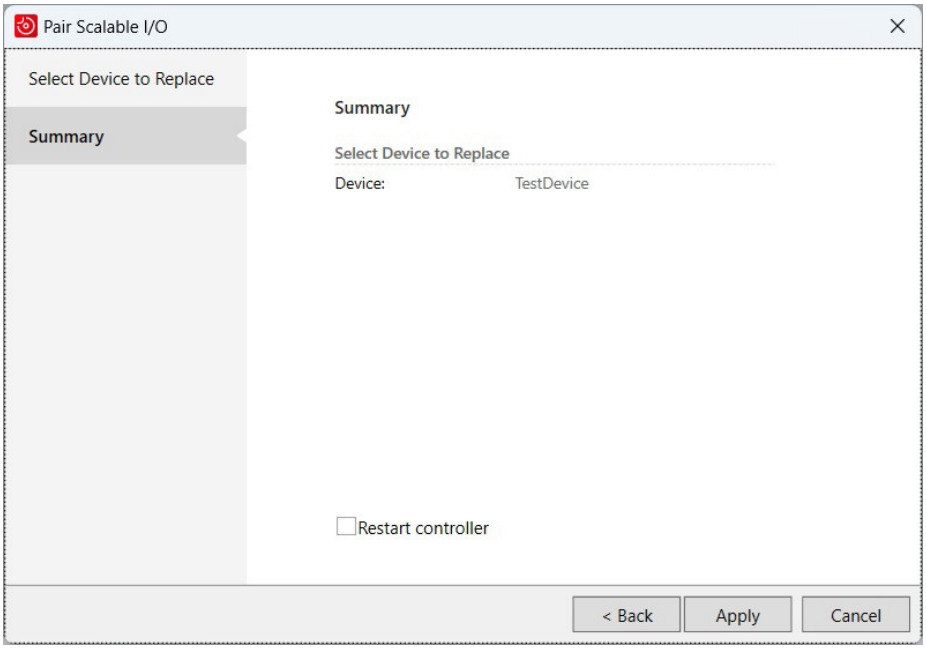


xx2400001313

8 The **Summary** view is displayed. Select **Restart controller** and then **Apply**.

Continues on next page

4.3.2 Online configuration
Continued



xx2400001314

9 The device is now paired, and the configuration is written to the controller.

Deactivating a device

Follow this procedure to deactivate a device.

Note

Prerequisites for deactivating a device:
- Connect as Local Client
- Manual mode

1 Start RobotStudio and connect to the OmniCore controller. Request write access.
2 In **I/O Engineering**, select **Live** to access the **Live configuration**.
3 In the **I/O System** tree, right-click the device to be deactivated and select **Deactivate**.
4 The device is now deactivated.

Removing an I/O device configuration

Use this function to remove a configuration.

Note

Prerequisites for removing an I/O device configuration:
- Manual mode
- The unit must be deactivated
- Write access

Continues on next page

1 Start RobotStudio and connect to the OmniCore controller. Request write access.
2 In **I/O Engineering**, select **Live** to access the **Live configuration**.
3 In the **I/O System** tree, right-click the I/O device to be removed and select **Delete**.

xx2400001596

4 The **Delete Configuration** dialog is displayed. Select **Delete**.
The pairing between the controller and device will be removed and the configuration will be deleted from the controller.

Tip

Select **Reset device** if the device should be reset to factory default.

5 Restart the controller.

Resetting a device configuration

Use this function to reset the device to factory default. All active configurations including safety will be removed from the device. The controller configuration will, however, not be affected.

Note

Prerequisites for resetting a device configuration:
- Manual mode
- If running, the unit must first be deactivated
- Write access

1 Start RobotStudio and connect to the OmniCore controller. Request write access.
2 In **I/O Engineering**, select **Live** to access the **Live configuration**.
3 In the **I/O System** tree, right-click the device to be reset to factory default and select **Reset**.
4 The **Reset device** dialog is displayed. Select **Reset**.

Continues on next page

4.3.2 Online configuration
Continued

The device and its settings will be reset, but the controller configuration will not be affected.

4.4 Configuring Scalable I/O devices using the FlexPendant

General

This section describes the recommended working procedure when installing and configuring ABB Scalable I/O devices using the FlexPendant.

> **Note**
>
> The system should be in manual mode while configuring or updating the I/O device using the FlexPendant.

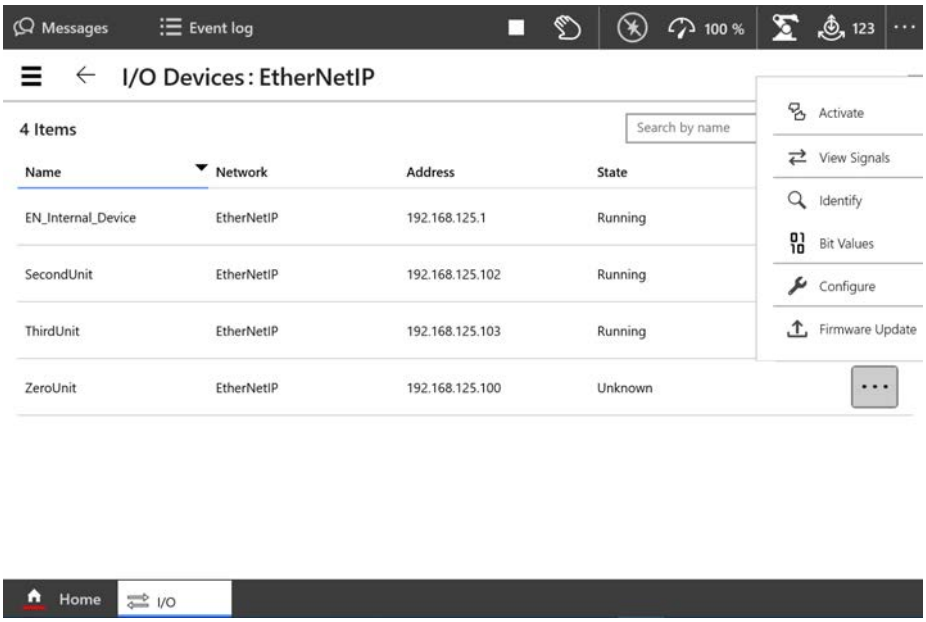
> **Note**
>
> Safety digital base devices cannot be configured using the FlexPendant.

Configuring an I/O device

When a base I/O device and an add-on I/O device are connected to the controller, these must be configured.

Use this procedure to configure a new I/O device on the FlexPendant.

1. Start the FlexPendant and connect to the OmniCore controller.
2. On the start screen, tap **I/O**, and then select **I/O Devices** from the menu.
3. Select the I/O device and and tap **Configure**.



xx2100000102

4. The **I/O Modernization** window is displayed.

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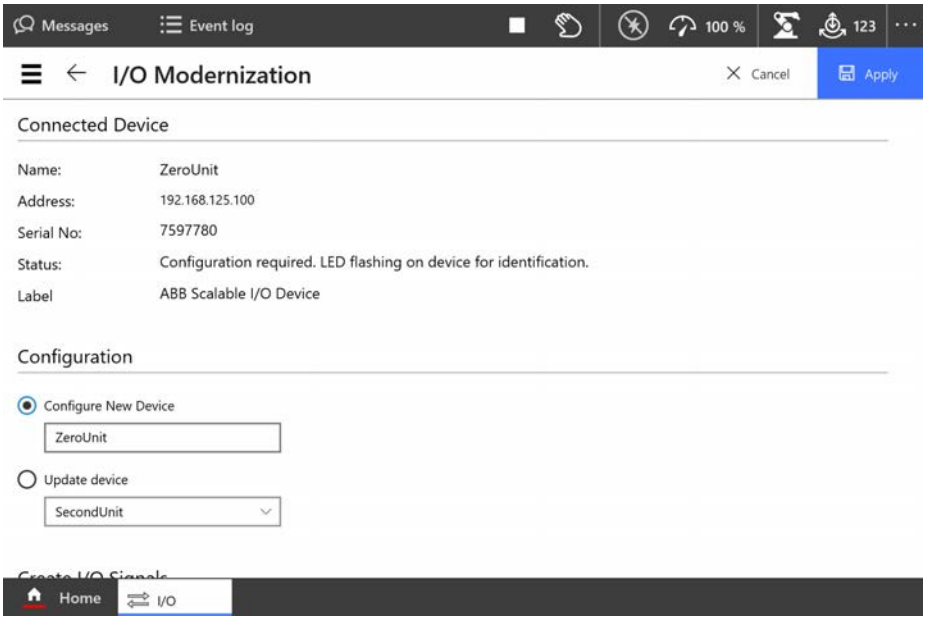


xx2100000101

Enter the device name in the **Configure New Device** option, and then tap **Apply**.

5 Tap **OK** to the question **The changes will not take effect until the controller is restarted. Do you want to restart now?**.

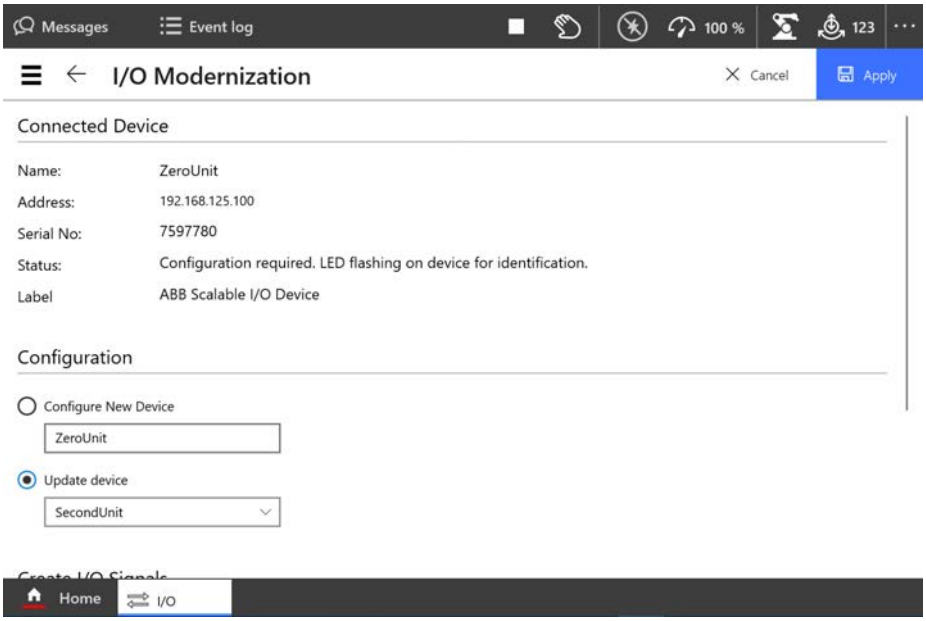
Updating an existing I/O device

When an add-on I/O device has been attached or removed, the I/O configuration of the base I/O device must be updated.

> **Note**
>
> Always attach or remove I/O devices from the right side of the base I/O device, otherwise the optical link is broken.

1 On the start screen, tap **I/O**, and then select **I/O Devices** from the menu.
2 Select the I/O device to be updated and and tap **Configure**.
3 The **I/O Modernization** window is displayed.

Continues on next page



xx2100000098

Enter the device name in the **Update device** option, and then tap **Apply**.

4 The I/O device is configured and a restart is required. Tap **OK**.

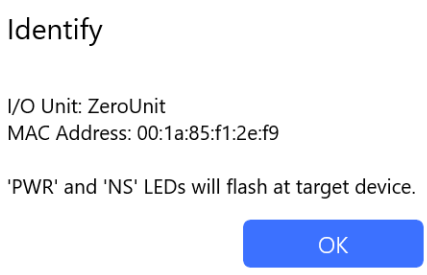
Identifying an I/O device

When there are multiple I/O devices in the controller, it is important to identify the physical I/O device for any device update, signal connection or troubleshooting.

1 On the start screen, tap **I/O**, and then select **I/O Devices** from the menu.

2 Select the I/O device to be identified and and tap **Identify**.

3 The **Identify** window is displayed.



xx2100000097

Tap **OK**.

4.5 Configuring safety digital base devices

Prerequisites

The **Safety services** grant is mandatory for configuration of safety digital base devices.

Recommended work process

In order to use the Safety digital base device in your configuration, the following work process is recommended:

1. Install the safety digital base device, see *Installing safety digital base devices*.
2. Configure the Safety digital base device (offline or online), see *Offline configuration* and *Online configuration*. Offline configuration can be used when there is no access to hardware, the Safety digital base device or the robot controller.

   Note

   When working with the Safety digital base device, the configuration tool will update and download a new safety configuration to the controller.

3. After the configuration, the dual channels must be defined using CL logic, see *Setting up dual channel signals on page 85* and *Application manual - Functional safety and SafeMove* for instructions on how to define logic diagrams.
4. Verify the parameters in the ABB Safety Configuration Report, see *Verifying safety parameters*.

   CAUTION

   The user must confirm that all configuration data of the Safety digital base device was downloaded correctly by reading out all parameters from the module (safe output connection) and visually inspect the content.

5. Validate the configuration of the Safety digital base device according to the validation process as described in *Application manual - Functional safety and SafeMove*.

   WARNING

   All downloaded configurations must be validated by user testing before the installation can be regarded as safe. User testing is the means by which all downloads are validated.

   WARNING

   The total intended safety functionality applied by the originator must be confirmed at commissioning of the Safety digital base device.

Continues on next page

CAUTION

After the Safety digital base device is configured, the user must check that ownership has been assigned to the right originator.

6 When the configuration is done, see *Application manual - Functional safety and SafeMove* for instructions on how to work with the safety configuration.

Configure safety digital base devices via I/O Engineering

Safety digital base devices are configured in the same way as the standard digital base devices. See *Configuring Scalable I/O devices using I/O Engineering on page 58*.

Configure safety digital base devices via FlexPendant

Note

Safety digital base devices cannot be configured using the FlexPendant.

Setting up dual channel signals

The safety digital base device is configured with dual channels. A dual channel is comprised of two signals, both electrically and in the software. In the safety digital base, there are two pairs for output and six pairs for input.

Output signals

There are two dual channel pairs for output signals. The four output signals are paired in the following way:

Dual channel pair	DSQC1042
1 (CH1)	SDO_1_+ SDO_1_-
	SDO_2_+ SDO 2-
2 (CH2)	SDO_3_+ SDO_3_-
	SDO_4_+ SDO_4_-

Note

To write a dual channel output signal, both signals in the pair must be set to high in the safety controller. This is defined with CL-copy logic.

See *Application manual - Functional safety and SafeMove* for instructions on how to define logic diagrams.

Continues on next page

Intput signals

There are six dual channel pairs for input signals. The twelve input signals are paired in the following way:

Dual channel pair	DSQC1042
1 (CH1)	SDI_1_+ SDI_1_-
	SDI_2_+ SDI_2_-
2 (CH2)	SDI_3_+ SDI_3_-
	SDI_4_+ SDI_4_-
3 (CH3)	SDI_5_+ SDI_5_-
	SDI_6_+ SDI_6_-
4 (CH4)	SDI_7_+ SDI_7_-
	SDI_8_+ SDI_8_-
5 (CH5)	SDI_9_+ SDI_9_-
	SDI_10_+ SDI_10_-
6 (CH6)	SDI_11_+ SDI_11_-
	SDI_12_+ SDI_12_-

Note

To read a dual channel input signal, it is enough to read any signal in the pair. They follow each other.

Verifying safety parameters

When configuring the Safety digital base device, a set of parameters are written to the safety controller configuration and can be viewed in the ABB Safety Configuration Report.

1. In the **Controller** tab in RobotStudio, select **I/O Engineering**.
2. In the **I/O Engineering** tab, select **I/O Safety Report**.
3. The **ABB Safety Configuration Report** is displayed.

Continues on next page

4 Verify the following parameters:

Parameter	Description	Values/Examples
Device name	The name that is defined during the device configuration.	Device name="ABBIO"
inSizeBits		inSizeBits="40"
outSizeBits		outSizeBits="8
scid	The Safety Configuration identifier/Checksum is a constant that is written in the safety configuration when the button **Apply** is pressed.	scid="2F7C2FF1"
nodeId	The IP address of the device, defined in hexdecimal form. This is the IP address that is visible in the configuration.	nodeId="C0A87D84"
snn	A unique Safety Network Number is set during device configuration for each safety network or safety sub-net. The safety network number can either be defined manually, or be retrieved automatically based on the current time stamp.	snn="4B12_02CD_273F"
scidDateTime	A time stamp for the configuration which in combination with scid forms the signature. Is set when the button **Apply** is pressed.	scidDateTime="2021-08-12T17:02:59.359+02:00"
timeCoordinationMsgMultiplier		timeCoordinationMsgMultiplier="5"
timeoutMultiplier		timeoutMultiplier="2"
Signal name	Generated name: DeviceName_slotNo_Type+ix	Signal name="ABBIO_0_DO1"

CAUTION

In case of a safety connection with **scid**=0, the correct configurations for originators and targets must be secured.

CAUTION

The user should assign **snn** numbers for each safety network or safety sub-net that are unique system-wide.

CAUTION

The configuration signature, composed of **scid** and **scidDateTime**, should only be considered verified after user testing.

Continues on next page

CAUTION

When configuring an originator with connection data and/or target configuration data, the data must be downloaded to the target so it can be tested and verified. Only then can SCIDs from the target be confirmed.

Troubleshooting safety digital base devices

Check group status signals

In the safety controller there are two group status signals, *SDIS* (DI_Status) and *SDOS* (DO_Status). The status signals indicate if errors are detected:

Reported status	Description
1	OK
0	ALARM

If a fault is detected, the status signal for the input/output channel will be set to 0 (ALARM). The signal will remain in status 0 for 1000 ms. This ensures that intermittent faults that only exist for a few milliseconds are latched long enough to be read by the controller.

Note

The reported output status for the dual output channel pair will go to ALARM if the outputs for the two signals from the controller/originator differ from each other, without any discrepancy delay.

The status will automatically be set to 1 (OK) when the following is true:

- the *Safety Input Latch Error Time* (1000 ms) has elapsed
- both inputs/outputs have been cleared
- the cause for the failure has been removed.

Check cables

If the status signal for the input/output channel is set to 0 (ALARM), perform the following checks:

1. Make sure that the cables are connected properly at both ends.
2. If the problem persists, replace the cables.

Reset safety configuration

When a safety digital base device has been configured and is running, and the safety configuration is reset, these steps must be followed in order to recover the device:

1. In the **Visual SafeMove** tab, select **Controller** > **Reset to factory settings** to reset the safety configuration. See also*Application manual - Functional safety and SafeMove*.
2. In **I/O Engineering**, select **Live** to access the **Live configuration**.

Continues on next page

In the **I/O System** tree, right-click the safety digital device and select **Deactivate**.

3 Right-click the safety digital device and select **Delete**.

4 When the configuration has been removed from the first device, a new device will be displayed in the list.

5 Right-click the new safety digital device and select **Configure Device**. See also *Configuring Scalable I/O devices using I/O Engineering on page 58*.

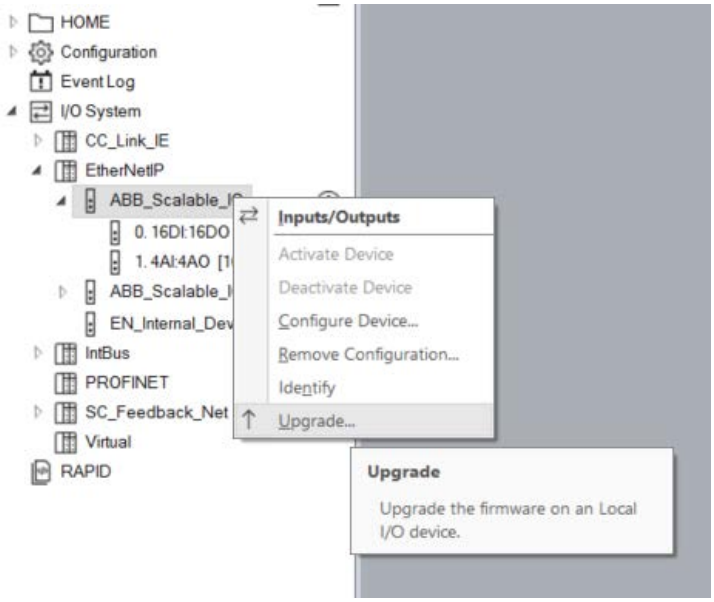
4.6 Firmware upgrade

Upgrade firmware from RobotStudio

Note

Firmware upgrade is not available for safety digital base devices or for attached add-on devices.

1. Set the OmniCore controller in manual mode.
2. If the device is in the running state, deactivate Scalable I/O on the FlexPendant:
   a. On the start screen, tap **I/O**, and then select **I/O Devices** from the menu.
   b. Select the device and and tap **Deactivate**.
3. Start RobotStudio and connect to the OmniCore controller.
4. Request write access.
5. In the **I/O System** tree, right-click the target I/O device and select **Upgrade**.



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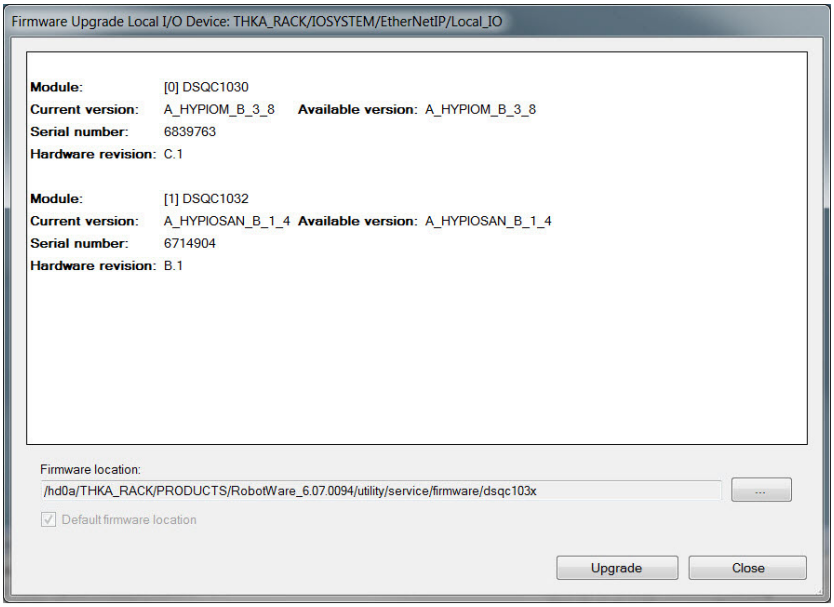
6. The **Firmware Upgrade Local I/O Device** window is displayed.

Note

The **Firmware location** field displays the default firmware file. To select a new firmware file, click the **...** button and browse to the folder with the new firmware file.

Continues on next page



xx1800000143

Note

The **Upgrade** button is enabled only if a new version is detected either in the default firmware path or in a browsed path.

7 Click **Upgrade**.

The firmware is upgraded and a message is displayed.

Upgrade firmware from the FlexPendant

Note

Firmware upgrade is not available for safety digital base devices or for attached add-on devices.

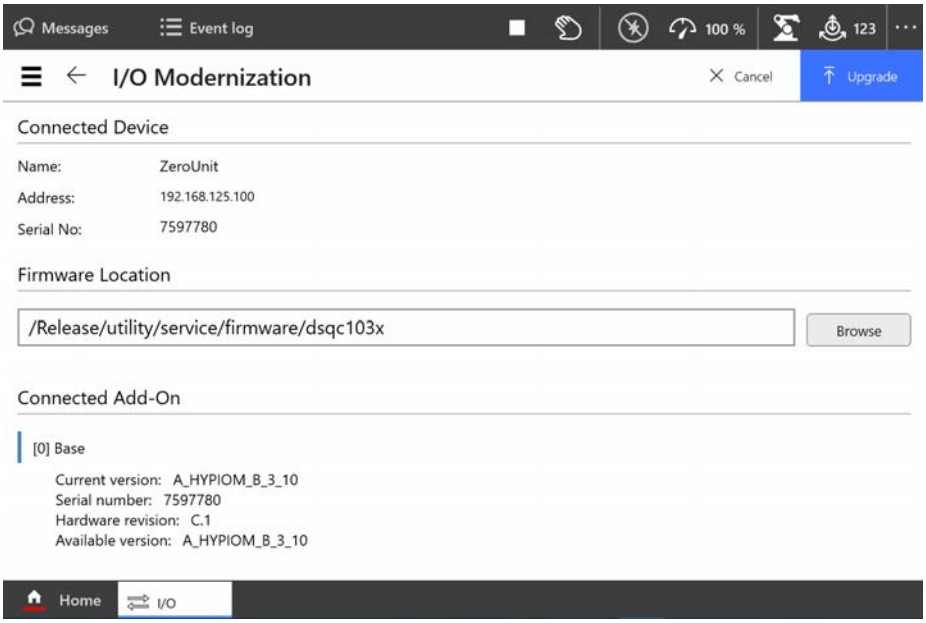
1 Set the OmniCore controller in manual mode.
2 On the start screen, tap **I/O**, and then select **I/O Devices** from the menu.
3 If the I/O device is in the running state, select the device and and tap **Deactivate**.
4 Select the I/O device and and tap **Firmware Update**.

Note

Firmware upgrade is not possible if the state of the selected I/O device is **Running**.

5 The **I/O Modernization** window is displayed.

Continues on next page



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Note

The **Firmware Location** field displays the default firmware file. To select a new firmware file, tap **Browse**.

6 Tap **Upgrade**.

The firmware is upgraded and a message is displayed.

Note

The **Upgrade** button is enabled only if a new version is detected either in the default firmware path or in a browsed path.

5 Reference material

5.1 Analog input point object

Analog Input Point Object (Class Code: 0Ahex)

The Analog Input Point Object contains information of the analog inputs of the Scalable I/O system.

Inputs cause the base module to produce data on the network. Each analog input point uses a low pass filter and a hysteresis which can both be configured. The sampled value is first passed through the low pass filter and then through the hysteresis. After this, the value is stored to attribute 3 (Value).

Class attributes

Attribute ID (hex)	Access rule	NV	Attribute name	Data type	Default value	Description
1	Get	NV	Revision	U16	2	

Instance attributes

Attribute ID (hex)	Access rule	NV	Attribute name	Data type	Default value	Description
3	Get	V	Value	U16		0 to 4095
32	Set	V	Low Pass Filter Order	U16	3	0 The Low Pass Filter Order exponent can be set to 0 – 16 and the sample time is 1 ms.
33	Set	V	Hysteresis	U16	4	The hysteresis of each analog input point can be set between 0 and 4095. New values (after filtering) must be outside the hysteresis window in order for it to be transferred to attribute 3 (Value).

Services

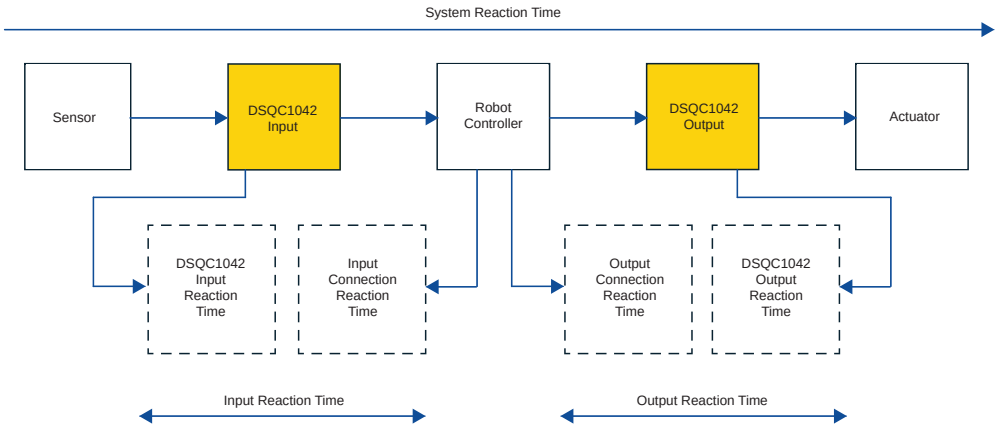
Service code (hex)	Implemented		Service name	Description
	Class	Instance		
0E	YES	YES	Get Attribute Single	
10	NO	YES	Set Attribute Single	

5.2 Reaction times

Overview

This section describes how to calculate input and output reaction times for the Safety digital base device, DSQC1042.

The system reaction time is the worst-case time from a safety related event as input to the system or as a fault within the system, until the time that the system is in the safety state. The Safety digital base device, DSQC1042 is part of a safety instrumented system including the OmniCore robot controller:



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Note

DSQC1042 supports PL d Cat 3 in use with OmniCore (dual channel is mandatory).

When considering the complete system reaction time, the complete safety chain must be considered. For the OmniCore controller it includes the controller and the manipulator. See *Application manual - Functional safety and SafeMove*.

Reaction time calculations

As the sensor and actuator reaction times varies, they are not included in the calculations presented in this section. The user is expected to add values in the empty calculation fields (see fields labeled **User value**) and then sum all components involved in the complete safety chain. The input and output reaction times mentioned in the following sections can be used as inputs for this purpose.

Input Reaction Time, no faults

Description

The **Input Reaction Time, no faults**, is the worst-case time, from the time an input change state at physical input terminal of DSQC1042 to the state change is received in the CIP Safety Scanner in OmniCore, when there are no faults in the input chain.

Continues on next page

Included parts

The **Input reaction time** consists of the following parts:

- DSQC1042 safety input delay time (see *Response times for components on page 98*).
- DSQC1042 max internal input processing time (see *Response times for components on page 98*).
- Safety Input Connection RPI. (Configurable, see *Configuration settings that affect reaction times on page 98*).
- OmniCore main computer input internal processing time (see *Response times for components on page 98*).
- Safety Task Period in OmniCore controller (see *Response times for components on page 98*).

Calculation

Use the following table for the calculation of the **Input Reaction Time, no faults**:

Part	Minimum [ms][i]	Calculation [ms][ii]
DSQC1042 safety input delay time	2	2
DSQC1042 max internal input processing time	13	13
Safety Input Connection RPI	10	User value
OmniCore main computer input internal processing time	0	0
Safety Task Period in OmniCore controller	4	4
Total Input Reaction Time, no faults:	**29**	

i **Minimum** shows the calculation for minimum RPI set to 10 ms.
ii **Calculation** can be used for own settings.

Input Reaction Time, channel faults

Description

The **Input Reaction Time, channel faults**, is the worst-case time, from a channel fault occurs at physical input terminal of DSQC1042 to the input signals are set to safe state in the CIP Safety Scanner in OmniCore, when there are no faults in the input chain.

See *Troubleshooting safety digital base devices on page 88*.

Included parts

The **Input reaction time** consists of the following parts:

- DSQC1042 safety input delay time (see *Response times for components on page 98*).
- DSQC1042 max internal input processing time (see *Response times for components on page 98*).
- Safety Input Connection RPI. (Configurable, see *Configuration settings that affect reaction times on page 98*).
- OmniCore main computer input internal processing time (see *Response times for components on page 98*).

Continues on next page

- Safety Task Period in OmniCore controller (see *Response times for components on page 98*).

Calculation

Use the following table for the calculation of the **Input Reaction Time, channel faults**:

Part	Minimum [ms] [i]	Calculation [ms] [ii]
DSQC1042 safety input delay time	2	2
DSQC1042 max internal input processing time	13	13
Safety Input Connection RPI	10	User value
OmniCore main computer input internal processing time	0	0
Safety Task Period in OmniCore controller	4	4
Total Input Reaction Time, no faults:	**29**	

i **Minimum** shows the calculation for minimum RPI set to 10 ms.
ii **Calculation** can be used for own settings.

Input Reaction Time, single fault within communication

Description

The **Input Reaction Time, single fault within communication**, is the worst-case time, from the time an internal error in the input subsystem is detected until the input signals goes to safe state in the CIP Safety Scanner in OmniCore.

Included parts

The **Input Reaction Time** consists of the following parts:

- Safety Input Connection Network Reaction Time. (Configurable, see *Configuration settings that affect reaction times on page 98*).

Calculation

Use the following tables for the calculation of the **Input Reaction Time, single fault within communication**:

Input Connection Network Reaction Time [i]	Minimum [ms] [ii]	Calculation [ms] [iii]
Safety Input Connection RPI	10	User value
Timeout Multiplier	2	User value
Input Connection Network Reaction Time:	**10 x (2 + 2) = 40**	

i Network reaction time = Input RPI *(Timeout_Multiplier+2)
ii **Minimum** shows the calculation for minimum RPI set to 10 ms.
iii **Calculation** can be used for own settings.

Output Reaction Time, no faults

Description

The **Output Reaction Time, no faults**, is the worst-case time, from the time a state change of a safe digital output in the CL logic in Safety Controller until a state change on physical output on DSQC1042, when there are no faults in the output chain.

Continues on next page

Included parts

The Output Reaction Time consists of the following parts:

- Safety Output Connection RPI.

  (Configurable, see chapter *Configuration settings that affect reaction times on page 98*).
- OmniCore main computer output internal processing time (see *Response times for components on page 98*).
- DSQC1042 output response time (see *Response times for components on page 98*).

Calculation

Use the following table for the calculation of the **Output Reaction Time, no faults**:

Part	Minimum [ms] [i]	Calculation [ms] [ii]
Safety Input Connection RPI	10	User value
OmniCore main computer output internal processing time	0	0
DSQC1042 output response time	21	21
Total Output Reaction Time, no faults:	**31**	

i **Minimum** shows the calculation for minimum RPI set to 10 ms.
ii **Calculation** can be used for own settings.

Output Reaction Time, single fault within system

Description

The **Output Reaction Time, single fault within system**, is the worst-case time, from the time an internal error in the output subsystem is detected until the output signals goes to safe state on physical output on DSQC1042.

Included parts

The **Output Reaction Time** consists of the following parts:

- Safety Output Connection Network Reaction Time. (Configurable, see *Configuration settings that affect reaction times on page 98*).
- DSQC1042 output response time (see *Response times for components on page 98*).

Calculation

Use the following tables for the calculation of the **Output Reaction Time, single fault within system**:

Output Connection Network Reaction Time [i]	Minimum [ms] [ii]	Calculation [ms] [iii]
Safety Output Connection RPI	10	User value
Timeout Multiplier	2	User value
Output Connection Network Reaction Time:	**10 x (2 + 2) = 40**	

i Network reaction time = Output RPI *(Timeout_Multiplier+2)
ii **Minimum** shows the calculation for minimum RPI set to 10 ms.
iii **Calculation** can be used for own settings.

Continues on next page

Part	Minimum [ms][i]	Calculation [ms][ii]
Safety Output Connection Network Reaction Time	40	User value
DSQC1042 output response time	21	21
Total Output Reaction Time, single fault within system:	**61**	

i **Minimum** shows the calculation for minimum RPI set to 10 ms.
ii **Calculation** can be used for own settings.

Response times for components

Component	Response time
DSQC1042 input delay time	2 ms
DSQC1042 internal input processing time	13 ms
DSQC1042 output processing time	21 ms
Main computer digital input	0 ms[i]
Main computer digital output	0 ms[i]
Safety Task Period[ii]	4 ms

i The theoretical time in the main computer is known, but there are internal delays within the main computer whose values are unknown.
ii Safety Controller scheduler executes on a 4 ms cycle and has a watchdog on 2 x (5-6) =12 ms.

Configuration settings that affect reaction times

Setting	Range	Comment
Timeout multiplier	Configurable 0 – 255 Default: 2	Configured from **Safety Parameters** for the I/O Unit in I/O Engineering. See *Configure the safe Scalable I/O properties on page 65*.
Input RPI	Configurable 10 – 100 ms Default: 20 ms	Configured from **Safe Input Connection** for the I/O Unit in I/O Engineering. See *Configure the safe input connection properties on page 70*.
Output RPI	Configurable 10 – 100 ms Default: 20 ms	Configured from **Safe Output Connection** for the I/O Unit in I/O Engineering. See *Configure the safe output connection properties on page 71*.

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