ABB Robotics

Application manual
DeviceNet Lean

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Application manual

DeviceNet Lean

RobotWare 5.15

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Table of contents

Manual overview

About this manual

This manual describes the DeviceNet Lean option and contains instructions for the DeviceNet Lean master configuration. It also describes the configuration of supported boards and units.

Usage

This manual should be used during installation and configuration of the DeviceNet Lean bus and upgrading of the DeviceNet Lean option.

Who should read this manual?

This manual is intended for:

- Personnel responsible for installations and configurations of fieldbus 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 parameter configuration

Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
1	Provides an overview of the DeviceNet Lean fieldbus and includes the following: • A general description of DeviceNet Lean and the communication protocol • Description of how the DeviceNet Lean master unit and I/O units are connected in a robot system • Definition of I/O units in the IRC5 controller and the configuration of the controller
2	Describes the DeviceNet Lean master. The chapter also describes: • Communication units • How to connect the DeviceNet Lean master to an I/O unit • Termination • Cable types and data rates • Repeater functions
3	Provides an overview of the DeviceNet Lean configuration. It also contains descriptions of workflows.
4	Describes the DeviceNet Lean specific system parameters.
5	Contains information and instructions for trouble shooting the DeviceNet Lean connection.

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Chapter	Contents
6	Provides detailed descriptions of I/O units available from ABB Robotics that support DeviceNet Lean. The chapter also describes: • DeviceNet Lean bus status LEDs at power-up • How to set the DeviceNet Lean bus address

References

Document references

References	Document ID
Application manual - Conveyor tracking	*3HAC16587-1*
Application manual - Motion coordination and supervision	*3HAC18154-1*
Application manual - Robot communication and I/O control	*3HAC020435-001*
Operating manual - IRC5 with FlexPendant	*3HAC16590-1*
Operating manual - RobotStudio	*3HAC032104-001*
Product manual - IRC5	*3HAC021313-001*
Product specification - IRC5 with FlexPendant	*3HAC041344-001*
Technical reference manual - System parameters	*3HAC17076-1*
Technical reference manual - RAPID Instructions, Functions and Data types	*3HAC16581-1*

Other references

References	Description
www.odva.org	The web site of ODVA (Open DeviceNet Vendor Association).
ODVA DeviceNet Specification, revision 2.0	Specification from ODVA (Open DeviceNet Vendor Associations).

Revisions

Revision	Description
-	First edition
A	The Workflow section is added in the DeviceNet Lean Configuration chapter. The image of DeviceNet Lean board, DSQC 572, is updated.

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Revision	Description
B	Updated for the RW 5.13 release. Changes in the *Introduction* chapter. • Added more features of *DeviceNet Lean* in the subsection *What is DeviceNet Lean? on page 15*. • Updated the section *I/O messages - connection types on page 16*. • Updated the subsection *General on page 18* in the *Definition of I/O Unit* section. • Updated the subsection *Further information on page 18* in the *Definition of I/O Unit* section. Changes in the *Configuration* chapter. • Added the subsection *Explict Messaging services on page 27* in the *Introduction to configuration* section. • Added the subsection *Predefined Unit Types on page 31* in the *DeviceNet Lean configuration* section. • Added the subsection *Configuration approaches on page 31* in the *DeviceNet Lean configuration* section. • Updated the subsection *Predefined Bus on page 31* in the *DeviceNet Lean configuration* section. • Updated the subsection *Edit unit type on page 33* in the *DeviceNet Lean configuration* section. • Updated the images in the subsections *Edit bus on page 33* and *Edit unit type on page 33* of the *DeviceNet Lean configuration* section. Changes in the *System Parameters* chapter. • Added the new system parameters *Auto Configuration on page 40* and *Bus Scan on page 41* in the type *Bus*. • Added the new system parameter *Vendor ID on page 43* in the type *Unit Type*. • Updated the system parameters *Product Code on page 44* and *Production Inhibit Time on page 45* in the type *Unit Type.* Changes in the *Trouble Shooting* chapter. • Added the section *Bus Scan on page 50*. • Updated the section *Bus off on page 49*. Changes in the *Board and Units* chapter. • Updated the subsection *I/O units on page 54* in the *General* section.
C	Updated for the RW 5.13.02 release. Changes in the *Introduction* chapter. • Updated the section *What is DeviceNet Lean? on page 15*. Changes in the *Configuration* chapter: • Added more information in the section *Explict Messaging services on page 27*. • Added the new section *Quick Connect on page 30*. • Added the new section *POLLED connection on page 30*. • Added more predefined unit types to the table in the section *Predefined Unit Types on page 31*. • Added the fifth step to the procedure in the section **Workflow - Automatic configuration**. • Updated the image in the section *Edit unit type on page 33*. Changes in the *System parameters* chapter. • Added the new system parameters *Poll Rate on page 46*and *Quick Connect on page 47*. Changes in the *Boards and units* chapter. • Updated the table *Technical data on page 84* for the DSQC 651 board. • Updated the table *Technical data on page 91* for the DSQC 652 board. • Updated the table *Technical data on page 99* for the DSQC 653 board.

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Revision	Description
D	Updated for the RW 5.14 release. The following I/O units are included in the **Unit descriptions** chapter: • *DSQC 351A and 351B, DeviceNet Lean/INTERBUS gateways on page 59*. • *DSQC 377A and DSQC 377B, Queue tracking units on page 66*. • *DSQC 378A and DSQC 378B, DeviceNet Lean/CCLink gateways on page 75*.
E	Updated for the RW 5.14.02 release. • Added the new system parameter **Connector ID**.
F	Updated the *Introduction* section in the chapter *System parameters on page 37* for RW 5.15 release.

Product documentation, M2004

Categories for manipulator documentation

The manipulator documentation 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.

All documents listed can be ordered from ABB on a DVD. The documents listed are valid for M2004 manipulator systems.

Product manuals

Manipulators, controllers, DressPack/SpotPack, and most other hardware will be 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 exploded views (or references to separate spare parts lists).
- Circuit diagrams (or references to circuit diagrams).

Technical reference manuals

The technical reference manuals describe reference information for robotics products.

- *Technical reference manual - Lubrication in gearboxes*: Description of types and volumes of lubrication for the manipulator gearboxes.
- *Technical reference manual - RAPID overview*: An overview of the RAPID programming language.
- *Technical reference manual - RAPID Instructions, Functions and Data types*: Description and syntax for all RAPID instructions, functions, and data types.
- *Technical reference manual - RAPID kernel*: A formal description of the RAPID programming language.
- *Technical reference manual - System parameters*: Description of system parameters and configuration workflows.

Application manuals

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

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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, DVD with PC software).
- How to install included or required hardware.
- How to use the application.
- Examples of how to use the application.

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 trouble shooters.

The group of manuals includes (among others):

- *Operating manual - Emergency safety information*
- *Operating manual - General safety information*
- *Operating manual - Getting started, IRC5 and RobotStudio*
- *Operating manual - Introduction to RAPID*
- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - RobotStudio*
- *Operating manual - Trouble shooting IRC5*, for the controller and manipulator.

Safety

Safety of personnel

When working inside the robot controller it is necessary to be aware of voltage-related risks.

A danger of high voltage is associated with the following parts:

- Units inside the controller, for example I/O units, can be supplied with power from an external source.
- The mains supply/mains switch.
- The power unit.
- The power supply unit for the computer system (230 VAC).
- The rectifier unit (400-480 VAC and 700 VDC). Capacitors!
- The drive unit (700 VDC).
- The service outlets (115/230 VAC).
- The power supply unit for tools, or special power supply units for the machining process.
- The external voltage connected to the controller remains live even when the robot is disconnected from the mains.
- Additional connections.

Therefore, it is important that all safety regulations are followed when doing mechanical and electrical installation work.

Safety regulations

Before beginning mechanical and/or electrical installations, ensure you are familiar with the safety regulations described in *Product manual - IRC5*.

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1 Introduction

1.1 About DeviceNet Lean

What is DeviceNet?

DeviceNet is a communications link to connect industrial devices. It is a simple networking solution that reduces both cost and time to wire and install industrial automation devices, and the direct connectivity provides improved communication between devices. DeviceNet is an open network standard.

Here are some examples of applications:

- Peer-to-peer data exchange where a DeviceNet product can produce and consume messages
- Master/slave operation defined as a proper subset of Peer-to-Peer
- A DeviceNet product can function as a client or server, or both

What is DeviceNet Lean?

DeviceNet Lean is an option with limited or simplified DeviceNet support. Following are the features of DeviceNet Lean:

- Verified functionality with ABB Robotics I/O units and AC 500 PLC. I/O units from other vendors are also possible to use, but not guaranteed to work if they are not certified by ODVA.
- The robot controller can act only as a master, not as a slave.
- Maximum cable length is 30 meters.
- Operates only at a baud rate of 500 kbits/s.
- Supports the COS and POLLED connection types. If the I/O unit supports COS, it is used. Otherwise, a POLLED connection type will automatically be selected with a pollrate optimized considering the current number of connected I/O units. If a POLLED connection type is needed on a unit that also supports COS, it can also be forced to use the POLLED connection type by specifying a pollrate.
- When using a polled connection on DeviceNet Lean a DO signal will be updated with the poll cycle.
- Supports FCI Fieldbus command interface services Get, Set, and Reset.
- Supports the automatic detection and configuration of all connected I/O units on the network. The automatic configuration is limited to mapping digital signals on the I/O unit’s reported input and output sizes.
- Supports a user initiated scan of the network.
- The input or output area size of I/O unit is read from the unit and does not need to be manually configured.
- Optimized activation or deactivation of I/O units that do not support quick connect (not configured to use quick connect).

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Communication protocol connections

The user must establish a connection with a device in order to exchange information with that device.

DeviceNet Lean defines the following type of messaging:

Type of message	Description
I/O messages	I/O messages are for time-critical and control-oriented data, and they provide a dedicated and special-purpose communication path between a producing application and one or more consuming applications.

I/O messages - connection types

The supported types of I/O connections are:

Type of I/O connection	Description
Change-Of-State (COS) connection	Units are configured to produce data upon a change of I/O data. This technique can improve system throughput significantly. Data messages must be acknowledged by the receiver before new messages can be sent. Heart beat messages are used to tell the receiver that the unit is still alive even if no data has changed state for a long time.
POLLED	I/O units produce data only at the master's request.

Hardware overview

The hardware of the DeviceNet Lean fieldbus consists of a master unit, DSQC 572, and distributed I/O units (called slave units). The DSQC 572 is mounted in a PCI slot and is connected to the main computer using a cable.

Slave units

The slave units are attached to the fieldbus network and controlled using DSQC 572.

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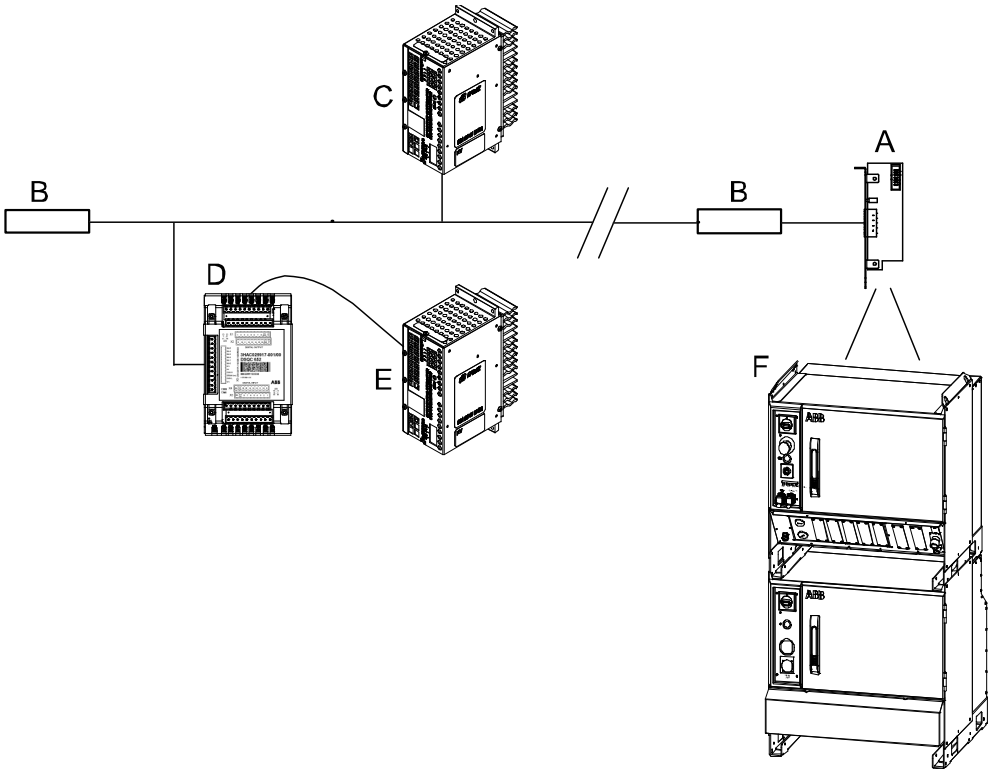
Illustration, example

The following illustration shows an example of the hardware.



xx0900000106

A	DSQC 572, DeviceNet Lean PCI card. Placed in the computer module.
B	Terminating resistor (121 Ohm).
C	DSQC 608/609, DeviceNet power supply 24 V
D	DSQC 652, Distributed digital I/O unit. The maximum length of the drop cable is 6 m.
E	DSQC 608/609, Customer power supply 24 V
F	IRC5 controller

Bus configuration

The configuration of the bus is done using RobotStudio, see *Operating manual - RobotStudio*.

1.2 Definition of I/O units

General

It is possible to connect any ODVA certified I/O unit that supports the predefined master/slave connection set to the DeviceNet Lean bus. But, the functionality is guaranteed only with ABB Robotics I/O unit types. For more information about the ABB Robotics I/O units, see *Boards and units on page 51*.

Further information

The following table provides references to additional information:

Information	See
How to install the I/O units mechanically and electrically.	*Product manual - IRC5*, section *Replacement of I/O units and gateways, IRC5*.
Allowed configurations of I/O units and how to setup the configurations.	*Technical reference manual - System parameters*.

2 Hardware description

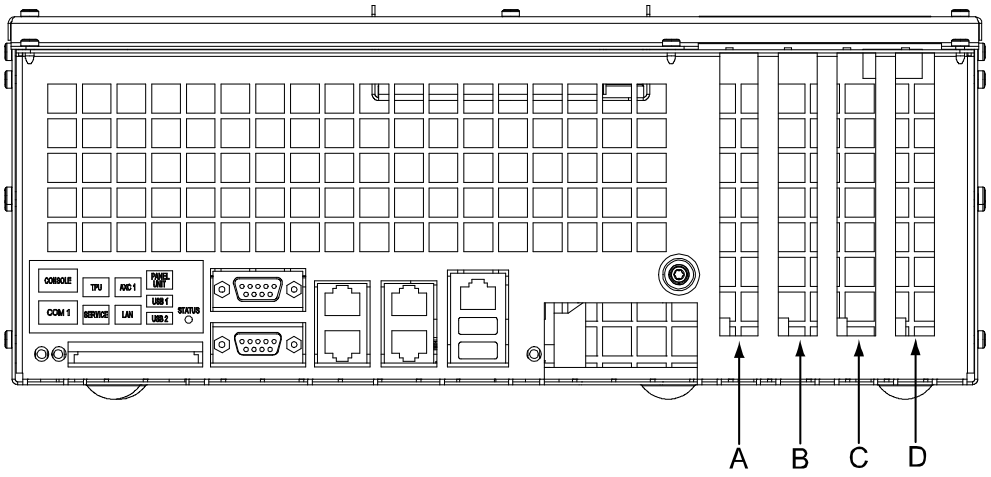
2.1 DeviceNet Lean card, DSQC 572

Description

The DSQC 572 is a PCI card mounted in the computer module in the second slot for PCI cards. DSQC 572 does not use the PCI connector on the mother board, instead it is connected with a ribbon cable to the motherboard.

Installation of DSQC 572

The figure illustrates where the DeviceNet Lean board is located in the computer unit.



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Description	Art. no.	Note	Pos.
DeviceNet Lean board	3HAC023242-001	DSQC 572	B

Prerequisites

The following configurations are required to setup the DeviceNet Lean card:

- Main computer revision 11 or later
- RobotWare 5.13 or later version
- DeviceNet Lean option installed

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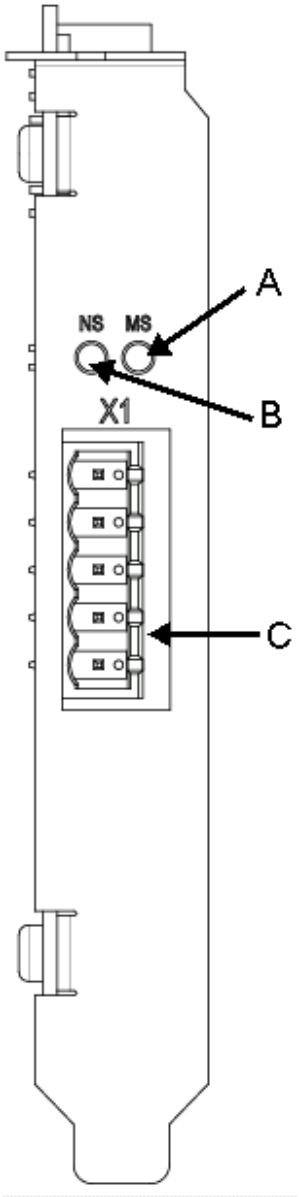
2.1 DeviceNet Lean card, DSQC 572

Continued

Illustration, DSQC 572

The following figure illustrates the front view of mounting bracket for the DSQC 572.



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A	Module Status LED
B	Network Status LED
C	DeviceNet Lean connector

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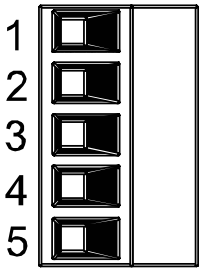
DeviceNet Lean connector



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The following table shows the connections to the DeviceNet Lean connector:

Signal name	I/O pin	Wire color	Function
V-	1	black	DeviceNet Lean network negative power (0 V)
CANL	2	blue	DeviceNet Lean communication bus terminal (low)
Shield	3	bare	Network cable shield
CANH	4	white	DeviceNet Lean communication bus terminal (high)
V+	5	red	DeviceNet Lean network positive power (24 V DC)

LEDs

Module Status (MS) LED:

LED color	Description
Off	No power.
Green	The device is in normal operation.
Flashing green	Configuration error or no configuration.
Flashing red	Recoverable fault.
Red	Unrecoverable fault.

Network Status (NS) LED:

LED color	Description
Off	Master not on network or no power.
Flashing green	Master is online but has no connections.
Green	Master has at least one connection.
Flashing red	One or more connections are timed out.
Red	Master cannot communicate on the network due to network error. (Master address is used by device or network disturbances.)

2.2 Connections

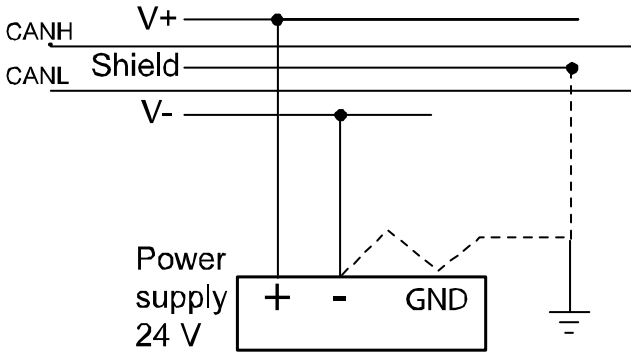
2.2.1 Shield grounding and power

General

The DeviceNet Lean shield and V- should be interconnected and grounded at only one place in the DeviceNet Lean network. For more advanced connections with several power supplies refer to the *DeviceNet Specification*, see *References on page 8*.

Grounding

The following illustration shows an example of cable grounding.



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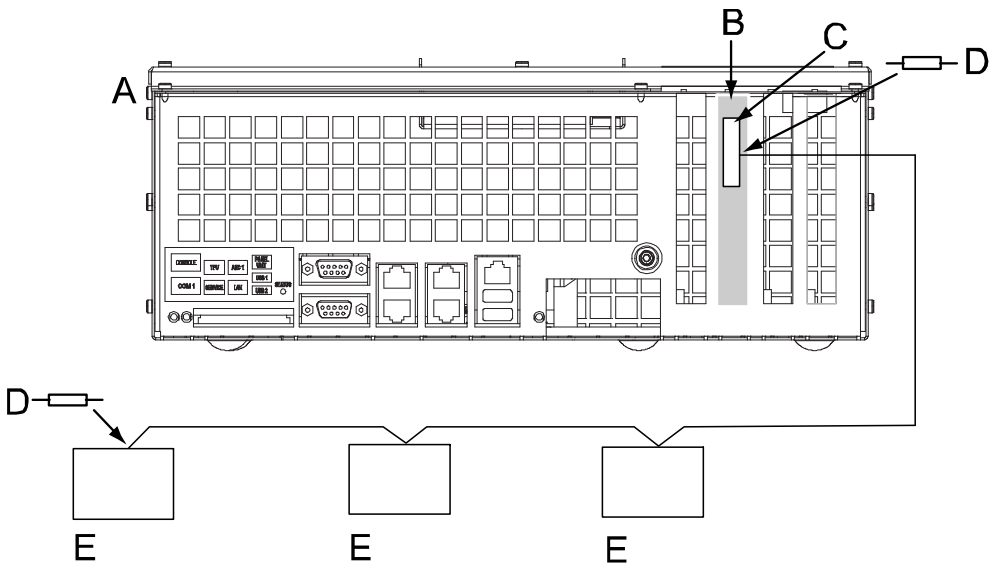
2.2.2 Connection of the DeviceNet Lean bus

Illustration

The following illustration shows an example of how to connect the DeviceNet Lean bus.



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A	Computer unit
B	DeviceNet Lean board
C	DeviceNet Lean connector
D	121 ohm, 1%, 0.25 W metal film resistor
E	I/O unit

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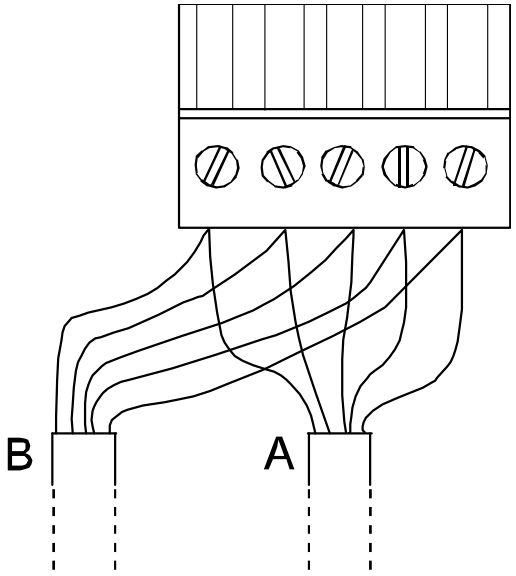
2.2.2 Connection of the DeviceNet Lean bus

Continued

Physical connection between DeviceNet Lean bus and DeviceNet Lean node

The following figure shows how the next DeviceNet Lean node is connected to the DeviceNet Lean bus.



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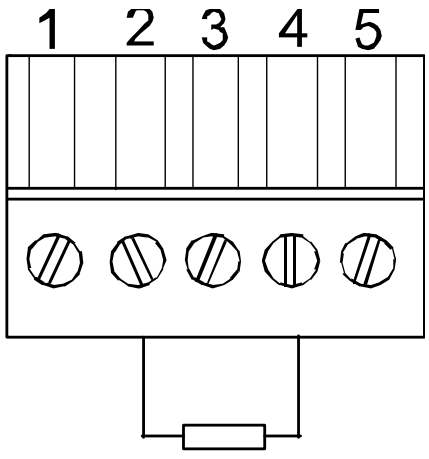
A	Incoming DeviceNet Lean bus cable
B	Outgoing DeviceNet Lean bus cable

Termination resistors in DeviceNet Lean bus

Each end of the DeviceNet Lean bus must be terminated with a 121 ohm resistor. The two terminating resistors should be as far apart as possible.

The termination resistor is placed in the cable connector. There is no internal termination on the DeviceNet Lean board. The termination resistor is connected between CANL and CANH - that is, between pin 2 and pin 4 according to the following illustration.



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2.2.3 Selecting cables

DeviceNet Lean cable

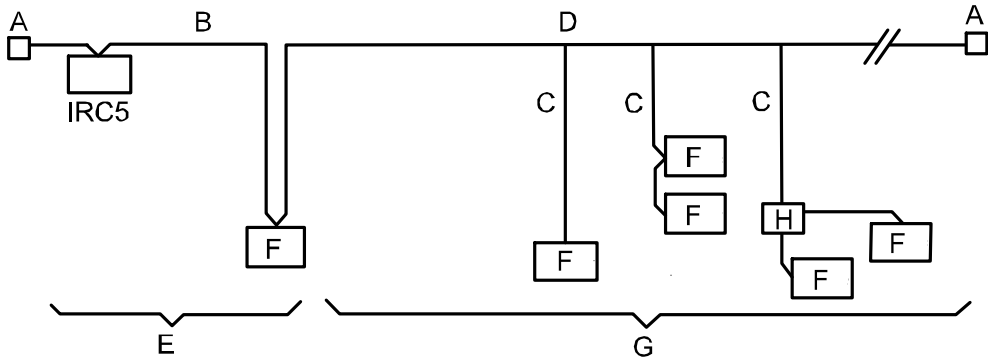
The end-to-end network distance varies with cable thickness. For information about cable length depending on cable type, see the following table.

For specification of the designations on the different cable types, see *ODVA DeviceNet Specification*.

Cable type	Max. length
Thick trunk length	30 m (100 ft)
Thin trunk length	30 m (100 ft)
Flat trunk cable	30 m (100 ft)
Maximum drop length	6 m (20 ft)
Cumulative drop length	12 m (40 ft)

Illustration of trunk line and drop lines

The following figure illustrates a trunk line with drop lines. Thick or thin cable can be used for trunk lines and drop lines. For information about cable thickness and data rate, see the tables in section *DeviceNet Lean cable on page 25*.



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A	Terminator
B	Trunk line
C	Drop line
D	Tap
E	Zero drop
F	Node
G	Short drop
H	T-connector

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3 Configuration

3.1 Introduction to configuration

Controller software

The IRC5 controller must be installed with software that supports DeviceNet Lean - that is, the option for DeviceNet Lean must be installed.

For description of how to add the DeviceNet Lean option, see *Operating manual - RobotStudio*.

PC software for configuration

RobotStudio is a PC software that is used to setup connections to robots and to work with robots.

The configuration for the DeviceNet Lean communication is done either manually in RobotStudio, or by loading a configuration file using RobotStudio. For information on how to work with RobotStudio, see*Operating manual - RobotStudio*.

Explict Messaging services

It is possible to configure I/O units through explicit messaging services. This could be done either at startup by defining the Fieldbus Commands to the configured unit, or at runtime from RAPID through the Fieldbus Command Interface (FCI). For more information, refer to *Technical reference manual - RAPID Instructions, Functions and Data types*, and *Application manual - Robot communication and I/O control*, section *Fieldbus Command Interface*.

For the explicit messaging at startup:

1. Use RobotStudio to define a Fieldbus Command type that is general to the unit type and could be used by many DeviceNet Lean units of this unit type.
2. Use RobotStudio to define a Fieldbus Command that is specific to a certain unit and that specifies the unit specific data to be send to the unit. The Fieldbus Command is linked to a certain unit. The data defined in the value parameter should fit the instance or attribute size on the DeviceNet Lean unit.

The DeviceNet Lean specific system parameters in the Fieldbus Command type are:

- Path (-DL_Path)
- Service (-DL_Service)

For more information, refer to the DeviceNet Lean Specification or the *Application manual - Robot communication and I/O control*.

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Following is a configuration file example that sends two Fieldbus Commands at startup to the I/O unit 'SafeTrigger'.

```
EIO_UNIT:
-Name "SafeTrigger" -UnitType "ABB_type" -Bus "DeviceNet_Lean"
-DL_Address 19
EIO_COMMAND_TYPE:
-Name "RackSize" -UnitType "ABB_type" -DefValue "0" -OrderNr 1\
-DL_Path "6,20 64 24 01 30 04,C6,1" -DL_Service 16
-Name "LastRack" -UnitType "ABB_type" -DefValue "0" -OrderNr 2\
-DL_Path "6,20 64 24 01 30 05,C1,1" -DL_Service 16
```

The preceding example shows how to use the -DL_Path and -DL_Service parameters. The syntax used in the -DL_Path command and in the I/O unit's EDS file is same. If a Class, Instance, or Attribute below 0x10 is specified, it is important to include a "0" before the value. For example, the value 8 is written as 08 in the -DL_Path string.

Following is a short description of the syntax used in the -DL_Path parameter.

```
"Path length, 20 Class 24 Instance 30 Attribute, Data type, Data type
length"
```

The following table provides a description of the parameters used in the syntax:

Parameter	Description
Path length	The byte count for the "20 64 24 01 30 05" string.
Class	The DeviceNet Lean Class number.
Instance	The instance number of the class.
Attribute	The attribute of the specified instance.
Data type	The data format of the attribute.
Data type length	The length in bytes of the specified Data type. The highest allowed value is 0x20 (32 bytes).

Following are the allowed values of the *Data type* and *Data type length* parameters:

Data Type	Description	Data type length
0x01	Signed 16-bit value	2
0x02	Unsigned 16 bit integer value	2
0x03	Signed 16-bit value	2
0x04	Logical Boolean with values TRUE and FALSE	1
0x05	Signed 8-bit integer value	1
0x08	Unsigned 8-bit integer value	1
0x09	Unsigned 32-bit integer value	4
0x0B	32-bit floating point value	4
0x16	Character string (1 byte per character, 1 byte length indicator)	X
0x18	Unsigned 8-bit integer value	1
0xC1	Logical Boolean with values TRUE and FALSE	1
0xC2	Signed 8-bit integer value	1

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Continued

Data Type	Description	Data type length
0xC3	Signed 16-bit value	2
0xC6	Unsigned 8-bit integer value	1
0xC7	Unsigned 16 bit integer value	2
0xC8	Unsigned 32-bit integer value	4
0xCA	32-bit floating point value	4
0xD1	Unsigned 8-bit integer value	1
0xD2	Signed 16-bit value	2
0xDA	Character string (1 byte per character, 1 byte length indicator)	X

The *-DL_Service* parameter describes what type of operation that should be performed against the specified *-DL_Path* parameter.

Following are the allowed values for *-DL_Service*:

Operation	Value	Description
Set	16	Set the value specified in '-DefValue' or EIO_COMMAND.
Get	14	Get the specified parameter. Display answer as an event message.
Reset	5	Performs a reset of the specified I/O unit.

The-*OrderNr* parameter is used to specify in what order the commands are send to the I/O unit.

If an FCI command is rejected by the I/O unit, the DeviceNet Lean master will generate an event message with the error code returned by the I/O unit. The following table shows some of the possible return values:

General Error Code	Semantics
0x02	Resource unavailable.
0x05	Path destination unknown.
0x08	Service not supported.
0x09	Invalid attribute value.
0x0B	Already in requested mode/state.
0x0D	Object already exists.
0x0E	Attribute not settable.
0x13	Not enough data.
0x14	Attribute not supported.
0x16	Object does not exist

CIP routing

To be able to use CIP routing the system parameter *Explicit Messaging* must be set in the unit configuration for those units that will use CIP routing. For details about the unit configuration, refer to *Application manual - EtherNet/IP Fieldbus Adapter*.

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Continued

Quick Connect

The Quick Connect functionality supported by the DeviceNet Lean master allows the I/O units to be configured to use Quick Connet. Quick Connect allows the I/O unit to skip certain startup tests and thereby improve the general startup time of the I/O unit when used in tool change applications. To activate the Quick Connect functionality, use the system parameter *Quick Connect on page 47*.

Additional configuration with Field Bus Commands is not needed to use the Quick Connect functionality in DeviceNet Lean. If Quick Connect is activated but not supported by the I/O unit, the connection attempt from the DeviceNet Lean master might fail.

POLLED connection

By default , the DeviceNet Lean master always tries to create a COS connection type against a configured I/O unit. If the I/O unit do not support a COS connection, a POLLED connection is created with a pollrate decided by the DeviceNet Lean master itself.

If a POLLED connection type is needed or if the pollrate needs to be configured manually, it is possible to force create a POLLED connection. This is done by specifying a value other then zero in the *Pollrate* parameter. For information about the *Pollrate* parameter, refer to *Poll Rate on page 46*.

3.2 DeviceNet Lean configuration

About the I/O units

The maximum number of I/O units that can be defined in the IRC5 system is described in *Technical reference manual - System parameters*, see *References on page 8*. DeviceNet Lean has an addressing range from 0-63.

The following units are counted as I/O units:

- All DeviceNet slave units configured as I/O units to the IRC5 DeviceNet Lean master.
- Simulated I/O units and other I/O units connected to other IRC5 fieldbuses.

Configuration

When the DeviceNet Lean option is installed in the IRC5 system, a number of predefined types are installed. The following table provides descriptions defining the types *Bus*, *Unit Type* and *Unit*.

Type	Description
Bus	A DeviceNet Lean bus must be defined before any communication on the bus is possible - that is, define rules for the DeviceNet Lean master to communicate on the network.
Unit Type	When creating a unit type, some system parameters are fieldbus specific. For detailed information about the parameters see *System parameters on page 37*.
Unit	See *Technical reference manual - System parameters*.
Signal	See *Technical reference manual - System parameters*.

Predefined Bus

The predefined bus type *DeviceNet_Lean* is added by the DeviceNet Lean option.

Predefined Unit Types

The following predefined Unit Types are added by the DeviceNet Lean option.

Predefined unit types	Description
d651_Lean	Used to define a unit of type DSQC 651
d652_Lean	Used to define a unit of type DSQC 652
d653_Lean	Used to define a unit of type DSQC 653
d351_Lean	Used to define a unit of type DSQC 351 (Interbus Gateway)
d378_Lean	Used to define a unit of type DSQC 378 (CC Link Gateway)
d377_Lean	Used to define a unit of type DSQC 377 (Encoder)
AC500_PLC_Lean	Used to define a unit of type ABB AC500 Stotz PLC with FBP DeviceNet Fieldbus Plug
DL_GENERIC	Used when the unit type is of no importance or unknown.

Configuration approaches

Following are the three general configuration strategies that can be used while configuring

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Continued

I/O units on the DeviceNet Lean bus.

- Manual configuration of units in Robot Studio. See *Workflow - Manual configuration of units in Robot Studio*.
- Manual configuration of units after a network scan operation. See *Workflow - Manual configuration of units after a network scan operation*.
- Automatic configuration of I/O units connected to a network. See *Workflow - Automatic configuration*.

Workflow - Manual configuration of units in Robot Studio

	Action	Note
1.	If required, change the address of the DeviceNet Lean master. This is required if another master or I/O unit on the network need to have address 0.	See the section *Edit bus on page 33*.
2.	Add I/O units to the DeviceNet Lean master. The minimum configuration is to set the *unit name*, the *unit type*, the address of the unit on the network, and connected to the DeviceNet_Lean bus.	See the section *Add I/O unit to the DeviceNet Lean master on page 34*.
3.	If required, change the configuration data for a unit's *unit type* or use the DL_GENERIC unit type if this is not needed.	See the section *Edit unit type on page 33*.
4.	Add signals to the configured units, that maps the data bits to or from the I/O unit that you want to read or write, from the IRC5 controller.	See the section *Add signals on page 35*.
5.	Warm start the IRC5 controller.	

Workflow - Manual configuration of units after a network scan operation

	Action	Note
1.	Connect the I/O units to the DeviceNet Lean network that needs to be configured.	See the section *Edit bus on page 33*.
2.	Set the bus parameter *Bus Scan* to Activated.	
3.	Warm start the IRC5 controller.	
4.	For each I/O unit that the scan discovered that should be configured in the IRC5 system, use the *Workflow -Manual configuration of units in Robot Studio* configuration steps to create unit type data.	

Workflow - Automatic configuration

	Action	Note
1.	Connect the I/O units to the DeviceNet Lean network that needs to be configured. **NOTE!** The I/O units found on the network that are not configured in the IRC5 controller or occupied by another master will be configured. If the I/O unit requires additional configuration through Field Bus Commands, this must be added manually.	See the section *Edit bus on page 33*.
2.	Set the bus parameter *Auto Configuration* to Activated.	
3.	Warm start the IRC5 controller. Information elogs are generated for each new I/O unit found and configured.	

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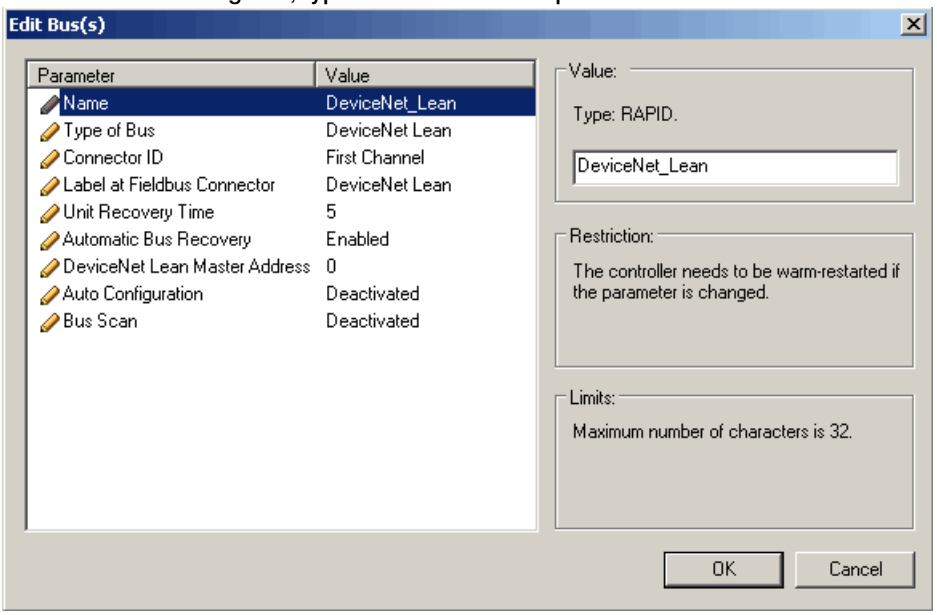
	Action	Note
4.	Warm start the IRC5 controller again to connect to the configured I/O units.	
5	If needed, remap or change the signals added on the I/O unit to reflect the meaning of the data bits.	

Edit bus

	Action
1	In RobotStudio, click **Configuration Editor** and select **I/O**.
2	Click **Bus**, then right-click on the bus to edit and select **Edit Bus**.
3	In the **Edit Bus** dialog box, type the values for the parameters.  en0900000126

Edit unit type

If the type of the unit connected on a DeviceNet Lean address on the network is of no importance, the *DL_GENERIC* unit type should be used. Otherwise, the unit type should be specified to reflect the*Vendor ID* and *Product Code* of the I/O unit. If an I/O unit connected to this address reports values that do not match the specified values in the *unit type*, an error message will be generated.

	Action
1	In RobotStudio, click **Configuration Editor** and select **I/O**.
2	Click **Unit Type**, then right-click on the bus to edit and select **Edit Unit Type**.

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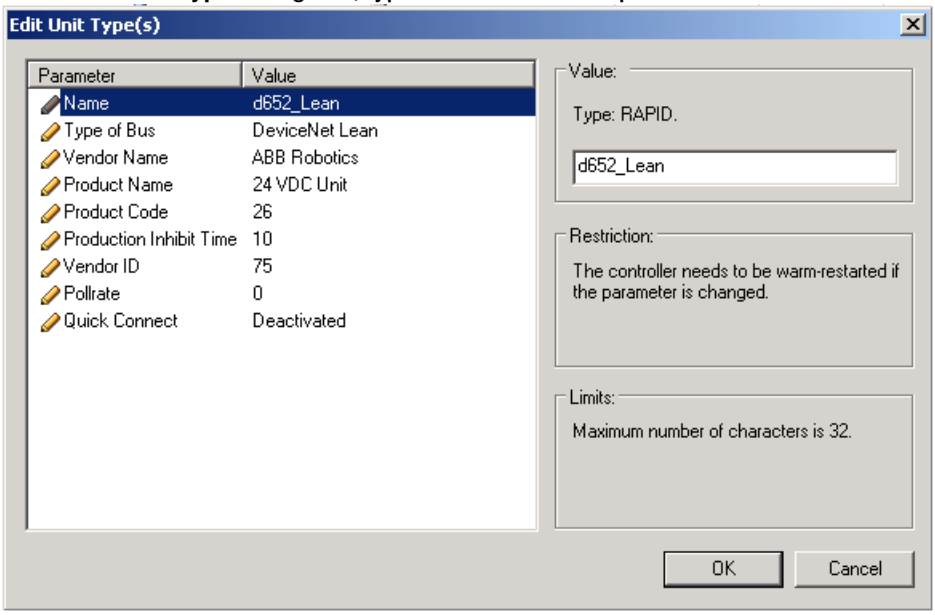
	Action
3	In the **Edit Unit Type** dialog box, type the values for the parameters.



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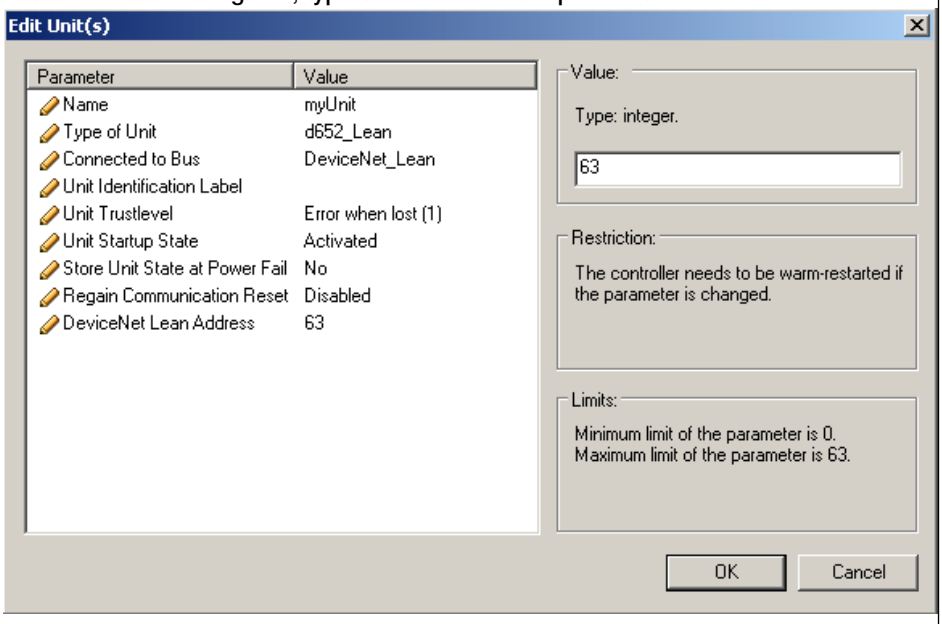
Add I/O unit to the DeviceNet Lean master

	Action
1	In RobotStudio, click **Configuration Editor** and select **I/O**.
2	Click **Unit**, then right-click in the workspace and select **Add Unit**.
3	In the **Edit Unit** dialog box, type the values for the parameters.



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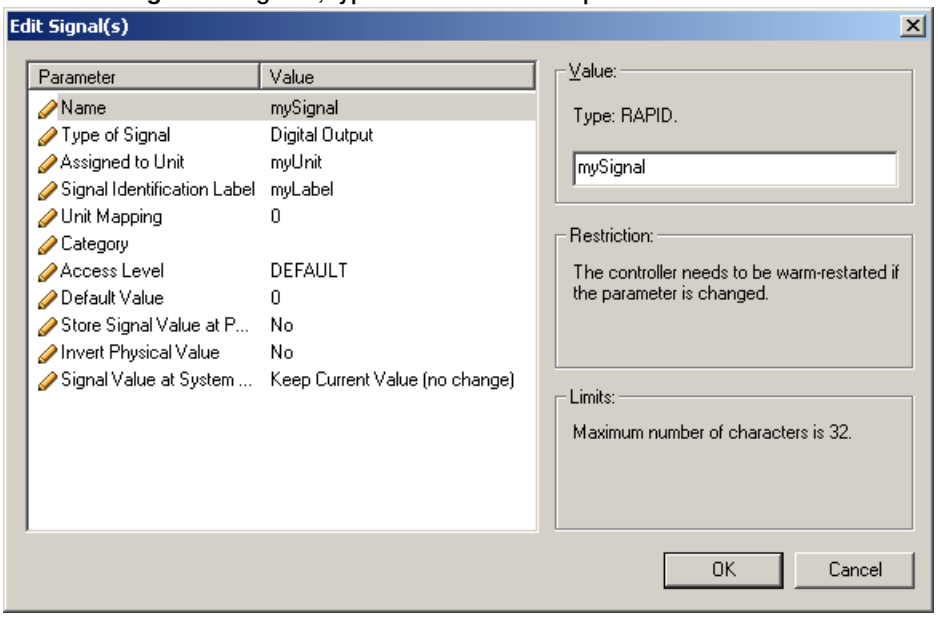
Add signals

	Action
1	In RobotStudio, click **Configuration Editor** and select **I/O**.
2	Click **Signal**, then right-click in the workspace and click **Add Signal**.
3	In the **Edit Signal** dialog box, type the values for the parameters.  xx0700000205

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4 System parameters

4.1 Introduction

About the system parameters

There are both DeviceNet Lean specific parameters and more general parameters. This chapter describes all DeviceNet Lean specific system parameters. The parameters are divided into the type that they belong to.

For information about other system parameters, see *Technical reference manual - System parameters*.

DeviceNet Lean system parameters

Bus

These parameters belong to the type *Bus* in the topic *I/O*.

Parameter	For more information, see ...
Name	*Technical reference manual - System parameters*
Type of Bus	*Technical reference manual - System parameters*
Connector ID	*Connector ID on page 42*
Label of Fieldbus Connector	*Technical reference manual - System parameters*
Unit Recovery Time	*Technical reference manual - System parameters*
DeviceNet Lean Master Address	*DeviceNet Lean Master Address on page 39*
Auto Configuration	*Auto Configuration on page 40*
Bus Scan	*Bus Scan on page 41*

Unit

These parameters belong to the type *Unit* in the topic *I/O*.

Parameter	For more information, see ...
Name	*Technical reference manual - System parameters*
Type of Unit	*Technical reference manual - System parameters*
Connect to Bus	*Technical reference manual - System parameters*
Unit Identification Label	*Technical reference manual - System parameters*
Unit Trustlevel	*Technical reference manual - System parameters*
Unit Startup State	*Technical reference manual - System parameters*
Store Unit State at Power Fail	*Technical reference manual - System parameters*
Regain Communication Reset	*Technical reference manual - System parameters*
Vendor ID	*Vendor ID on page 43*
Product Code	*Product Code on page 44*
Production Inhibit Time	*Production Inhibit Time on page 45*

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Continued

Parameter	For more information, see ...
Poll Rate	*Poll Rate on page 46*
Quick Connect	*Quick Connect on page 47*

Unit Type

These parameters belong to the type *Unit Type* in the topic *I/O*.

Parameter	For more information, see ...
Name	*Technical reference manual - System parameters*
Type of Bus	*Technical reference manual - System parameters*
Vendor Name	*Technical reference manual - System parameters*
Product Name	*Technical reference manual - System parameters*
Internal Slave	*Technical reference manual - System parameters*
DeviceNet Lean Address	*DeviceNet Lean Address on page 48*

4.2 Type Bus

4.2.1 DeviceNet Lean Master Address

Parent

DeviceNet Lean Master Address belongs to the type *Bus*, in the topic *I/O*.

Cfg name

DL_MasterAddress

Description

DeviceNet Lean Master Address is the address that the master uses to communicate.

Usage

DeviceNet Lean Master Address is mandatory for a DeviceNet Lean fieldbus and decides what address the master should use to communicate with other devices on the DeviceNet network.

Prerequisites

DeviceNet Lean option must be installed.

Limitations

The *DeviceNet Lean Master Address* must not use the same address as another device on the network.

Default value

The default value is 0.

Allowed values

Allowed values are the integers 0-63.

4.2.2 Auto Configuration

Parent

Auto Configuration belongs to the type *Bus*, in the topic *I/O*.

Cfg name

DL_AutoConfig

Description

Auto Configuration scans the DeviceNet Lean network during the system startup and configures the found units in the IRC5 controller.

Usage

The *Auto Configuration* parameter is used as an easy way to find and configure a new unit on the network. The configuration created by this function should be updated with signal names that reflect the purpose of the signal. The *Auto Configuration* parameter will always be restored to *Deactivated* at system startup.

Prerequisites

DeviceNet Lean option must be installed.

Limitations

Signals are always configured as single bit digital signals.

Default value

The default value is *Deactivated*.

Allowed values

Activated or *Deactivated*.

4.2.3 Bus Scan

Parent

Bus Scan belongs to the type *Bus*, in the topic *I/O*.

Cfg name

DL_BusScan

Description

The *Bus Scan* function scans the DeviceNet Lean network during system startup and display information about found units.

Usage

The *Bus Scan* function is used to quickly locate an I/O unit and its configuration parameters, like *Vendor ID* and *Product code*. The *Bus Scan* parameter will always be restored to *Deactivated* at system startup.

Prerequisites

DeviceNet Lean option must be installed.

Limitations

The product name and other configuration parameters of an I/O unit is shown only if the DeviceNet Lean master is able to connect to the unit.

Default value

The default value is *Deactivated*.

Allowed values

Activated or *Deactivated*.

4.2.4 Connector ID

Parent

Connector ID belongs to the type *Bus*, in the topic *I/O*.

Cfg name

ConnectorID

Description

The parameter *Connector ID* specifies the hardware interface (connection port) that the DeviceNet Lean option shall use.

Usage

The *Connector ID* parameter is used to select one of the available connection ports to use.

Prerequisites

The option *DeviceNet Lean* (748-1) must be installed.

Default value

First Board

Allowed values

First Board

4.3 Type Unit Type

4.3.1 Vendor ID

Parent

Vendor ID belongs to the type *Unit Type*, in the topic *I/O*.

Cfg name

DL_VendorID

Description

Vendor ID is the vendor ID of an I/O unit as specified by the supplier.

Usage

Vendor ID is used as an identification of the I/O unit to secure communication to the correct device.

Prerequisites

DeviceNet Lean option must be installed.

Allowed values

0 - 65535

4.3.2 Product Code

Parent

Product Code belongs to the type *Unit Type*, in the topic *I/O*.

Cfg name

DL_ProductCode

Description

Product Code is the product code of an I/O unit as specified by the supplier.

Usage

Product Code is used as an identification of the I/O unit to secure communication to the correct device.

Prerequisites

DeviceNet Lean option must be installed.

Allowed values

0 - 65535

4.3.3 Production Inhibit Time

Parent

Production Inhibit Time belongs to the type *Unit Type*, in the topic*I/O*.

Cfg name

DL_ProdInhibitTime

Description

Production Inhibit Time specifies the minimum time, expressed in milliseconds, between network messages sent by the unit.

Usage

Production Inhibit Time is used to control the minimum time between transmissions from the I/O unit in order to prevent overloading of the DeviceNet Lean network.

Prerequisites

The *DeviceNet Lean* option must be installed.

Limitations

Maximum and minimum values might be constrained by the unit.

Default value

The default value is 10.

Allowed values

Allowed values are the integers 5-65535.

4.3.4 Poll Rate

Parent

Poll Rate belongs to the type *Unit Type*, in the topic *I/O*.

Cfg name

DL_Pollrate

Description

Poll Rate specifies how often the DeviceNet Lean master should exchange input or output signals with an I/O unit (expressed in milliseconds).

Usage

Poll Rate is used to force the DeviceNet Lean master to create a POLLED connection type against an I/O unit with the specified Poll Rate time. If the default value 0 is used, the DeviceNet Lean master will try to use a COS connection against the I/O unit. If COS is not supported, a POLLED connection will automatically be created with a pollrate decided by the DeviceNet Lean master.

Note

When using a polled connection on DeviceNet Lean a DO signal will be updated with the poll cycle.

Prerequisites

The DeviceNet Lean option must be installed.

Limitations

Maximum and minimum values might be constrained by the unit.

Default value

The default value is 0 (deactivated).

Allowed values

Allowed values are the integers 0-65535.

4.3.5 Quick Connect

Parent

Quick Connect belongs to the type *Unit Type*, in the topic *I/O*.

Cfg name

DL_QuickConnect

Description

Quick Connect specifies whether the DeviceNet Lean master should configure the I/O unit to use the Quick Connect functionality.

Usage

Quick Connect is used to allow the I/O unit to skip certain startup test sequences. This shortens the time it takes for the I/O unit to accept a connection from the DeviceNet Lean master. Primary use of this function is in tool change applications.

Prerequisites

The DeviceNet Lean option must be installed

Default value

The default value is *Deactivated*.

Allowed values

Activated or *Deactivated*.

4.4 Type Unit

4.4.1 DeviceNet Lean Address

Parent

DeviceNet Lean Address belongs to the type *Unit*, in the topic *I/O*.

Cfg name

DL_Address

Description

DeviceNet Lean Address specifies the address that the I/O unit is assumed to be using on the network, and which the master should try to setup a connection against.

Usage

DeviceNet Lean Address is a DeviceNet Lean specific parameter that is only available for DeviceNet Lean units.

Prerequisites

The *DeviceNet Lean* option must be installed.

Limitations

There can be no sharing of addresses on the DeviceNet Lean network. All addresses on a DeviceNet Lean network must be unique.

Default value

The default value is 63.

Allowed values

Allowed values are the integers 0-63.

5 Trouble shooting

5.1 Bus off

Description

The DeviceNet Lean bus goes bus off when an excessive number of communication errors are detected and the CAN chip automatically goes off-line.

An event message will inform the users that bus off has occurred. The DeviceNet Lean bus will automatically try to recover from bus off and if succeeded an event message will inform the user that the bus has recovered from bus off.

To turn off the automatically bus off recovery, use the system parameter *Automatically Bus Restart*. Refer to *Technical reference manual - System parameters*.

Consequences

Bus off indicates a serious communication fault such as incorrect baud rate or physical layer error (short, open, and so on).

Possible causes

The possible causes of bus off are:

- Different baud rates on the master and some I/O units (the I/O units do not support auto baud rate).
- No or faulty power on the bus.
- Short circuit between CAN high and CAN low.
- Cable length on trunk cables and drop cables.
- Faulty terminations.
- The network cable length exceeds 30 meters.

Recommended actions

The following table provides the action that needs to be taken for the possible causes of bus off.

Cause	Action/Information
Different baud rates on the master and some I/O units.	Cycle the power of the units or manually change the baud rate of the units. (DeviceNet Lean operates at a baud rate of 500 kbits/s.)
No or faulty power on the bus.	See *Shield grounding and power on page 22*.
Cable length on trunk cables and drop cables.	See *Selecting cables on page 25*.
Faulty terminations.	Refer to *Connection of the DeviceNet Lean bus on page 23*.

Note

If the DeviceNet Lean bus goes bus off, the I/O units on the bus can also go bus off. The only way to recover these units is to cycle the power on the I/O unit.

5.2 Bus Scan

Overview

When a bus scan or auto configuration operation is activated, the DeviceNet Lean master will send requests to all valid network addresses. If the unit is already configured against another DeviceNet master, or operating at wrong baud rate, or is not online, the unit can not be contacted for the data gathering of the required configuration parameters. If the I/O unit is not found with auto configuration, it might still be possible that the unit will work if it is manually added.

6 Boards and units

6.1 General

6.1.1 DeviceNet Lean Bus and I/O board status LED description

General

Each of the units connected to the DeviceNet Lean bus includes LED indicators which indicate the condition of the unit and the function of the network communication.

LEDs

The LEDs found on the units connected may be divided into two categories.

Common LEDs

The following LEDs can be found on all units:

- MS - Module status
- NS - Network status

Specific LEDs

Certain units also include the following LEDs:

- DeviceNet Tx - DeviceNet network transmit
- DeviceNet Rx - DeviceNet network receive

MS - Module status

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	No power applied to the device.	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 self test.	If flashing for more than a few seconds, check hardware.

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6.1.1 DeviceNet Lean Bus and I/O board status LED description

Continued

NS - Network status

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	Device has no power or is not online. The device has not completed the Dup_MAC_ID test yet.	Check status of MS LED. Check power to affected module.
GREEN steady	The device is online and has connection in the established state. For a group 2 device only: the device is allocated to a master. For a UCMM capable device: the device has one or more established connections.	If no light, check other LED modes.
GREEN flashing	Device is online, but has no connections in the established state. The device has passed the Dup_MAC_ID test, is online, but has no established connections to other nodes. For a group 2 device only: the device is not allocated to a master. For a UCMM capable device: the device has no established connections.	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.

DeviceNet Tx - DeviceNet network transmit

The following table shows the different states of the DeviceNet Tx LED.

LED color	Description	Remedy/cause
GREEN steady	Physically connected to the DeviceNet Tx line.	If no light when transmission is expected, check error messages. Check system boards in rack.
GREEN flashing	Flashes when the unit is transmitting data on the DeviceNet Lean bus.	

DeviceNet Rx - DeviceNet network receive

The following table shows the different states of the DeviceNet Rx LED.

LED color	Description	Remedy/cause
GREEN steady	Physically connected to the DeviceNet Rx line.	If no light, check network and connections.
GREEN flashing	Flashes when the unit is receiving data on the DeviceNet Lean bus.	

6.1.2 DeviceNet Lean bus status LEDs at power-up

Process

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.

Additional LEDs

If a device has other LEDs, each LED is tested in sequence.

6.1.3 I/O units

General

You can connect up to 20 I/O units to the same controller, but the number of I/O units that are practical to connect always depends on the amount of the total network traffic they produce.

Requirements

Description	Data/value	More information
Verified I/O units	DSQC 651 DSQC 652 DSQC 653 IRC 5 DeviceNet m/s option AC 500 PLC	*Unit descriptions on page 58*.
Allowed I/O units	I/O units that supports the predefined master/slave connection set.	See *ODVA DeviceNet Specification*.
The maximum cable length between controller and external I/O unit.	30 m	*Selecting cables on page 25*.
Controller placement on cable chain.	At one end or anywhere between the ends.	
Power supply to I/O units.	24 VDC	
Termination of DeviceNet Lean bus.	121 ohm resistor	*Termination resistors in DeviceNet Lean bus on page 24*.

6.1.4 Coil neutralization

External units

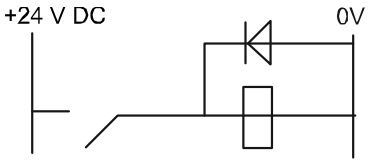
External relay coils, solenoids, and other units that are connected to the controller must be neutralized. The following sections describe how this can be done.

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.



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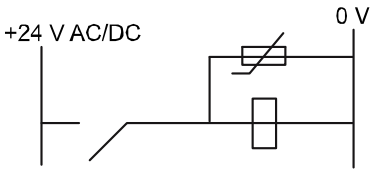
Clamping with a varistor

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



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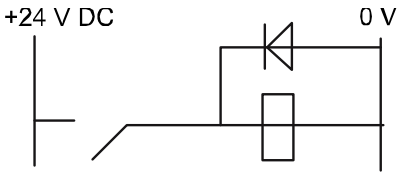
Clamping with an RC circuit

R 100 ohm, 1W C 0.1 - 1 mF.

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



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6.1.5 Setting DeviceNet Lean bus ID

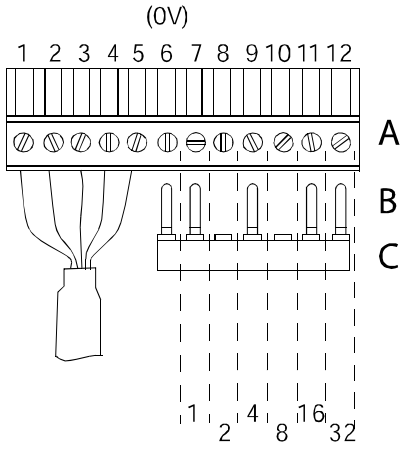
Description

Each I/O unit is given a unique address (ID).

How to set the ID

The connector contains address pins and can be keyed as shown in the following figure. When all terminals are unconnected the highest address 63 is obtained. When all terminals are connected to 0 V, the address would be 0.

To obtain the address 10:	Cut address pins 2 and 8
To obtain the address 25:	Cut address pins 1, 8 and 16



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A	Connector X5
B	Address pins
C	Address key

Note

Do not change the address with power on.

Connector X5

Signal name	X5 pin
1	Supply voltage GND - Black
2	CAN signal low - Blue
3	Shield
4	CAN signal high - White
5	Supply voltage 24 VDC - Red
6	Logic GND
7	Board ID bit 0 (LSB)
8	Board ID bit 1

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Signal name	X5 pin
9	Board ID bit 2
10	Board ID bit 3
11	Board ID bit 4
12	Board ID bit 5 (MSB)

6.2 Unit descriptions

6.2.1 Overview of I/O units

Overview

This section provides description of the I/O units that support DeviceNet Lean communication.

Board designation	Name of unit	Type of unit	Article number
DSQC 351B	DeviceNet/INTERBUS	Gateway unit	3HNE00006-1
DSQC 377B	Queue tracking	Encoder interface unit	3HNE01586-1
DSQC 378B	DeviceNet/CCLink	Gateway unit	3HNE00421-1
DSQC 651	AD combi I/O	Distributed I/O unit	3HAC025784-001
DSQC 652	Digital I/O	Distributed I/O unit	3HAC025917-001
DSQC 653	Digital I/O with relay outputs	Distributed I/O unit	3HAC025918-001

6.2.2 DSQC 351A and 351B, DeviceNet Lean/INTERBUS gateways

Description

The DSQC 351A and 351B are the circuit boards normally mounted in the control module. As an option, it may also be mounted in an external I/O unit.

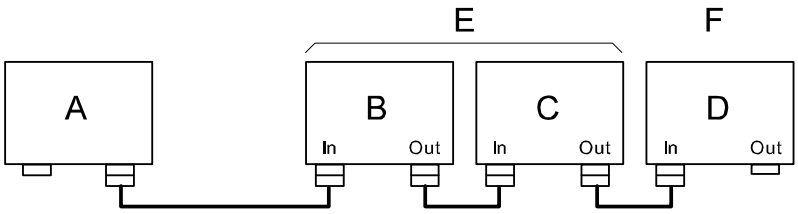
The units handle input and output signals between the DeviceNet Lean system and the INTERBUS system.

There are no functional differences between DSQC 351A and DSQC 351B.

Communication concept

The INTERBUS system is able to communicate with a number of external devices, depending on the number of process words occupied by each unit. The robot controller may be equipped with several DSQC 351A/B boards. The INTERBUS inputs and outputs are accessible in the robot controller as general inputs and outputs.

The following figure is an outline diagram of the communication concept:



xx0100000224

A	Master PLC (customer equipment)
B	Robot 1 controller, word 1-4
C	Robot 2 controller, word 5-8
D	Robot 3 controller, word 9-12
E	128 inputs/128 outputs
F	64 inputs/64 outputs

Note

A link is connected between pin 5 and 9 in the plug on the interconnection cable connected to the OUT connector (connector X21) of each unit. The link informs the INTERBUS unit that more units are connected further out in the chain. (The last unit does not have a cable connected and therefore no link.)

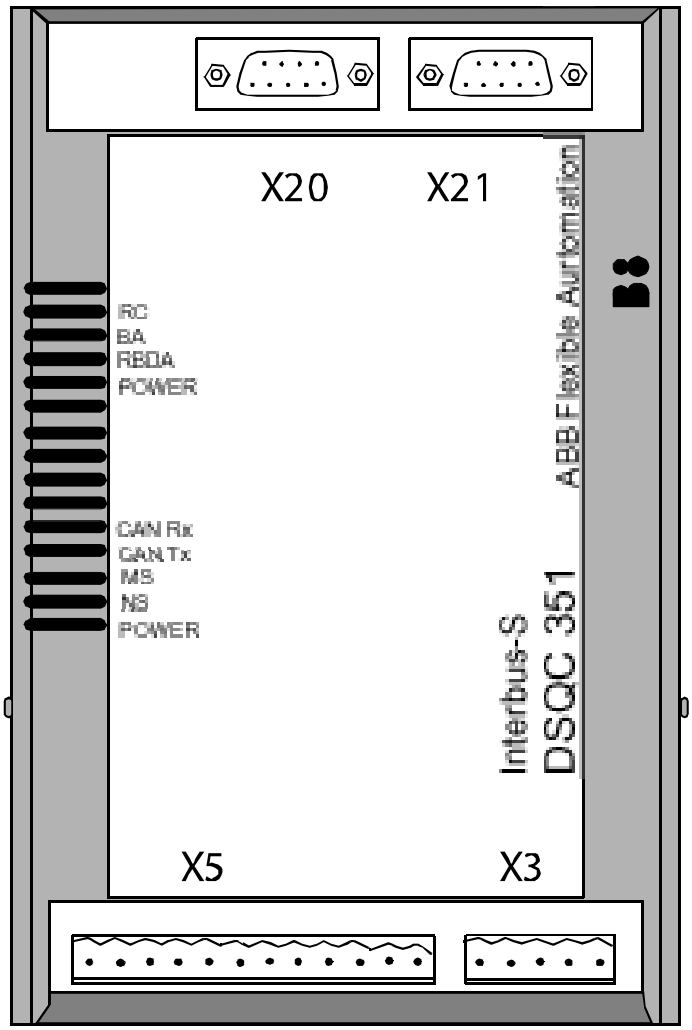
Continues on next page

6.2.2 DSQC 351A and 351B, DeviceNet Lean/INTERBUS gateways

Continued

Illustration of DSQC 351A/B

The illustration below shows the DSQC 351A/B board:



xx0100000225

Parts

The table below refers to *Illustration of DSQC 351A/B on page 60*.

Item	Description
X3	Back-up feed supply See section *Connector X3 on page 61* for connection tables!
X5	DeviceNet Lean connector See section *Connector X5 on page 62*!
X20	INTERBUS, input See section *Connector X20 on page 62* for connection tables!
X21	INTERBUS, output See section *Connector X21 on page 62* for connection tables!

Continues on next page

Continued

Facts, DSQC 351A/B

This section specifies a number of facts applicable to the DSQC 351A/B. Unless stated otherwise, the data applies to the standard version.

Also see the *DSQC 351A and 351B, DeviceNet Lean/INTERBUS gateways on page 59*, International Standard DIN 19258.

Technical data

SW connections	Support for the following connections: • Polled • Change-Of-State • Change-Of-State with acknowledge suppression For descriptions of the different types of I/O connections, see *I/O messages - connection types on page 16*.
Baud rate	500 Kbps

Supply

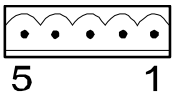
The INTERBUS gateway must be fed externally to avoid shutting down the INTERBUS net if a robot cell is switched off. The 24V power supply must be fed from an external power source and be connected to connector X3.

INTERBUS master setup

The unit must be given an ID address, and setup parameters must be entered into the INTERBUS master system.

The unit ID to be entered in the INTERBUS master is 3. The length code depends on the selected data. The width is between 1 and 4 configured by the Fieldbus Command Type, *DataWidth*.

Connector X3



xx0100000221

The table below shows the connections to connector X3:

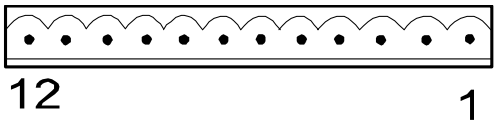
Signal name	X3 pin	Function
0 VDC	1	Supply voltage GND
NC	2	Not connected
GND	3	Ground connection
NC	4	Not connected
+ 24 VDC	5	Supply voltage + 24 VDC

Continues on next page

6.2.2 DSQC 351A and 351B, DeviceNet Lean/INTERBUS gateways

Continued

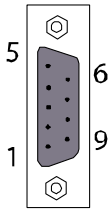
Connector X5



xx0100000244

Connector X5 is a DeviceNet Lean connector specified in section *Setting DeviceNet Lean bus ID on page 56*.

Connector X20

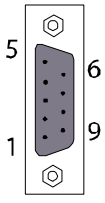


xx0100000220

The table below shows the connections to connector X20:

Signal name	X20 pin	Function
TPDO1	1	Communication line TPDO1
TPDI1	2	Communication line TPDI1
GND	3	Ground connection
NC	4	Not connected
NC	5	Not connected
TPDO1-N	6	Communication line TPDO1-N
TPDI1-N	7	Communication line TPDI1-N
NC	8	Not connected
NC	9	Not connected

Connector X21



xx0100000220

The table below shows the connections to connector X21:

Signal name	X21 pin	Function
TPDO2	1	Communication line TPDO2
TPDI2	2	Communication line TPDI2
GND	3	Ground connection
NC	4	Not connected

Continues on next page

Continued

Signal name	X21 pin	Function
+ 5 V	5	+ 5 VDC
TPDO2-N	6	Communication line TPDO2-N
TPDI2-N	7	Communication line TPDI2-N
NC	8	Not connected
RBST	9	Synchronization

Note

Pin 5 and pin 9 in X21 must be linked together.

Board specific LEDs

The designations refer to LEDs shown in the figure in the section *Illustration of DSQC 351A/B on page 60*.

Designation	Color	Description
POWER-24 VDC (upper indicator)	GREEN	Indicates that a supply voltage is present, and has a level above 12 VDC. If there is no light, check that voltage is present on power module. Check also that power is present in power connector. If it is not, check cables and connectors. If power is applied to unit but unit does not work, replace unit.
POWER- 5 VDC (lower indicator)	GREEN	Lit when both 5 VDC supplies are within limits, and no reset is active. If there is no light, check that voltage is present on power module. Check also that power is present in power connector. If it is not, check cables and connectors. If power is applied to unit but unit does not work, replace unit.
RBDA	RED	Lit when this INTERBUS station is last in the INTERBUS network. If it is not, verify the INTERBUS configuration.
BA	GREEN	Lit when INTERBUS is active. If there is no light, check network, nodes and connections.
RC	GREEN	Lit when INTERBUS communication runs without errors. If there is no light, check system messages in robot and in INTERBUS net.

General LEDs

The significance of the LEDs are specified in section *DeviceNet Lean Bus and I/O board status LED description on page 51*.

Continues on next page

6.2.2 DSQC 351A and 351B, DeviceNet Lean/INTERBUS gateways

Continued

Input map

The figure below shows the digital input mapping.

Input byte	Bit 7	6	5	4	3	2	1	0	Bit range
0	DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1	0-7
1	DI 16	DI 15	DI 14	DI 13	DI 12	DI 11	DI 10	DI 9	8-15
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Depends on DataWidth
(m*2)-1	DI (m*16)	DI (m*16)-1	DI (m*16)-2	DI (m*16)-3	DI (m*16)-4	DI (m*16)-5	DI (m*16)-6	DI (m*16)-7	Depends on DataWidth
(m*2)	Interbus Status	N.U.	N.U.	N.U.	N.U.	N.U.	N.U.	N.U.	Depends on DataWidth

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m	The number of words (16 bit) that the unit has been configured to, using the Fieldbus Command Type`DataWidth`.
INTER-BUS Status	The status of the INTERBUS communication can be monitored using the signal *INTERBUS Status*. When *INTERBUS Status* is set it indicates that the unit is in data communication with the PLC/master controlling it, i.e. bus is active (the BA LED is lit).
N.U.	Not used. The signal position is reserved for future use and shall not be used.

The *INTERBUS Status* signal is located in the last bit of the last byte of the input area. For example, if the `DataWidth` is set to 4 (words) there are 8 bytes of input data (bit 0-63), and the *INTERBUS Status* is located in the last bit of the 9th byte i.e. bit 71.

Output map

The figure below shows the digital output mapping.

Output byte	Bit 7	6	5	4	3	2	1	0	Bit range
0	DO 8	DO 7	DO 6	DO 5	DO 4	DO 3	DO 2	DO 1	0-7
1	DO 16	DO 15	DO 14	DO 13	DO 12	DO 11	DO 10	DO 9	8-15
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Depends on DataWidth
(m*2)-1	DO (m*16)	DO (m*16)-1	DO (m*16)-2	DO (m*16)-3	DO (m*16)-4	DO (m*16)-5	DO (m*16)-6	DO (m*16)-7	Depends on DataWidth

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m	The number of words (16 bit) that the unit has been configured to, using the Fieldbus Command Type*DataWidth*.

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Continued

Fieldbus Command Types

Following table gives necessary data on the Fieldbus Command Types for DeviceNet Lean communication.

Fieldbus Command Type	Path (DeviceNet Lean parameter)	Allowed values	Usage
DataWidth	6, 20 65 24 01 30 01, C6, 1	0-3 according to: 0 = 1 word (16 DO, 16+1 DI) 1 = 2 words (32 DO, 32+1 DI) 2 = 3 words (48 DO, 48+1 DI) 3 = 4 words (64 DO, 64+1 DI)	Determines the size of the input and output data areas of the INTERBUS gateway.

Additional information

The data areas of the gateway are **byte-consistent**, which means that signals within the same byte (groups of 8 bits) are handled as one piece and are guaranteed to belong to the same bus-cycle. Normally this does not cause any problems, but if a signal group has been defined across the byte boundaries as for example, a 16 bit group signal this needs to be considered. It is important to make sure that undesired behaviors are avoided in the case when the group signal is updated at exactly the same time as the gateway is being polled/scanned by one of the masters.

The values for the Fieldbus Command Types are stored in flash memory of the gateway module. Any change of these values requires a reset (or power cycle) of the gateway module before it actually assumes these new values. By using the standard configuration files for the gateways, the robot controller will automatically issue a reset command to activate the modified configuration.

6.2.3 DSQC 377A and DSQC 377B, Queue tracking units

Description

The encoder units DSQC 377A and DSQC 377B provides connection for one encoder and one digital input (synchronization switch), and includes queue tracking functions.

There are no functional differences between DSQC 377A and DSQC 377B.

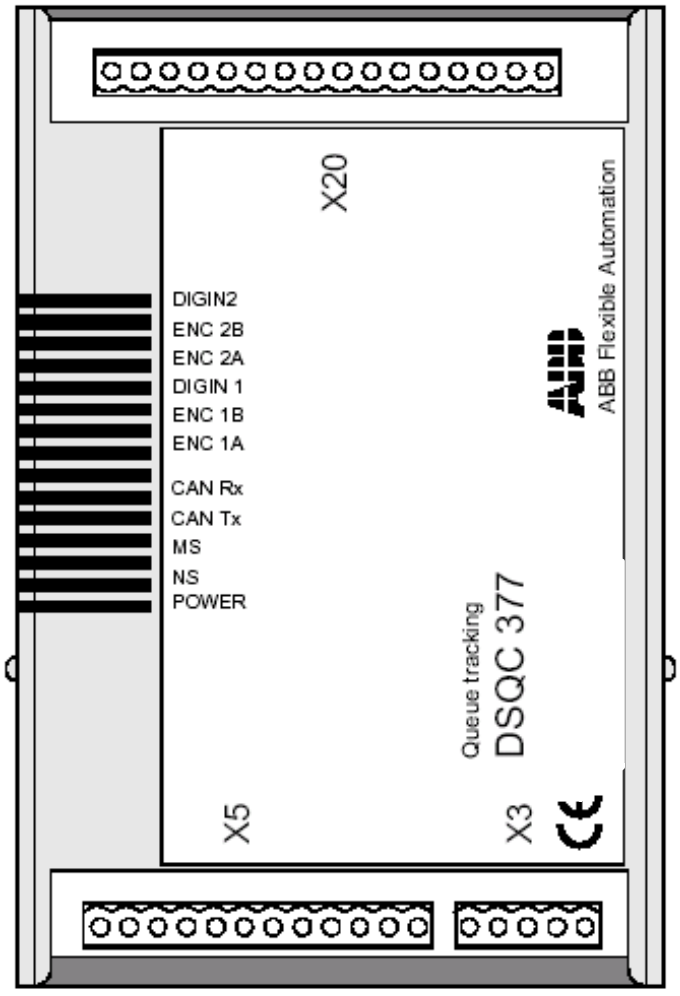
Usage

The encoder unit is normally used for installation on a conveyor to enable the robot programs to synchronize to the motion (position) of the conveyor.

The digital input is used for synchronization switch (also called sync signal), which means conveyor synchronization point.

Illustration of DSQC 377A/B

The figure below shows the DSQC 377A/B board:



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Continued

Parts

Item	Description
X3	Back-up feed supply See the section *Connector X3 on page 68* for connection tables.
X5	DeciceNet Lean connector See the section *Connector X5 on page 69*
X20	Conveyor connection See the section *Connector X20 on page 69* for connection tables.

Facts, DSQC 377A/B

This section specifies a number of facts applicable to the DSQC 377A/B. Unless stated otherwise, the data applies to the standard version.

Technical data

No. of encoder inputs	1
No. of digital inputs	1 (24 VDC)
Supply voltage	24 VDC
Supply source	24 V I/O or external supply
SW connections	Support for the polled connection. For descriptions of the different types of I/O connections, see *I/O messages - connection types on page 16*.
Baud rate	500 Kbps

Also see *Product specification - Controller IRC5 with FlexPendant*.

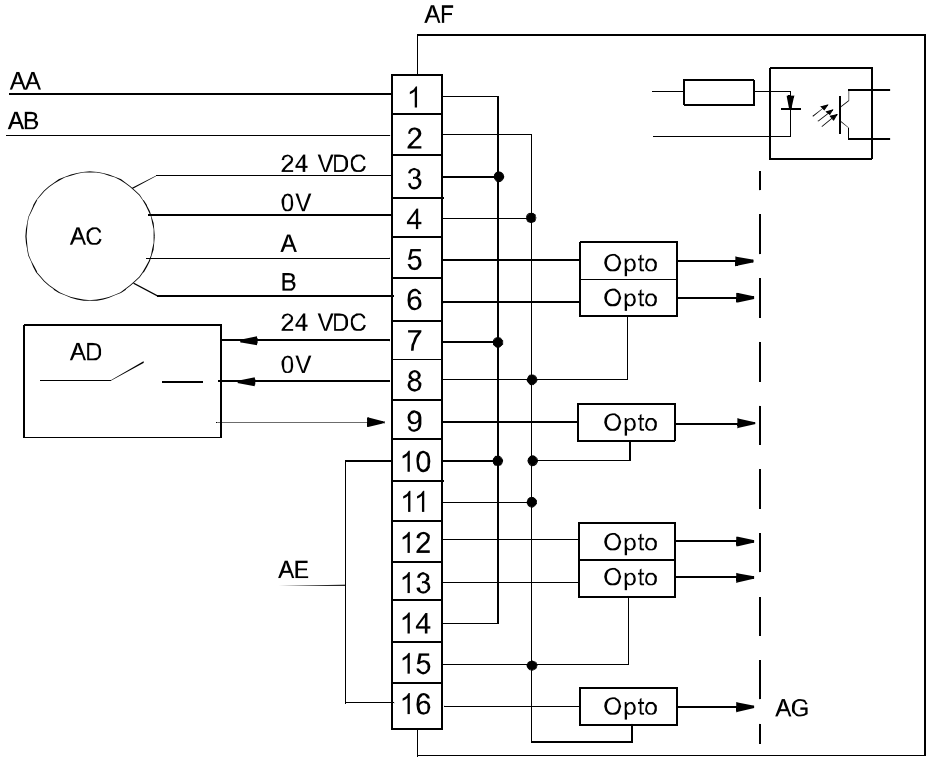
Continues on next page

6.2.3 DSQC 377A and DSQC 377B, Queue tracking units

Continued

Encoder connections

The wiring diagram in the figure below shows how to connect the encoder and sync signal switch to the encoder unit. As can be seen from the illustration, the encoder is supplied with 24 VDC and 0 V. The encoder has two channels. The main unit uses quadrature decoding to compute position and direction information.



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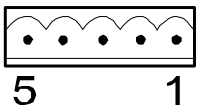
AA	24 V I/O or external supply
AB	0 V I/O or external supply
AC	Encoder
AD	Sync switch
AE	10-16 not used
AF	Encoder interface unit
AG	Galvanic isolation

Connector X3



xx0100000221

The table below shows the connections to connector X3:

Signal name	X3 pin	Function
0 VDC	1	Supply voltage GND
NC	2	Not connected

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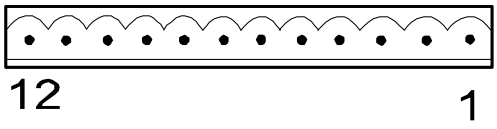
Continued

Signal name	X3 pin	Function
GND	3	Ground connection
NC	4	Not connected
+ 24 VDC	5	Supply voltage + 24 VDC

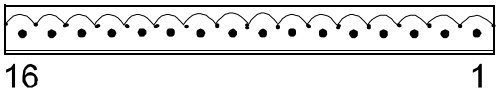
Connector X5



xx0100000244

Connector X5 is a DeviceNet Lean connector specified in section *Setting DeviceNet Lean bus ID on page 56*.

Connector X20



xx0100000235

X20 is the encoder and digital input connector.

The following table shows the connections to connector X20:

Signal name	X20 pin
24 VDC supply	1
0 V	2
Encoder 1 - 24VDC	3
Encoder 1 - 0V	4
Encoder 1 - Phase A	5
Encoder 1 - Phase B	6
Digital input 1 - 24 VDC	7
Digital input 1 - 0 V	8
Digital input 1 - Signal	9
Not used	10
Not used	11
Not used	12
Not used	13
Not used	14
Not used	15
Not used	16

Continues on next page

6.2.3 DSQC 377A and DSQC 377B, Queue tracking units

Continued

Board specific LEDs

The table below shows the significance of the LEDs on the board. For location of the LEDs see *Illustration of DSQC 377A/B on page 66*.

Designation	Color	Description
POWER, 24 VDC	Green	Indicates that a supply voltage is present, and has a level above 12 VDC. If there is no light, check that voltage is present on power unit and in connector X20. If not, check cables and connectors. If power is applied to the unit but it does not work, replace the unit.
NS/MS	Green/red	Network and module status LEDs. See section *DeviceNet Lean Bus and I/O board status LED description on page 51*.
CAN Tx/CAN Rx	Green/red	See section *DeviceNet Lean Bus and I/O board status LED description on page 51*.
ENC 1A/1B	Green	Indicates phase 1 and 2 from encoder. Flashes at each Encoder pulse. At frequencies higher than a few Hz, flashing can no longer be observed (light will appear weaker). If there is no light, there is an error due to one or more of the following reasons: • Faulty power supply for input circuit (internal or external). • Defective input circuit on board. • Short circuit or broken wire in external wiring or connectors. • Internal error in unit. Constant light indicates constant high level on input and vice versa. No light on one LED indicates fault in one encoder phase.
DIGIN1	Green	Lit when digital input is active. The input is used for external start signal/conveyor synchronization point. If there is no light, there is an error due to one or more of the following reasons: • Faulty power supply for input circuit (internal or external). • Faulty limit switch, photocell etc. • Short circuit or broken wire in external wiring or connectors. • Defective input circuit on board.
ENC 2A/2B		Not used.
DIGIN2		Not used.

Continues on next page

Input map

The figure below shows the input mapping.

Note

Pay attention to the order of the bits for the analog signals.

Input byte	Bit 7	6	5	4	3	2	1	0	Bit range
0								LSB	0-31
1				Position					
2									
3	MSB								
4								LSB	32-63
5				Speed					
6									
7	MSB								
8	MSB			ObjectsInQ				LSB	64-71
9								LSB	72-87
10	MSB			CntFromEnc1					
11								LSB	88-103
12	MSB			CntFromEnc2					
13	N.U.	EncA Fault	Encoder Selected	NewObj Strobe	Pass Stw	Ready	Null Speed	Connec-ted	104-111
14	N.U.	N.U.	N.U.	N.U.	PowerUp Status	ScaleEnc Pulse	DirOf Travel	Simu-lating	112-119
15								LSB	120-151
16				TimeStamp					
17									
18	MSB								

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Note

The signals *CntFromEnc1*, *CntFromEnc2,* and *ScaleEncPulse* are dependent on the signal *PosInJobQ* (bit 42 in the output map). DSQC 377-mode is obtained by setting the output signal to 1, and DSQC 354-mode is obtained by setting the output signal to 0.

Generally *PosInJobQ* concerns only the queue tracking mode. All signals on the DSQC 377 are available even in DSQC 354-mode (c1PosInJobQ=0). The only thing *c1PosInJObQ* disables, is that the object position is not sent to the main controller.

Continues on next page

6.2.3 DSQC 377A and DSQC 377B, Queue tracking units

Continued

Following table specifies the input signals.

Signal name	Type	Bit	Description
Position	AI	0-31	Position in meters of the first object in the queue. Accuracy: 0.1 mm
Speed	AI	32-63	Speed of the conveyor in m/s. Resolution: 10 µm/s
ObjectsInQ	GI	64-71	Number of objects in queue (0-255). Objects that have entered the queue (passed the sync switch) but have not left the queue (have become connected or gone outside the start window).
CntFromEnc1	GI	72-87	Counter value from encoder to controller (Low Word). The bit group is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
CntFromEnc2	GI	88-103	Counter value from encoder to controller (High Word). The bit group is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
Connected	DI	104	Set when an object is being tracked.
NullSpeed	DI	105	Set when the conveyor is stopped.
Ready	DI	106	Internal handshake signal (toggled).
PassStw	DI	107	Set when an object has gone outside the start window or has fallen off the conveyor.
NewObjStrobe	DI	108	New position from the encoder node to enter the job queue. The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
EncSelected	DI	109	Indicates which encoder is active. 0 = EncA (must be 0) The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
EncAFault	DI	110	Encoder A is faulty. The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
N.U.		111	Not used.
Simulating	DI	112	Module is in simulated mode, i.e. `Speed` and `Position` are simulated rather than taken from the actual encoder. The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
DirOfTravel	DI	113	Indicates the direction of the conveyor. 0 = Backward 1 = Forward
ScaleEncPulse	DI	114	The encoder pulse scaled down by the factor given by the command *ScalingFactor*.
PowerUpStatus	DI	115	Indicates how the last shutdown was made. 0 = Abnormal 1 = Normal
N.U.		116-119	Not used.

Continues on next page

Continued

Signal name	Type	Bit	Description
TimeStamp	GI	120-151	Holds the time when following signals were last sampled: • Position • Speed • Connected • NullSpeed

Output map

The following figure shows the output signals mapping.

Output byte	Bit 7	6	5	4	3	2	1	0	Bit range
0	Sim Mode	N.U.	Soft SyncSig	Enc Select	RemAll PObj	Rem1 PObj	DropW Obj	WaitW Obj	0-7
1	CntToEnc1							LSB	8-23
2	MSB								
3	CntToEnc2							LSB	24-39
4	MSB								
5	N.U.	N.U.	N.U.	N.U.	N.U.	PosIn JobQ	Force Job	CntTo EncStr	43-47

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Note

The signals *CntToEnc1*, *CntToEnc2,* and *CntToEncStr* are dependent on the signal *PosInJobQ* (bit 42 in the output map). DSQC 377-mode is obtained by setting the signal to 1, and DSQC 354-mode is obtained by setting the signal to 0.

Generally *PosInJobQ* concerns only the queue tracking mode. All signals on the DSQC 377 are available even in DSQC 354 mode (c1PosInJobQ=0). The only thing *c1PosInJObQ* disables, is that the object position is not sent to the main controller.

Following table specifies the output signals.

Signal name	Type	Bit	Description
WaitWObj	DO	0	Set when the robot is waiting for an object to enter the start window.
DropWObj	DO	1	Drop and disconnect the currently tracked object. The object is removed from the queue.
Rem1PObj	DO	2	Remove first pending object from the queue. (If an object is connected it is not removed.)
RemAllPObj	DO	3	Remove all pending objects in the queue. (If an object is connected it is not removed.)

Continues on next page

6.2.3 DSQC 377A and DSQC 377B, Queue tracking units

Continued

Signal name	Type	Bit	Description
EncSelect	DO	4	Select encoder: 0=EncA (must be 0) 1=EncB, not used
SoftSyncSig	DO	5	Soft sync-signal This signal can be used instead of a physical signal connected to Digital input 1 of the module.
N.U.		6	Not used.
SimMode	DO	7	If set this signal set the module in simulation mode (simulate Position and Speed instead of using the encoder values). The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
CntToEnc1	GO	8-23	Counter value from controller to encoder (Low Word). The bit group is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
CntToEnc2	GO	24-39	Counter value from controller to encoder (High Word). The bit group is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
CntToEncStr	DO	40	Indication to module that the "CntToEncX" signals contain valid values. The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
ForceJob	DO	41	Run this job even if checkpoint fails (always set/reset together with the CntToEncStr signal). The bit is valid for DSQC 377-mode, i.e. when *PosInJobQ* is set to 1.
PosInJobQ	DO	42	Set if the module shall send encoder values to the controller instead of handling the queue itself. 0=Queue tracking disabled (DSQC 354-mode) 1=Queue tracking enabled
N.U.		43-47	Not used.

Additional information

For detailed information on using the DSQC 377A/B in an application refer to *Application manual - Motion coordination and supervision*.

NOTE!

If another*DeviceNet Lean Master Address*than the default value (2) is used, see detailed information about *DeviceNet Lean Master Address on page 39*.

6.2.4 DSQC 378A and DSQC 378B, DeviceNet Lean/CCLink gateways

Description

The DSQC 378A and DSQC 378B units offer an interface between the CCLink bus and the DeviceNet Lean bus as used on the robot system. The units are regarded as *intelligent devices* by the CCLink PLC.

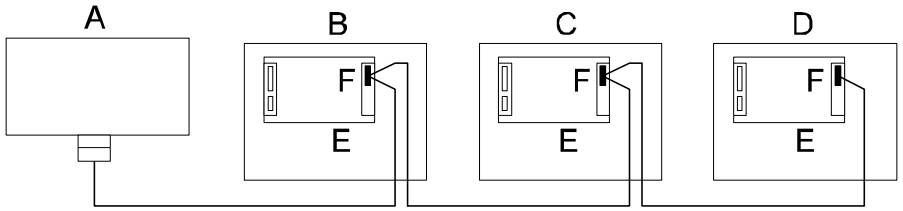
There are no functional differences between DSQC 378A and DSQC 378B.

Communication concept

The CCLink can communicate with a number of external devices, depending on the number of stations occupied by each unit. There is a maximum of 64 stations, each capable of up to 32 I/O points and 8 points word data. The units are setup to have between 1 and 4 occupied stations each. The CCLink unit is connected to the CCLink PLC by a twisted pair cable with shield.

The CCLink inputs and outputs are accessible in the robot controller as general inputs and outputs.

Following figure is an outline diagram of the communication concept:



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A	Master PLC (customer equipment)
B	Robot 1 controller
C	Robot 2 controller
D	Robot 3 controller
E	DSQC 378A/B controller
F	Connector X8 controller

Note

The CCLink cable must be terminated with termination resistors (110 ohm) in both ends.

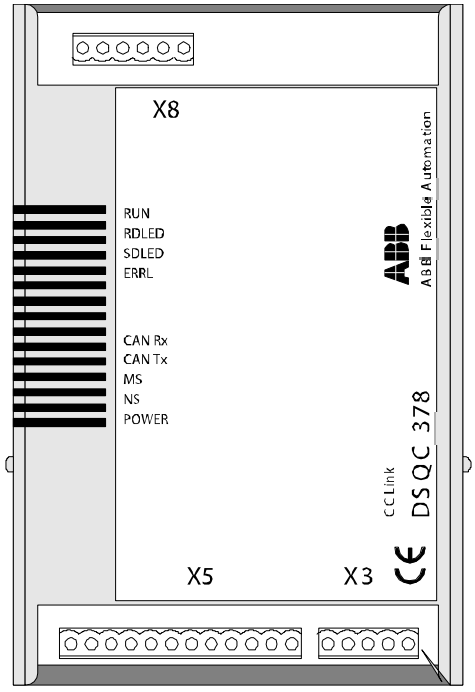
Continues on next page

6.2.4 DSQC 378A and DSQC 378B, DeviceNet Lean/CCLink gateways

Continued

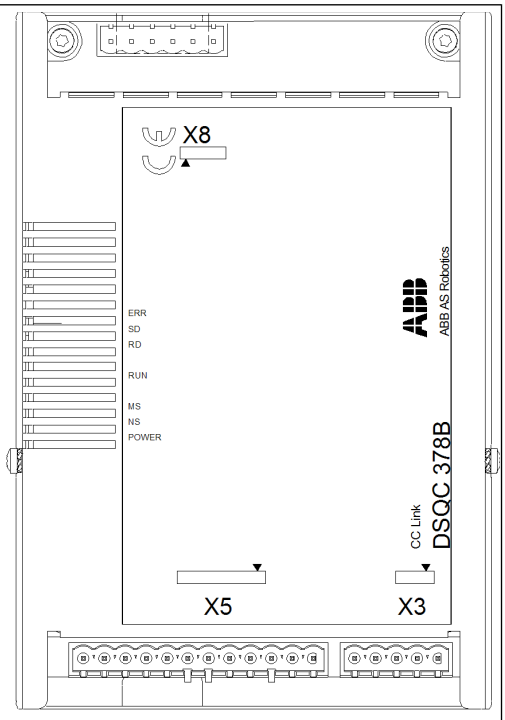
Illustration of DSQC 378A and DSQC 378B

The following figures show the DSQC 378A and DSQC 378B boards:



xx0400000825

DSQC 378A



xx1000001343

DSQC 378B

Parts

Item	Description
X3	Back-up feed supply See section *Connector X3 on page 77* for connection tables!
X5	DeviceNet Lean connector See section *Connector X5 on page 77*!
X8	CCLink network connector See section *Connector X8 on page 77* for connection tables!

Facts, DSQC 378A/B

This section specifies a number of facts applicable to the DSQC 378A/B. Unless stated otherwise, the data applies to the standard version.

Technical data

SW connections	Support for the following connections: • Polled • Change-Of-State • Change-Of-State with acknowledge suppression For descriptions of the different types of I/O connections, see *I/O messages - connection types on page 16*.
Baud rate	500 Kbps

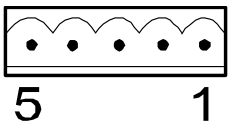
Continues on next page

Continued

Unit setup

The unit must be given an ID address, and setup parameters must be entered into the system.

Connector X3

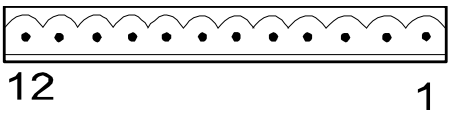


xx0100000221

The following table shows the connections to connector X3:

Signal name	X3 pin	Function
0 VDC	1	Supply voltage GND
NC	2	Not connected
GND	3	Ground connection
NC	4	Not connected
+ 24 VDC	5	Supply voltage +24 VDC

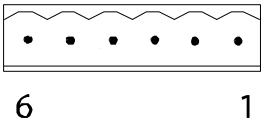
Connector X5



xx0100000244

Connector X5 is a DeviceNet Lean connector specified in section *Setting DeviceNet Lean bus ID on page 56*.

Connector X8



xx020000

The table below shows the connections to connector X8:

Signal name	X8 pin	Function
SLD	1	Shield, connected to power GND/Housing
DA	2	Signal line, A
DG	3	Digital GND, connected to signal GND
DB	4	Signal line, B
NC	5	Not connected
FG	6	Power GND, same as SLD

Continues on next page

6.2.4 DSQC 378A and DSQC 378B, DeviceNet Lean/CCLink gateways

Continued

Board specific LEDs

The designations refer to LEDs shown in the figure in section *Illustration of DSQC 378A and DSQC 378B on page 76*.

Designation	Color	Description
POWER-24 VDC	Green	Indicates that a supply voltage is present, and has a level above 12 VDC. If there is no light, check that voltage is present on power module. Check also that power is present in power connector. If it is not, check cables and connectors. If power is applied to unit but unit does not work, replace unit.
RUN (ON: H output)		**ON:** Receive both refresh and polling signals or just the refresh signal normally, after joining the network. See figure below this table. **OFF:** 1 Before joining the network. 2 Unable to detect carriers neither for channel 1 or 2. 3 Time out. 4 Resetting hardware.
RDLED (ON: L output) *(DSQC 378A)* RD *(DSQC 378B)*		**ON:** Detecting the carrier for channel 1 or 2. Check cables and terminator. **OFF:** 1 Unable to detect carriers neither for channel 1 or 2. 2 Resetting hardware.
SDLED (ON: L output) *(DSQC 378A)* SD *(DSQC 378B)*		**ON:** During transmission to During transmission + (0.41 ms * $2^{(n-1)}$) n = 1-8 Check setup in both robot controller and PLC. **OFF:** 1 Other than listed under ON. 2 Resetting hardware.
ERRL (ON: L output) *(DSQC 378A)* ERR *(DSQC 378B)*		**ON:** 1 CRC error. Check setup in both robot controller and PLC. 2 Switch setting error during cancellation of reset (0, 65, or greater is set including the number of occupied stations). 3 Baud rate switch setting error during cancellation of reset (5 or greater). **OFF:** 1 Normal communication. 2 Resetting hardware. **BLINKING:** The switch setting has been changed from the setting at the reset cancellation (blinks for 0.4 sec.).

Continues on next page

Continued

The following figure describes the LED sequences.

Note

Read the figure line by line. The Operation column describes the operation status depending on the status of the four LEDs.

○ = On ◑ = Blinking ● = Off

ERRL/ ERR	SDLED/ SD	RDLED/ RD	RUN	Operation
◑	◑	○	○	Communicating normally, but CRC errors have often been detected due to noise.
◑ 0.4 sec	◑	○	○	The baud rate or station number setting has been changed from the settings at reset cancellation.
◑	◑	●	○	• (Impossible operation status.)
◑	●	○	○	Unable to respond because the received data caused a CRC error.
◑	●	●	○	• (Impossible operation status.)
●	◑	○	○	Normal communication.
●	◑	●	○	• (Impossible operation status.)
●	●	○	○	No data for the host.
●	●	●	○	• (Impossible operation status.)
◑	◑	○	●	Responds to polling signal, but the refresh reception caused a CRC error.
◑	◑	●	●	• (Impossible operation status.)
◑	●	○	●	Data for the host caused a CRC error.
◑	●	●	●	• (Impossible operation status.)
●	◑	○	●	• (Impossible operation status.)
●	◑	●	●	• (Impossible operation status.)
●	●	○	●	Either no data for the host or unable to receive the data for host due to noise.
●	●	●	●	Unable to receive due to wire breakage etc. Power off hardware being set.
○	●	○ /●	●	Baud rate and/or station number setting error.

en0400000827

General LEDs

The significance of the LEDs are specified in section *DeviceNet Lean Bus and I/O board status LED description on page 51*.

Continues on next page

6.2.4 DSQC 378A and DSQC 378B, DeviceNet Lean/CCLink gateways

Continued

Input map

The figure below shows the digital input mapping.

Input byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1	0-7
1	DI 16	DI 15	DI 14	DI 13	DI 12	DI 11	DI 10	DI 9	8-15
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Depends on OccStat and BasicIO
m-1	DI (m*8)	DI (m*8)-1	DI (m*8)-2	DI (m*8)-3	DI (m*8)-4	DI (m*8)-5	DI (m*8)-6	DI (m*8)-7	Depends on OccStat and BasicIO
m	CCLink Status	N.U.	N.U.	N.U.	N.U.	N.U.	N.U.	N.U.	Depends on OccStat and BasicIO

en0400000823

m	The size in bytes (8 bit) that the unit has been configured to, using the Fieldbus Command Types `OccStat` and `BasicIO`. See table in section *Fieldbus Command Types on page 81*.
CCLink Status	The status of the CCLink communication can be monitored using the signal *CCLink Status*. When *CCLink Status* is set it indicates that the CCLink communication is OK.
N.U.	Not used. The signal position is reserved for future use and shall not be used.

The *CCLink Status* signal is located at the last bit of the last byte of the input area. For example, if `OccStat` is set to 2 and `BasicIO` is set to 0 there are 6 bytes of input data (bit 0-47), and the *CCLink Status* is located in the last bit of the 7th byte i.e. bit 55.

Output map

The figure below shows the digital output mapping.

Output byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DO 8	DO 7	DO 6	DO 5	DO 4	DO 3	DO 2	DO 1	0-7
1	DO 16	DO 15	DO 14	DO 13	DO 12	DO 11	DO 10	DO 9	8-15
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Depends on OccStat and BasicIO
m-1	DO (m*8)	DO (m*8)-1	DO (m*8)-2	DO (m*8)-3	DO (m*8)-4	DO (m*8)-5	DO (m*8)-6	DO (m*8)-7	Depends on OccStat and Basic IO

en0400000824

m	The size in bytes (8 bit) that the unit has been configured to, using the Fieldbus Command Types `OccStat` and `BasicIO`. See table in section *Fieldbus Command Types on page 81*.

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Continued

Fieldbus Command Types

Following table gives necessary data on the Fieldbus Command Types for DeviceNet Lean communication.

Fieldbus Command Type	Path (DeviceNet Lean parameter)	Allowed values	Usage
StationNo	6, 20 68 24 01 30 01, C6, 1	1-64	Determines the address of the DSQC 378A/B on the CCLink connection.
BaudRate	6, 20 68 24 01 30 02, C6, 1	0-4 according to: 0 = 156 kbps 1 = 625 kbps 2 = 2.5 Mbps 3 = 5 Mbps 4 = 10 Mbps	Determines the communication speed on the CCLink bus.
OccStat	6, 20 68 24 01 30 03, C6, 1	1-4 according to: 1 = 1 occupied station 2 = 2 occupied stations 3 = 3 occupied stations 4 = 4 occupied stations	Occupied stations. Determines the size of the input and output data areas of the CCLink module. The size, expressed in bits and bytes, also depends on the value of `BasicIO`. See table in section *Size of input/output data areas on page 81*.
BasicIO	6, 20 68 24 01 30 04, C6, 1	0-1 according to: 0 = Bit I/O only 1 = Bit I/O and word I/O	Determines the type of I/O data to be exchanged with the CCLink master. This also affects the size of the input and output data areas of the CCLink module. The size, expressed in bits and bytes, also depends on the value of `OccStat`. See table in section *Size of input/output data areas on page 81*.

Size of input/output data areas

The size of the input/output data areas expressed in bits and bytes are determined by the values of the Fieldbus Command Types`OccStat` and `BasicIO` according to following table:

Value of OccStat	No. of bits when BasicIO = 0	No. of bytes when BasicIO = 0	No. of bits when BasicIO = 1	No. of bytes when BasicIO = 1
1	16	2	80	10
2	48	6	176	22
3	80	10	272	34
4	112	14	368	46

Continues on next page

6.2.4 DSQC 378A and DSQC 378B, DeviceNet Lean/CCLink gateways

Continued

Additional information

The data areas of the gateway are **byte-consistent**, which means that signals within the same byte (group of 8 bits) are handled as one piece and are guaranteed to belong to the same bus-cycle. Normally this does not cause any problems, but if a signal group has been defined across the byte boundaries as for example, a 16 bit group signal this needs to be considered. It is important to make sure that undesired behaviors are avoided in the case when the group signal is updated at exactly the same time as the gateway is being polled/scanned by one of the masters.

The values for the Fieldbus Command Types are stored in flash memory of the gateway module. Any change of these values requires a reset (or power cycle) of the gateway module before it actually assumes these new values. By using the standard configuration files for the gateways, the robot controller will automatically issue a reset command to activate the modified configuration.

6.2.5 DSQC 651, AD combi I/O

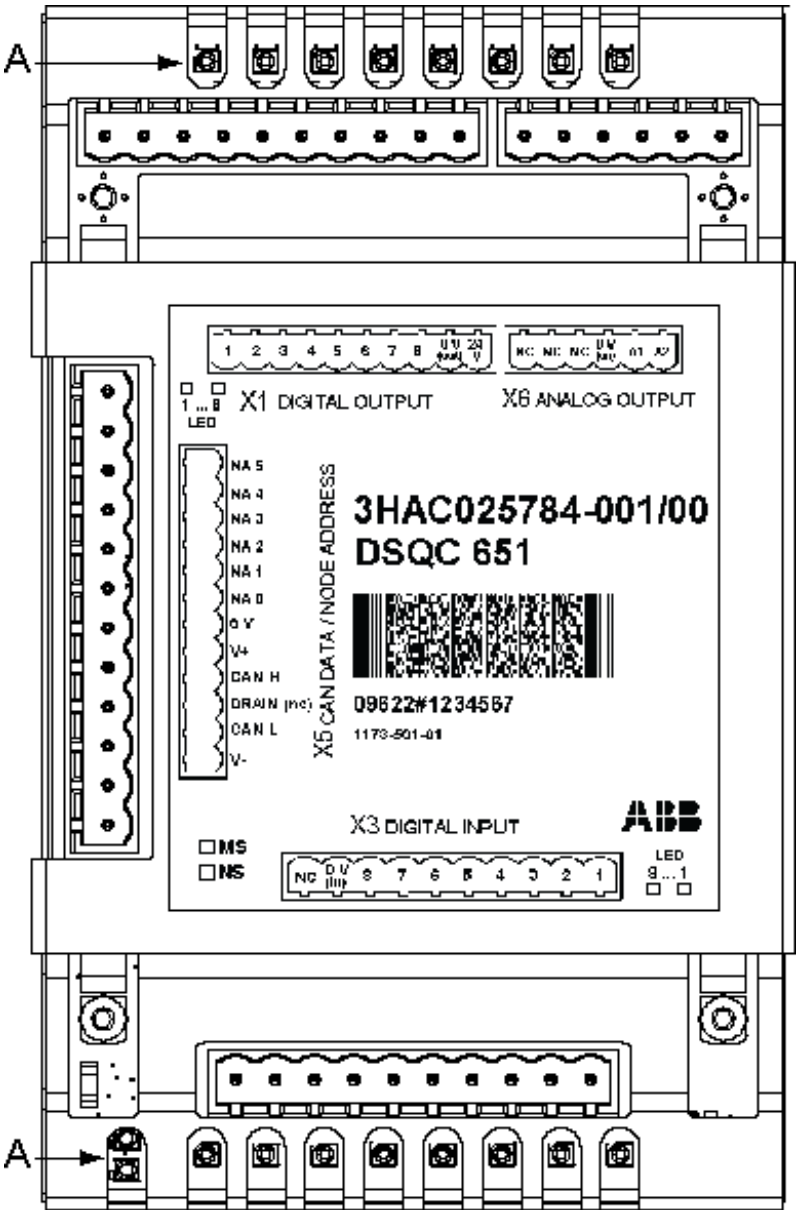
Description

The DSQC 651 is a circuit board normally mounted inside the robot controller. As an option, it may also be mounted in an external I/O module.

The combi I/O unit handles digital and analog communication between the robot system and any external systems.

Illustration

The following figure shows the DSQC 651 unit:



xx0600002853

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6.2.5 DSQC 651, AD combi I/O

Continued

Parts

The following table refers to the illustration in section *Illustration on page 83*.

Item	Description
A	Status LEDs
X1	Digital outputs See *Connector X1 on page 86* for connection table!
X3	Digital inputs See *Connector X3 on page 86* for connection table!
X5	DeviceNet connector See *Connector X5 on page 87*!
X6	Analog outputs See *Connector X6 on page 87*!

Facts, DSQC 651

This section specifies a number of facts applicable to the DSQC 651. Unless stated otherwise, the data applies to the standard version.

Technical data

Digital inputs	Number of digital inputs: 8 Rated voltage: • 24 VDC Input voltage range: • "1" ---> 15 to 35 V • "0" ---> -35 to 5 V Input current at rated voltage: • Typical ---> 5 mA (approx) Switch-over level: • Typical --->12V (approx) Delay (with default filtering): • Typical --->5 ms • minimum --->4 ms • maximum --->6ms Power dissipation or channel at rated voltage: • Typical --->150 mW (approx)
Digital outputs	Number of digital outputs: 8 Short-circuit protected outputs with current limitation and thermal overload protection. Miswiring protection +35V to – 35V connected to output. Rated voltage: • 24 VDC Voltage drop over output: • maximum ---> 0.5V with 500mA Rated output current: • 500 mA/channel Current limit: • Typical ---> 1.4A Leakage current: • maximum ---> 0.1 mA Delay output: • maximum ---> 0.5 ms

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Continued

Analog outputs	Number of analog outputs: 2 (galvanically isolated from the controller electronics) Short-circuit protected outputs Output voltage: • 0-10 VDC Load Impedance: • min 2 kohm Resolution: • 12 bits Inaccuracy (Over temperature range + 5 C to +70 C): • maximum 25 cmV (0.5 % of full scale)
Supply voltage	24 VDC
Power supply, digital, and analog I/O	Integrated power supply in controller. Separate 24 VDC power, supplied by customer in non-ABB external I/O unit.
External supply for digital outputs	Reverse polarity protection. Voltage: • 19 - 35 V
Analog supply	Analog supply +16/-8V internally on the board. From the DeviceNet cable 24 Volt. DC/DC converter“ flyback” Isolation voltage: • 500 VDC Voltage: • 16 V / -8V Current consumption: • 40mA (approx)
SW connections	Support for the following connections: • POLLED • Change-Of-State • Change-Of-State with acknowledge suppression (not supported by DeviceNet Lean) • Cyclic (not supported by DeviceNet Lean) • Cyclic with acknowledge suppression (not supported by DeviceNet Lean)

Unit setup

The unit must be given an address, and setup parameters must be entered into the system.

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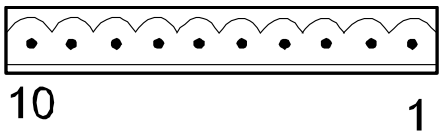
6.2.5 DSQC 651, AD combi I/O

Continued

Connector X1

If supervision of the supply voltage is required, a bridge connection can be made to an optional digital input. This also requires the particular unit to have a separate power supply, in order to be able to monitor the regular power supply voltage.

The supervision instruction must be written in the RAPID program.

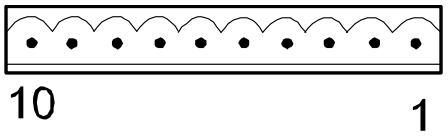


xx0200000264

The following table shows the connections to connector X1:

Unit function	Signal name	X1 pin
Optically isolated output	Out ch 1	1
Optically isolated output	Out ch 2	2
Optically isolated output	Out ch 3	3
Optically isolated output	Out ch 4	4
Optically isolated output	Out ch 5	5
Optically isolated output	Out ch 6	6
Optically isolated output	Out ch 7	7
Optically isolated output	Out ch 8	8
Optically isolated output	0 V for outputs	9
Optically isolated output	24 V for outputs	10

Connector X3



xx0200000264

The following table shows the connections to connector X3:

Unit function	Signal name	X3 pin
Optically isolated input	In ch 1	1
Optically isolated input	In ch 2	2
Optically isolated input	In ch 3	3
Optically isolated input	In ch 4	4
Optically isolated input	In ch 5	5
Optically isolated input	In ch 6	6
Optically isolated input	In ch 7	7
Optically isolated input	In ch 8	8
Optically isolated input	0 V for inputs	9
Optically isolated input	Not used	10

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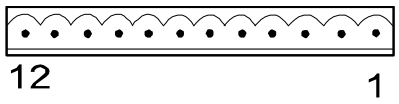
Continued

The input current is 5.5 mA (at 24 V) on the digital inputs. A capacitor connected to ground, to prevent disturbances, causes a short rush of current when setting the input.

When connecting outputs, sensitive to pre-oscillation current, a series resistor (100 Ohms) may be used.

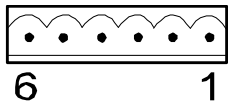
Connector X5



xx0100000244

Connector X5 is a DeviceNet connector specified in section *Setting DeviceNet Lean bus ID on page 56*.

Connector X6



xx0200000265

The following table shows the connections to connector X6:

Signal name	X6 pin	Explanation
-	1	No connection
-	2	No connection
-	3	No connection
0 VA	4	0 V for Out channels 1-2
AN_OCH1	5	Out channels 1
AN_OCH2	6	Out channels 2

LEDs

The significance of the LEDs are specified in section *DeviceNet Lean Bus and I/O board status LED description on page 51*.

Input map

The following figure shows the digital input mapping.

Input byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1	0-7
1	DI 16	DI 15	DI 14	DI 13	DI 12	DI 11	DI 10	DI 9	8-15

xx0300000613

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6.2.5 DSQC 651, AD combi I/O

Continued

Output map

The following figure shows the analog and digital output mapping.

> **Note**
>
> Pay attention to the order of the bits for the analog signals.

Output byte	Bit 7	6	5	4	3	2	1	0	Bit range
0	AO 1							LSB	0-15
1	MSB								
2	AO 2							LSB	16-31
3	MSB								
4	DO 8	DO 7	DO 6	DO 5	DO 4	DO 3	DO 2	DO 1	32-39

en0600002851

LSB	The *least* significant bit of the binary number representing the analog signal.
MSB	The *most* significant bit of the binary number representing the analog signal.

Numerical format

The numerical representation of the values are described in the following table:

Signal	Analog physical value	Hexadecimal number	Bit value
AO 1-AO 2	+10 V	0xFFFF	MaxBitVal = 65535
AO 1-AO 2	+5 V	0x7FFF	
AO 1-AO 2	0 V	0x0	MinBitVal = 0

Electronic Data Sheet

The Electrocic Data Sheet for the DeviceNet Master/Slave units, matching the configuration of DSQC 651 can be obtained from the RobotWare DVD, PC, or IRC5 controller. The EDS file, dsqc651.eds, for DSQC 651 is available at one of the following locations:

- **On the RobotWare DVD:** *<DVD-drive>:\utility\fieldbus\PROFIBUS\EDS*
- **On the PC where the RobotWare is installed:** *...\ABB Industrial IT\RoboticsIT\Mediapool\<RobotWare_xx.xx.xxxx>\utility\service\EDS*
- **On the IRC5 Controller:** *\hd0a\<RobotWare_xx.xx.xxxx>\utility\service\EDS*

Continues on next page

Additional information

The following table shows the physical type of the signals, resolution, and so on.

Signal	Type	Range	Resolution	Encoding type
AO 1	Voltage	0 V .. +10 V	12 bit	Unsigned
AO 2	Voltage	0 V .. +10 V	12 bit	Unsigned

6.2.6 DSQC 652, Digital I/O

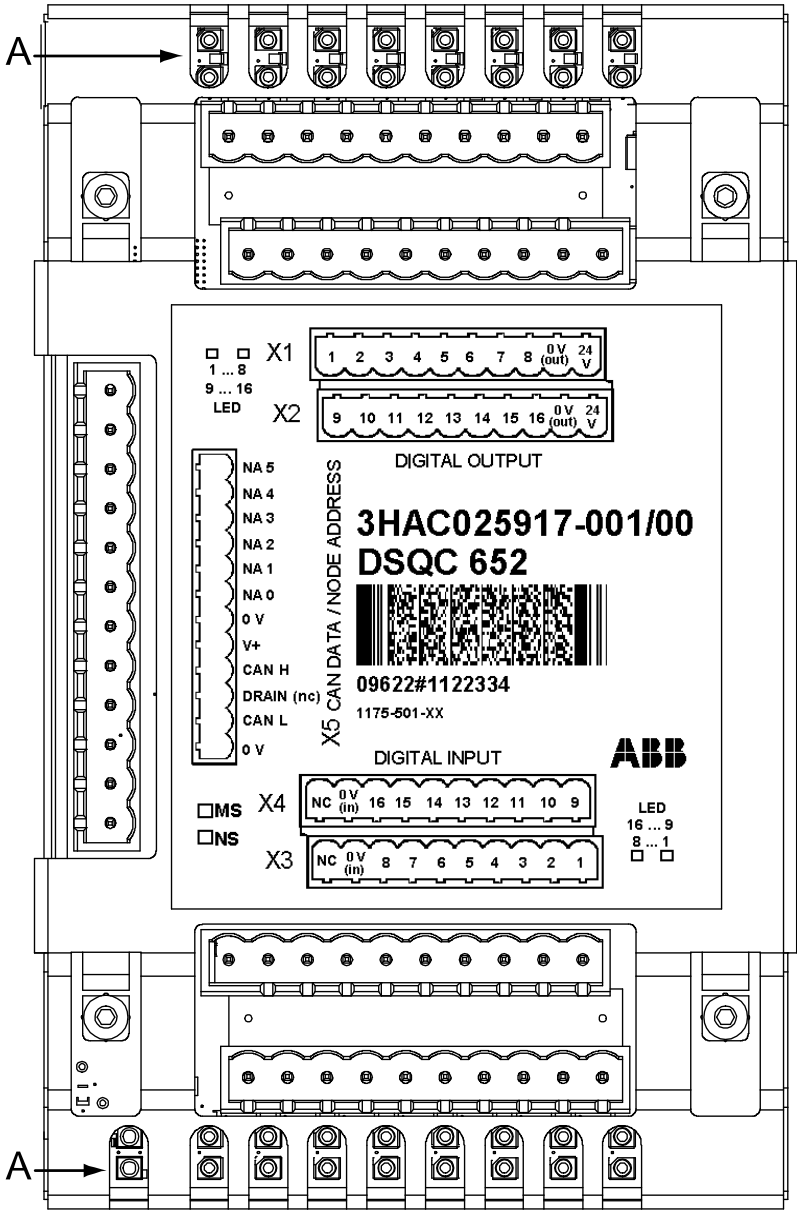
Description

The DSQC 652 is a circuit board normally mounted inside the robot controller. As an option, it may also be mounted in an external I/O module.

The unit handles digital input and output signals between the robot system and any external systems.

Illustration

The following figure shows the DSQC 652 board:



xx0600002855

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Parts

The following table refers to the illustration in section *Illustration on page 90*.

Item	Description
A	Status LEDs
X1	Digital outputs See section *Connector X1 on page 93* for connection table!
X2	Digital outputs See *Connector X2 on page 93*for connection table!
X3	Digital inputs See *Connector X3 on page 95* for connection table!
X4	Digital inputs See *Connector X4 on page 95* for connection table!
X5	DeviceNet connector See *Connector X5 on page 96*!

Facts, DSQC 652

This section specifies a number of facts applicable to the DSQC 652. Unless stated otherwise, the data applies to the standard version.

Technical data

Digital inputs	Number of digital inputs: 16 Rated voltage: • 24 VDC Input voltage range: • "1" ---> 15 to 35 V • "0" ---> -35 to 5 V Input current at rated voltage: • Typical ---> 5 mA (approx) Switch-over level: • Typical --->12V (approx) Delay (with default filtering): • Typical --->5 ms • minimum --->4 ms • maximum --->6ms Power dissipation or channel at rated voltage: • Typical --->150 mW (approx)

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6.2.6 DSQC 652, Digital I/O

Continued

Digital outputs	Number of digital inputs: 16 Short-circuit protected outputs with current limitation and thermal overload protection. Miswiring protection +35V to –35V connected to output. Rated voltage: • 24 VDC Voltage drop over output: • maximum ---> 0.5V with 500mA Rated output current: • 500 mA/channel Current limit: • Typical ---> 1.4A Leakage current: • maximum ---> 0.1 mA Delay output: • maximum ---> 0.5 ms
Supply voltage	24 VDC
Supply source	24 V I/O or separate external supply
External supply for digital outputs Reverse polarity protection.	Voltage: • 19 - 35 V
SW connections	Support for the following connections: • Polled • Change-Of-State • Change-Of-State with acknowledge suppression (not supported by DeviceNet Lean) • Cyclic (not supported by DeviceNet Lean) • Cyclic with acknowledge suppression (not supported by DeviceNet Lean)

Unit setup

The unit must be given an address, and setup parameters must be entered into the system.

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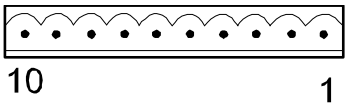
Connector X1

If supply voltage supervision is required, a bridge connection can be made to an optional digital input. The supervision instruction must be written in the RAPID program.



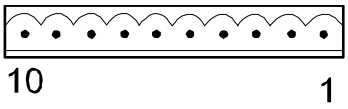
xx0200000264

The following table shows the connections to connector X1:

Unit function	Signal name	X1 pin
Optically isolated output	Out ch 1	1
Optically isolated output	Out ch 2	2
Optically isolated output	Out ch 3	3
Optically isolated output	Out ch 4	4
Optically isolated output	Out ch 5	5
Optically isolated output	Out ch 6	6
Optically isolated output	Out ch 7	7
Optically isolated output	Out ch 8	8
Optically isolated output	0 V for outputs	9
Optically isolated output	24 V for outputs	10

Connector X2

If supply voltage supervision is required, a bridge connection can be made to an optional digital input. The supervision instruction must be written in the RAPID program.



xx0200000264

The following table shows the connections to connector X2:

Unit function	Signal name	X2 pin
Optically isolated output	Out ch 9	1
Optically isolated output	Out ch 10	2
Optically isolated output	Out ch 11	3
Optically isolated output	Out ch 12	4
Optically isolated output	Out ch 13	5
Optically isolated output	Out ch 14	6
Optically isolated output	Out ch 15	7
Optically isolated output	Out ch 16	8
Optically isolated output	0 V for outputs	9

Continues on next page

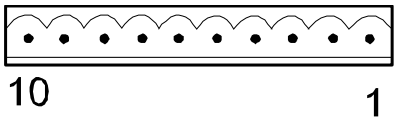
6.2.6 DSQC 652, Digital I/O

Continued

Unit function	Signal name	X2 pin
Optically isolated output	24 V for outputs	10

Continues on next page

Connector X3



xx0200000264

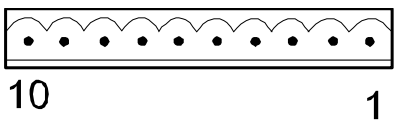
The following table shows the connections to connector X3:

Unit function	Signal name	X3 pin
Optically isolated input	In ch 1	1
Optically isolated input	In ch 2	2
Optically isolated input	In ch 3	3
Optically isolated input	In ch 4	4
Optically isolated input	In ch 5	5
Optically isolated input	In ch 6	6
Optically isolated input	In ch 7	7
Optically isolated input	In ch 8	8
Optically isolated input	0 V for inputs	9
Optically isolated input	Not used	10

The input current is 5.5 mA (at 24 V) on the digital inputs. A capacitor connected to ground, to prevent disturbances, causes a short rush of current when setting the input.

When connecting outputs, sensitive to pre-oscillation current, a series resistor (100 Ohms) may be used.

Connector X4



xx0200000264

The following table shows the connections to connector X4:

Unit function	Signal name	X4 pin
Optically isolated input	In ch 9	1
Optically isolated input	In ch 10	2
Optically isolated input	In ch 11	3
Optically isolated input	In ch 12	4
Optically isolated input	In ch 13	5
Optically isolated input	In ch 14	6
Optically isolated input	In ch 15	7
Optically isolated input	In ch 16	8
Optically isolated input	0 V for inputs	9

Continues on next page

6.2.6 DSQC 652, Digital I/O

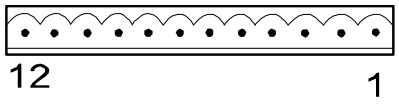
Continued

Unit function	Signal name	X4 pin
Optically isolated input	Not used	10

The input current is 5.5 mA (at 24 V) on the digital inputs. A capacitor connected to ground, to prevent disturbances, causes a short rush of current when setting the input.

When connecting outputs, sensitive to pre-oscillation current, a series resistor (100 ohms) may be used.

Connector X5



xx0100000244

Connector X5 is a DeviceNet connector specified in section *Setting DeviceNet Lean bus ID on page 56*.

LEDs

The significance of the LEDs are specified in section *DeviceNet Lean Bus and I/O board status LED description on page 51*.

Input map

The following figure shows the digital input mapping.

Input byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1	0-7
1	DI 16	DI 15	DI 14	DI 13	DI 12	DI 11	DI 10	DI 9	8-15

xx0300000613

Output map

The following figure shows the digital output mapping.

Output byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DO 8	DO 7	DO 6	DO 5	DO 4	DO 3	DO 2	DO 1	0-7
1	DO 16	DO 15	DO 14	DO 13	DO 12	DO 11	DO 10	DO 9	8-15

en0400000716

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Electronic Data Sheet

The Electrocic Data Sheet for the DeviceNet Master/Slave units, matching the configuration of DSQC 652 can be obtained from the RobotWare DVD, PC, or IRC5 controller. The EDS file, dsqc652.eds, for DSQC 652 is available at one of the following locations:

- **On the RobotWare DVD**: *<DVD-drive>:\utility\fieldbus\PROFIBUS\EDS*
- **On the PC where the RobotWare is installed**: *...\ABB Industrial IT\RoboticsIT\Mediapool\<RobotWare_xx.xx.xxxx>\utility\service\EDS*
- **On the IRC5 Controller**: *\hd0a\<RobotWare_xx.xx.xxxx>\utility\service\EDS*

6.2.7 DSQC 653, Digital I/O with relay outputs

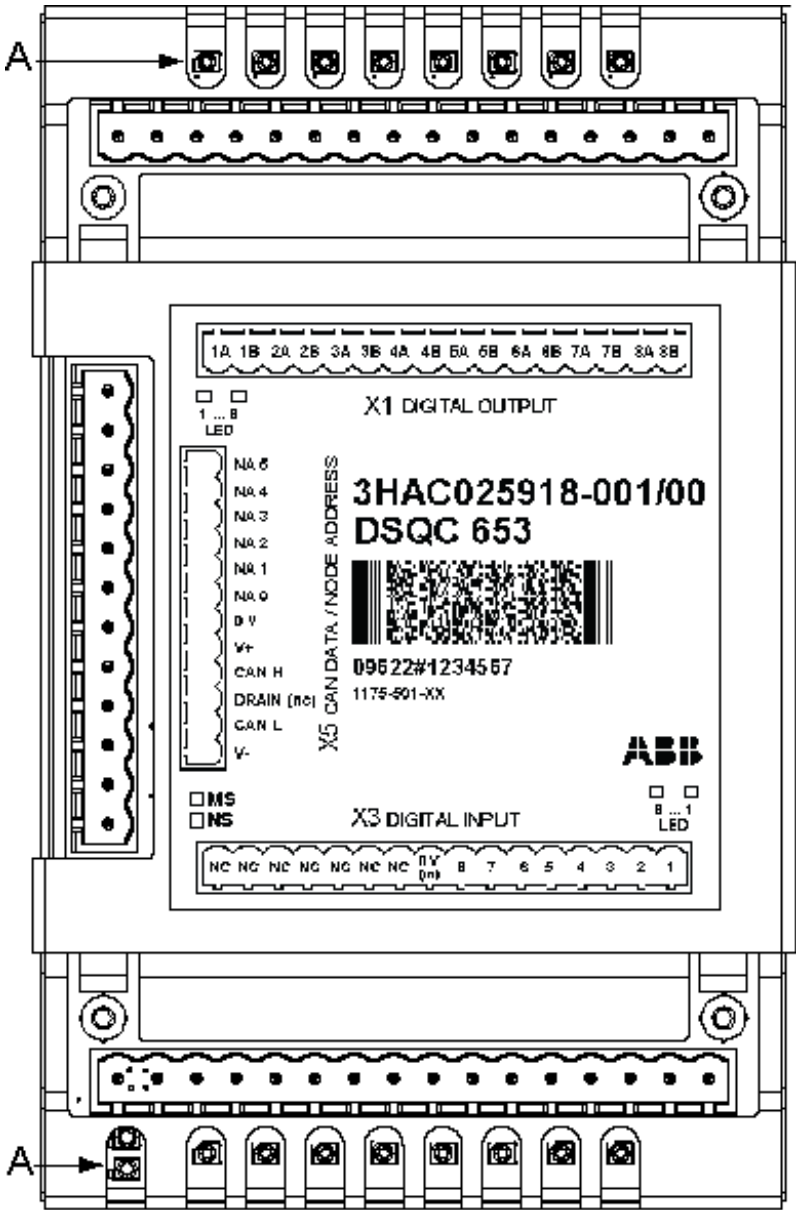
Description

The DSQC 653 is a circuit board normally mounted inside the robot controller. As an option, it may also be mounted in an external I/O module.

The unit handles input and output signals between the robot system and any external systems through relay outputs and digital inputs.

Illustration

The following figure shows the DSQC 653 board:



xx0600002857

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Parts

The following table refers to the illustration in section *Illustration on page 98*.

Item	Description
A	Status LEDs
X1	Relay outputs See section *Connector X1 on page 101* for connection table!
X3	Digital inputs See section *Connector X3 on page 102*for connection table!
X5	DeviceNet connector See section *Connector X5 on page 102*!

Facts, DSQC 653

This section specifies a number of facts applicable to the DSQC 653. Unless stated otherwise, the data applies to the standard version.

Technical data

Digital inputs	Number of digital inputs: 8 Rated voltage: • 24 VDC Input voltage range: • "1" ---> 15 to 35 V • "0" ---> -35 to 5 V Input current at rated voltage: • Typical ---> 5 mA (approx) Switch-over level: • Typical --->12V (approx) Delay (with default filtering): • Typical --->5 ms • minimum --->4 ms • maximum --->6ms Power dissipation or channel at rated voltage: • Typical --->150 mW (approx)
Relay outputs	Number of relay outputs: 8 Single pole with one make contact (normally open) Rated voltage • 24 VDC/120 VAC rms Rated output current • 2 A/channel Output load • minimum 2.5 VA/channel Delay time on board • Typical - 6 ms (make contact), 7 ms (break contact)
Supply voltage	24 VDC
Supply source	24 V I/O or separate external supply
External supply for relay outputs	Voltage • 19 - 35 VDC, 24 - 140 VAC rms

Continues on next page

6.2.7 DSQC 653, Digital I/O with relay outputs

Continued

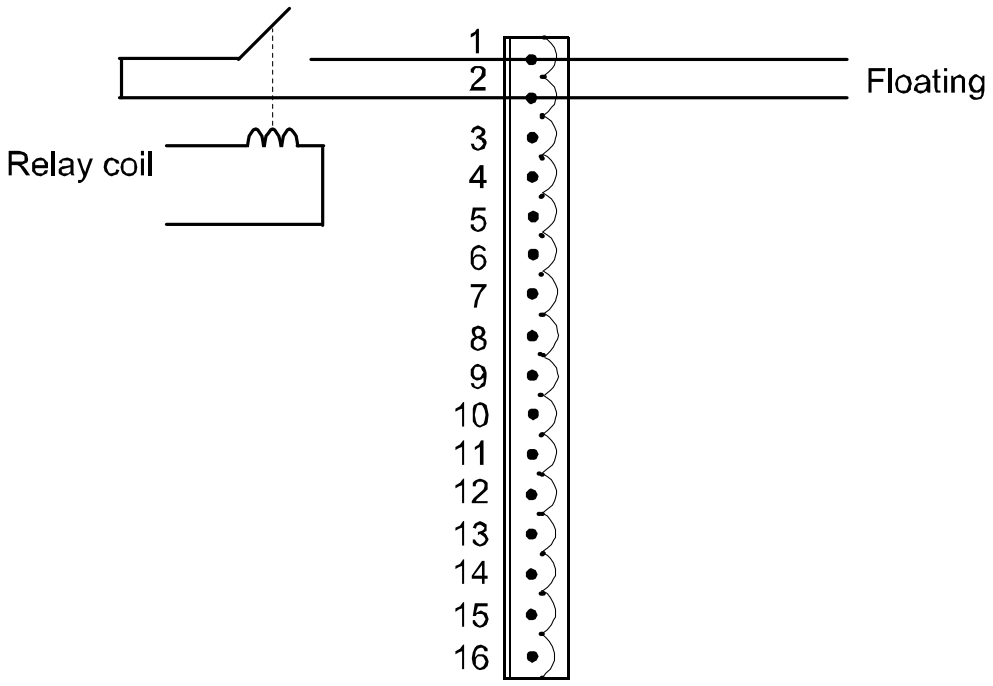
SW connections	Support for the following connections: • Polled • Change-Of-State • Change-Of-State with acknowledge suppression (not supported by DeviceNet Lean) • Cyclic (not supported by DeviceNet Lean) • Cyclic with acknowledge suppression (not supported by DeviceNet Lean)

Unit setup

The unit must be given an address, and setup parameters must be entered into the system.

Connecting digital outputs and digital inputs

The following illustration shows how to connect the relay outputs for the connector X1. When a bit is set to 1, the relay output will be activated.



en0500001565

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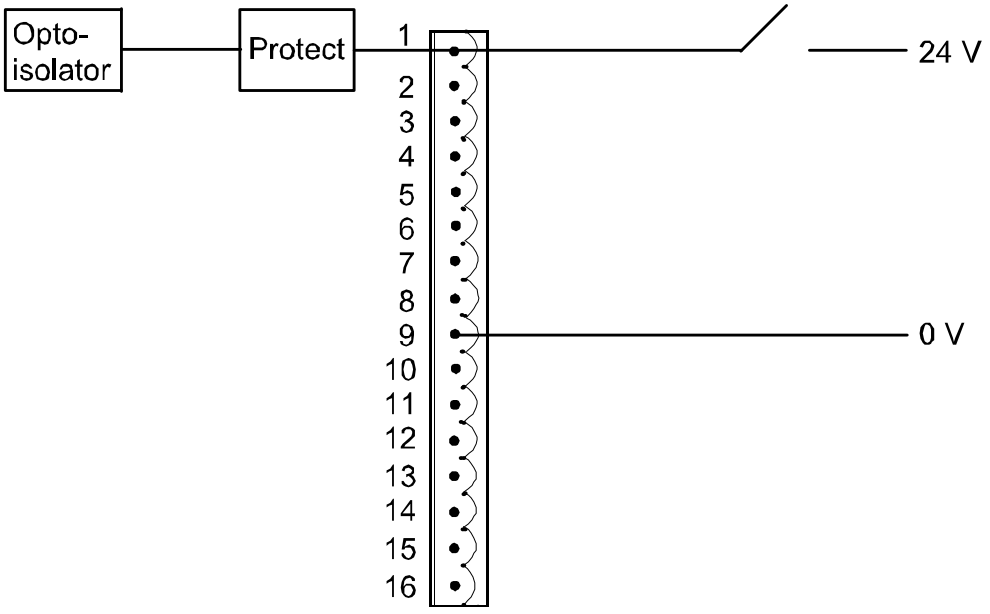
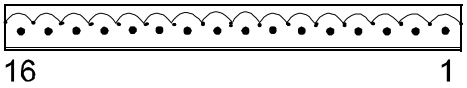
Continued

The following illustration shows how to connect the digital inputs for the connector X3.



en0500001566

Connector X1



xx0100000235

The following table shows the connections to connector X1:

Signal name	X1 pin	Function
Out ch 1a	1	Contact, relay 1
Out ch 1b	2	Contact, relay 1
Out ch 2a	3	Contact, relay 2
Out ch 2b	4	Contact, relay 2
Out ch 3a	5	Contact, relay 3
Out ch 3b	6	Contact, relay 3
Out ch 4a	7	Contact, relay 4
Out ch 4b	8	Contact, relay 4
Out ch 5a	9	Contact, relay 5
Out ch 5b	10	Contact, relay 5
Out ch 6a	11	Contact, relay 6
Out ch 6b	12	Contact, relay 6
Out ch 7a	13	Contact, relay 7
Out ch 7b	14	Contact, relay 7
Out ch 8a	15	Contact, relay 8

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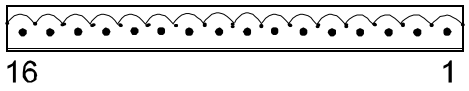
6.2.7 DSQC 653, Digital I/O with relay outputs

Continued

Signal name	X1 pin	Function
Out ch 8b	16	Contact, relay 8

Connector X3



xx0100000235

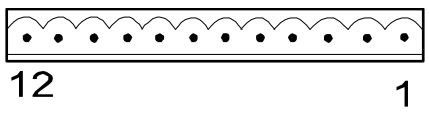
The following table shows the connections to connector X3:

Signal name	X3 pin
In ch 1	1
In ch 2	2
In ch 3	3
In ch 4	4
In ch 5	5
In ch 6	6
In ch 7	7
In ch 8	8
0 v for inputs	9
Not used	10
Not used	11
Not used	12
Not used	13
Not used	14
Not used	15
Not used	16

The input current is 5.5 mA (at 24 V) on the digital inputs. A capacitor connected to ground, to prevent disturbances, causes a short rush of current when setting the input.

When connecting outputs, sensitive to pre-oscillation current, a series resistor (100 Ohms) may be used.

Connector X5



xx0100000244

Connector X5 is a DeviceNet connector specified in section *Setting DeviceNet Lean bus ID on page 56*.

Continues on next page

LEDs

The significance of the LEDs are specified in section *DeviceNet Lean Bus and I/O board status LED description on page 51*.

Input map

The following figure shows the digital input mapping.

Input byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1	0-7

en0600002850

Output map

The following figure shows the digital output mapping.

Output byte	Bit								Bit range
	7	6	5	4	3	2	1	0	
0	DO 8	DO 7	DO 6	DO 5	DO 4	DO 3	DO 2	DO 1	0-7

en0600002849

Electronic Data Sheet

The Electrocic Data Sheet for the DeviceNet Master/Slave units, matching the configuration of DSQC 653 can be obtained from the RobotWare DVD, PC, or IRC5 controller. The EDS file, dsqc653.eds, for DSQC 653 is available at one of the following locations:

- **On the RobotWare DVD**: *<DVD-drive>:\utility\fieldbus\PROFIBUS\EDS*
- **On the PC where the RobotWare is installed**: *...\ABB Industrial IT\RoboticsIT\Mediapool\<RobotWare_xx.xx.xxxx>\utility\service\EDS*
- **On the IRC5 Controller**: *\hd0a\<RobotWare_xx.xx.xxxx>\utility\service\EDS*

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