ABB

ROBOTICS

Application manual
Scalable I/O

Application manual

Scalable I/O

RobotWare 7.5

Document ID: 3HAC070208-001

Revision: E

Table of contents

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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.

Usage

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

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	*3HAC073447-001*
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*

Continued

Revisions

Revision	Description
A	Released with RobotWare 7.0.
B	Released with RobotWare 7.0.1. • Updated the section *Coil neutralization on page 52*.
C	Released with RobotWare 7.0.2. • Updated the section *Connecting the EtherNet/IP network on page 28*.
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 13*, *Hardware overview on page 15*, *I/O device descriptions on page 29*, *Status LED descriptions on page 41*, *Technical data on page 49*, *Information about ABB Scalable I/O devices on page 53* and *Configuring Scalable I/O devices using RobotStudio on page 55*. • New section: *Setting up safety digital base devices on page 69*. • Updated the section *References on page 7*. • Information about node commissioning for other EtherNet/IP scanners added in sections *Introduction on page 13*, *Installing base devices on page 17*, and *Reset button on page 30*. • Limitation added in section *Information about ABB Scalable I/O devices on page 53* that COS is not supported for DSQC1042, safety digital base. • Section *Identifying an I/O device on page 64* updated with information that the MS LED also flashes during identification plus that for DSQC1042 only the PWR (Power) LED flashes.

Product documentation

Categories for user documentation from ABB Robotics

The user documentation from ABB Robotics is divided into a number of categories. This listing is based on the type of information in the documents, regardless of whether the products are standard or optional.

> 💡 **Tip**
>
> All documents can be found via myABB Business Portal, *www.abb.com/myABB*.

Product manuals

Manipulators, controllers, DressPack/SpotPack, and most other hardware is delivered with a **Product manual** that generally contains:

- Safety information.
- Installation and commissioning (descriptions of mechanical installation or electrical connections).
- Maintenance (descriptions of all required preventive maintenance procedures including intervals and expected life time of parts).
- Repair (descriptions of all recommended repair procedures including spare parts).
- Calibration.
- Decommissioning.
- Reference information (safety standards, unit conversions, screw joints, lists of tools).
- Spare parts list with corresponding figures (or references to separate spare parts lists).
- References to circuit diagrams.

Technical reference manuals

The technical reference manuals describe reference information for robotics products, for example lubrication, the RAPID language, and system parameters.

Application manuals

Specific applications (for example software or hardware options) are described in **Application manuals**. An application manual can describe one or several applications.

An application manual generally contains information about:

- The purpose of the application (what it does and when it is useful).
- What is included (for example cables, I/O boards, RAPID instructions, system parameters, software).
- How to install included or required hardware.
- How to use the application.
- Examples of how to use the application.

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Product documentation

Operating manuals

The operating manuals describe hands-on handling of the products. The manuals are aimed at those having first-hand operational contact with the product, that is production cell operators, programmers, and troubleshooters.

Safety

Safety regulations

Before beginning mechanical and/or electrical installations, ensure you are familiar with the safety information in the product manuals for the robot.

The integrator of the robot system is responsible for the safety of the robot system.

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 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 base device communicates over the EtherNet/IP communication protocol to the robot controller or to other EtherNet/IP scanners. Up to 20 devices in total can be connected to the robot controller over EtherNet/IP. This includes base devices and other third-party I/O devices.

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, see *Reset button on page 30*. The TCP/IP Object can then be accessed for the purpose of this.

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 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 base devices.

Safety

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

> **Note**
>
> The safety I/O functionality is available from RobotWare 7.5.

For detailed information about the safety digital base, see *DSQC1042 Safety digital base on page 38*.

Continued

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.
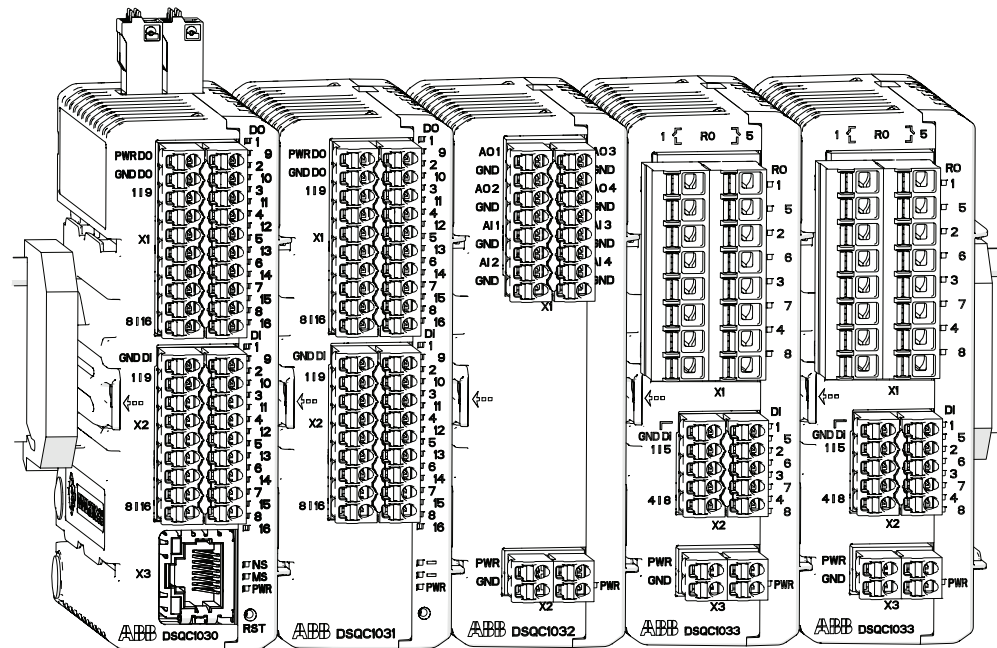- Fast signal setting with *Change of State*.

2 Hardware overview

2.1 Installing the I/O devices

2.1.1 Introduction

Scalable I/O devices

The illustration below shows the base device and connected add-on devices.

xx1600002032

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

Continues on next page

2.1.1 Introduction
Continued

The main dimensions for the I/O devices are 75x36x101 (Length x Width x Height).

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

2.1.2 Installing base devices

General

The scalable 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.

The base device communicates over the EtherNet/IP communication protocol to the robot controller or to other EtherNet/IP scanners. [1] Up to 20 devices in total can be connected to the robot controller over EtherNet/IP, this includes base devices and other third-party I/O devices.

When the 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-ons.
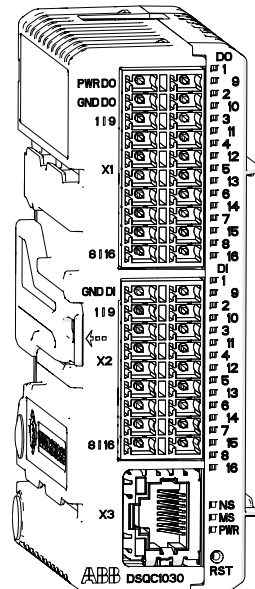
xx1600002033

> **Note**
>
> The safety digital base, DSQC1042, is installed in the same way as the digital base DSQC1030.

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[1] For more information about communication to other scanners, see *Node commissioning for other EtherNet/IP scanners on page 13*.

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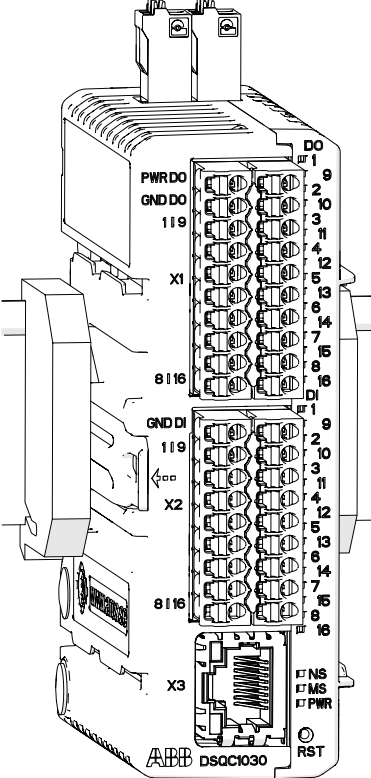
Use this procedure to install the base device. See also the product manual for the robot controller, listed in *References on page 7*.

	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 30*.
5	Connect process power supply and GND to the input and output connectors X1 and X2. ℹ **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.
6	Connect wires to the inputs and outputs as required.	

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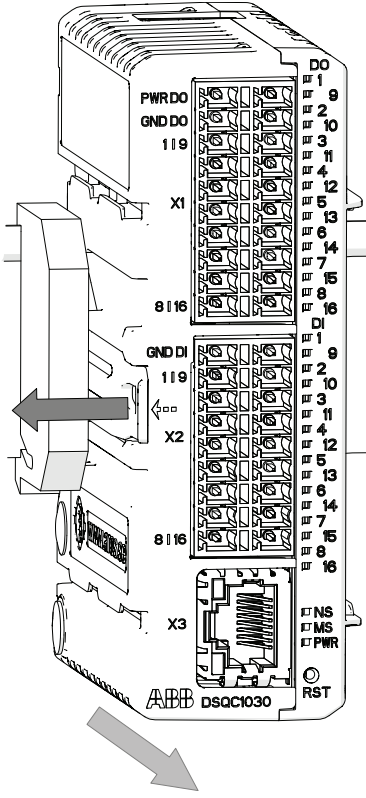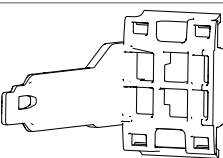
	Action	Note
7	Configure the device, see *Configuring an I/O device on page 55*.	

Removing 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
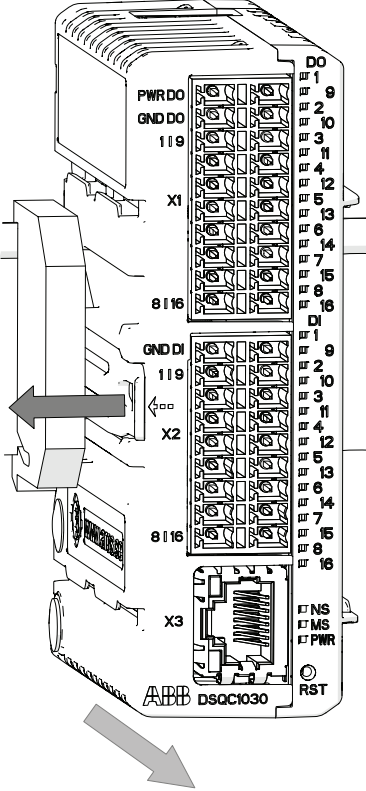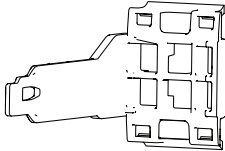
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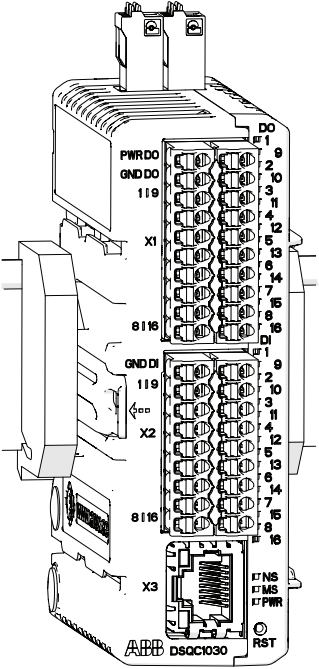
Replacing base devices

	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 *Replacing a broken I/O device on page 59*.	

Installing additional (external/remote) 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.

2.1.3 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.
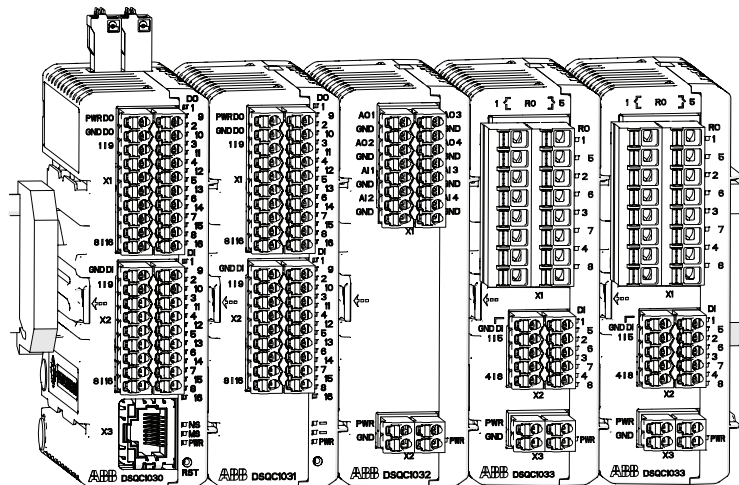
xx1600002032

Installing add-on devices
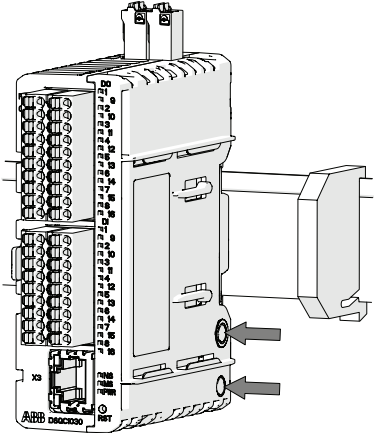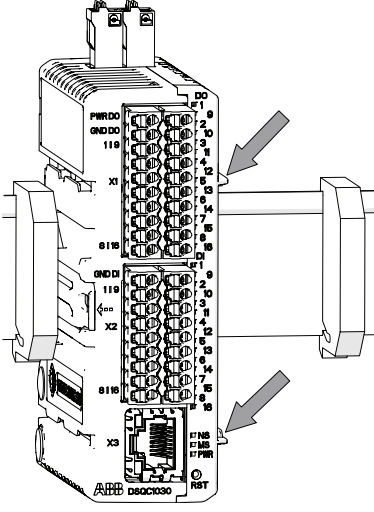
	Action	Note
1	⚠ **DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	

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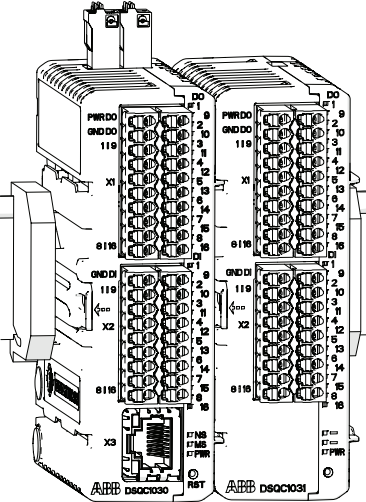
	Action	Note
2	Clean the optical interface on both the base device and the add-on from dirt or dust using a soft cloth.	xx1700000277
3	Fit the add-on device to the guide rails on the right side of the base device or the last device according to the arrows. Press the add-on device until it snaps onto the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

2 Hardware overview

	Action	Note
4	Connect the logic and process power supply. For information about the pinout see *I/O device descriptions on page 29*. ℹ️ **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 an I/O device on page 55*.	

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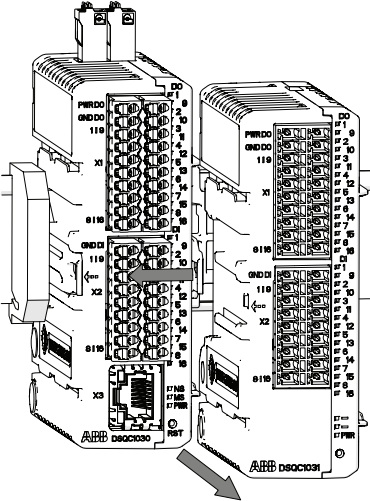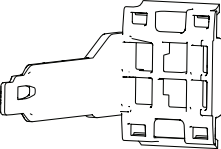
	Action	Note
1	⚠️ **DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Disconnect all connectors.	

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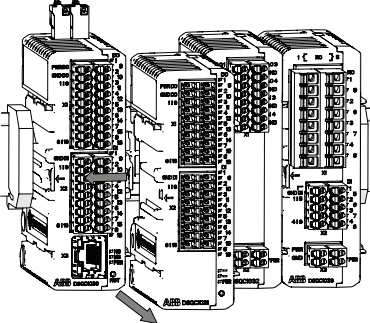
	Action	Note
3	Press the DIN bracket gently to the left and pull the device straight out.	xx1700000274
4	Snap off the DIN bracket from the rail and refit it to the removed device.	xx1600002039

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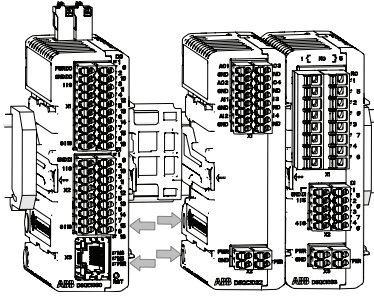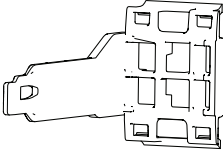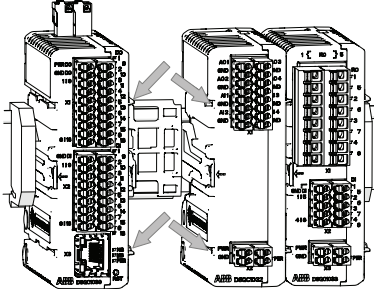
	Action	Note
1	⚠ **DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	
2	Disconnect all connectors.	
3	Press the DIN bracket gently to the left and pull the device straight out. Leave the DIN bracket attached to the rail.	xx1600002037

Continues on next page

2 Hardware overview

	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. ℹ **Note** The device must be updated if the order is changed, see *Updating an existing I/O device on page 57*.	xx1600002038 ℹ **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.	

2.1.4 Installing safety digital base devices

General

The safety digital base devices are installed in the same way as the base devices. See *Installing base devices on page 17*.

2.2 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 configuration possibilities are 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*.

2.3 I/O device descriptions

2.3.1 DSQC1030 Digital base

Description

The DSQC1030 base device has 16 digital inputs and 16 digital outputs and can be combined with up to four additional add-on devices.
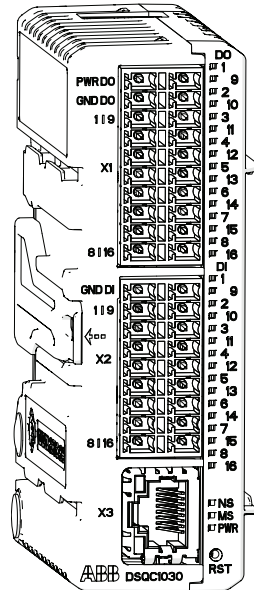
xx1600002033

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

Status LEDs

The DSQC1030 base device has the following status LEDs. For more information about the status LEDs, see *Status LED descriptions on page 41*.

LED label	Description
DO 1-16	Digital outputs
DI 1-16	Digital inputs
PWR	Power
NS	Network status
MS	Module status
	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[i]	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[i]	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
	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).

Reset button

The DSQC1030 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.

> ℹ **Note**
>
> Factory reset can also be made remotely via RobotStudio, see *Removing and resetting an I/O device configuration on page 63*.

2.3.2 DSQC1031 Digital add-on

Description

The DSQC1031 digital add-on device has 16 digital inputs and 16 digital outputs and must be used together with a DSQC1030 base device.
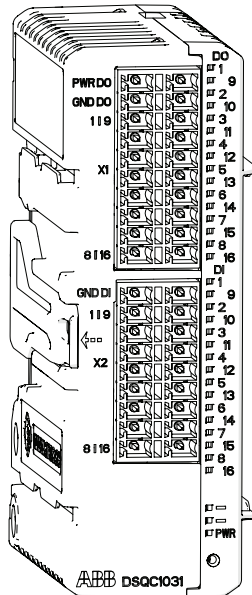
xx1600002034

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

Status LEDs

The DSQC1031 device has the following status LEDs. For more information about the status LEDs, see *Status LED descriptions on page 41*.

LED label	Description
DO 1-16	Digital outputs
DI 1-16	Digital inputs
PWR	Power

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

2.3.3 DSQC1032 Analog add-on

Description

The DSQC1032 analog add-on device has 4 analog inputs and 4 analog outputs and must be used together with a DSQC1030 base device.
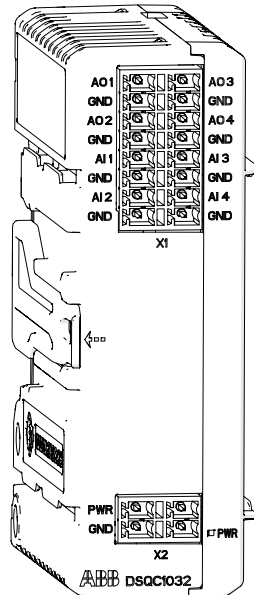
xx1600002035

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

Status LEDs

The DSQC1032 device has the following status LEDs. For more information about the status LEDs, see *Status LED descriptions on page 41*.

LED label	Description
PWR	Power

Continues on next page

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

2.3.4 DSQC1033 Relay add-on

Description

The DSQC1033 relay add-on device has 8 digital inputs and 8 relay outputs and must be used together with a DSQC1030 base device.
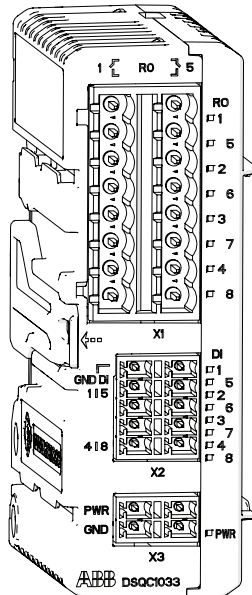
xx1600002036

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

Status LEDs

The DSQC1031 device has the following status LEDs. For more information about the status LEDs, see .

LED label	Description
RO 1-8	Relay outputs
DI 1-8	Digital inputs
PWR	Power

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

2.3.5 DSQC1042 Safety digital base

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.
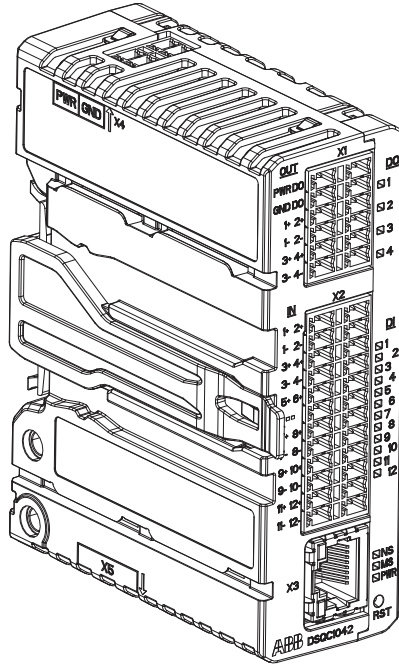
xx2100001681

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

Status LEDs

The DSQC1042 safety digital base device has the following status LEDs. For more information about the status LEDs, see *Status LED descriptions on page 41*.

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

Continues on next page

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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 - DO1+	10- DO2+
		3 - DO1-	9 - DO2-
		2 - DO3+	8 - DO4+
		1 - DO3-	7 - DO4-
	X2 Digital inputs *i*	12 - DI01+	24 - DI02+
		11 - DI01-	23 - DI02-
		10 - DI03+	22 - DI04+
		9 - DI03-	21 - DI04+-
		8 - DI05+	20 - DI06+
		7 - DI05-	19 - DI06-
		6 - DI07+	18 - DI08+
		5 - DI07-	17 - DI08-
		4 - DI09+	16 - DI10+
		3 - DI09-	15 - DI10-
		2 - DI011+	14 - DI12+
		1 - DI011-	13 - DI12-
	X3 EtherNet		
Down	X5 EtherNet		

Reset button

The DSQC1042 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.

2.3.5 DSQC1042 Safety digital base
Continued

> **ⓘ Note**
>
> Factory reset can also be made remotely via RobotStudio, see *Removing and resetting an I/O device configuration on page 63*.

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	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

2.4 Status LED descriptions

Introduction

The I/O devices have LED indicators which indicate the condition of the device and the function of the network communication.

2.4.1 Digital base LEDs

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	Remedy/cause
OFF	The device has no power or is not online. The device has not completed the startup.	Check power supply.
GREEN steady	The device is online and has connection in the established state.	If no light, check other LED modes.
GREEN flashing	Device is online, but has no connections in the established state.	Check that other nodes in the network are operative. Check parameter to see whether module has correct ID.
RED flashing	One or more I/O connections are in the time-out state.	Check system messages.
RED steady	Failed communication device. The device has detected an error rendering it incapable of communicating on the network. (Duplicate MAC_ID, or Bus-off).	Check system messages and parameters.

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	Remedy/cause
OFF	The device has no power. The device has not completed the startup.	Check power supply.
GREEN steady	Device is operating in a normal condition.	If no light, check other LED modes.
GREEN flashing	Device needs commissioning due to missing, incomplete or incorrect configuration. The device may be in the stand-by state.	Check system parameters. Check messages.
RED flashing	Recoverable minor fault.	Check messages.
RED steady	The device has an unrecoverable fault.	Device may need replacing.
RED/GREEN flashing	The device is running startup self test.	If flashing for more than a few seconds, check hardware.

Continues on next page

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	Remedy/cause
OFF	The device has no power or is not online. The device has not completed the startup.	Check status of MS LED. Check power supply.
GREEN steady	The device is online and has connection in the established state.	If no light, check other LED modes.
GREEN flashing	Device is online, but has no connections in the established state.	Check that other nodes in the network are operative. Check parameter to see whether module has correct ID.
RED flashing	One or more I/O connections are in the time-out state.	Check system messages.
RED steady	Failed communication device. The device has detected an error rendering it incapable of communicating on the network. (Duplicate MAC_ID, or Bus-off).	Check system messages and parameters.

Ethernet LEDs

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

Speed

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

Link/activity

LED color	Description	Remedy/cause
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.

2.4.1 Digital base LEDs
Continued

Order	LED action
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.

2.4.2 Safety digital base LEDs

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.
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.
RED flashing (Red 100 ms)	The reset button has been pressed for more than 3 s. The device goes back to the previous state.
RED/GREEN flashing (Red 100 ms, Green 100 ms, Red 100 ms)	The reset button has been pressed for more than 10 s. The device goes back to the previous state.
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	The device has no power or is not online.
GREEN steady	The device is online and has connection in the established state.
GREEN flashing	The device is idle or in standby state.
RED flashing	Abort. The device has a recoverable fault.

Continues on next page

LED color	Description
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.

Speed

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

Link/activity

LED color	Description	Remedy/cause
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.

2.4.3 Add-on module LEDs

Power LED

All add-on modules have a Power LED displaying the state of the module. The modules using digital inputs and outputs also have a separate LED for each input and output.

LED color	Description
GREEN steady	Addressed.
GREEN flashing	Not addressed.
RED flashing	Boot.

2.4.4 Input and Output LEDs

Input and Output LEDs

Each digital input, digital output, and relay output has a green LED indicating if the signal is active. The LEDs are controlled by software.

LED color	Description
OFF	Signal LOW
GREEN steady	Signal HIGH

2.5 Technical data

Technical data

Supply voltage

Description	Data	Note
Voltage range	20.4 – 28.8 VDC	
Input current, Digital base, 24V SYS	100 mA (TBC)	DSQC1030
Input current, Digital base, 24V Process	8 A	DSQC1030
Input current, Digital add-on, 24V Process	8 A	DSQC1031
Input current, Analog add-on, 24V Process	100 mA (TBC)	DSQC1032
Input current, Relay add-on, 24V Process	100 mA (TBC)	DSQC1033
Input current, Safety digital base, 24V SYS	150 mA (TBC)	DSQC1042
Input current, Safety digital base, 24V Process	2 A	DSQC1042
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 inductive load, Safety digital base	< 700 mH	(max switching repetition rate: 10 sec)
Max capacitive load	10 mF	
Max capacitive load, Safety digital base	< 3.3 mF	
Recommended cable area	1 mm^2	
Surge protected	Yes	
Thermal protection	Yes	
Max delay time	0.5 ms	

Continues on next page

2 Hardware overview

Description	Data	Note
Max delay time, Safety digital base	21 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 Lo, Safety digital base	<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	0.5 ms	
Filter time	0 – 65 ms	Programmable. Default value 5.5 ms
Internal delay time, Safety digital base	13 ms	
Filter time, Safety digital base	2 ms	

Analog inputs

Description	Data	Note
Input range	0 – 10 V	
Resolution	12 bits, 2.44 mV	
Inaccuracy	0.5% + 25 mV	
Input impedance	100 kOhm	typically
Reverse polarity protected	Yes	
Surge protected	Yes	
Delay time	2ms	

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	

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Relay outputs

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

2.6 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.

+24 V DC   0 V

xx0100000163
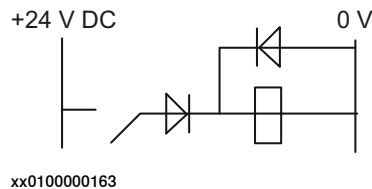
Clamping with a varistor

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

+24 V AC/DC   0 V

xx0100000164
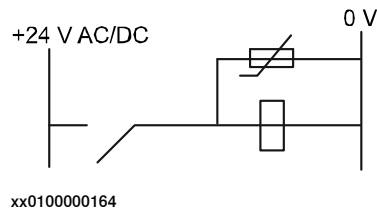
Clamping with an RC circuit

R 100 ohm, 1W C 0.1 - 1 mF

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

+24 V DC   0 V

xx0100000165
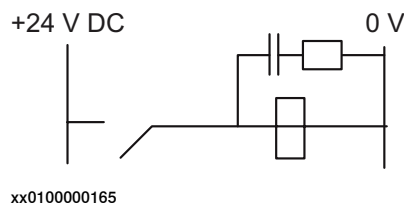
3 Software overview

3.1 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 RobotStudio or the FlexPendant. For more information about I/O device configuration, see *Using ABB Scalable I/O devices on page 55*.

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:

...\RobotWare\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).

Safety devices

The safety digital base devices are configured in the same way as other base devices. See *Using ABB Scalable I/O devices on page 55*. After the configuration, the dual channels must be defined using CL logic. See *Setting up safety digital base devices on page 69*.

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

> **Note**
>
> The network reaction time is carefully set to optimal for the safety digital base.

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

3.2 Using ABB Scalable I/O devices

3.2.1 Configuring Scalable I/O devices using RobotStudio

General

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

For information about configuration using the FlexPendant, see *Configuring Scalable I/O devices using the FlexPendant on page 66*.

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

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.

Configuring an I/O device

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

This procedure describes how to configure the base I/O device and add-on I/O device at the same time. However, if more add-on I/O devices should be attached after the first configuration of the base I/O device, use the *Updating an existing I/O device on page 57* procedure to update the configuration of the base I/O device.

1 Start RobotStudio and connect to the OmniCore controller. Request write access.

2 The I/O device that has not yet been configured is connected to the private network. The name of the detected I/O device appears.
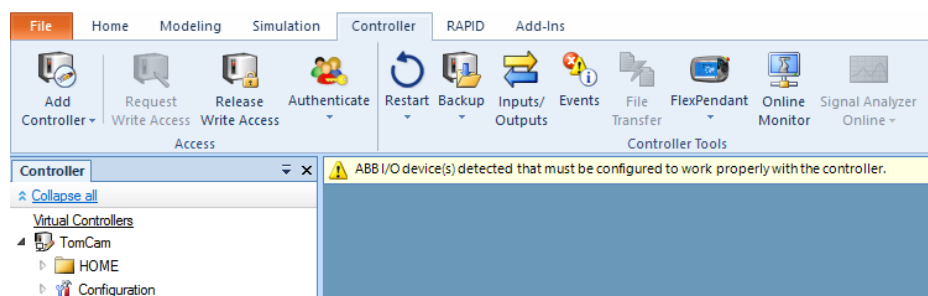
xx2100000064

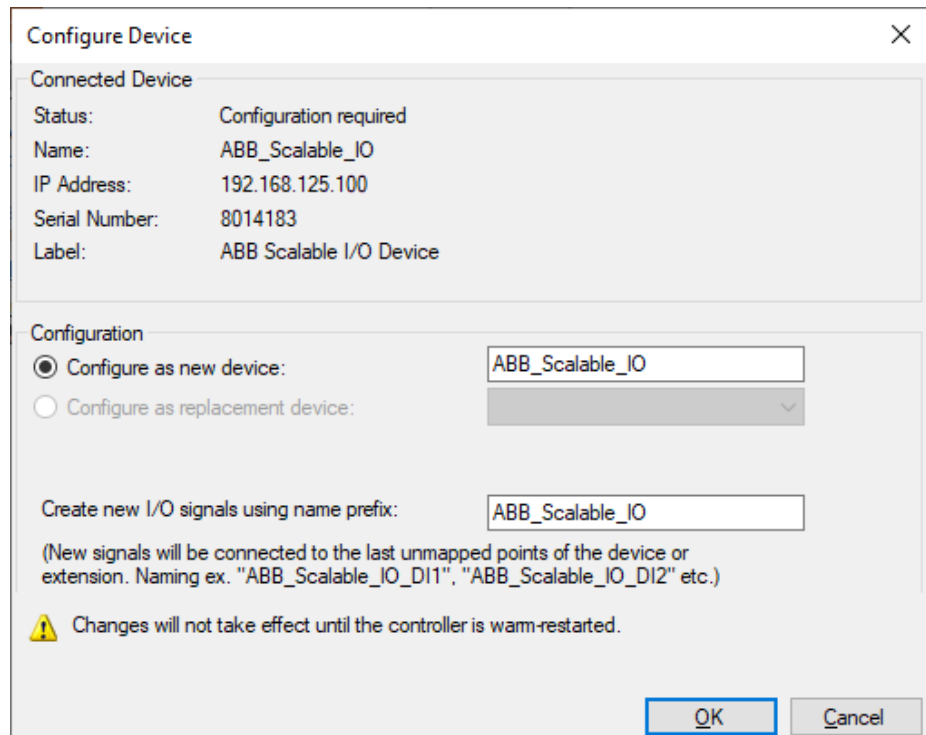3 Right-click the detected I/O device and select **Configure**.

Or

In the **I/O System** tree, right-click the I/O device and select **Configure Device**.
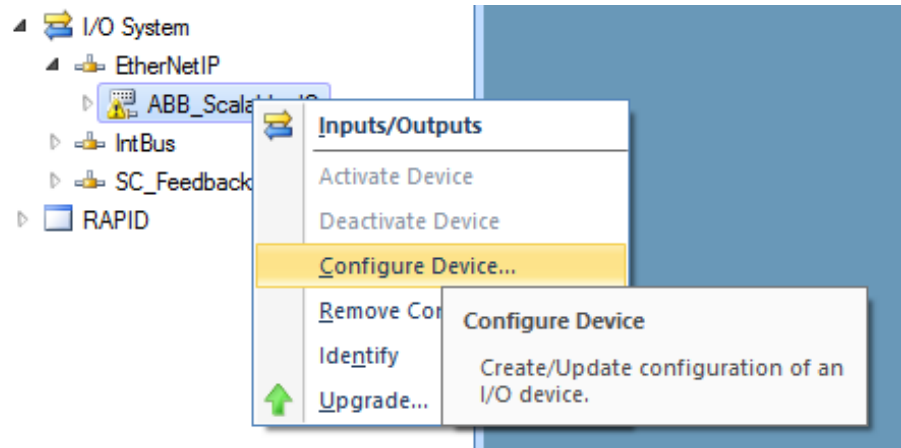
xx2100000063

4 The **Configure Device** dialog is displayed.

xx2100000065

Complete the following fields:

- **Configure as new device**: Enter the name of the I/O device.

> **ℹ Note**
>
> The name will be stored in the I/O device and will be used for identification and addressing.

- **Create new I/O signals using name prefix**: Enter the signal prefix to be used in signal names. Not mandatory.

> **ℹ Note**
>
> If this field is left empty, no signals will be added to the configuration.

Select **OK**. The I/O device, and its signals, are added.

5 Restart the controller.

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.

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

The update function can also be used for the generation of default signals on a device.

1 Start RobotStudio and connect to the OmniCore controller. Request write access.

2 The add-on I/O device is attached or removed from the base module. The modified I/O device appears.
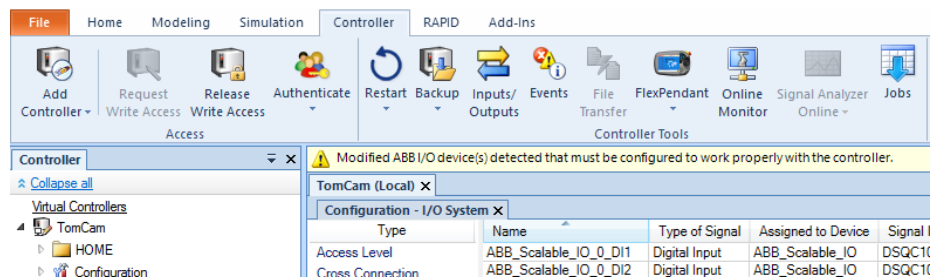
xx2100000078

3 Right-click the modified I/O device and select **Configure**.

Or

In the **I/O System** tree, right-click the I/O device to be updated and select **Configure Device**.
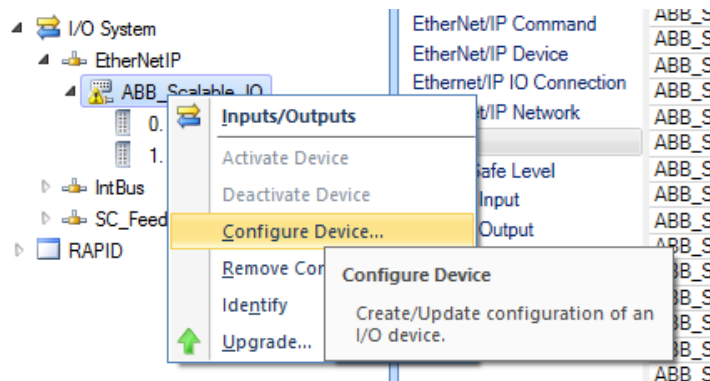
xx2100000079

4 The **Configure Device** dialog is displayed.
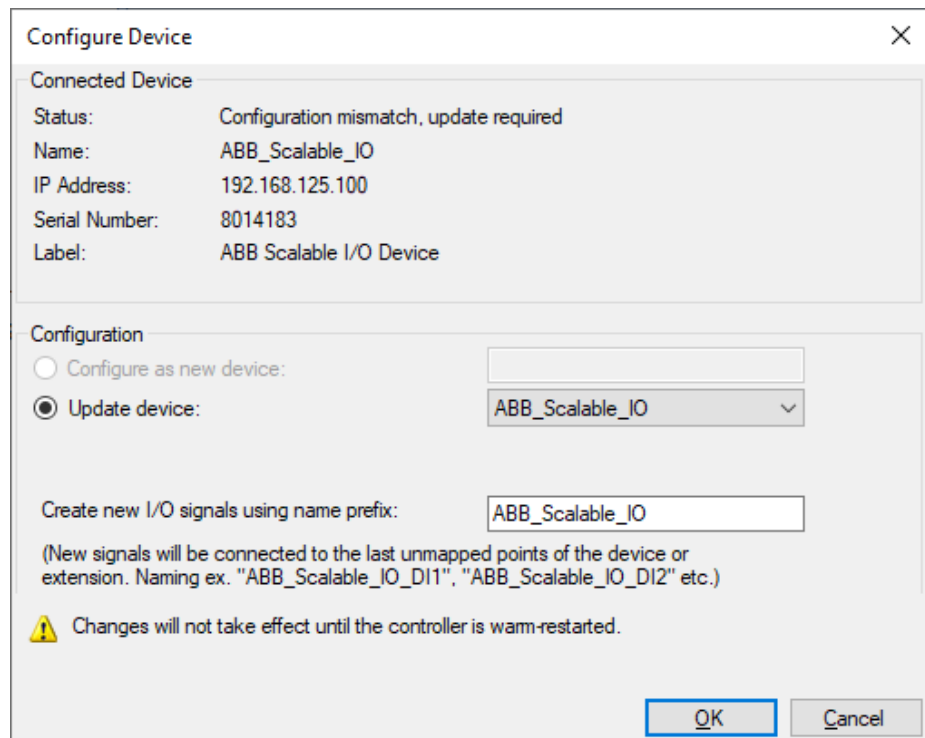
xx2100000081

Complete the following fields:

- **Update device**: Select the I/O device that is to be updated.
- **Create new I/O signals using name prefix**: Enter the signal prefix to be used in signal names. Not mandatory.

> **Note**
>
> If this field is left empty, no signals will be added to the configuration.

Select **OK**. The I/O device is updated.

Continues on next page

5   Restart the controller.

Replacing a broken I/O device

When a base I/O device is damaged, broken or faulty, it should be replaced.

> ℹ️ **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.

1   Start RobotStudio and connect to the OmniCore controller. Request write access.

2   A new I/O device is connected to the private network. The detected I/O device appears.
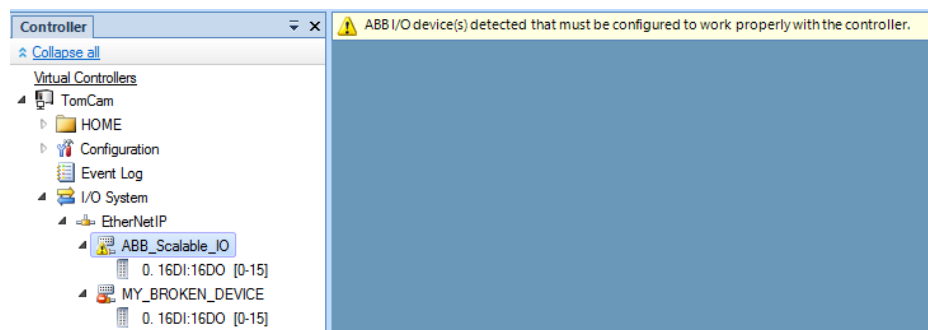
xx2100000082

3   Right-click the new I/O device and select **Configure**.

Or

In the **I/O System** tree, right-click the new I/O device and select **Configure Device**.

4   The **Configure Device** dialog is displayed.

xx2100000083

Complete the following fields:

- **Configure as new device**: Shows the new I/O device that will replace the faulty one.

- **Configure as replacement device**: Select the faulty I/O device that needs to be replaced.

> **Note**
>
> In this example, *ABB_Scalable_IO* is the new I/O device to replace the faulty I/O device, *MY_BROKEN_DEVICE*.

- **Create new I/O signals using name prefix**: Enter the signal prefix to be used in signal names. Not mandatory.

> **Note**
>
> If this field is left empty, no signals will be added to the configuration.

Select **OK**. The I/O device is updated.

5   Restart 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.

Continues on next page

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Replacing an existing I/O device configuration

Existing ABB Scalable I/O configurations found on the controller can be inherited by new ABB Scalable I/O devices. This means that devices can be created in the controller ahead of time without access to the physical device. This also extends to simulated devices that also can be turned into physical devices by configuring a new ABB Scalable I/O device using the simulated device configuration.

1 Start RobotStudio and connect to the OmniCore controller. Request write access.

2 A new I/O device is connected to the private network. The detected I/O device appears.
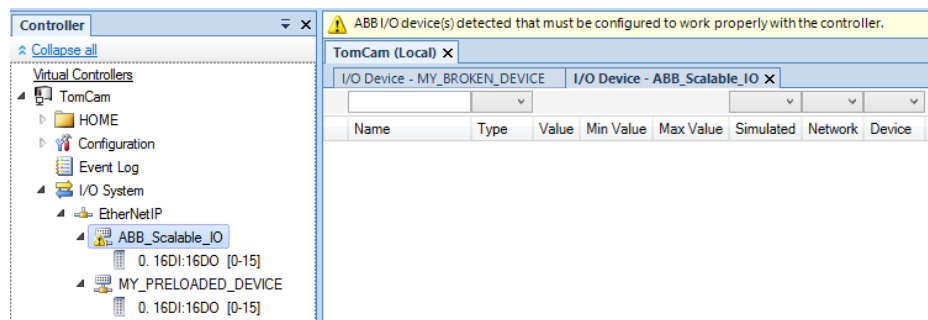
xx2100000084

3 Right-click the new I/O device and select **Configure**.

Or

In the **I/O System** tree, right-click the new I/O device and select **Configure Device**.

4 The **Configure Device** dialog is displayed.

xx2100000085

Complete the following fields:

- **Configure as new device**: Shows the new I/O device that will replace the existing and inherit its configuration.

- **Configure as replacement device**: Select the existing I/O device to be replaced.

> **Note**
>
> In this example, *ABB_Scalable_IO* is the new I/O device to replace the existing I/O device, *MY_PRELOADED_DEVICE*.

- **Create new I/O signals using name prefix**: Enter the signal prefix to be used in signal names. Not mandatory.

> **Note**
>
> If this field is left empty, no signals will be added to the configuration.

Select **OK**. The new I/O device will inherit the configuration of the selected device.

5 Restart the controller.

Removing and resetting an I/O device configuration

Use this function to remove a configuration and reset the device to factory default.

1 Start RobotStudio and connect to the OmniCore controller. Request write access.

2 In the **I/O System** tree, right-click the I/O device to be removed and select **Remove Configuration**.
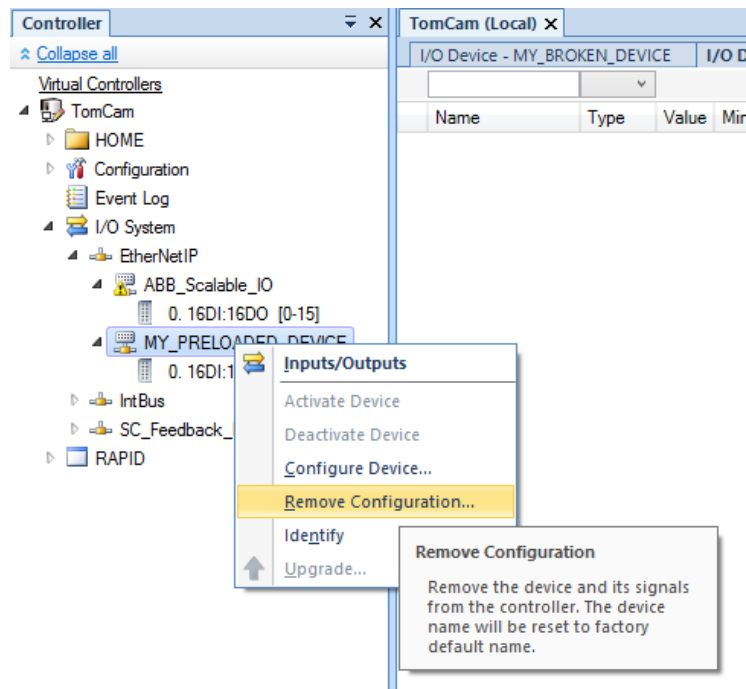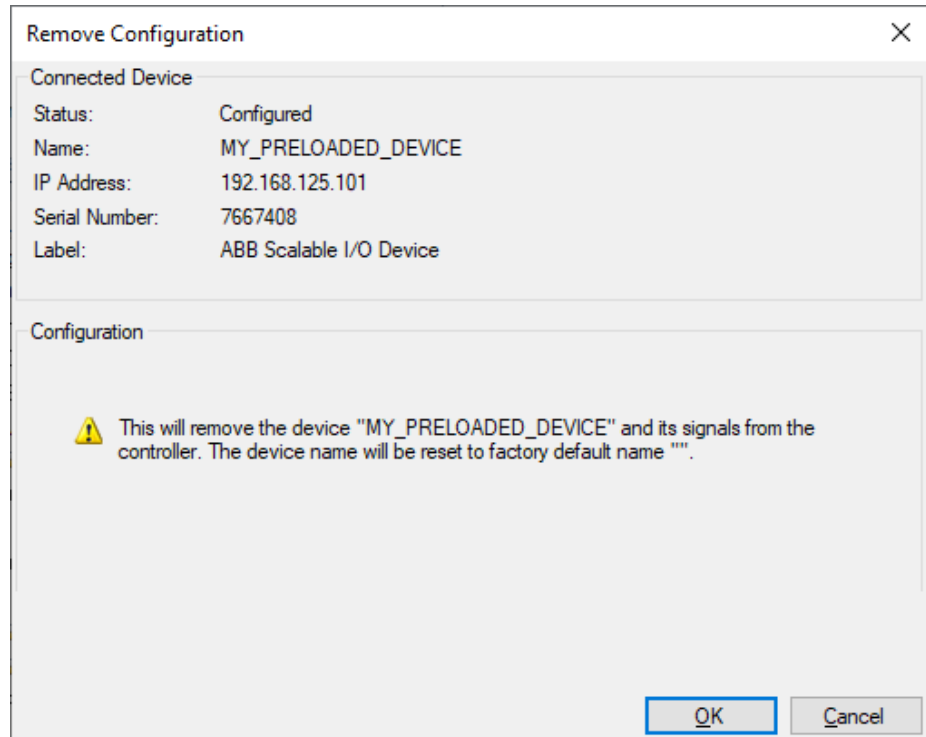

xx2100000086

3 The **Remove Configuration** dialog is displayed.

xx2100000087

Select **OK**. The I/O device is removed.
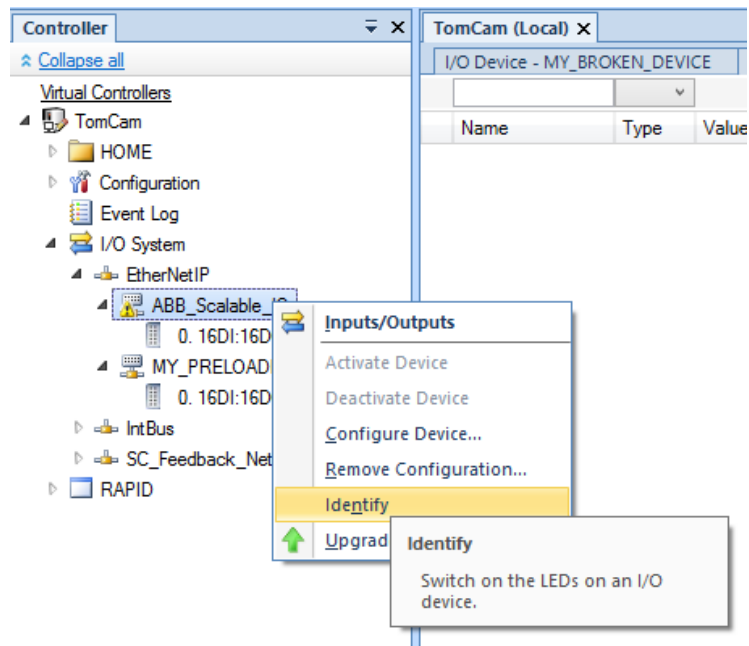
4 Restart the controller.

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.

Continues on next page

2 In the **I/O System** tree, right-click the target I/O device to be identified and select **Identify**.

xx2100000077

3 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.

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

3.2.2 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.

For information about configuration using RobotStudio, see *Configuring Scalable I/O devices using RobotStudio on page 55*.

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

> ℹ️ **Note**
>
> Safe 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**.

| Messages | Event log | ■ | | 100 % | | 123 | ⋯ |

I/O Devices : EtherNetIP

4 Items   Search by name

Name	Network	Address	State	
EN_Internal_Device	EtherNetIP	192.168.125.1	Running	
SecondUnit	EtherNetIP	192.168.125.102	Running	
ThirdUnit	EtherNetIP	192.168.125.103	Running	
ZeroUnit	EtherNetIP	192.168.125.100	Unknown	⋯

Activate
View Signals
Identify
Bit Values
Configure
Firmware Update

🏠 Home   I/O

xx2100000102

Continues on next page

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

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.

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.**

3.2.3 Setting up safety digital base devices

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	Output signals
Dual channel pair 1	DOUT1
	DOUT2
Dual channel pair 2	DOUT3
	DOUT4

> **ℹ 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.

Intput signals

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

Dual channel pair	Output signals
Dual channel pair 1	DIN1
	DIN2
Dual channel pair 2	DIN3
	DIN4
Dual channel pair 3	DIN5
	DIN6
Dual channel pair 4	DIN7
	DIN8
Dual channel pair 5	DIN9
	DIN10
Dual channel pair 6	DIN11
	DIN12

Continues on next page

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

Verifying parameters in the ABB Safety Configuration Report

When configuring a 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.

These parameters are expected to be verified in the report with the following values:

| 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 **Configure** 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	The Safety Network Number is a constant number for the private network of all controllers.	snn="5Afe12345678"
scidDateTime	A time stamp for the configuration which in combination with scid forms the signature. Is set when the button **Configure** is pressed.	scidDateTime="2021-08-12T17:02:59.359+02:00"
timeCoordinationMsgMultiplier		timeCoordinationMsgMultiplier="5"
timeoutMultiplier		timeoutMultiplier="2"
Signal name	Generated name: Device-Name_slotNo_Type+ix	Signal name="ABBIO_0_DO1"

3.3 Firmware upgrade

Upgrade firmware from RobotStudio

> **ℹ Note**
>
> Firmware upgrade is not available for Safe digital base devices or for attached Add-ons.

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**.
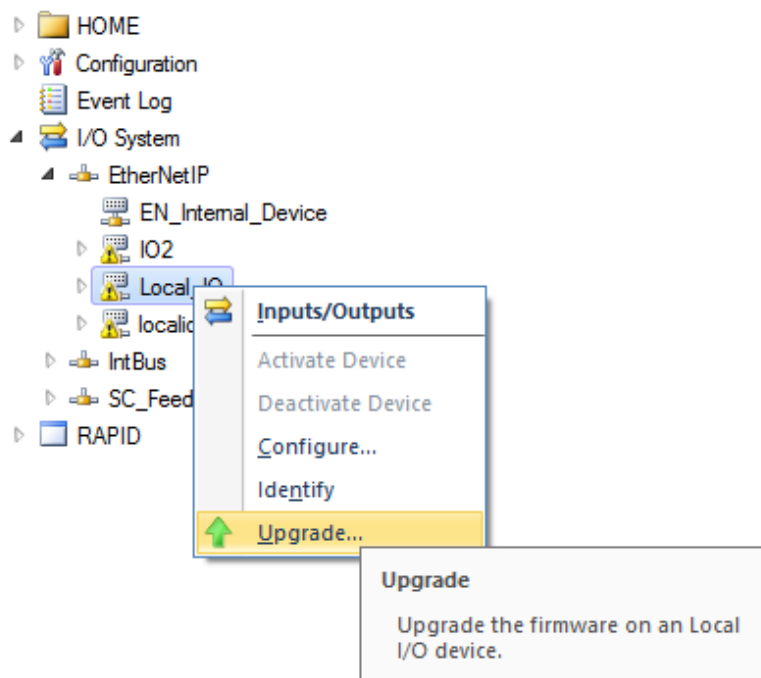
xx1900001181

6. The **Firmware Upgrade Local I/O Device** window is displayed.
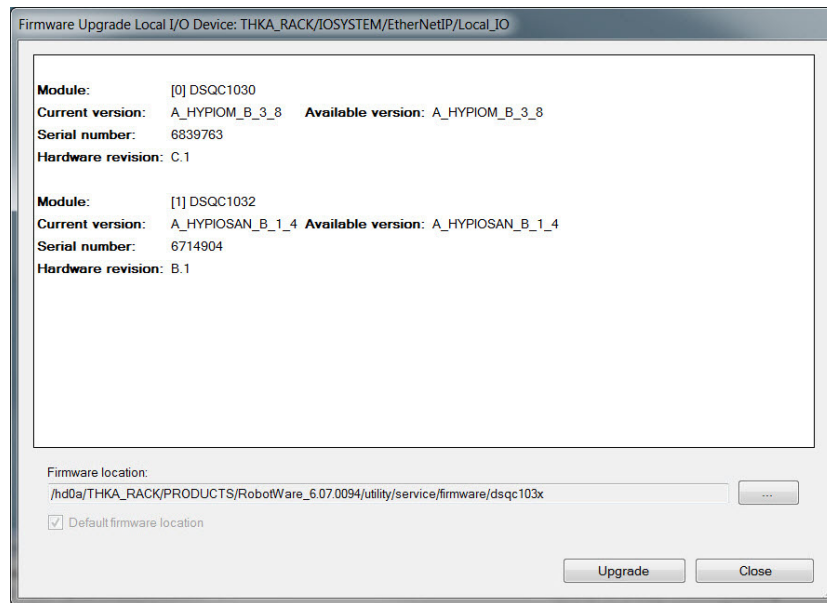
> **ℹ Note**
>
> The **Firmware location** field displays the default firmware file. To select a new firmware file, click the **...** button and browse to the folder with the new firmware file.

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 Safe digital base devices or for attached Add-ons.

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**.

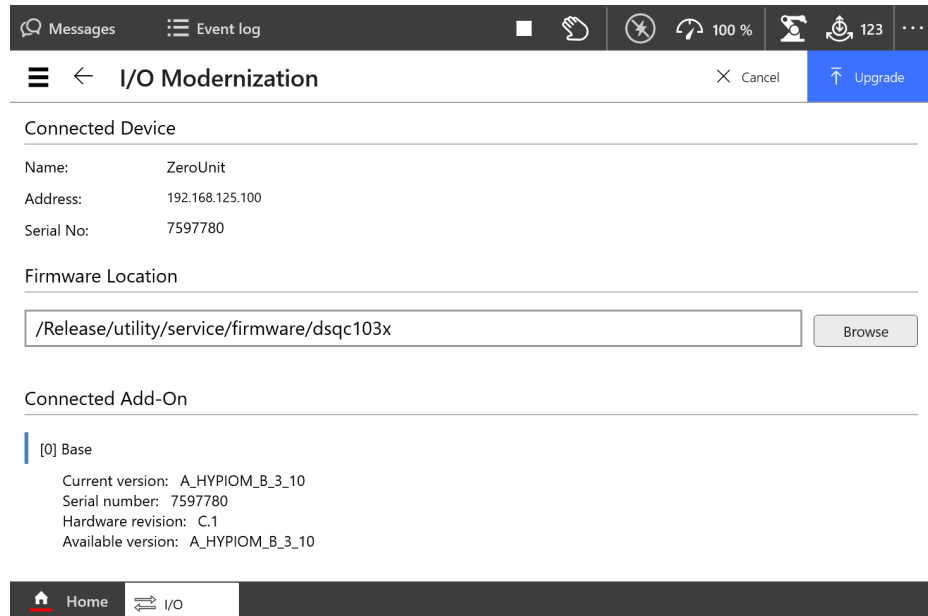4 Select the I/O device and and tap **Firmware Update**.

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

Continues on next page

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

xx2100000103

> | ℹ️ | **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.

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

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