The heart of Robotics

Product Manual

Control Cabinet, IRC5P

3HNA009834-001 en Rev.06

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3HNA009834-001 en Rev.06

First Edition: 10 Dec. 2007
Last Revised: 08 October 2010

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Product Manual, Control Cabinet IRC5P

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Product Manual, Control Cabinet IRC5P

This manual provides information on the installation of the IRC5P control cabinet and associated systems, and instructions for performing preventive maintenance and repair.

WARNING! Before performing any work described in this manual, the Safety Manual must be read and understood. Work must only be performed by skilled personnel with the proper training.

The Safety Manual is included in the Software and Documentation DVD following each robot, and is also shipped with the robot as paper copy, included in the control cabinet.

1 Introduction

About This Manual

This manual contains instructions for:

- Mechanical installation and electrical connections of the controller (control cabinet), purge unit and electrical connection of various external systems.
- Maintenance of the controller.
- Mechanical and electrical repair of the controller (component replacement instructions).

Usage

This manual should be used during:

- Installation.
- Maintenance work.
- Repair work.

Who Should Read This Manual?

This manual is intended for:

- Installation personnel.
- Maintenance personnel.
- Repair personnel.

Prerequisites

The reader should:

- Be a trained installer, maintenance an/or repair craftsman.
- Have the required knowledge of mechanical and electrical installation, maintenance and repair work.

Organization of Chapters

The manual is organized in the following chapters:

#	Chapter	Description
1	Introduction	This chapter.
2	Safety	Safety information which must be studied before performing any work on the system.
3	System Description	Information on design of the controller, pendant and purge unit.
4	Technical Specifications	Specifications for controller, pendant and purge unit.
5	Installation and Commissioning	Information about installation of the controller, purge unit and associated connections.
6	Preventive Maintenance	Information about maintenance work, including maintenance schedules.
7	Repair	Information about replacing components in the controller.
8	Trouble Shooting	Description of LED indicators on controller front and general trouble shooting information.
9	Decommissioning	General information for decommissioning the controller

#	Chapter	Description
10	Reference Information	Information about cables, connectors, bonding and screw tightening torques

References

Following manuals are referred to in this manual.:

Safety Manual 3HNA008924-001	This manual must be read before any work on the robot is performed.
Unit Description, IRC5P 3HNA009628-001	Includes technical description of the control system electronics etc.
Unit Description, Paint 3HNA012856-001	Includes technical description of the units used in the paint system.
Operator’s Manual, IRC5P 3HNA008861-001	Includes instructions for setting up conveyor tracking, entering calibration data etc.

2 Safety

Safety Information

Before performing any work described in this manual, it is extremely important that all safety information is observed!

There are general safety aspects that must be read through, as well as more specific safety information that describes danger and safety risks when performing the procedures. Read the Safety Manual before performing any service work.

WARNING! Before performing any work described in this manual, the Safety Manual must be read and understood. Work must only be performed by skilled personnel with the proper training.

Potential Hazards

The following lists some of the most relevant hazards. The list is intended as a short reference and is no substitute for reading the complete Safety Manual.

- The robot is a powerful machine. Always make sure that nobody is within the reach of the robot when running the robot for test etc.
- Releasing the robot axis brakes can be potentially dangerous. Never release the brakes unless you know the risks involved.
- The robot is normally installed in a hazardous area where there are risks of explosion. Always consider these risks when working with the robot and bringing tools and equipment into the area.
- The robot may be working with fluids which may be toxic, at high temperatures and/or pressure. Always pay attention when working with such fluids.
- Always be aware of hazards associated with electric power when working with the robot.
- Always be aware of hazards related to the applicator. These can be dangers related to the electrostatic high voltage or the bell cup on the bell atomizer.

3 System Description

3.1 Introduction

About this Chapter

This chapter provides an overview of the design of the control cabinet, pendant and purge unit.

WARNING! Repair work on the control cabinet must only be performed in accordance with procedures given in the Repair chapter in this manual.

References

For detailed description of the function of the different control systems in the control cabinet and purge unit, see ‘Unit Description, IRC5P’.

For detailed description of the operation of the pendant, see ‘Operator’s Manual, IRC5P’.

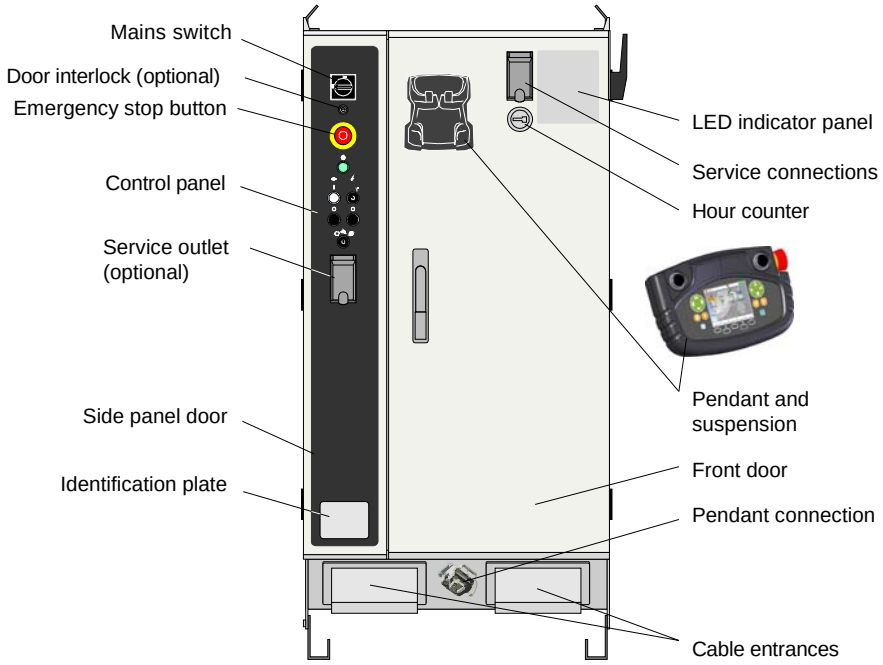
3.2 Basic Design

3.2.1 Front Components

General

The control cabinet is available in one version as shown in the illustration below. The cabinet has a side panel at the left and a front door. Both panel and door can be opened to get access to the cabinet internal components and connection points.

Figure 1 Control cabinet front



Control Panel

The control panel includes following functions:

Mains switch	Switches mains power on/off to the robot
Emergency stop button	Pressing the button will immediately stop the robot operation, remove power from the axis motors and activate the axis brakes.
Purge OK indicator	Indicates when the purge sequence is completed.
Motor on/off	Apply / remove power to the axis motors.
High voltage on/off	Apply / remove high voltage to the applicator (optional)
Mode selector	Set the robot to Manual Reduced Speed mode, Manual High Speed mode or Automatic mode.

For detailed description of the control panel functions, see ’Control Panel Description’ on page 27.

The robot may be supplied without control panel on the control cabinet. The reason for this may be that the control panel is to be installed in an external control desk, or that the robot is controlled from an external PLC via serial lines.

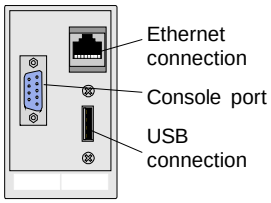
Service Outlet

Optional power outlet for service (measuring instruments etc.).

Service Connections

The service connections include the following connections.

Figure 2 Service connections



– Ethernet connector for connection of a PC for loading programs, program backup etc.
– PIB Console port for monitoring and debugging CAN nodes for service purposes (typically IPS system). The connector is connected to PIB-X12.
– USB connector for connection of USB memory stick.

CAUTION! Only memory sticks recommended by ABB must be used. Using other memory sticks than recommended may cause RobotWare system failure.

For more information on the service connections, see ‘Operator’s Manual, IRC5P’, Installation and Commissioning / Connections.

Pendant

The pendant (Paint Teach Pendant Unit, PTPU, or TPU) is used to perform robot-near tasks, like jogging.

For description, see ’Pendant Description’ on page 29.

LED Indicator Panel

The LEDs on the panel are used during service and operation to watch system status.

For detailed description of the LEDs, see ’LED Indicator Panel’ on page 197.

Hour Counter

The hour counter measures system running hours (when axis motors are ‘on’).

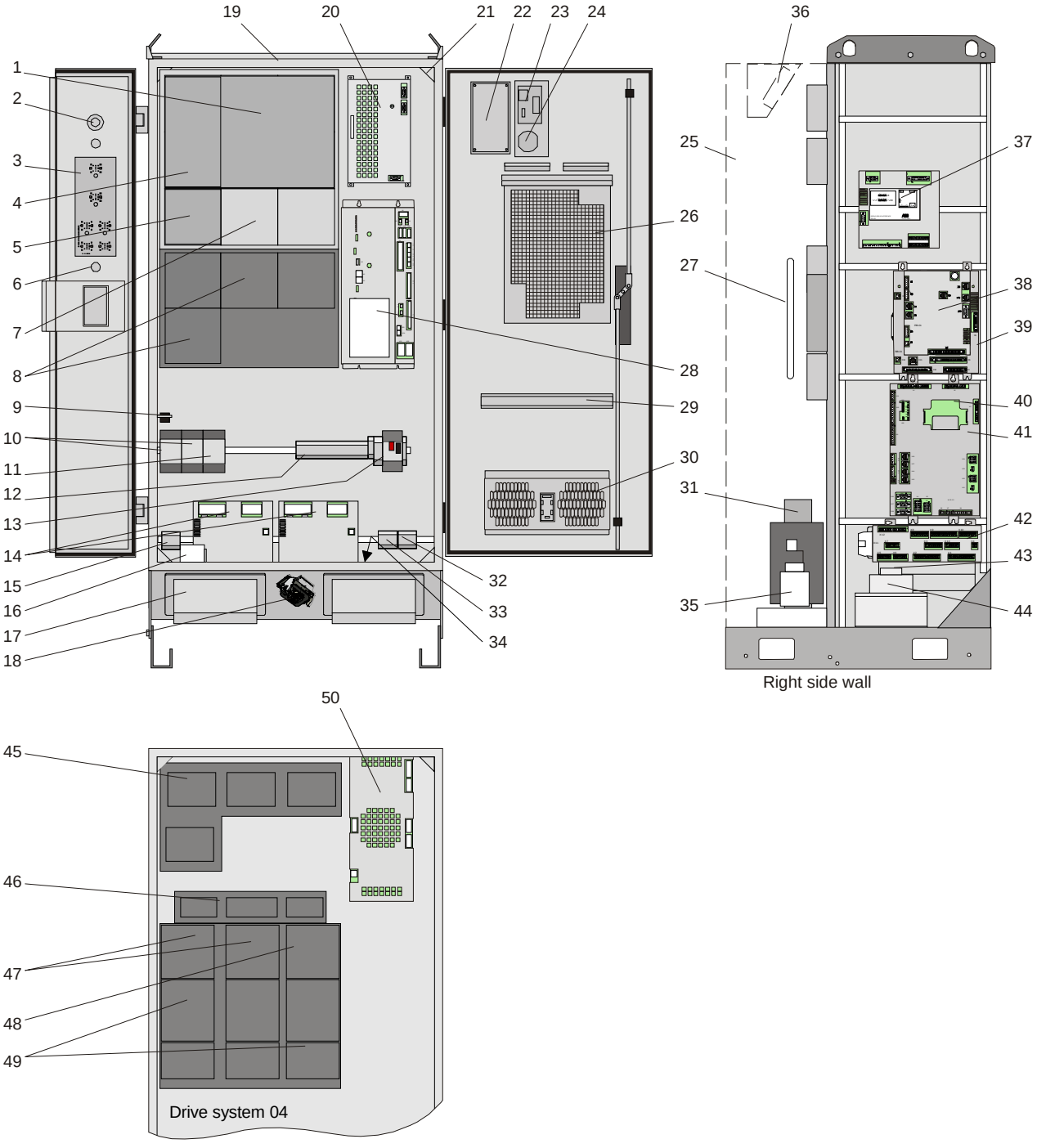
3.2.2 Internal Components

General

The following description and illustration give a brief summary of the main components.

For overview of connections in the control cabinet, see 'Controller Connections Overview' on page 42.

Figure 3 Control cabinet, component overview



1	Main drive unit, MDU	26	Main computer unit
2	Mains power switch	27	Brake resistor bleeders
3	Control panel board, CPB	28	Power distribution board, PDB
4	Additional rectifier unit, ARU	29	Rail for mounting optional units
5	Additional drive unit, ADU, axis 7	30	Door fan unit
6	Mode selector	31	Transformer
7	Additional drive unit, ADU, axis 8	32	CAN1.2 for external distributed I/O
8	CBS drive units	33	CAN1.1 for internal distributed I/O
9	Manipulator connections	34	Ground rail
10	Motor relays robot / pump	35	Choke filter (IRB 5500)
11	CBS Purge relay (IRB 5500)	36	Servo fan unit
12	Transformer terminal board	37	Servo drive interface board, SDI
13	PDB fuse	38	Paint interface board, PIB
14	Optional I/O units (field bus nodes)	39	Safety interface board, SIB
15	Optional servo disconnect terminal	40	Measuring system battery
16	Mains fuse and connection	41	Manipulator interface board, MIB
17	Cable inlet	42	Safety connection board, SCB
18	Pendant connector and TIB board	43	Mains fuse
19	Optional internal light	44	Mains filter
20	Axis computer board, DSQC 668	45	CBS drive units / Non I-Drive pump motors
21	Door switch	46	Capacitor unit
22	System LED board, ALED	47	Axis 7/8 drive units
23	Service connections	48	Rectifier unit
24	Hour counter	49	Axis motor drive units
25	Cabinet rear housing	50	Axis computer board, DSQC 601

Motor Drivers

The drive units and associated rectifiers are used for controlling the manipulator axis motors (axis motor drivers) and non I-Drive paint pumps (pump motor drivers). The bleeder resistors are used for the drivers to bleed off excessive power.

Fan Unit

The fan unit provides for air circulation through the rear side of the control cabinet. Air is sucked into the cabinet via a filter at the top and routed passed the motor drivers, bleeder resistors and transformer. The components that produce the most heat emission are located on the back panel.

Mains Power Units

Mains power is entered into the controller via terminals on the mains fuse and noise filter. The mains transformer located on the rear side provides the voltages needed by the control systems.

Computer Systems

The computer system for the robot consists of the main computer, mounted on the front door, and the axis computer installed on the cabinet back wall.

Paint Interface Board, PIB	The Paint Interface Board PIB is the central interface between the control system and the paint application equipment.
Safety Interface Board, SIB	The Safety Interface Board SIB contains most of the electromechanical parts of the safety chains. The board acts as interconnection point between the Manipulator Interface Board (MIB) and the Paint Interface Board (PIB).
Power Distribution Board, PDB	The Power Distribution Board PDB provides 24 V DC voltages for the robot control system electronics with separate current limits.
Manipulator Interface Board, MIB	The Manipulator Interface Board MIB serves as interface between the control system and manipulator / process equipment. The board is equipped with zener barriers for purge sensor and battery supply for the manipulator (measuring system).
Safety Connection Board, SCB	The Safety Connection Board SCB includes connections for the various safety functions for the robot and also connections for encoders and external panel. The board includes only connectors and no active components.
Pendant Interface Board, TIB	The Pendant Interface board TIB is a connection board for routing signals between the pendant and Safety Interface board SIB. The board also includes connection for Exi Sync Signal.
Remote Service	The control cabinet can optionally contain a remote service box. The box can be installed on the inside of the door on the rail for mounting optional units. For more information on remote service, see ‘Product Manual, Remote Service’.
Internal Light	Optionally the control cabinet includes an internal LED light and associated adapter. The light is switched on/off by the door switch.
Door Switch	The door switch switches ‘on’ the optional internal light and switches ‘off’ the optional cooler when the front door is opened.

3.2.3 Cabinet Labelling

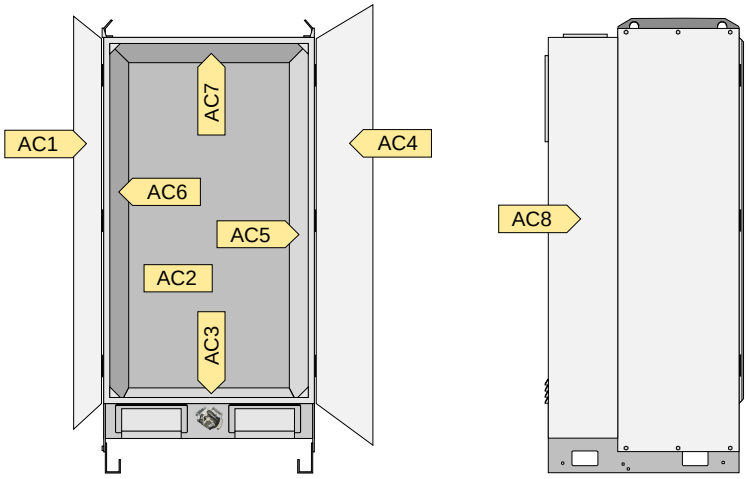
General

Following naming conventions should be noted when working with the controller.

Control Cabinet Panels

The different components, connectors and terminal boards are located on the cabinet back wall and side wall etc. Each of these panels are labelled AC1, AC2, etc. as described below.

Figure 4 Control cabinet panels



AC1	Panel door	AC5	Right side wall
AC2	Back wall	AC6	Left side wall
AC3	Bottom plate	AC7	Top plate
AC4	Front door	AC8	Cabinet rear side

Connection Labelling

Connectors are labelled X1, X2, etc., and terminal boards are labelled XT1, XT2, etc.

A connector or terminal board located on one of the cabinet panels is labelled with the designation of the panel in addition to the name of the connector (or terminal board), e.g. +2-XT1 which means terminal board XT1 located on the cabinet back wall AC2.

A connector or terminal board located on one of the units in the cabinet is labelled with the name of the unit in addition to the name of the connector (or terminal board), e.g. MIB-X22 which means connector X22 on the MIB unit.

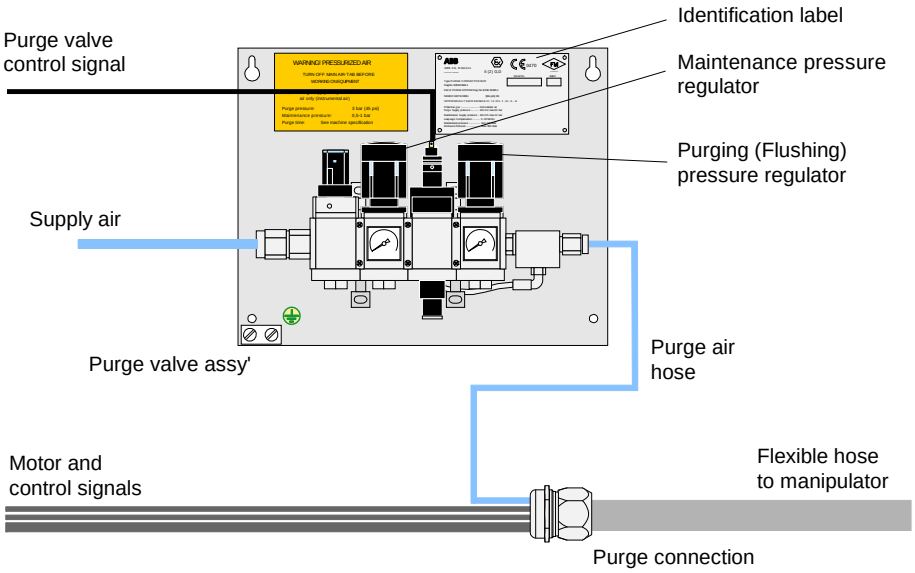
3.2.4 Purge System

General

When the robot is installed in an area where explosion hazard is present, it is equipped with a purge system. The purpose of this system is to apply compressed air in the manipulator. The compressed air is kept at a higher pressure than the atmospheric pressure and so preventing hazardous gases from entering the manipulator interior.

For more details on the purge unit, see ‘Unit Description, IRC5P’, Purge System.

Figure 5 Purge unit design



Description

The purge valve assembly includes various valves for controlling and regulating the purge air supply to the robot. Supply air is connected to the purge unit and, via the control valves, routed to the manipulator via the purge connector and flexible hose.

Versions

Different versions of the purge unit are available:

The purge unit shown in the above illustration is used for all stand-alone robots.

For robots operating on a trolley, a different type of purge unit, called ‘Purge Unit with Connector Box’, is used. This purge unit includes a purged chamber with cable connections. The main reason for using this type is to provide flexible cables via the trolley cable chain. For information on this purge unit type, see ’Purge Unit w/Connector Box’ on page 111.

3.2.5 Identification Labels

Description

Identification plates/labels indicating the type of device and serial number etc., are found on the control cabinet, purge unit, pendant, Pendant Interface Board TIB, Manipulator Interface Board MIB, Pressure Sensor Interface Board PSIB, Digital Sensor Interface Board DSIB and manipulator.

The identification labels are located on the control cabinet front (Figure 1), purge unit front (Figure 5), pendant rear (Figure 13), and on the boards.

Note: The identification labels shown in the illustrations below only serve as examples. For exact identification, see labels on your devices.

Identification plate for manipulator is shown in ‘Product Manual, Manipulator’.

Figure 6 Control cabinet identification plate

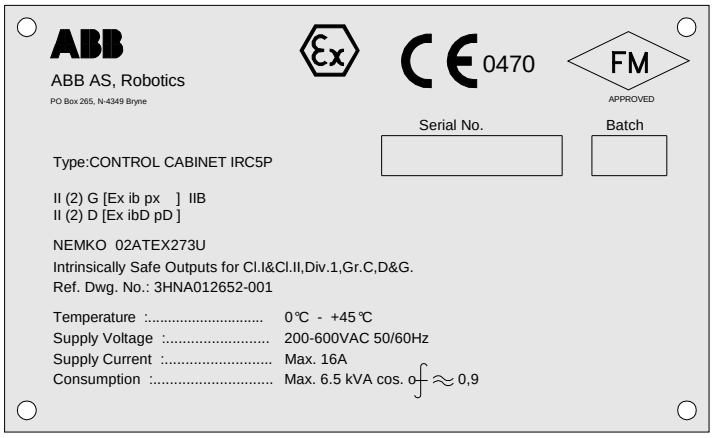


Figure 7 Purge unit identification plate

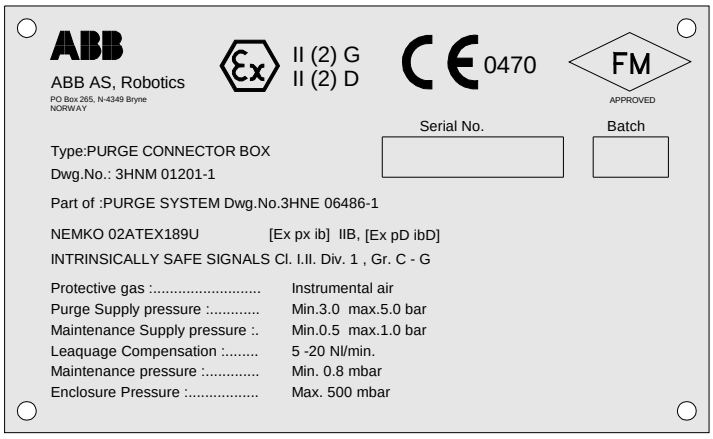


Figure 8 Pendant identification label

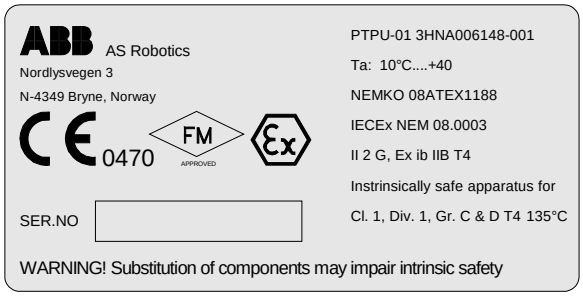
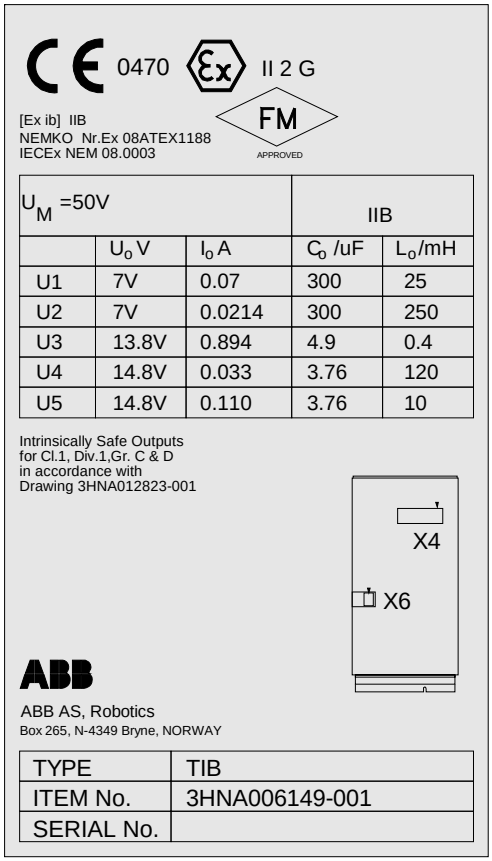


Figure 9 TIB adapter identification label



U_M =50V			IIB	
	U_o V	I_o A	C_o /uF	L_o/mH
U1	7V	0.07	300	25
U2	7V	0.0214	300	250
U3	13.8V	0.894	4.9	0.4
U4	14.8V	0.033	3.76	120
U5	14.8V	0.110	3.76	10

Figure 10 MIB adapter identification label

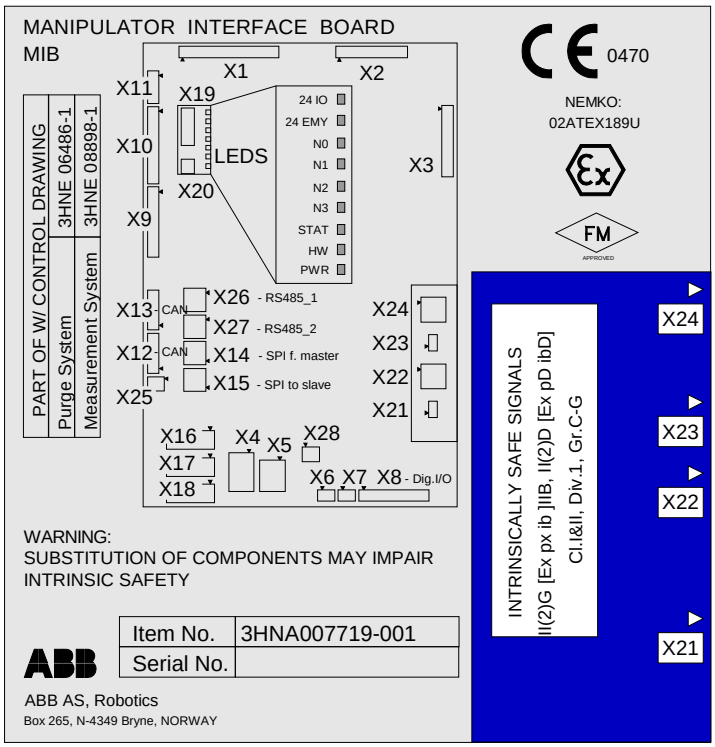


Figure 11 PSIB identification label

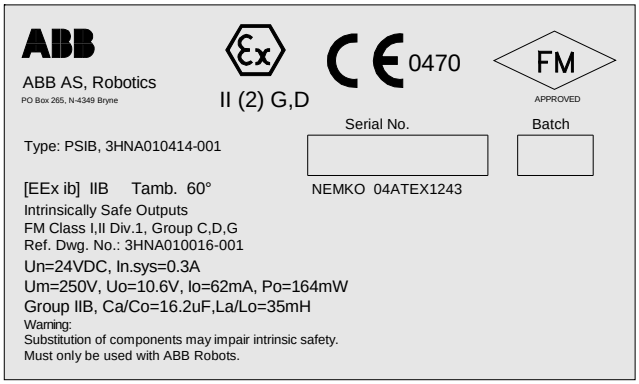
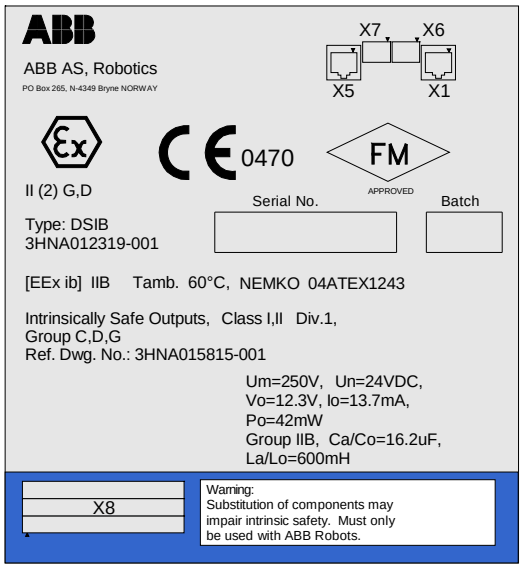


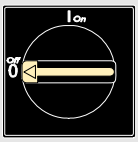
Figure 12 DSIB identification label



3.3 Control Panel Description

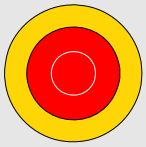
Panel Overview

The following gives a description of the control panel switches and indicators.



Mains Power Switch, QS1

Switch for applying mains power to the robot system.

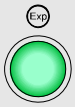


Emergency Stop Button, SB3

Push/pull button for instant stop of the robot regardless of operating mode.

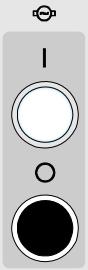
To reactivate emergency stop chain, the button must be released (pulled out or rotated clockwise), then the Motor On button must be used.

If pressed during a program, operation can not be resumed on the same object.



Purging OK Indicator, HL1

Indicator lamp informing the user when the purge sequence is completed at start-up and the robot is ready for operation.



Motor On/Off Switches, SH4/SB5

Used to enable (I) or disable (0) electrical power for the manipulator axis motors.

The indicator in the ‘on’ button will be lit when power is applied. (Motor ‘on’ is one of many conditions for applying power).

The Motor On switch is also used to reset the emergency stop chain and to enable run chain in Manual mode.

Continuous light: Ready for program execution.

Fast flashing light: (4Hz): The robot is not calibrated or revolution counters are not updated. The motors have been switched on. By fast flashing, call for service assistance.

Slow flashing light: (1Hz): One of the spray booth safety switches is active. The motors have been switched ‘off’.

High Voltage On/Off Key Switch, SA7/SB8

Toggle key switch used to switch power for high voltage equipment on (“I”), and button used to switch power for high voltage equipment off (0).

Toggle key switch means that the switch returns to off position when released, as indicated by the (“I”) notation.

The switch is only applicable if the robot is fitted with HV controller.

Operating Mode Selector, SA1

Key switch used to lock the robot in one of the following 3 operating modes:

Automatic / mode: Used for running ready-made programs in production. Joystick can not be used.

Manual Reduced Speed / mode: Manual mode for programming and setup. Max. speed: 250 mm/s (600 inches/min.)

Manual High Speed / mode: Manual mode for testing at full program speed.

WARNING:
The Mode Selector is a key type switch, intended to increase personal safety. When operating within the working area of the robot, the switch shall always be in Manual mode, and the operator shall keep the key with him so it is not possible for other persons to take over control of the robot.

IMPORTANT:
In Manual High Speed mode, the System Speed is by default set to a low value. This is a safety feature to avoid a ‘high speed surprise’ in case the key switch was set one notch too far when switching to programming mode. The system speed must be set to 100% manually in order to obtain full speed.

Mode Change Acknowledge
When leaving Manual Reduced Speed mode, an Acknowledge input is required. If operated from the pendant, a dialog for this purpose is shown. For systems controlled by a PLC or RobView, there is a Paint Command available for this purpose.

3.4 Pendant Description

Description

The pendant (Paint Teach Pendant Unit, PTPU) is a device to perform robot-near tasks, like jogging. The pendant may be placed in the pendant suspension on the control cabinet front.

The pendant includes a display and control keys for operating the robot. In addition, the pendant includes 2 joysticks, Emergency Stop button and on the rear an Enabling Device.

For detailed description of the operation of the pendant, see ‘Operator’s Manual, IRC5P’.

Figure 13 Pendant design

The pendant is connected to the pendant connector at the bottom front of the control cabinet.

Optionally, the pendant may also be connected via hot plug connection or external pendant connection. For further information, see ’Pendant Connection’ on page 103.

Important: If the pendant is not connected, a dummy connector must be installed in its place to avoid breaking the emergency stop chain.

The pendant and connection are explosion protected Exi for operation in hazardous areas.

4 Technical Specifications

4.1 Introduction

About this Chapter

This chapter provides technical specifications on the IRC5P Controller, Pendant and Purge Unit.

WARNING! Repair work on the controller must only be performed in accordance with procedures given in the Repairs chapter in this manual.

4.2 Controller Specifications

General Specifications

Dimensions	See Figure 14
Weight:	180 - 200 Kg (Depending on supplied options)
Airborne noise level:	< 70 dB (A) Leq (acc. to Machinery directive MD 2006/42/EC) (The sound pressure level outside the working space)
Color specification:	Grey NCS 2502B
Ingress protection degree:	IP54
Ambient temperature:	Max. 48°C
Temperature for complete robot system during transportation and storage:	-25°C - +55°C
Relative humidity:	Max. 95% Non-condensing. (Complete robot during transportation, storing and operation)
Internal light:	LED light (optional)

Important: The max. ambient temperature for the controller does not apply under the following circumstances: The controller is covered with plastic or other material which restricts heat emission, the controller does not have sufficient clearance at the back and sides (see 'Cabinet Location' on page 48), more cabinets are installed close together, the controller is installed close to a heat source, items (e.g. a ring binder) are placed on top of the controller and acts as temperature insulation, the controller is dirty, the controller fans are not running, the fan air inlet/outlet is restricted, the robot is programmed with excessive acceleration etc.

Power Supply

Mains voltage:	200-600VAC, three-phase, +10%, -15%
Mains fuse:	Min. 16A (slow blow)
Mains frequency:	48.5 to 61.8 Hz
Power consumption:	
- Stand by:	<300 W
- Production (average):	<700 - 1500 W
Absolute measurement backup:	7000 h (non-rechargeable battery)

Service Connections

Service connections available on front of the cabinet door.

Ethernet connector:	10 Mbit/s: Shielded twisted pair (10 Base T STP) 100 Mbit/s (<10 m): CAT5E, 100 Base T STP 100 Mbit/s (10-100 m): CAT6, 100 Base T STP
ACA Console port:	RS232 (Baud rate 9600 Bd, flow control Xon/Xoff)
USB connector:	USB memory stick (to be ordered from ABB)

Inputs and Outputs

Different types of distributed I/O units can be installed. The following table shows the maximum number of physical signals that can be used on each unit. For more details, see technical specifications for relevant unit in ‘Unit Description, IRC5P’, Distributed I/O.

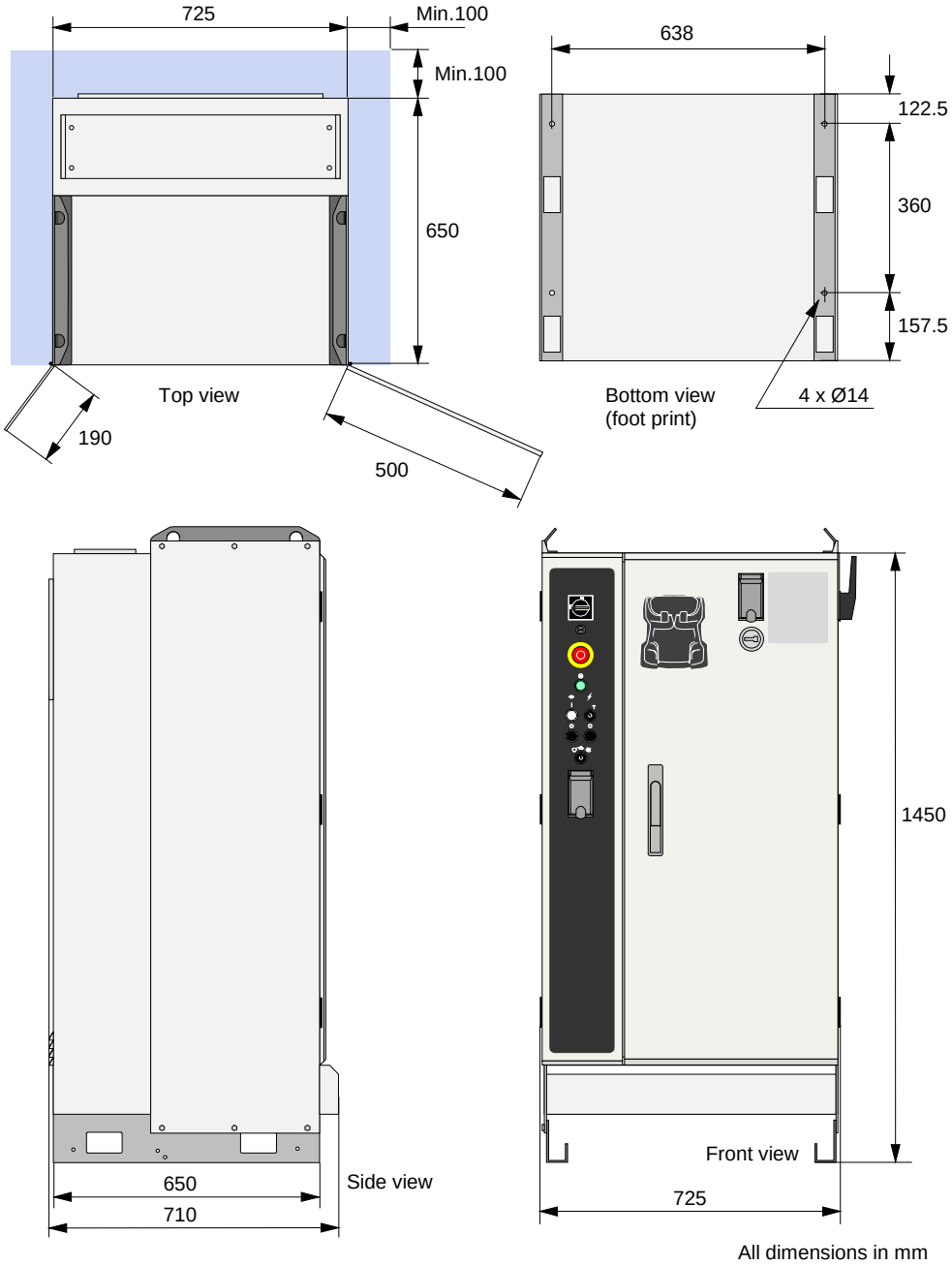
Type	Name	Function
AD Combi I/O	DSQC 651	8 digital in / 8 digital out / 2 analog out
Digital I/O	DSQC 652	16 digital in / 16 digital out *1
Relay I/O	DSQC 653	8 digital in / 8 digital out
Digital I/O 120 VAC	DSQC 654	8 digital in / 8 digital out
Analog interface board	ANIB	8 analog in / 4 analog out / 4 digital out
Digital Sensor interface brd.	DSIB	16 namur sensor inputs
Pressure sensor interf. brd.	PSIB	8 pressure sersor inputs
Process I/O	PIO	16 *4 digital in / 8 digital out /16 analog in *3 /12 analog out *3 / 4 encoder inputs *4
Digital I/O	DSQC 328	16 digital in / 16 digital out
Analog I/O	DSQC 355	4 analog in / 4 analog out
Profibus DP slave	DSQC 352	128 *2 digital in / 128 digital out
Allen-Bradley Remote I/O	DSQC 350	128 *2 digital in / 128 digital out
Interbus-S slave	DSQC 351	64 *2 digital in / 64 digital out
CC-Link	DSQC 378	176 *5 digital in / 176 digital out
Encoder unit	DSQC 377	2 encoders / 2 sync signals

*1) The digital signals are supplied in groups, each group having 8 inputs or outputs.
*2) To calculate the number of logical signals, add 2 status signals for RIO unit and 1 for Interbus-S, Profibus DP and CC-Link.
*3) Selectable voltage or current.
*4) Encoder inputs or digital inputs.
*5) The system has a limitation of 255 input/output signals for one unit. However, when using the DSQC 378 together with the IPS, you can define 368 (*2) inputs and 368 outputs.

Dimensions

Controller dimensions are shown in the illustration below.

Figure 14 Controller dimensions



All dimensions in mm

4.3 Pendant Specifications

Dimensions

Pendant dimensions are shown in the illustration below.

Figure 15 Pendant dimensions

General Specifications

Weight:	0.918Kg
Ex-approved	Explosion protected Exi for installation in hazardous area Zone 1 (Europe) and Division I, Class I & II.
Ingress protection degree	IP54
Ambient temperature	+10°C - +40°C
Display	3½ “ TFT-LCD dynamic color screen (RGB) 240 x 320 pixels, 8 - 22 vertical lines
Live handle	Safety handle to enable the manipulator motion.
Emergency stop button	Safety button for instantly stopping the manipulator motion.
Thumb joysticks	Two thumb operated joysticks to control the manipulator axes.
Green key group	Buttons for menu navigation.
Orange key group	Buttons for manipulator motion.
Blue key group	Buttons for information on the current operation.
Soft keys	Buttons with functions that are indicated on the display.
Cable	10m standard

4.4 Purge Unit Specifications

Description

The purge unit is used to supply compressed air to the manipulator when the manipulator is installed in a hazardous area.

A special version of the purge unit, called ‘purge unit w/connector box’ is used for trolley robots. This purge unit is described in section ’Purge Unit w/Connector Box’ on page 111.

General Specifications

Dimensions purge unit:	See Figure 16
Dimensions purge unit w/connector box:	See Figure 57
Purging sequence time:	Depending on robot type. For information, see manipulator identification label (‘Product Manual, Manipulator’, System Description).

Protection Gas

Dew point:	< +2°C at 6 bar
Solid particle size:	< 5 microns
Oil content	< 1ppm (<1mg/m³)

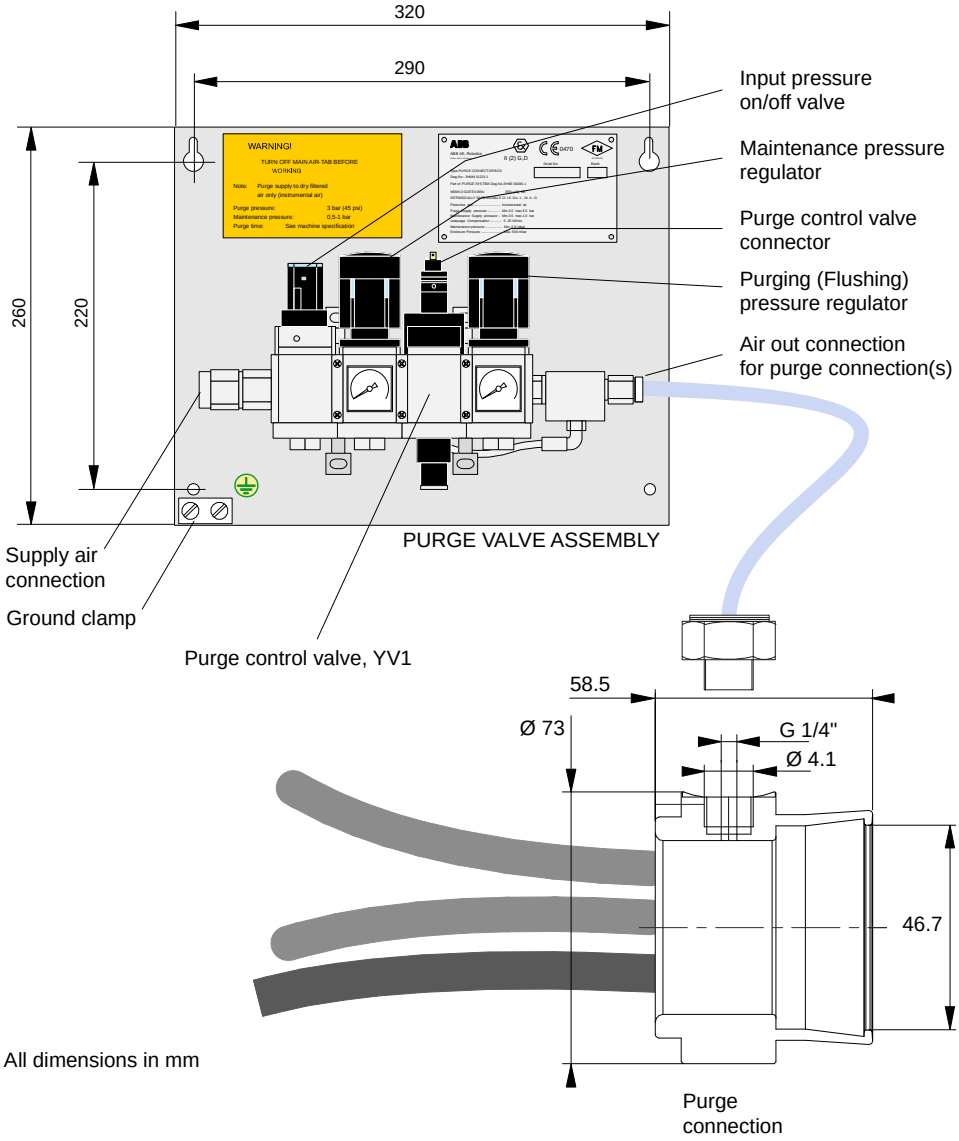
Air Pressure and Consumption

Min. supply pressure:	3 bar
Air consumption during purging	min. 500 NL/min.
Air consumption during maintenance	10-20 NL/min.
Air pressure purging:	3 bar
Air pressure maintenance:	0.5 - 1 bar

Dimensions

Purge unit dimensions are shown in the illustration below. (Not applicable for IRB 5500 slim arm and trolley robots).

Figure 16 Purge unit dimensions



5 Installation and Commissioning

5.1 Introduction

5.1.1 General

About this Chapter

This chapter provides information and instructions for installation of the robot controller and purge unit including interconnections to the purge unit and manipulator.

The chapter includes information on lifting and locating the cabinet at the working site, perform interconnection between controller and purge unit, etc. The chapter also includes description for connecting safety systems, mains power, external I/O functions, etc.

Important: This chapter only describes installation of the controller and associated connections. For complete installation instructions, see also ‘Product Manual, Manipulator’ for installation of the manipulator, ‘Unit Description, Paint’ for connection of the paint system and ‘Operator’s Manual, IRC5P’ for starting up the robot system.

Safety Information

Before any work described in this chapter is commenced, it is extremely important that all safety information is observed.

There are general safety aspects that must be read through, as well as more specific safety information that describes danger and safety risks when performing the procedures. Read the Safety Manual before performing any installation work.

WARNING! No installation work must be performed on the robot before the safety guidelines in the Safety Manual have been read and understood. Work must only be performed by skilled personnel with the proper training.

Welding

Welding on the control cabinet, manipulator or any other components of the robot system should be avoided as it can cause severe damage to the electronic components in the system. If welding can not be avoided, ‘Welding Safety Precautions’ found under ‘Safety Risks Related to Installation’ in the ‘Safety Manual’ must be read before any welding activities are started.

Purge Unit

Installation of the purge unit is described in this manual since the description is the same for all robot models.

Non-ex Robot

The following description applies for the explosion proof version of the robot (ex-version). Non-ex robots come without purge unit. Connections to the purge unit can be disregarded. The cable from the manipulator is to be routed to the control

cabinet instead of the purge unit as described in the guidelines. The points in spray booth safety concerning explosion hazards can be disregarded for the non-ex robot.

Utility Need

Following utilities will be required for the installation and operation of the robot and paint equipment.

- Mains power
- Compressed air for purge system (ex-robots) and paint system
- Paint supply station

Environmental Conditions

For information on environmental conditions, see ‘Safety Manual’ and ’Controller Specifications’ on page 32.

Other Information

Other information which may be needed during the installation is available on the supplied DVD-ROM. This is information such as various manuals, circuit diagrams and spare parts catalogue. For complete information, see README file on DVD-ROM.

Preparing the Installation Site

Before you start the installation, it is recommended that you make necessary drawings to establish location of manipulator, control cabinet and other components to be installed, designing a solid mounting base for the manipulator and plan the location of process equipment, conduits for cables and hoses etc.

Check for Damage

When unpacking the robot, control cabinet and associated components, check that it has not been damaged during transportation. If any damage is found, immediately contact the carrier for an inspection and filing of the ‘Arrival Quality Report’, found in the ‘Documents on Delivery’ folder. Also check that all components are correctly delivered in accordance with the packing list attached to the shipping crate.

5.1.2 Installation Guidelines

General

The following sections detail the main steps on how to unload, transport, install and connect the IRC5P controller and purge unit.

Installation Procedure

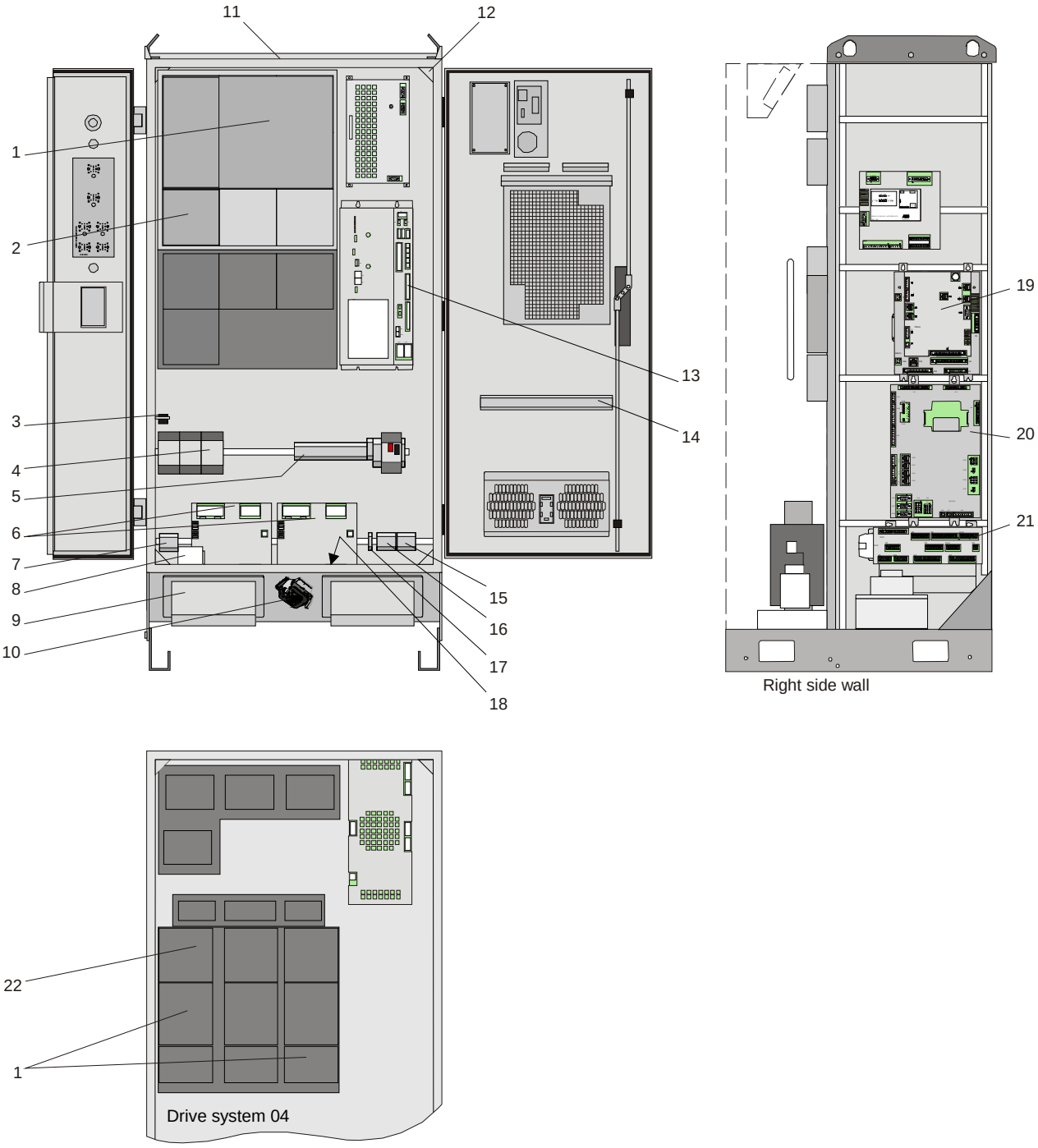
#	Action	Reference
1	Prepare for installation.	What you should be aware of before starting to install the controller is described in section 'Introduction' on page 39.
2	Remove the controller from the shipping crate and take it to the installation site.	How to lift and transport the controller is described in section 'Lifting and Transporting the Controller' on page 47.
3	Install controller at the working site.	How to perform physical installation of the controller is described in section 'Cabinet Location' on page 48.
4	Install purge unit.	For information on installation of the purge unit, see 'Purge Unit Installation' on page 49.
6	Perform system interconnection.	How to connect the manipulator and purge unit to the controller is described in section 'System Interconnections' on page 51.
7	Connect IS-Ground.	For information on how to connect IS-Ground, see 'IS-Ground Connection' on page 59.
8	Connect safety system for production or test.	How to perform required connections for the safety system is described in 'Robot Safety System Connections' on page 64.
9	Perform cabin safety system connections.	How to perform required connections for the cabin safety system is described in 'Cabin Safety System Connections' on page 78.
10	Install conveyor encoder and sync switch for conveyor tracking.	'Encoder and Sync Switch Installation' on page 86.
11	Perform optional external system connections as required.	'Digital I/O Connection' on page 98. 'Remote Panel Connections' on page 99. 'External Connection' on page 104.
12	Perform Field Bus connections as required.	For information, see 'Unit Description, IRC5P', Distributed I/O.
13	Connect mains power.	For information on mains power connection, see 'Power Connections' on page 114.
14	Install cooler if supplied.	For information on installation of optional cooler, see 'Cabinet Cooler Installation' on page 105.
15	Conclude installation.	'Concluding Activities' on page 122.

5.1.3 Controller Connections Overview

Description

The following illustration and table show the connectors and terminal boards for user connections in the control cabinet and reference to where in the manual the connections are described.

Figure 17 Control cabinet, location of connections



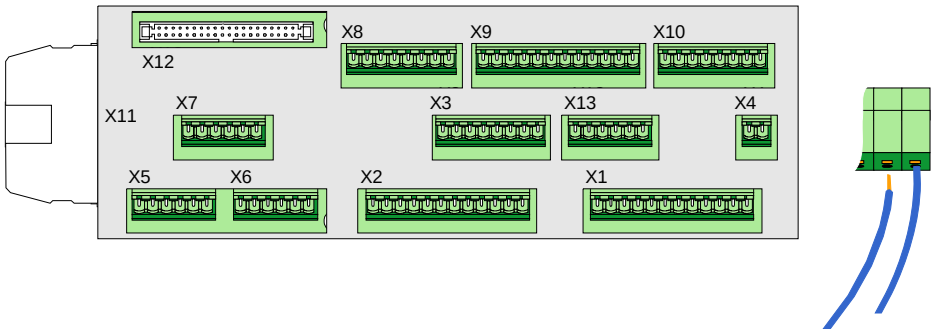
#	Conn.	Connection	Reference
1	X11	Drive unit axis 1	'System Interconnections' on page 51
	X12	Drive unit axis 2	'System Interconnections' on page 51
	X13	Drive unit axis 3	'System Interconnections' on page 51
	X14	Drive unit axis 4	'System Interconnections' on page 51
	X15	Drive unit axis 5	'System Interconnections' on page 51
	X16	Drive unit axis 6	'System Interconnections' on page 51
2	X2	Drive unit axis 7	'System Interconnections' on page 51
3	X11, X12, X111, X211	Manipulator & non I-Drive pump motor power	'System Interconnections' on page 51 'Connectors' on page 61
4	KA110	CBS Purge relay for CBS with IRB 5500	'System Interconnections' on page 51
5	XT1	Transformer wiring	'Transformer Wiring' on page 117
6		Optional Systems	'Unit Description, IRC5P, Distributed I/O.'
7	XT5	Optional servo disconnect terminal	'Servo Disconnect' on page 109
8	FR1	Mains power connection	'Mains Power Connection' on page 115
	XT1.1	External 115/230 VAC connection	'Supply for Internal Light' on page 118
9		Cable inlet	'System Interconnections' on page 51
10	X20	Pendant connection	'Pendant Connection' on page 103
11		Optional internal light	'Supply for Internal Light' on page 118
12		Door switch	'Supply for Internal Light' on page 118 and 'Cabinet Cooler Installation' on page 105
13	PDB-X18	External 24V	'24 VDC for External Use' on page 120
14		Optional field bus nodes	'Unit Description, IRC5P'
15	XT65	CAN1.2 for external distributed I/O	'Unit Description, IRC5P', Distributed I/O
16	XT10	CAN1.1 for internal distributed I/O	'Unit Description, IRC5P', Distributed I/O
17	X1	Optional home position relay	'Home Position Switch' on page 110
18		Ground rail	'IS-Ground Connection' on page 59
19	PIB-X9	Communication pressure sensors	'System Interconnections' on page 51
20	MIB-X21	SMU battery power	'System Interconnections' on page 51
	MIB-X22	Purge sensor	'System Interconnections' on page 51
	MIB-X23	SMU battery power	'System Interconnections' on page 51
	MIB-X24	Purge sensor	'System Interconnections' on page 51
	MIB-X4	Serial line to manipulator	'System Interconnections' on page 51
	MIB-X5	Serial line to pumps	'System Interconnections' on page 51
	MIB-X6	Purge valve	'System Interconnections' on page 51
	MIB-X7	Purge valve	'System Interconnections' on page 51
21	SCB	Safety system, Encoder etc.	'Safety Connection Board' on page 44
22	X19	Drive unit axis 7	'System Interconnections' on page 51

5.1.4 Safety Connection Board

Connection Overview

The following illustration and table show the connectors on the Safety Connection Board, SCB.

Figure 18 Safety Connection Board, SCB



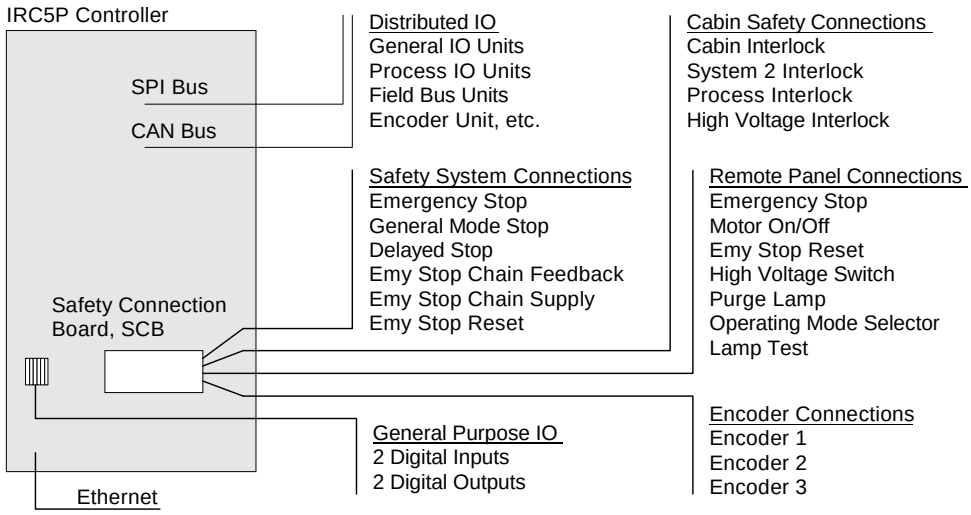
Conn.	Connection	Reference
SCB - X1	Emergency stop (Cat.0) Auto mode stop (Cat.0) Test mode stop (Cat.0)	'Robot Safety System Connections' on page 64
SCB - X2	General mode stop (Cat.0) Delayed stop (Cat.1) Emy stop feedback	'Robot Safety System Connections' on page 64
SCB - X3	Cabin interlock System 2 interlock Process interlock	'Cabin Safety System Connections' on page 78
SCB - X4	Ext emy stop chain supply	'Robot Safety System Connections' on page 64
SCB - X5	Encoder input 1	'Encoder and Sync Switch Installation' on page 86
SCB - X6	Encoder input 2	'Encoder and Sync Switch Installation' on page 86
SCB - X7	Encoder input 3	'Encoder and Sync Switch Installation' on page 86
SCB - X8	Remote panel connection	'Remote Panel Connections' on page 99
SCB - X9	Remote panel connection	'Remote Panel Connections' on page 99
SCB - X10	Remote panel connection	'Remote Panel Connections' on page 99
SCB - X11	System connector	System connection to SIB - X11
SCB - X12	System connector	Panel connection to SIB - X10
SCB - X13	Emergency stop reset High voltage interlock	'Robot Safety System Connections' on page 64 'Cabin Safety System Connections' on page 78

5.1.5 External Connection Overview

General

Following external connections are available in the controller.

Figure 19 Connection overview



Safety System Connections

Connection of the robot safety system. These connections are described in section 'Robot Safety System Connections' on page 64.

Cabin Safety Connections

Connection of the spray booth (cabin) safety systems. These connections are described in section 'Robot Safety System Connections' on page 64.

Remote Panel Connections

The robot may be controlled from a main panel on the controller, a remote panel or from a PLC. Remote panel connections describe necessary connections if a remote panel is used. Described under 'Remote Panel Connections' on page 99.

Encoder Connections

The encoder connections may be used for connection to the conveyor for the tracking function and/or inputs from paint flow monitoring. For information on connections, see 'Encoder and Sync Switch Installation' on page 86.

Distributed I/O

Different field bus nodes are available for connection of digital and analog I/O, field bus nodes for communication with PLC etc. For information on connections etc, see 'Unit Description, IRC5P', Distributed I/O.

Ethernet Communication

Ethernet can be used to connect a PC to the controller for download of robot programs, configurations, backup etc. Ethernet can also be used for communication between the controller and an external PC or for including one or more robots in an Ethernet network. For information, see 'Ethernet Communication' on page 101.

5.2 Component Installation

5.2.1 Introduction

About this Section

This section provides information for installation of the control cabinet and purge unit, and information for performing necessary system interconnections.

Following sections are available:

- Installing the control cabinet
- Installing the purge unit
- Perform system component interconnections
- IS Ground connection

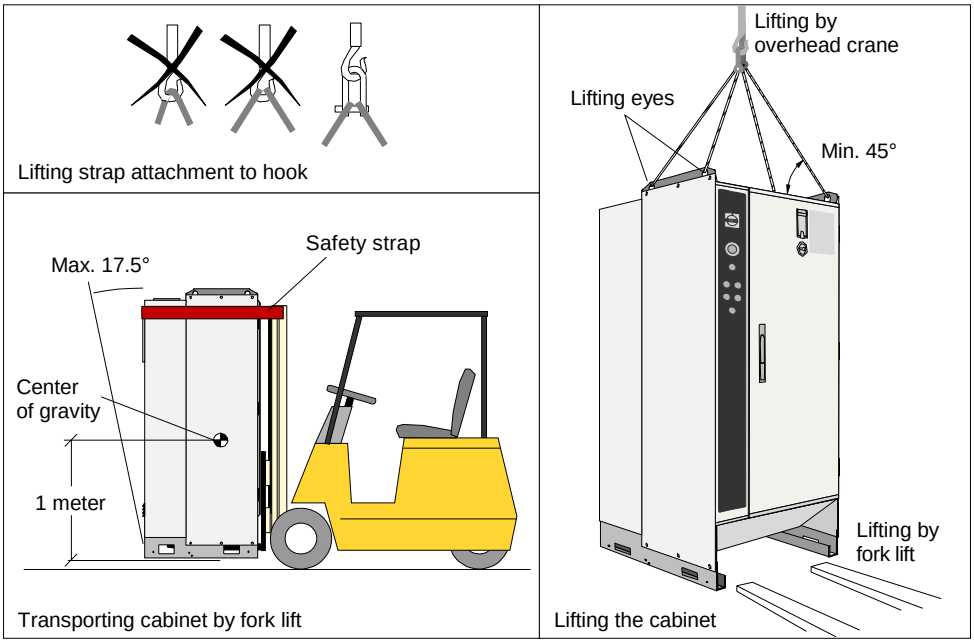
5.2.2 Lifting and Transporting the Controller

General

The control cabinet is shipped on a transportation pallet at an upright position.

Weight of the control cabinet is given in 'Controller Specifications' on page 32.

Figure 20 Control cabinet lifting



Procedure

This procedure describes how to lift and transport the control cabinet.

WARNING! Attach the top of the cabinet to the fork lift using a strap or similar to prevent it from tipping over by braking etc. See Figure 20, lower left illustration.

1. After having unloaded the control cabinet crate from the lorry, use a fork lift and transport the cabinet to the installation site or as close to the site as possible before removing it from the pallet.
2. Unpack the supplied packages and check that the content is correct and undamaged.
3. Place the cabinet on the floor and remove packing material.

WARNING! Do not walk under the hanging load.

4. Transport the cabinet to its permanent location using an overhead crane or fork lift. See Figure 20, lower left and right illustration.

CAUTION! If lifting straps are used, they must be attached to all 4 lifting eyes.

For information on location of the cabinet and information on how to secure the cabinet to the floor, etc., see 'Cabinet Location' on page 48.

5.2.3 Cabinet Location

General

The control cabinet may be located at a convenient location outside the spray booth. The cabinet should be placed in a manner which will provide proper cooling and give space for entering cables via a cable conduit etc. The cables should be routed under the cabinet from the back and entered into the cabinet via the bottom front entrances. The cabinet should, for safety reasons, be secured to the floor using 4 e.a. 10 mm bolts. Access to the control cabinet interior is available from the front.

For information on controller dimensions, weight, footprint, etc, see ’Controller Specifications’ on page 32.

Temperature Requirements

To meet the requirements of proper cooling, the cabinet must have a free space of minimum 10 cm at the back and sides. This is especially important where the ambient temperature approaches the specified maximum. For temperature higher than specified maximum, additional cooling device is required.

For information on controller temperature range, see ’Controller Specifications’ on page 32.

Cooler

For installation of cooler, see ’Cabinet Cooler Installation’ on page 105.

Protection Standard

The cabinet enclosure protects against dust, splashing water and contact with live parts. Degree of protection rating is IP54 in accordance with EN IEC 60529 and NEMA 12. Avoid however spraying the control cabinet with water or other liquids.

Vibration and Shock

The control cabinet and its contents can withstand shocks due to the normal transport in the workshop. If the floor on which the cabinet is to stand permanently is subject to vibration, the cabinet should be mounted on shock-absorbing vibration dampers.

Isolation Transformer

If the plant has a history of extreme mains power transients and interference voltages, an isolation transformer or an interference suppression device should be installed.

5.2.4 Purge Unit Installation

General

The purge unit must be installed between the control cabinet and the robot to provide compressed air inside of the robot to prevent hazardous gases from entering into the robot interior.

The purge unit is available in a special version, called ‘Purge Unit with Connector Box’, for use with trolley mounted robots. For installation of this purge unit, see ’Purge Unit w/Connector Box’ on page 111.

Non-ex robots may be supplied with a pressurized junction box substituting the purge unit. The design of this box is the same as the purge unit, but it includes only supply pressure on/off valve and maintenance pressure regulator and gauge.

Purge Unit Location

The purge unit must be installed outside the hazardous area, e.g. on the cabin wall (the cabin wall must be grounded).

The distance from the control cabinet to the purge unit and from the purge unit to the manipulator must be planned in accordance to the length of the supplied cables. The cables may be supplied in standard lengths or lengths specified by the customer.

It is recommended to install (locate) the purge unit preliminary and wait with finding the final position until after the cables have been laid.

Flexible Hose Layout

The flexible hose is normally laid in a cable conduit. The hose is resistant to solvents.

CAUTION! The flexible hose must not be stretched as this will put strain on the internal cables which can not be stretched in the same way. If the flexible hose is to be installed in vertical direction, e.g. where the robot and purge unit are placed on different floors, the flexible hose MUST be secured with suitable clamps at e.g. 600 mm distance to prevent the weight of the hose to apply strain to the internal cables.

A flexible hose laying horizontally in a cable conduit does not need to be clamped.

Purge Unit Air Connection

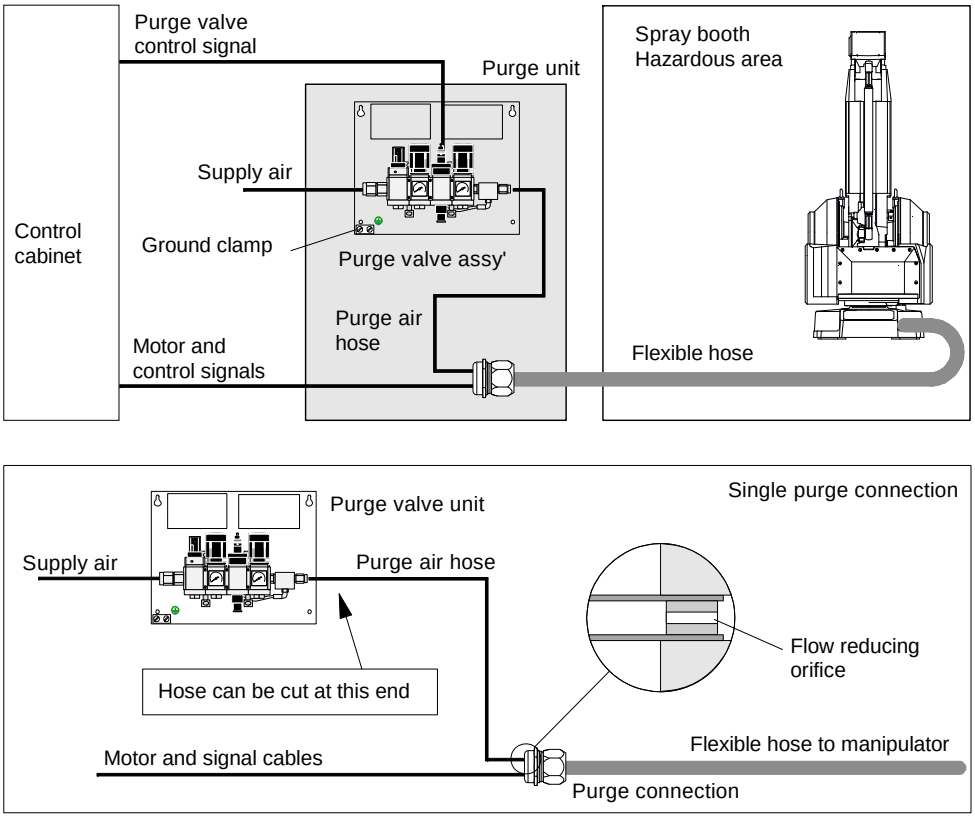
The purge system must be connected to a clean air supply such as instrument air. This is important to avoid internal contamination and corrosion. The air connection must be able to supply approx. 30 m^3/h during the purging sequence and 0.3 m^3/h during normal operation (maintenance pressure). The purging sequence time at start-up is depending on the robot type as noted on the robot identification plate on the manipulator, see ‘Product Manual, Manipulator’, System Description.

For specification of the purge air, see also ’Purge Unit Specifications’ on page 36.

Installation

The purge unit consists of the purge valve assembly and a purge connection. The purge valve assembly can be mounted on the cabin wall or at another suitable location, and the purge connector(s) can be placed at a convenient location, either in the cable conduit or fastened to the cabin wall etc. using a suitable clamp. For dimensions, see 'Purge Unit Specifications' on page 36.

Figure 21 Purge unit location and connections



Purge Air Hose Connection

The hose between the purge valve unit and purge connection must be maximum 10 meters, but can be cut to required length. If the hose needs cutting, make sure that the end with the orifice inside the hose is not cut off. This is also marked on the hose. The hose must not be joined in a manner which will restrict the air supply.

5.3 System Interconnections

General

This section describes connections which apply for all robot types and configurations.

CAUTION! Bonding connections of external electronic components must be properly performed. - Ref: ’Bonding Information’ on page 211.

The electrical interconnections are depending on manipulator type. Connections for the different manipulator types are described as follows:

– ’Electrical Interconnections IRB 5500’ on page 52
– ’Electrical Interconnections IRB 52, IRB 5400, IRB 580, IRB 540’ on page 55

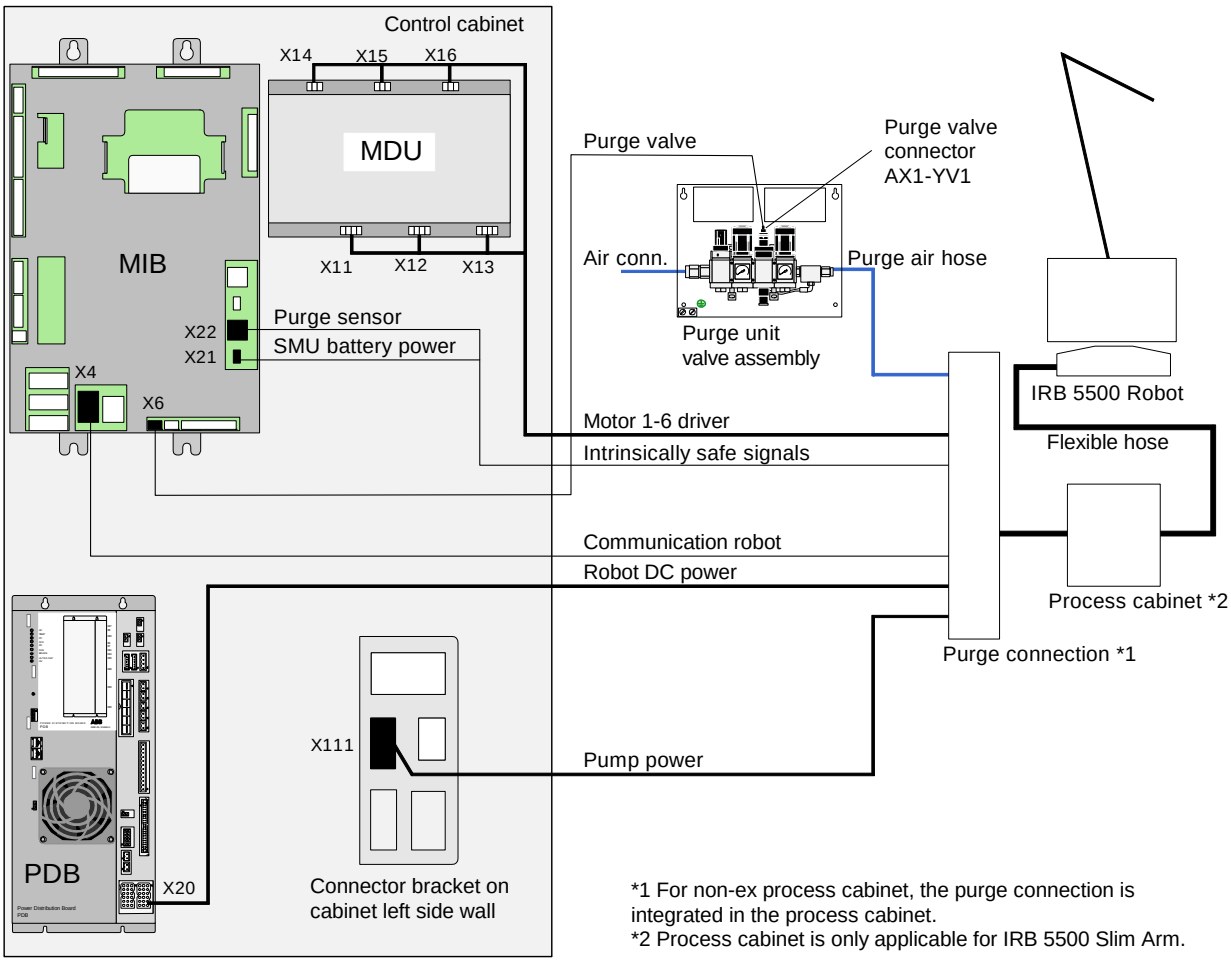
5.3.1 Electrical Interconnections IRB 5500

Procedure

Perform following procedure to interconnect control cabinet, manipulator, purge unit and if applicable pump system or CBS robot.

1. Open control cabinet front door.
2. Connect purge valve cable to connector AX1-YV1 on purge unit.
3. Route cables from purge connection unit through inlet in bottom of control cabinet. Clamp cables to ground rail and connect as described in the following.

Figure 22 Electrical interconnections IRB 5500



4. Connect robot purge valve cable to connector MIB-X6.
5. Connect robot motor 1-6 driver cable directly to motor drivers, connector X11 - X16.
6. Connect robot DC power cable to connector PDB-X20.
7. Connect communication robot cable to connector MIB-X4.

8. Connect robot intrinsically safe signals cable to connector MIB-X22 (purge sensor) and X21 (SMU battery power).
9. If the robot is equipped with pumps, connect pump power cable to connector X111.
10. If the paint robot is equipped with a CBS robot (see Figure 23):

    Connect CBS purge valve cable to connector MIB-X7.

    Connect CBS power cable to connector X211.

    Connect CBS communication cable to connector MIB-X5.

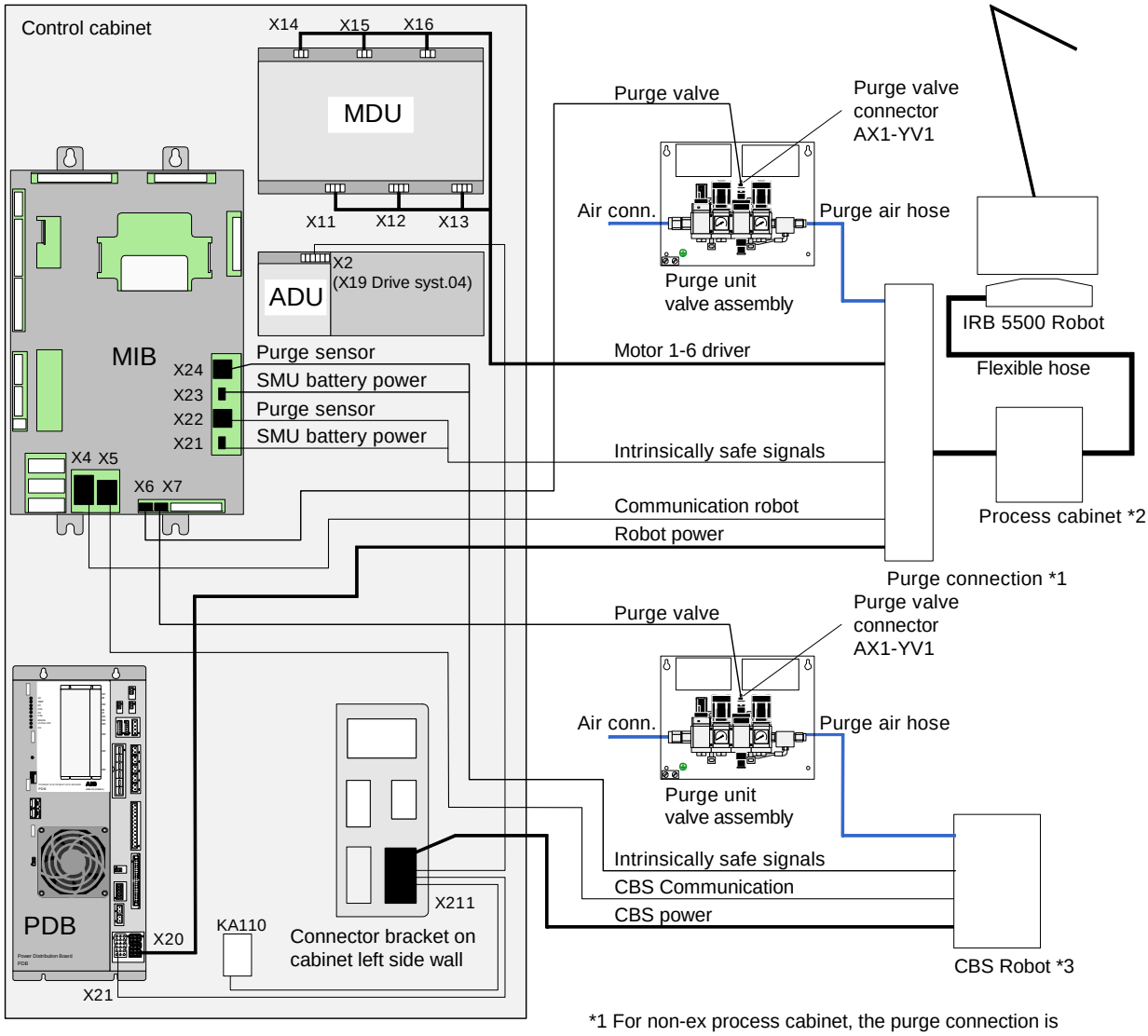
    Connect CBS intrinsically safe signals cable to connector MIB-X24 (purge sensor) and X23 (SMU battery power).

Important: If you disconnect X21/23 (SMU battery power) after the robot has been calibrated (revolution counter updated) you will have to re-calibrate the robot.

11. Fasten all screens to the cable inlet bracket.

CAUTION! All cables must be secured with strain relief clamps at the bottom entrance and p-clips at connection point. - Ref: ’Clamping Cables’ on page 213.

Figure 23 Electrical connections IRB 5500 with CBS robot



*1 For non-ex process cabinet, the purge connection is integrated in the process cabinet.
*2 Process cabinet is only applicable for IRB 5500 Slim Arm.
*3 Purge connection is integrated in the CBS robot.

5.3.2 Electrical Interconnections IRB 52, IRB 5400, IRB 580, IRB 540

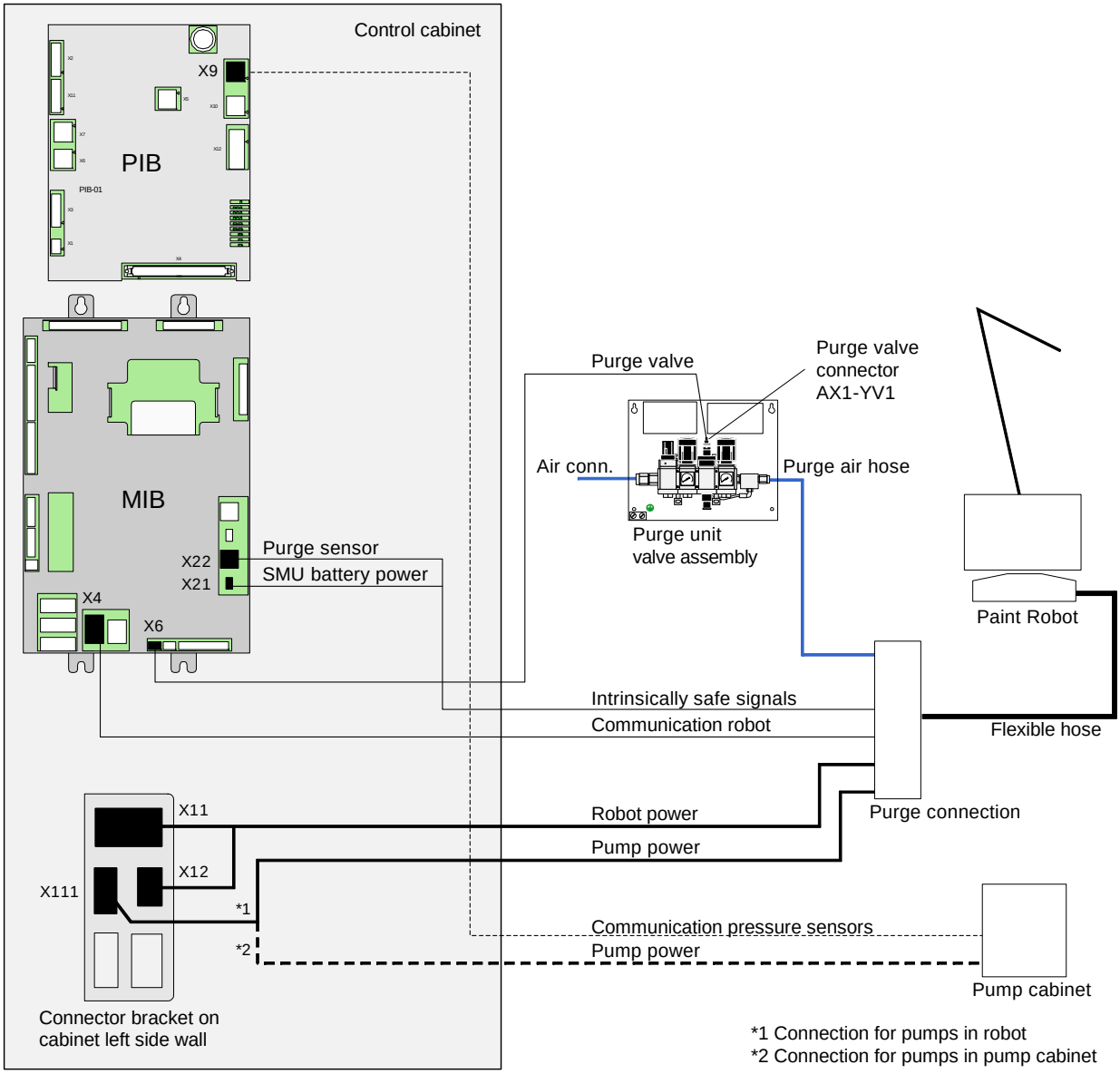
Procedure

Perform following procedure to interconnect control cabinet, manipulator, purge unit and if applicable pump system or CBS robot.

Note: If 'purge unit w/connector box' is used (trolley robot), connect cables from robot in purge unit and purge sensor cable to connector AX1-X4 on purge unit as described in 'Connecting Manipulator to Purge Unit' on page 112.

1. Open control cabinet front door.

Figure 24 Electrical interconnections IRB 52, IRB 5400, IRB 580, IRB 540



2. Connect purge valve cable to connector AX1-YV1 on purge unit.

3. Route cables from purge connection unit through inlet in bottom of control cabinet. Clamp cables to ground rail and connect as described in the following.
4. Connect robot purge valve cable to connector MIB-X6.
5. Connect robot power cable to connector X11, X12.
6. Connect communication robot cable to connector MIB-X4.
7. Connect robot intrinsically safe signals cable to connector MIB-X22 (purge sensor) and X21 (SMU battery power).
8. If the paint robot is equipped with pumps, connect pump power cable to connector X111.
9. If the paint robot is equipped with a pump cabinet, connect pump power cable to connector X111 and communication pressure sensors cable to connector PIB-X9.
10. If the paint robot is equipped with an inline CBS robot (see Figure 25):

    Connect CBS power cable to connector X211.
11. If the paint robot is equipped with a non-inline CBS robot (see Figure 26):

    Connect CBS purge valve cable to connector MIB-X7.

    Connect CBS power cable to connector X211.

    Connect CBS communication cable to connector MIB-X5.

    Connect CBS intrinsically safe signals cable to connector MIB-X24 (purge sensor) and X23 (SMU battery power).

Important: If you disconnect X21/23 (SMU battery power) after the robot has been calibrated (revolution counter updated) you will have to re-calibrate the robot.

12. Fasten all screens to the cable inlet bracket.

CAUTION! All cables must be secured with strain relief clamps at the bottom entrance and p-clips at connection point. - Ref: ’Clamping Cables’ on page 213.

Figure 25 Electrical connections IRB 5400 with inline CBS robot

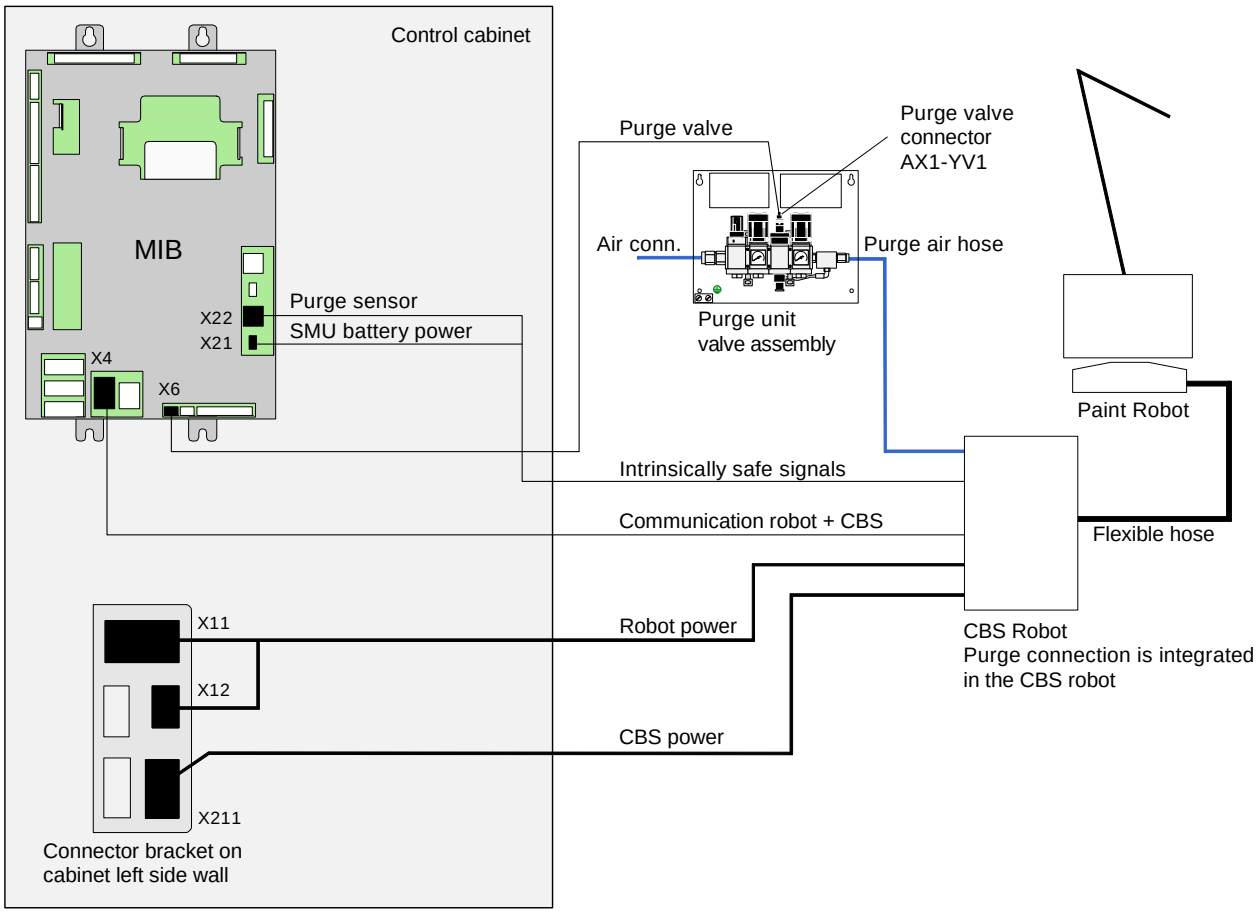
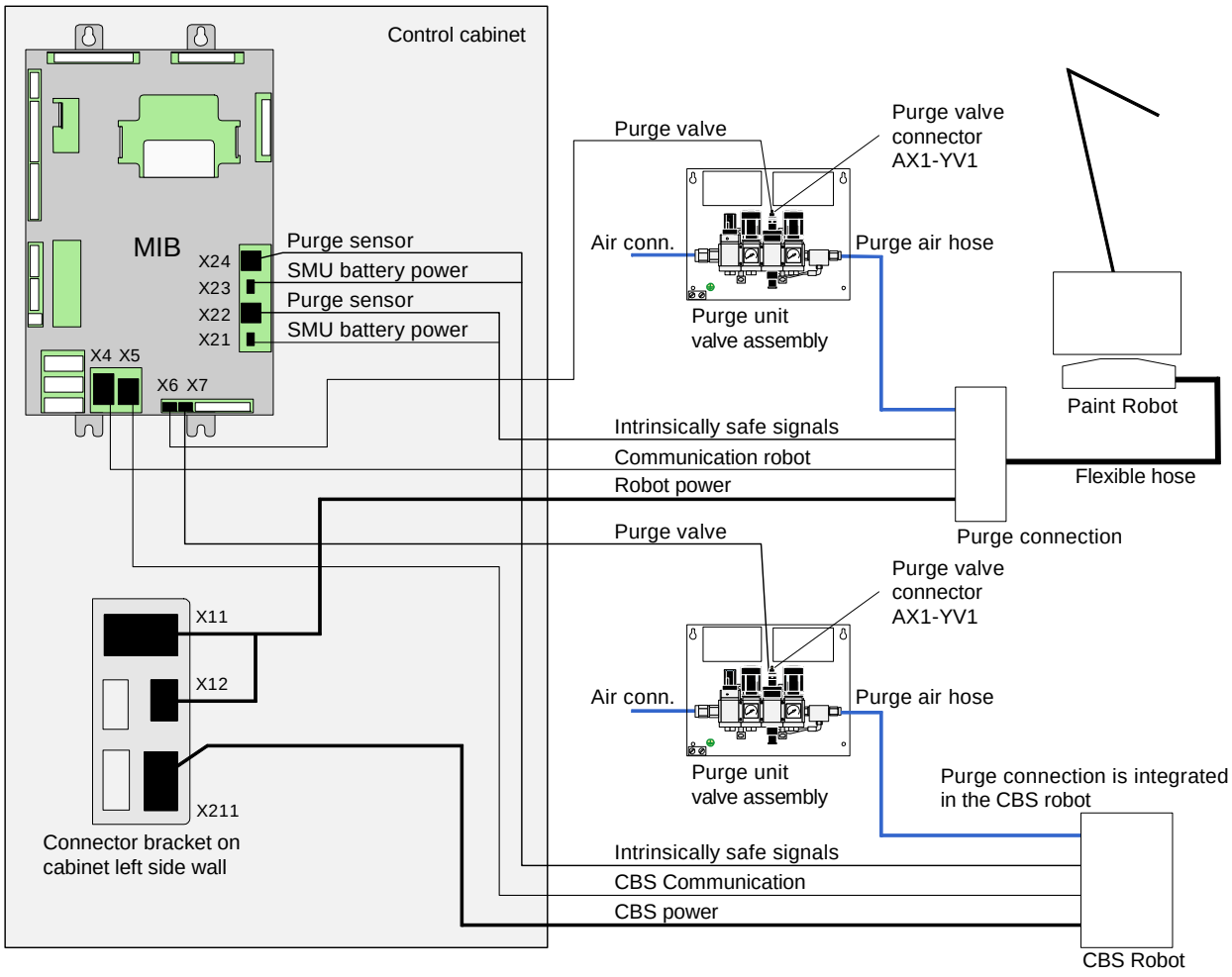


Figure 26 Electrical connections IRB 5400 with non-inline CBS robot

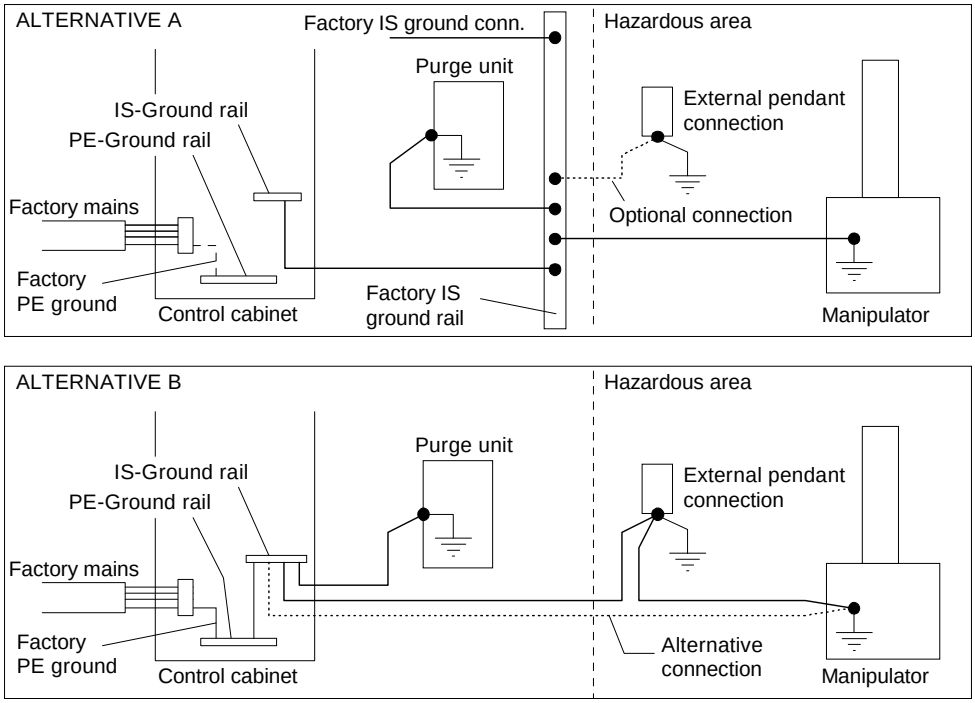


5.3.3 IS-Ground Connection

Description

In an ex-installation using paint equipment, it is important that IS-ground connections (Intrinsically Safe Ground) are installed. The connections must be performed according to local standards, and following two examples must be regarded as guidelines only.

Figure 27 Ground connections, factory PE-ground



For location of rails, see 'Controller Connections Overview' on page 42.

Alternative A

If a separate IS ground rail, connected to the factory IS-ground is available. Connect an IS-ground wire of minimum 10 mm² (AWG 6) between:

- Control cabinet IS-ground rail - factory IS-ground rail.
- Purge unit IS-ground screw - factory IS-ground rail
- Manipulator IS-ground screw - factory IS-ground rail.
- Remove connection in control cabinet between PE-ground rail and IS-ground rail (Yellow/green wire marked blue).

Alternative B

If a separate IS ground rail, connected to the factory IS-ground is not available. Connect an IS-ground wire of minimum 10 mm² (AWG 6) between IS-ground screws as follows:

- Manipulator - purge unit - controller.
- Or alternatively, manipulator - controller and purge unit - controller.

Notes

If the optional external pendant connection is used, the connector is grounded via a ground wire in the cable. If required, an additional ground wire can be installed as shown in Figure 27.

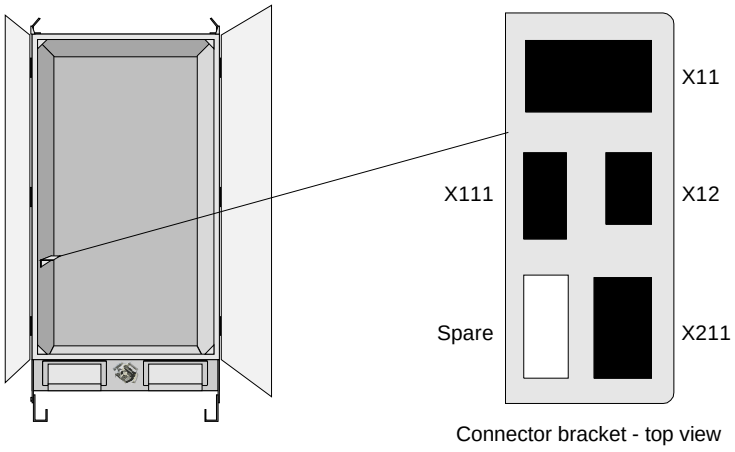
The PE-ground rail in the control cabinet is connected to the factory PE-ground by means of the ground wire in the mains supply cable.

5.3.4 Connectors

Connector Overview

This section shows the location of the connectors on connector brackets in the control cabinet side wall.

Figure 28 Location of connectors

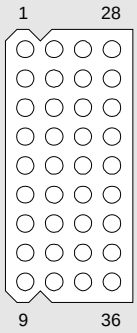


Conn.	Description	Comment
X11	Motor power for manipulator	Standard connector (Not used for IRB 5500)
X12	+24VDC for manipulator	Standard connector (Not used for IRB 5500)
X111	Paint pumps in manipulator / pump cabinet or 8th axis connector	Optional connector
X211	CBS robot	Optional connector

Identification of the signals in the above connectors can be found on the following pages.

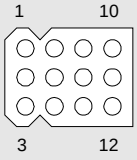
X11

Motor Power for Manipulator

Connector	#	Signal name	#	Signal name
	1	M1-U1	19	M4-U
	2	M1-U2	20	M4-V
	3	M1-V1	21	M4-W
	4	M1-V2	22	M5-U
	5	M1-W1	23	M5-V
	6	M1-W2	24	M5-W
	7	M2-U1	25	M6-U
	8	M2-U2	26	M6-V
	9	M2-V1	27	M6-W
	10	M2-V2	28	M7-U1
	11	M2-W1	29	M7-U2
	12	M2-W2	30	M7-V1
	13	M3-U1	31	M7-V2
	14	M3-U2	32	M7-W1
	15	M3-V1	33	M7-W2
	16	M3-V2	34	
	17	M3-W1	35	PE
	18	M3-W2	36	PE

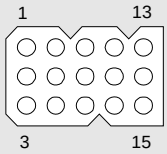
X12

+24VDC for Manipulator

Connector	#	Signal name
	1	+24V Power MCOB
	2	+24V Power brake
	3	+24V Brake release emy. ext.
	4	0V Brake release emy. ext.
	5	0V Power MCOB
	6	+24V Power function
	7	0V Power function
	8	Manipulator enable
	9	+24V High voltage controller supply
	10	0V High voltage controller supply
	11	SMU +24V SYS
	12	SMU 0V SYS

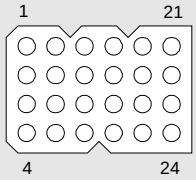
X111

Paint Pumps in Manipulator / Pump Cabinet or 8th Axis

Connector	#	Signal name	#	Signal name
	1	PM1-U / M8-U1	8	
	2	PM1-V / M8-U2	9	
	3	PM1-W / M8-V1	10	
	4	PM2-U / M8-V2	11	
	5	PM2-V / M8-W1	12	
	6	PM2-W / M8-W2	13	
	7		14	
	8		15	PE

X211

CBS Robot

Connector	#	Signal name	#	Signal name
	1	M1 U AXIS 1	13	POWER BRAKE RELEASE EMY EXT.
	2	M1 V AXIS 1	14	GND
	3	M1 W AXIS 1	15	GND
	4	M2 U AXIS 2	16	POWER FUCTION
	5	M2 V AXIS 2	17	POWER SAFETY
	6	M2 W AXIS 2	18	NC
	7	M3 U DCU PUMP MOTOR	19	RUN CHAIN 1 OUT
	8	M3 V DCU PUMP MOTOR	20	RUN CHAIN 2 OUT
	9	M3 W DCU PUMP MOTOR	21	RUN CHAIN 1 IN
	10	NC	22	RUN CHAIN 2 IN
	11	24V POWER	23	NC
	12	POWER BRAKE	24	PE

5.4 Robot Safety System Connections

5.4.1 Introduction

About this Section

This section describes the function of the robot's safety chains and includes information on user connections in the chains.

All connections in the safety system are performed via connectors on the Safety Connection Board, SCB. For location of the board, see 'Controller Connections Overview' on page 42.

WARNING! All connections in the safety system must be performed in accordance with the following description.

The Safety Chains

The system has 2 safety chains related to the robot as listed below.

- Emergency Stop Chain
- Run Chain

The function and connections in these chains are described in the following.

The system also has safety chains and interlock functions related to the cabin and process equipment. These chains are described under 'Cabin Safety System Connections' on page 78.

Before any connections are made in the safety chains, section 'Safety System Standards' on page 65 must be read.

Tightening Torque

All screw connections in the safety system must be tightened in accordance with 'Tightening Torques' on page 216.

5.4.2 Safety System Standards

General

Normal emergency stop standards require 2 different activities to be performed to re-establish running mode after an emergency stop situation:

- The activated emergency stop switch must be manually released.
- Power must be re-applied to the robot's axis motors.

The Safety Chains

There are 2 safety chains in the system; the emergency stop chain and the run chain.

The Emergency Stop Chain includes the main panel emergency stop button, the pendant emergency stop button and possibly one or more external emergency stop buttons. All stops are category 0 stops.

The Run Chain includes auto mode stop, test mode stop, general mode stop and delayed stop. All stops except delayed stop (category 1) are category 0 stops.

Emergency Stop Reset

The emergency stop chain needs a reset signal to be applied after an emergency stop. If the robot includes a control panel, this reset signal will be applied automatically when pressing the Motor On button. If the panel is not available, an external reset signal must be applied after breaking the emergency stop chain before motor power can be re-applied.

The run chain does not require a reset signal.

Emergency Stop Category 0

Emergency Stop Category 0 stops the robot by immediate removal of power to the axis motors and activating the axis brakes. Different types of emergency stop category 0 are available; External Emergency Stop, General Mode Stop and Auto Mode Stop. Which type to use must be based on risk analyses for the installation.

WARNING! Emergency Stop Category 0 must not be used as a convenient way to stop the robot in situations which are not emergency situations. Using emergency stop category 0 will remove motor power and activate the axis brakes instantly, causing unnecessary wear of the brake disks (depending on the speed of the robot when the stop occurs).

Note: The axis brakes are primarily designed for holding the robot in position when idle. The brakes are certified for 300 stops performed with category 0 stop before worn to an extent where they can no longer hold the robot in position.

Important: Warranty claim will not be accepted for a damaged motor if the failure is caused by excessively worn brake.

Emergency Stop Category 1

Emergency Stop Category 1 is a controlled stop function which will allow the robot control system to stop the motion of the robot while the robot is running in the

programmed path. After a category 1 stop (Delayed Stop), the robot can be re-started and operation resumed after the cause for the emergency stop has been removed. Stopping the robot by category 1 stop will cause the robot to stop immediately using electrical power to brake and stop the motor speed and then remove power and apply brakes after 2 seconds.

WARNING! Emergency stop category 1 must not be used as a convenient substitute for emergency stop category 0 where emergency stop directly involves people getting in contact with the robot and conveyor operation.

Stop Time

The time for the robot to stop after an emergency stop category 0 are as shown in the table below. Note that the indicated times are dependent on the weight of the application equipment mounted on the robot.

Speed	Stop time
500 mm/s	80 ms
1000 mm/s	100 ms
1500 mm/s	120 ms

Switch Type

Connections for the emergency stop system in the robot emergency stop chain will fulfil these requirements, provided that the correct types of switches are used. These switches must be as follows:

- Switches used for Emergency Stop, General Mode Stop and Auto Mode Stop must be of positive opening contact type according EN IEC 60204-1 and EN IEC 60947-5-1. Additionally installed External Emergency Stop switch(es) must be of a type which will be locked after operated, and re-opened by pulling / rotating the switch knob.
- Any connections or use of switch types not complying with the description and diagrams in this manual that will corrupt the function of the emergency stop system will be the full responsibility of the user.

Dual Safety Chains

The emergency stop-, run-, motor-, enabling device- and process (cabin interlock) chains operate in a dual chain system, Chain 1 and Chain 2. Both chains must be activated in order to obtain robot motion state.

Chain Monitoring

The dual safety chains are monitored by software and hardware. If one of the chains does not activate within a time T after the other chain is activated, an error will occur. In this system, the time T is equal to 2 seconds.

5.4.3 Safety System Connection Overview

General

The following gives an overview of the connections needed for the safety system.

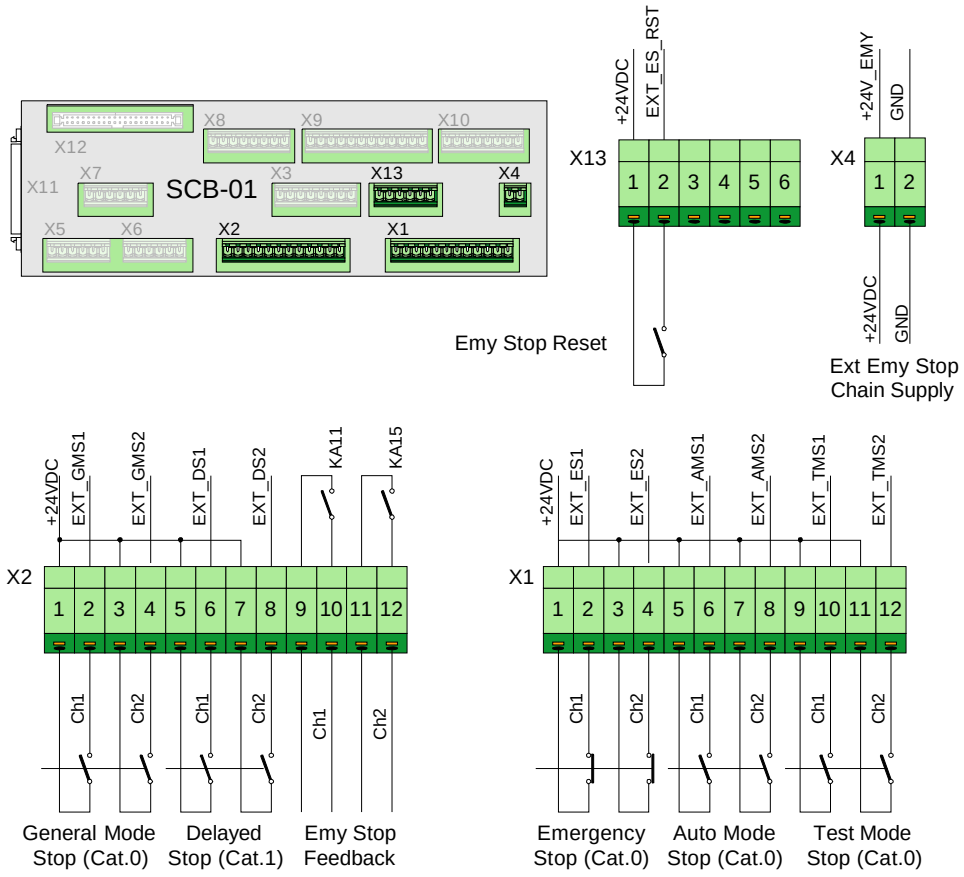
The connections are performed by removing links in the safety connectors and install 2 pole switches in their place.

The safety system can also be set up for test run as described in section 'Connecting Safety System for Test' on page 69.

Connection Overview

The illustration below shows the connections for the emergency stop chain and run chain.

Figure 29 Safety system connections



Procedure

1. The emergency stop chain is as default connected for Internal +24VDC Supply. If it is required to have the emergency stop chain operative when the robot is switched 'off', the chain may be connected to External +24VDC Supply as described in section 'Emergency Stop Chain Supply' on page 70.
2. If required, install Emergency Stop Switch(es) (Category 0) in addition to the Emergency Stop Switches on the main panel and pendant. For information, see

section ’External Emergency Stop (Category 0)’ on page 70. This type of emergency stop is included in the emergency stop chain and is typically used in a simple robot installation.

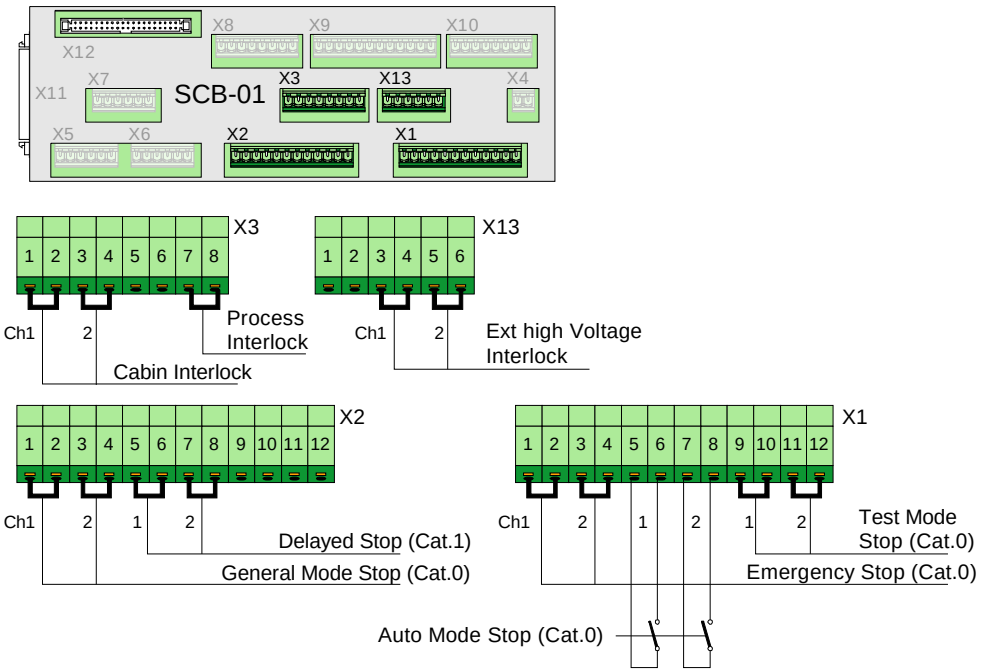
The emergency stop chain can also be implemented in the plant’s emergency stop chain. For information on this connection, see ’Emergency Stop Feedback’ on page 71.

3. Install Auto Mode Stop (Category 0) switch to prevent people from entering the robot working area while the robot is in operation. For connection information, see section ’Auto Mode Stop (Category 0)’ on page 73.
4. If the Robot’s emergency stop system is to be implemented in the plant’s emergency stop system, General Mode Stop (Category 0) or Delayed Stop (Category 1) in the Run Chain may be used instead of the ‘normal’ Emergency Stop function. For information on this connection, see section ’General Mode Stop (Category 0)’ on page 74, alternatively ’Delayed Stop (Category 1)’ on page 74.
5. If required, install External Emergency Stop Reset Button(s) or connect reset input to the plants emergency stop system controller. For information on these connections, see section ’Emergency Stop Reset’ on page 70.
6. If required, implement an Extra Enabling Device in addition to the enabling device on the pendant. For information, see section ’Test Mode Stop Category 0)’ on page 75.
7. If required, install Cabin Safety Switches. These functions can be used to disable functions such as fluid pumps, spray-gun, bell, electrostatic high voltage etc. for safety reasons. For information on these connections, see section ’Cabin Safety System Connections’ on page 78.

Connecting Safety System for Test

The robot may be set up for test run which is a mode where only the most essential safety connections are performed.

Figure 30 Safety system links



To prepare the robot for this mode, jumpers have been installed for all safety chain switches except Auto Mode Stop (Category 0) for chain 1 and chain 2.

WARNING! Running the robot for test using the links as described below must be done in a safe manner. It is the full responsibility of the user to make sure that this is obtained. Before setting the robot into normal operation, the safety switches MUST BE PROPERLY INSTALLED.

1. Check that links are installed as shown in Figure 30.
2. Install a 2 pole switch for Auto Mode Stop as shown in Figure 30.

WARNING! The auto mode stop switch simulates the spray booth entrance door interlock. The switch must be placed in conjunction with a fence etc. in such a way that no person can get inside the working area for the robot (switch closed) without breaking this connection (switch opened).

3. When the test period is completed, all jumpers must be removed and switches installed in their place.

5.4.4 Emergency Stop Chain

General

The emergency stop (emy stop) chain is a dual channel chain where all switches and relay contacts in the chain must be closed to enable power to be applied to the axis motors. Breaking the emergency stop chain will cause electric power to be removed from the robot axis motors and activate the axis brakes (breaking the run chain). Breaking the chain will also disable the paint system, switch off high voltage and stop pump motors, etc. After having stopped the robot by breaking the emergency stop chain, it is required that the emergency stop button is manually pulled out and that emergency stop reset is activated before power can be re-applied to the robot. The two chains are called Chain 1 (Ch1) and Chain 2 (Ch2).

A principle diagram of the run chain is shown in Figure 31.

Emergency Stop Chain Supply

The emergency stop chain 1 and 2 are supplied by the internal +24VDC in the control cabinet.

The chain can also be supplied by an external +24VDC supply. The emergency stop chain in the robot system will then be active also when the control cabinet main switch is switched ‘off’. This function may be desired if the robot emergency stop system is connected in the plant emergency stop system.

- External power for the emergency stop chain can be connected to connections marked ‘Ext Emy Stop Chain Supply’ in connector SCB-X4 pin 1-2 as shown in Figure 29 and in principle diagram in Figure 31.

External Emergency Stop (Category 0)

This is a connection where the user may implement one or more normally closed (positive opening) switches in the robot’s emergency stop chain. This connection is normally used in single robot installations. In more complex installations, the General Mode Stop (category 0) or Delayed Stop (Category 1) function is normally used. Which type to use must be based on risk analyses for the installation.

- To install Emergency Stop switch(es), remove 2 jumpers (for chain 1 and 2) and install a 2 pole, normally closed switch at terminals marked ‘Emergency Stop’ in connector SCB-X1 pin 1-4 as shown in Figure 29 and in principle diagram in Figure 31. The switch must comply with ’Safety System Standards’ on page 65.

Emergency Stop Reset

The emergency stop chain must be reset after the chain has been broken. To reset the system, the cause for the emergency stop must first be removed and then a reset signal must be applied.

An emergency stop reset signal is automatically applied when pressing the Motor On button on the control panel, but the signal may also be applied from an external PLC or reset switch. The emergency stop reset signal is also used to send an acknowledge signal to various internal and external systems.

- To connect an external ‘Emergency Stop Reset’ signal, install a normally open switch at terminals marked ‘Emergency Stop Reset’ in connector SCB-X13 pin 1-2 as shown in Figure 29 and in principle diagram in Figure 31.

Important: The emergency stop reset signal is part of the safety system and has for this reason a time limit of max. 2.5 seconds. The length of the reset signal must for this reason not exceed this limit. If exceeded, the enable chain will shut down.

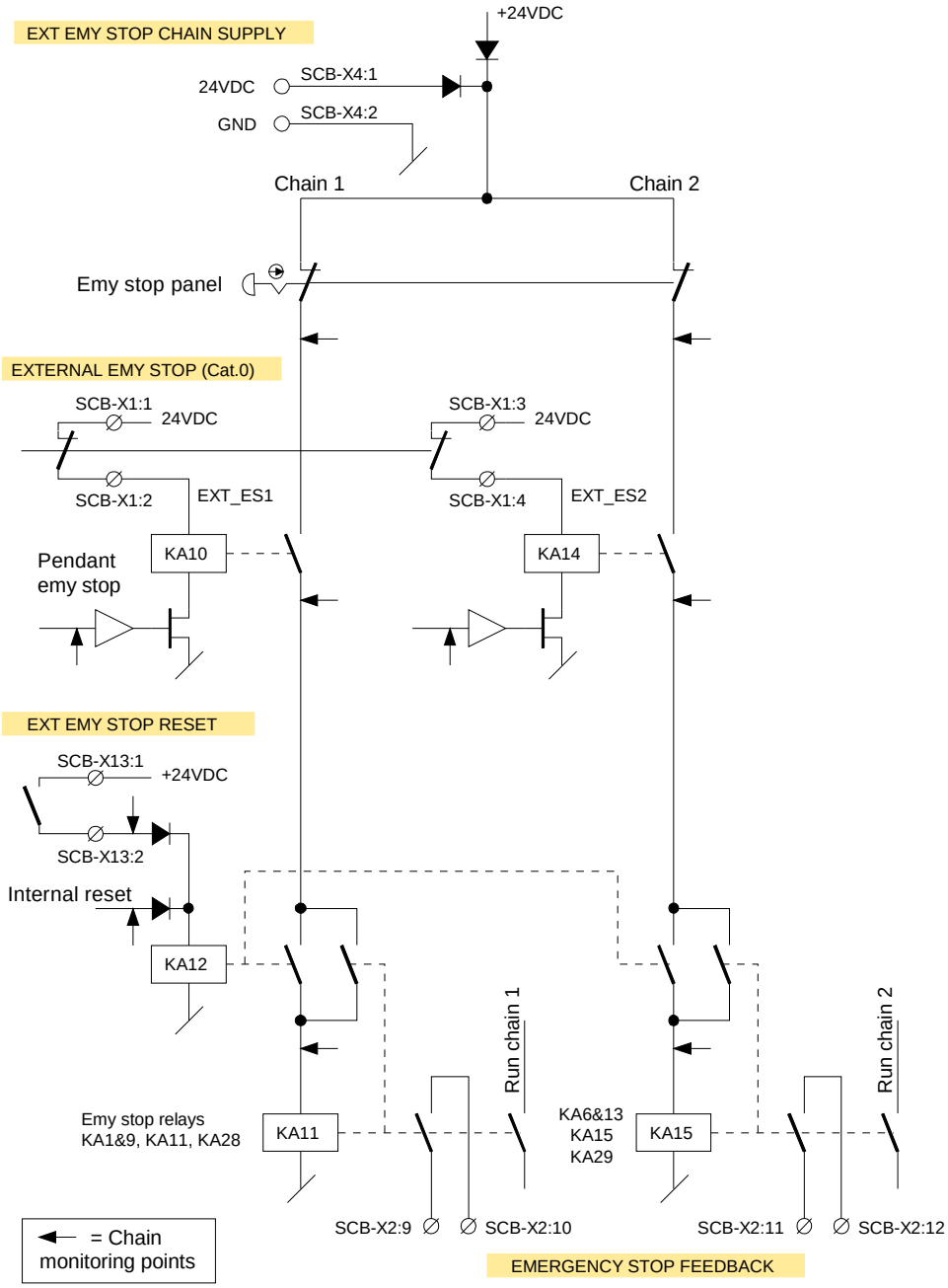
Emergency Stop Feedback

The external emergency stop feedback connections (chain 1 and chain 2) can be used to implement the robot’s emergency stop chains into the plant emergency stop chain. An emergency stop in the robot can thereby be used to activate the plant emergency stop. The relay switches to be used for this purpose are galvanically isolated from the rest of the emergency stop chain in the robot. The switches are closed when the robot emergency stop chains in the robot are OK.

- To include the robot’s emergency stop chain in an external chain, connect the external chain at terminals marked ‘Emergency Stop Feedback’ (for chain 1 and 2) in connector SCB-X2 pin 9-12 as shown in Figure 29 and in principle diagram in Figure 31. Supply voltage should be 24VDC, max 500mA. The external chain connection must be non-capacitive.

WARNING! To avoid damage to the internal emergency stop chain in the IRC5P controller and thereby violate the safety system, the customer must provide individual monitoring of safety chain 1 and 2 and current limiting at 500mA in the external chain.

Figure 31 Two-channel emergency stop chain, principle diagram



5.4.5 Run Chain

General

The run chain is a dual channel chain where all switches must be closed to be able to run the robot. Breaking the run chain will remove electric power from the robot axis motors. By closing the run chain, power will be re-applied to the motors, and operation can continue. The function of the run chain is depending on the position of the Mode Selector on the main control panel. This section describes the connections that can be made in the run chain.

A principle diagram of the run chain is shown in Figure 32.

Mode Selection

Test modes, Manual Reduced Speed / - Manual High Speed / and Automatic / mode, are operating modes selected by the mode selector key switch on the main panel, and are part of the total safety concept for the robot installation. The three operating modes are as follows:

	Automatic mode:	Used to run the robot in production.
	Manual Reduced Speed mode:	Used for program teach and program optimizing purpose. Maximum robot speed is restricted to 250 mm/sec.
	Manual High Speed Mode:	Used to run the program for test and program optimizing. Robot may be running at full speed (no optimizing operations that can change the path of the robot can be performed).

CAUTION! The key in the mode selector must be brought to the operating site together with the pendant to avoid another person from accidentally changing the operating mode for the robot.

Auto Mode Stop (Category 0)

Operating the Auto Mode Stop function will remove power from the robot when the mode selector is in Automatic mode. Typical use of this function is as safety switch for the spray booth entrance door to allow for a person to enter the spray booth for test or programming when the robot is in Manual Reduced / High Speed mode. If the spray booth has more entrances, switches must be installed in series for all entrances. Light grid / switches must also be installed at the conveyor entrance / exit etc.

- To install the Auto Mode Stop switch, install a 2 pole switch at terminals marked ‘Auto Mode Stop’ (for chain 1 and 2) in connector SCB-X1 pin 5-8 as shown in Figure 29 and in principle diagram in Figure 32. The switch must be of a type which will be closed when activated (spray booth door closed etc.). The switch must comply with ’Safety System Standards’ on page 65.

Note: To prevent running the robot without paying attention to the auto mode stop switch, the robot is shipped without jumper installed in this position.

WARNING! It is the full responsibility of the user to make sure that all entrances to the working area of the robot are protected by Auto Mode Stop switches. This is essential to prevent personnel from entering the working area of the robot while the robot is in operating mode (Auto).

General Mode Stop (Category 0)

Operating General Mode Stop will stop the robot and remove electric power from the axis motors the same way as when breaking the emergency stop chain. The difference between using the emergency stop and the general mode stop function is that reset signal is not required to reset the stop condition. Power must be re-applied to the axis motors by activating Motor On on the main panel or from an external panel or PLC.

The General Mode Stop function is normally used in more complex installations where the robot emergency stop system is integrated with the factory emergency stop system.

- To install the General Mode Stop function, remove two jumpers (for chain 1 and 2) and install a 2 pole switch at terminals marked ‘General Mode Stop’ in connector SCB-X2 pin 1-4 as shown in Figure 29 and in principle diagram in Figure 32. The switch must be of a type which will be closed when activated. The switch must comply with ’Safety System Standards’ on page 65.

Delayed Stop (Category 1)

Delayed Stop is a Category 1 stop, and is a controlled stop function which will allow the robot control system to stop the motion of the robot while the robot is running in the programmed path. After a category 1 stop, the robot can be re-started and operation resumed after the cause for the stop has been removed. Stopping the robot by category 1 stop will cause the robot to stop immediately and power to be removed after 2 seconds.

Delayed Stop is typically used to protect entrance doors located at a distance from the robot and conveyor or used in conjunction with plant emergency stops not directly involving the robot operation.

WARNING! Emergency Stop Category 1 (delayed stop) must not be used as a convenient substitute for emergency stop category 0 (general mode stop) where emergency stop directly involves people getting in contact with the robot and conveyor operation.

- To install the Delayed Stop function, remove two jumpers (for chain 1 and 2) and install a 2 pole switch at terminals marked ‘Delayed Stop’ in connector SCB-X2 pin 5-8 as shown in Figure 29 and in principle diagram in Figure 32. The switch must be of a type which will be closed when activated (spray booth door closed etc.). The switch must comply with ’Safety System Standards’ on page 65.

Test Mode Stop Category 0)

The test mode stop may be used to implement an enabling device in series with the enabling device on the pendant. If used, both this enabling device and the enabling device on the pendant must be operated to be able to apply power to the axis motors. The enabling device function is only functioning in Manual Reduced Speed / mode and Manual High Speed / mode. The extra enabling device may be used as an extra safety function during programming and test. The device must be designed in the same way as the device on the pendant, i.e. the handle must be held in center position to be activated. Releasing the device or pressing too hard will operate the stop function.

- To install the extra enabling device, remove two jumpers (for chain 1 and 2) and install a 2 pole switch at terminals marked ‘Test Mode Stop’ in connector SCB-X1 pin 9-12 as shown in Figure 29 and in principle diagram in Figure 32. The switch must be of a type which will open when not activated (released or pressed too hard). The switch must comply with ’Safety System Standards’ on page 65.

The enabling device must comply with EN ISO 10218-1, 6.4.6.

Important: These connection points are not Ex protected. If used in a hazardous area, the enabling device must fulfill the requirements for such use.

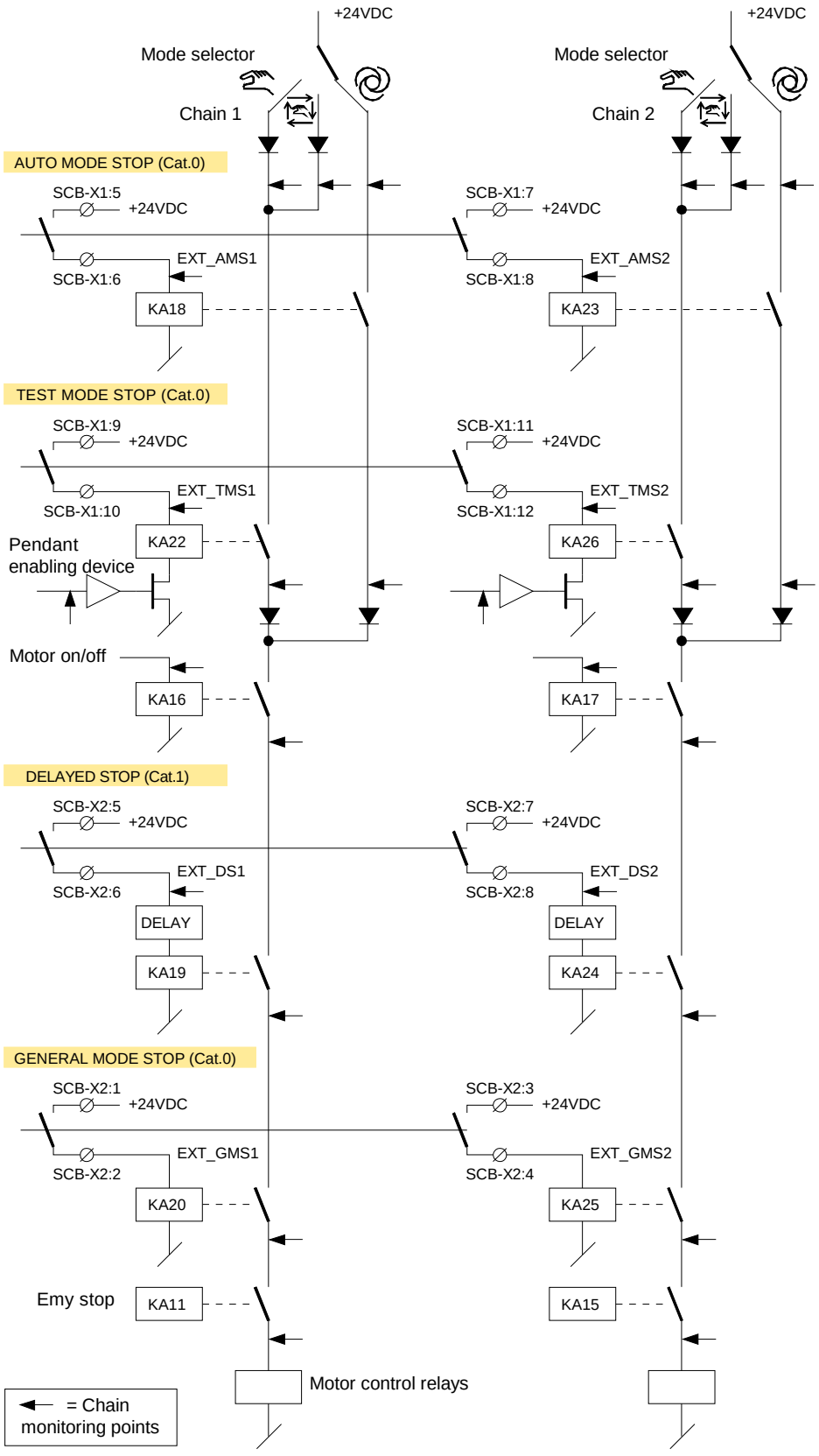
Hardware Motor On

Hardware Motor-on is the signal which will apply power to the robot when all conditions for starting the robot are correct. In Automatic / mode, the signal is applied by pressing the motor-on button on the main control panel, but the signal may also be applied from an external control desk or PLC etc. In Manual Reduced Speed / mode and Manual High Speed / mode, the motor-on signal is applied by activating the enabling device on the pendant. The power will remain ‘on’ until the enabling device is released or pressed too hard.

Software Motor On

The software motor-on function is used to apply power to the robot from the pendant or external control systems etc. As a part of the total safety concept, a precondition for applying power by this function is that hardware motor-on has been activated. An attempt to apply power to the robot from the pendant without having activated the hardware motor-on will result in a warning message. Software will always switch off this signal when hardware is not allowing motor-on.

Figure 32 Two-channel run chain, principle diagram



5.4.6 Emergency Brake Release Switch

General

A switch may be installed to enable releasing the axis brakes for the robot in an emergency situation. This may be a situation where a person is trapped by the robot arm and brakes can not be released quickly by normal means, e.g. at power failure or the pendant is not at hand.

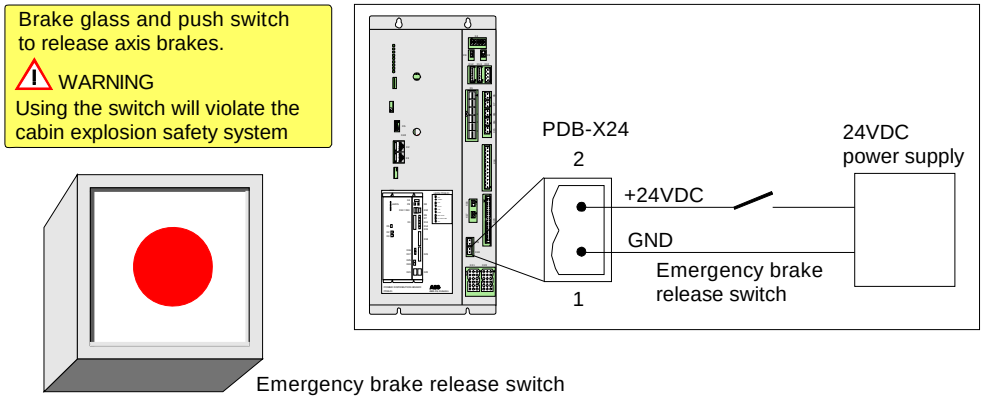
Installation

The emergency brake release switch should be a switch installed behind a breakable glass (like a fire alarm) to prevent the switch from being used for normal brake release purposes. The switch must be marked with a warning sign informing that using the switch will violate the spray booth explosion safety functions.

The switch must be placed in a convenient location outside the spray booth with a clear view of the robot.

WARNING! The emergency brake release switch will apply 24VDC to the axis brakes even if the purge system is not active and must only be used in emergency situations.

Figure 33 Emergency brake release switch design and connection



A 24VDC power supply, capable of supplying minimum 4 Ampere is required for this function. If the switch is to work also by power failure, the power supply must be battery backed.

1. Install a normally open switch and 24VDC power supply between pin 1 and 2 in connector X24 on the PDB board as shown in the figure above.
2. Install switch element inside a box with a breakable glass.
3. Make a sign similar to the one shown in the illustration and place it above or beside the switch.

5.5 Cabin Safety System Connections

5.5.1 Introduction

About this Section

This section describes the function of the cabin safety chains and cabin interlock functions and includes information on user connections in the chains.

All connections in the safety system are performed via connectors on the Safety Connection Board, SCB. For location of the board, see 'Controller Connections Overview' on page 42.

WARNING! All connections in the safety system must be performed in accordance with the following description.

The Safety Chains

The system has various safety chains and interlock functions related to the cabin and the process equipment as listed below. The function and connections in these chains are described in the following.

- Cabin Interlock
- High Voltage Interlock
- System 2 Interlock
- Process Interlock
- Emergency Shut Down Valve

The system also has 2 safety chains related to the robot which are the Emergency Stop Chain and the Run Chain. These chains are described under 'Robot Safety System Connections' on page 64.

Before any connections are made in the safety chains, section 'Safety System Standards' on page 65 must be read.

Tightening Torque

All screw connections in the safety system must be tightened in accordance with 'Tightening Torques' on page 216.

5.5.2 Cabin Safety Connection Overview

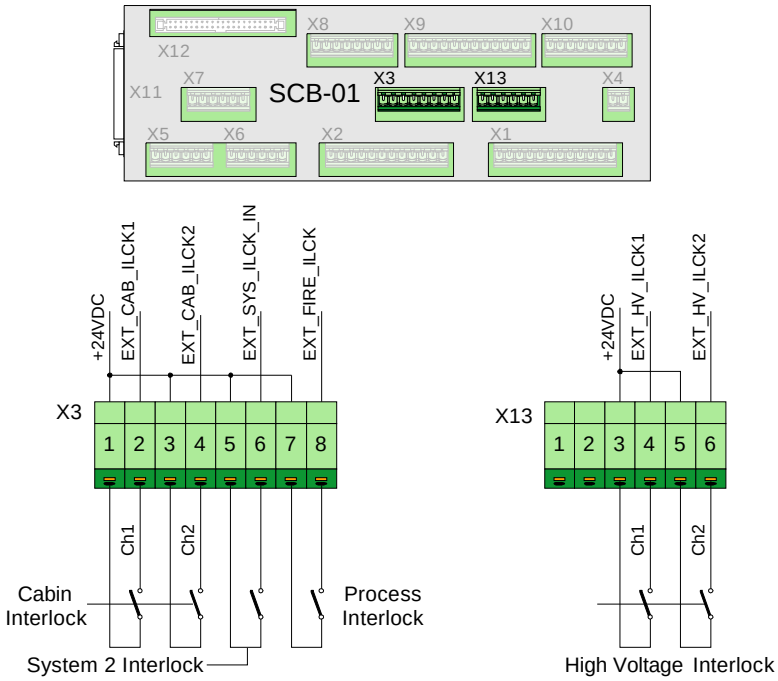
General

Cabin safety connections are a number of interlock functions which can/must be installed to provide personnel safety and to ensure safe operation of the cabin and robot paint systems.

Description

The illustration below shows an overview of the cabin safety connections and the procedure gives a short description of the connections which must/may be connected with references to where complete information can be found.

Figure 34 Cabin interlock connections



Procedure

1. Connect Cabin Interlock switches in the cabin interlock chain to disable paint functions when certain vital cabin functions are not present, like cabin ventilation. For information, see ’Cabin Interlock’ on page 80.
2. Connect High Voltage Interlock switches on the cabin entrance door to prevent people from entering the cabin when high voltage is ‘on’. For information, see ’High Voltage Interlock’ on page 81.
3. If required, install System 2 Interlock switch for bell applicator, paint pumps or DCU (CBS). For information, see ’System 2 Interlock’ on page 82.
4. If required, connect Process Interlock switch for switching off all paint related functions. For information, see ’Process Interlock’ on page 83.
5. If required, install Emergency Shut-Down valve in manipulator. For information, see ’Emergency Shut Down Valve’ on page 85.

5.5.3 Cabin Interlock

General

The purpose of the cabin interlock chain is to disable paint functions which are emitting flammable material (paint, solvent, etc.) into the cabin, if vital cabin functions are not present, like the cabin ventilation (cabin fans), fire extinguishing system. This is achieved by including dual switches on the cabin fan relay in the cabin interlock chain.

Description

When the cabin interlock chain is broken, +24V_FUNC will be disconnected from the manipulator board and one of the VCD modules. Paint functions connected to these modules (via pilot valves) will thereby be disabled. Paint functions which are normally connected to these modules are spray-gun needle, shaping air, etc.

Paint functions connected to the other VCD modules, powered by +24V_MAN, will not be affected by the cabin interlock chain. Typical connections to these modules are color change, etc.

Which functions that are interlocked and not interlocked can be found in the Process Diagram.

When breaking the cabin interlock chain, the system will use approx. 1/2 second to make a controlled stop of the paint functions. When closing the chain, power will be re-applied to the interlocked paint control functions, and operation can continue.

Following conditions must be present to close the cabin interlock chain.

- Cabin interlock chain must be closed. (Cabin ventilation fans must be running).
- The emergency stop- and enable chain must be closed.
- Robot must be purged (purge relay must be closed).

Installation

To install the Cabin Interlock switch, install a 2 pole switch at terminals marked ‘Cabin Interlock’ (for chain 1 and 2) in connector SCB-X3 pin 1-4 as shown in Figure 34 and in principle diagram in Figure 35. The switch must be of a Normal Open fail safe type, which will be opened to disable paint functions.

The switch must comply with ’Safety System Standards’ on page 65.

5.5.4 High Voltage Interlock

General

The high voltage interlock chain is used to prevent personnel from entering the cabin when the high voltage is ‘on’.

Description

The personnel hazard related to the high voltage is accomplished by installing either a manual interlock switch or a switch function controlled by the plant’s safety supervision system, a PLC, cabin door, etc. The manual high voltage interlock switch is typically used when the robot is supplied without main panel (or remote panel) or if the high voltage interlock switch is not installed on the panel.

Following conditions must be present to close the high voltage interlock chain.

- High voltage interlock chain must be closed.
- Cabin interlock chain must be closed. (Cabin ventilation fans must be running).
- The emergency stop- and enable chain must be closed.
- Robot must be purged (purge relay must be closed).

Installation

To install the High Voltage Interlock switch, install a 2 pole switch at terminals marked ‘High Voltage Interlock’ (for chain 1 and 2) in connector SCB-X13 pin 3-6 as shown in Figure 34 and in principle diagram in Figure 35. The switch must be of a Normal Open fail safe type which will be opened to switch off the high voltage.

The switch must comply with ’Safety System Standards’ on page 65.

5.5.5 System 2 Interlock

General

The System 2 Interlock chain can be used to interlock an optional system 2 and/or bell turbine rotation.

System 2 is typically used for one of the following functions.

– Controlling paint pumps if material for the paint applicator is supplied by pumps.
– Controlling the DCU if the CBS system is used.

The system 2 interlock can also be used to interlock the bell cup rotation if the bell applicator is used.

Description

To activate the chain, following functions must be active in addition to the Manual Pump Interlock switch:

– Cabin interlock A/B: Cabin interlock chain A and B must be closed.
– CPU pump & HW enable: Control systems are running and OK.
– Emergency stop: Emergency stop must not be activated.
– Pump fuse: Pump fuse must not have tripped.

Connections

To install the System 2 Interlock switch, install a switch at terminals marked ‘System 2 Interlock’ in connector SCB-X3 pin 5-6 as shown in Figure 34 and in principle diagram in Figure 35. The switch must be of a Normal Open fail safe type which will be opened to disable system 2 functions.

The switch must comply with ’Safety System Standards’ on page 65.

5.5.6 Process Interlock

General

The process interlock chain is used to disable all paint related functions when the process interlock switch is activated.

The function may be used in situations where it is required to shut down all hazardous paint functions such as the valves controlling paint and solvent etc. (same valves as are closed by the cabin interlock chain), the high voltage supply to the paint applicator (same function as the high voltage interlock) and functions controlled by the Safety 2 System Interlock.

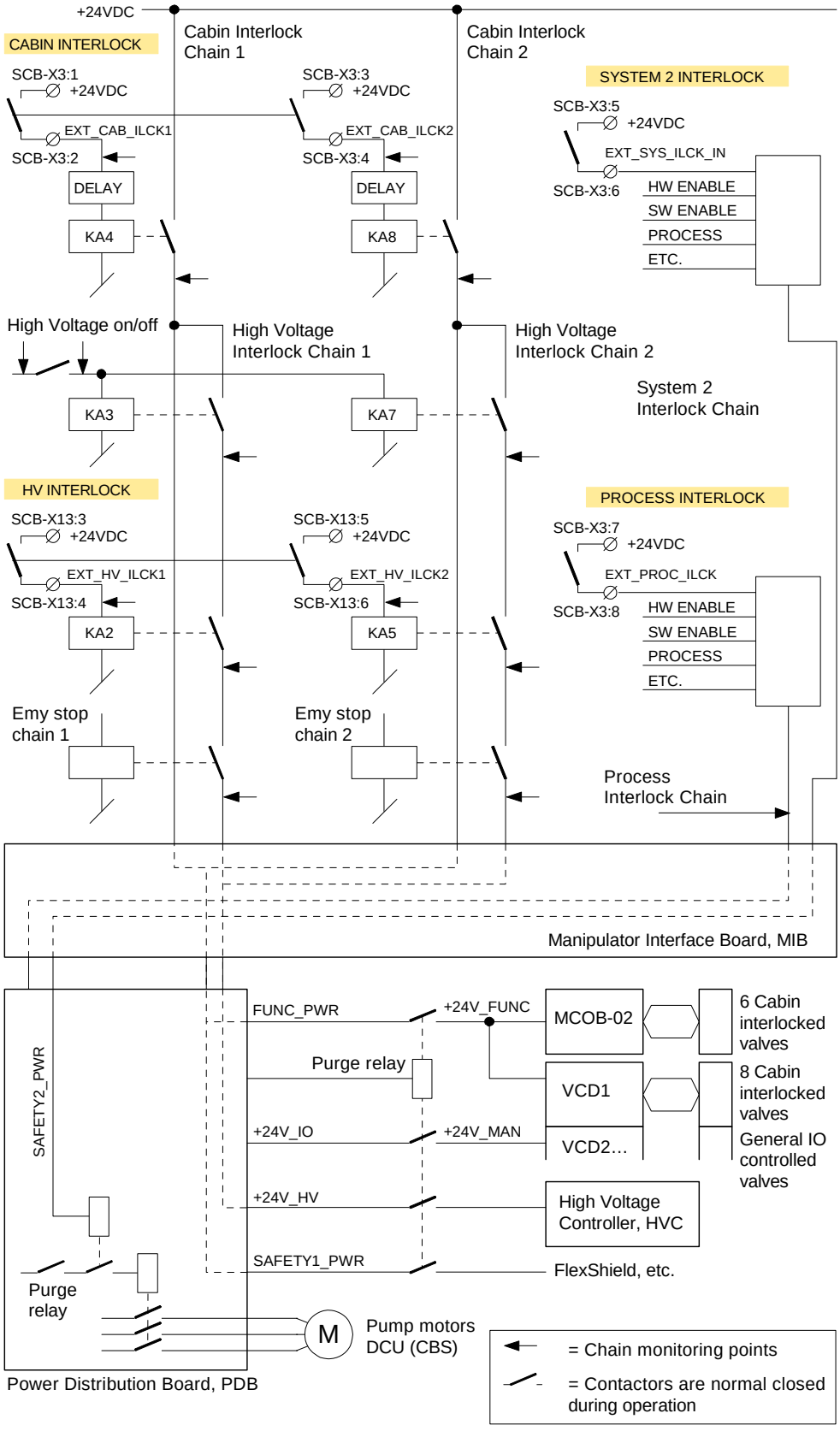
The process interlock may be used by the plant’s control system for the cabin e.g. to close all hazardous functions of the paint system in case of a fire etc.

Connections

To install the Process Interlock switch, install a switch at terminals marked ‘Process Interlock’ in connector SCB-X3 pin 7-8 as shown in Figure 34 and in principle diagram in Figure 35. The switch must be of a Normal Open fail safe type which will be opened to disable process functions.

The switch must comply with ’Safety System Standards’ on page 65.

Figure 35 Cabin Interlock chains

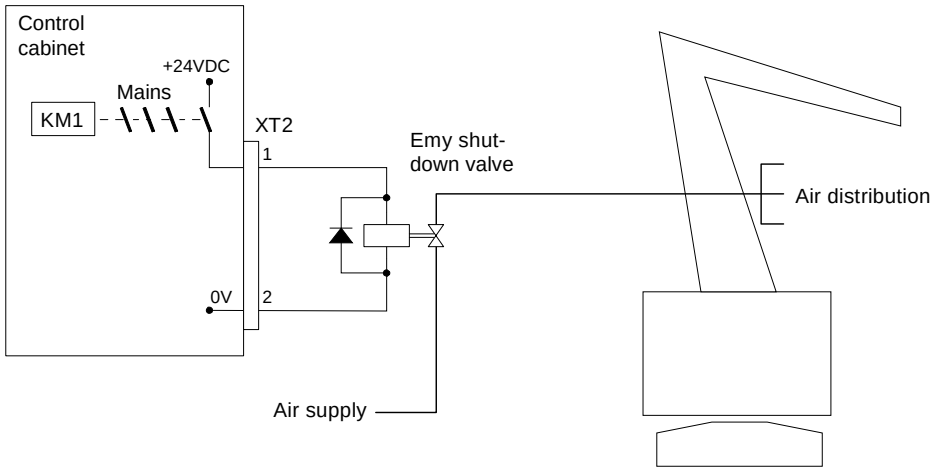


5.5.7 Emergency Shut Down Valve

General

Optionally an emergency shut down valve can be connected to the control system. The purpose of the emergency shut down valve is to cut off all air supply to the paint equipment on the manipulator or CBS in case of an emergency.

Figure 36 Emergency shut down valve, principle diagram



Basic Function

To open the valve, following conditions must be present:

- Emergency stop must not be activated.
- Purging sequence must be completed and the robot ready for operation.
- The run chain must be closed.

Connections

Install emergency shut down valve. Connect valve to terminal XT2: pin 1(+24VDC) and 2 (GND). Install voltage suppression diode as shown in diagram above. Route main air supply to the robot's paint systems via the valve.

5.6 Encoder and Sync Switch Installation

5.6.1 Introduction

General

Conveyor tracking is a function to be used when the robot is operating on objects on a moving conveyor line. By using the tracking function, the robot programs will be executed correctly in relation to the work object, independent on how the work object moves on the conveyor.

To enable the tracking function, a conveyor encoder and a sync switch must be installed on the conveyor and the robot must have been supplied with the tracking function.

The following sections provide information on the installation and connection of the encoder and sync switch. For information on how to enter the required data and parameters for setting up the tracking function, see ‘Operator’s Manual, IRC5P’.

Important Considerations

To ensure good operation of the tracking function, following points must be observed:

- The robot or robots (and trolley rail system if used) must be installed as accurately as possible, which normally means at about +/- 0.5 mm maximum deviation from theoretical positions.
- If robots are installed on both sides of the conveyor, the robots and rails must also be installed symmetrically relative to the object, so that mirroring of robot programs can be possible in the same part of the robot’s work envelopes.
- The conveyor must be able to run steadily at all speeds to avoid jerky or swinging motions of the work objects on the conveyor.
- It must be possible to install an encoder at a location which will reflect the true speed of the conveyor in front of the robot. This means a location as close to the robot as practically possible.
- The distance between the encoder and the connection point for the encoder (control cabinet) should be kept as short as practically possible to minimize the effect of noise on the encoder signal.
- One encoder may be connected to serve more than one robot.

5.6.2 Encoder Specifications

General

The encoder is used to inform the robot control system of the position (motion) of the conveyor to enable the tracking function to run the robot program correctly in relation to the work objects on the conveyor. The tracking function is obtained by installing the encoder on the conveyor and enter the signal from the encoder to the control system via terminals in the control cabinet.

Encoder Type

The encoder must be of 2 phase type to enable registration of reverse conveyor motion and to avoid ‘false counting’ related to vibration etc. when the conveyor is not moving. The encoder can be PNP or NPN type.

Number of Pulses

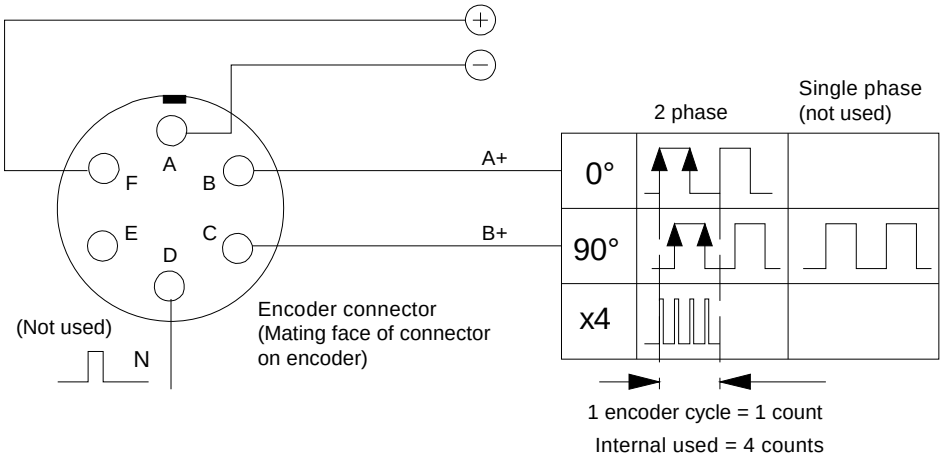
The number of pulses per meter must be selected in relation to the speed of the conveyor and the gearing between the encoder and the conveyor. The parameter value should be between 1250 and 5000 cycles per meter.

In the following, we use this notion: Counts = cycles = 4 * pulse transitions. The robot motion controller uses all the pulse transitions, so that the number of increments used will be 4 times the number of full cycles from the encoder. The system specifies only one count per cycle in the parameter (see pulse diagram in Figure 37). This means that the controller will read 5000 - 20000 pulses for the encoder cycle ratio given above. Reducing the number of pulses below 5000 will reduce the accuracy of the robot (5000 pulses/m = 0.2 mm/pulse). Increasing the value beyond 10000 will have no significant effect as inaccuracies in robot and cell calibration will be dominant. High values may however introduce a max. frequency problem if long cables are used.

Recommended Encoder

The recommended Lenord and Bauer encoder shown below includes connections for supply voltage and 2 output phases with 90° phase shift. The sync pulse connection is not used.

Figure 37 Encoder connection - Lenord & Bauer



Rotating Direction

The physical rotating direction of the encoder after installation is dependent on the design of the arrangement connecting the encoder to the conveyor. Basically, both rotating directions can be equally used, but it is required that it counts ‘up’ when the conveyor moves forwards and counts ‘down’ when the conveyor moves backwards.

The rotating direction of the encoder can be changed electrically by interchanging the 2 phases (0° and 90°) of the output signals, - Ref: Figure 40.

For information on how to find encoder rotating direction, see ‘Operator’s Manual, IRC5P’, chapter ‘Installation and Commissioning’.

Technical Specifications

Output signal:	Open collector PNP or NPN output
Voltage:	10-30V (normally supplied by 24VDC from robot)
Current:	Max. 10mA (for each connected robot)
Phase:	2 phase with 90 degrees phase shift
Duty cycle:	50%
Max. frequency:	40KHz *

* Maximum frequency is strongly dependent on cable quality and cable length.
Recommended cable is 3 pair screened cable.

Encoder Noise Suppression

The encoder must be connected using a screened cable. If this cable is long, the inductance in the cable will produce spike pulses on the encoder signal which may, over a period of time, damage the opto couplers in the control electronics. The spike pulses (which can be of considerable amplitude), can be removed by installing a capacitor between the signal wire and ground for each of the 2 phases. The capacitors should be connected at the encoder end, not on the electronics end. Typical capacitor value is 100 nF - 1 µF, depending on the length of the cable (longer cable, larger capacitor). The correct capacitor can be found by viewing the encoder signal using an oscilloscope.

5.6.3 Sync Switch Specifications

General

The sync signal (synchronization signal, sometimes called start signal) is used to enter the position of the work object on the conveyor into the robot control system. The sync signal is entered by installing a sync switch on the conveyor. The sync switch will detect each object as it passes the switch.

LEDs labelled Start 1 / 2 (Start 1 and Start 2) for sync switch 1 (and sync switch 2 if two sync switches are installed) indicating the operation of the sync switch are present on the control cabinet LED display.

Switch Specification

The sync switch should be selected so that it provides a reliable and repeatable signal for the work objects on the conveyor, regardless of conveyor speed. The switch arrangement must be designed so that it only gives one signal for each work object, and that it does not give any signal if the work object should happen to pass the switch in backwards direction. (If the switch gives multiple signals when an object passes, the parameter SyncFilter can be set so that only one signal is accepted. For information, see ‘Operator’s Manual, IRC5P’).

Switch Types

Different types of switching devices may be used. Most common is a limit switch, but photocell with switch output or Namur initiator etc. may also be used.

Switch Location

The sync switch may be installed in the hazardous area of the spray booth or in the non-hazardous area outside the spray booth. Different requirements apply to the switch and its connection to the control system in these situations. For information, see ’Sync Switch Connection - General Information’ on page 95.

5.6.4 Connection Overview

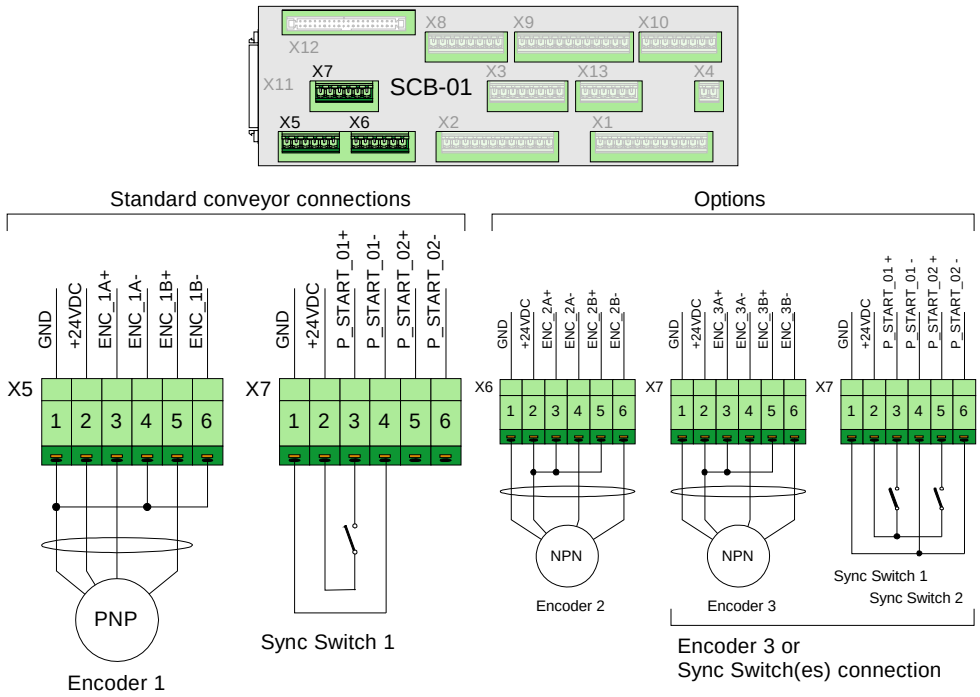
Connector Description

The illustration below shows the connections for 1, 2 or 3 encoders and sync switch. Connections are made on the Safety Connection Board, SCB.

Connections for conveyor tracking will normally consist of one PNP encoder connected to connector X5 and one sync switch connected to connector X7.

CAUTION! To avoid interference to encoder signals, 4 wire twisted pair screened cables must be used for encoder connections.

Figure 38 Encoder and Sync Switch connection



Options

The encoder inputs support both PNP and NPN type encoders. Optionally an NPN encoder can be installed. Optionally connector X7 may be used for a third encoder or for connection of a second sync switch, as shown in the illustration.

The optional components must be configured explicitly.

Note: The system supports 24VDC encoders. If RS422 encoders are used, a signal converter such as BLE-01 must be used.

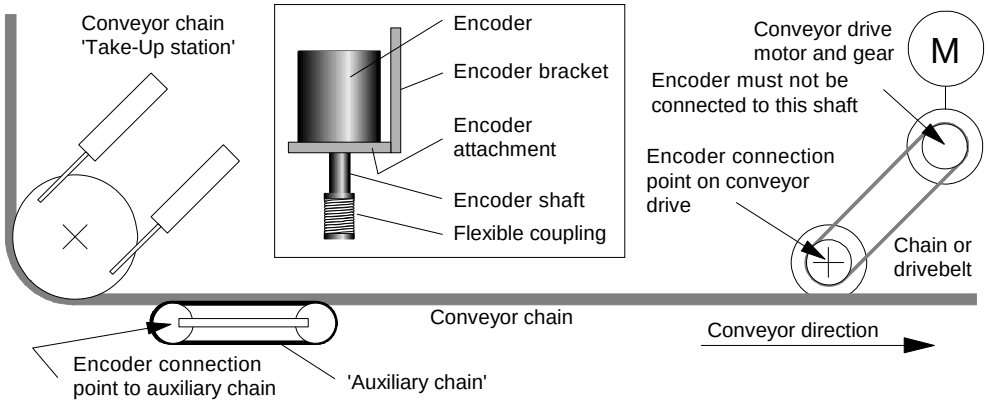
Extra encoders can be used for a second conveyor, a backup encoder, or for monitoring of paint flow e.g. when using Küppers initiators. For more information on monitoring paint flow, refer to the gear flow meter in the ‘Unit Description, Paint’ manual.

5.6.5 Encoder Installation

General

The encoder must be installed in such a way that it gives a precise feedback of the conveyor motion (reflects the true conveyor motion). This means that the encoder should be installed as close to the robot as practically possible, typically not more than 30 meters away, and that a good connection between the encoder shaft and the conveyor should be made.

Figure 39 Conveyor and encoder, top view



CAUTION! The encoder is a sensitive measuring device and it is for this reason important that no other forces than the shaft rotation is transferred from the conveyor to the encoder, and that the encoder is mounted using shock absorbers to prevent damage from vibration.

Mechanical Connection

The encoder can be installed in conjunction with the conveyor drive unit or connected via a chain system, called ‘auxiliary chain’, gripping into the conveyor chain. The encoder shaft can be connected to the shaft of the conveyor drive wheel or one of the wheels of the ‘auxiliary chain’.

Important: The encoder must not be connected directly to the conveyor drive unit itself, as play in the drive belt will not be registered, and, if the drive belt should break, the robot will operate as if the conveyor was still running.

Using Flexible Coupling

The connection can be performed either directly to the shaft via a flexible coupling, or more commonly via a drive belt, chain- or gear wheel arrangement. If a flexible coupling is used, it must be a coupling specially designed for this purpose. A coupling using a plastic/rubber hose should be avoided as it makes a connection which is too stiff and thereby may cause damage to the encoder.

Conveyors with ‘Take-Up’ Station

If a ‘Take-Up’ is used (used to keep tension in the conveyor chain), the encoder must be placed on the same side of the ‘Take-Up’ station as the robot.

Encoder Connection - General Information

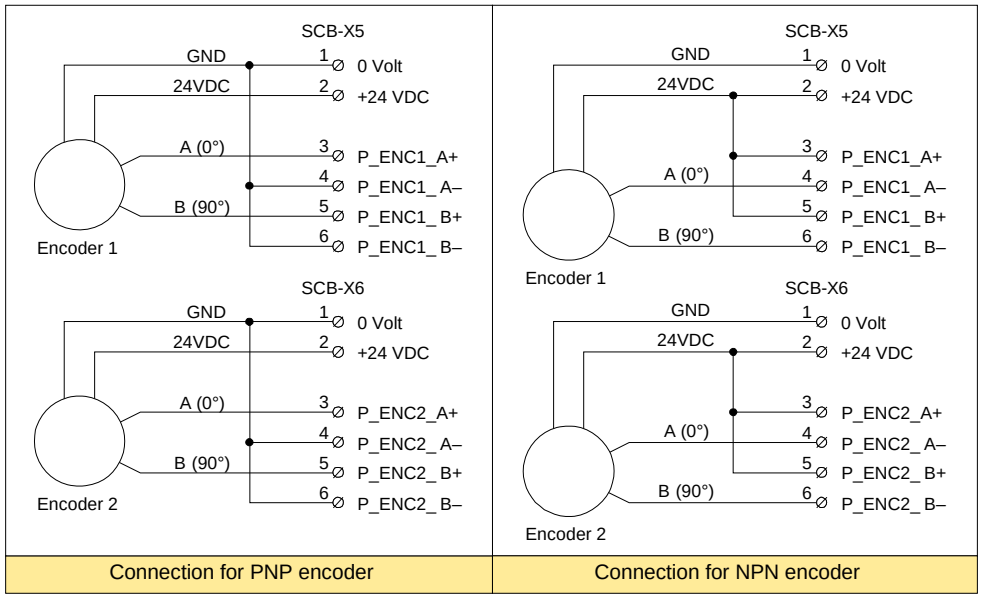
The encoder is connected to encoder inputs on the SCB board in the control cabinet. The connection of the encoder may be performed in different ways as described in the following:

- A single encoder for normal conveyor tracking.
- One encoder used to serve two or more robots.
- Two encoders to provide a backup encoder.

CAUTION! The encoder must be connected using a screened cable. If the cable is long, special considerations concerning generated spike pulses must be taken. - Ref: 'Encoder Noise Suppression' on page 88.

Connecting Encoder to Control Cabinet

Figure 40 Encoder connection in control cabinet



The encoder is connected to inputs on connector X5 - X7 on the SCB board in the control cabinet as shown above and in Figure 38.

The 2 phases, A(0°) and B(90°), must be connected so that the encoder counts 'up' when the conveyor moves forwards and counts 'down' when the conveyor moves backwards. For information on finding the rotating direction, see 'Rotating Direction' on page 88.

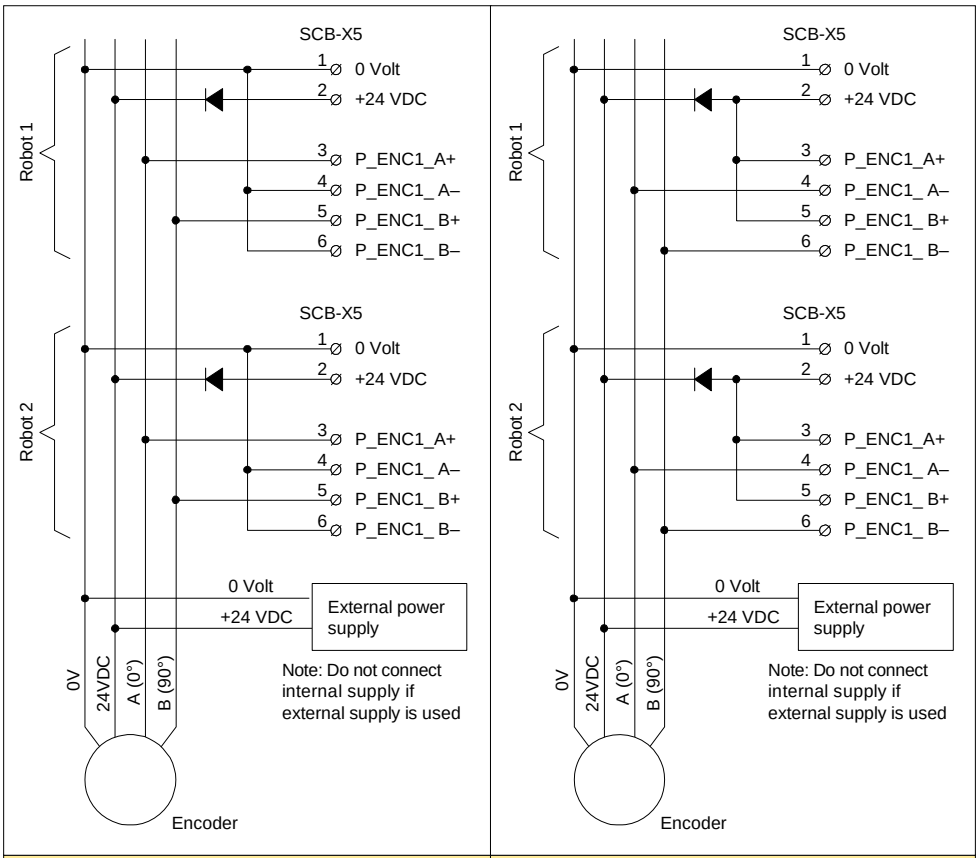
Connections for the second encoder shown above can only be used if the 2nd encoder is to be used as backup.

The 2 LEDs for each of the encoders on the cabinet LED display will flash to show the pulses from the encoder. By running the conveyor extremely slowly, these indicators can be used to verify the pulses from the encoder.

Connecting One Encoder to More Robots

One encoder can be used to control several robots. In this situation, power for the encoder may be supplied by an external power supply, or by the robots.

Figure 41 Connecting one encoder to more robots



If the power supply is taken from the robot, the supply must be connected to all the robots to make sure that the encoder will be operational even if one robot is switched ‘off’. When supplying power from the robots in this way, it is important that a diode is installed for each robot to prevent power from one of the robots which is ‘on’ to be fed to a robot which is ‘off’.

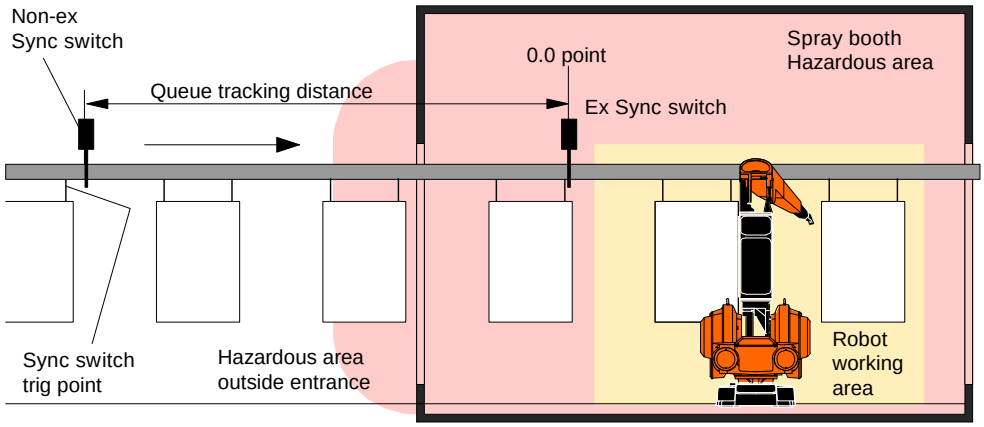
If an external supply is used, the internal supply must not be connected.

5.6.6 Sync. Switch Installation

General

The sync switch may be positioned to detect the work object suspension or the work object directly.

Figure 42 Location of sync switch in an installation



Location of Switch

To reduce possible variation in the synchronization signal due to uneven conveyor motion, swinging of work objects etc., the switch should be placed as close to the robot as practically possible.

The switch may also be placed outside the hazardous area. This location must be used if a non-ex switch and non-ex connection is used. The switch can be installed on a bracket mounted on the conveyor.

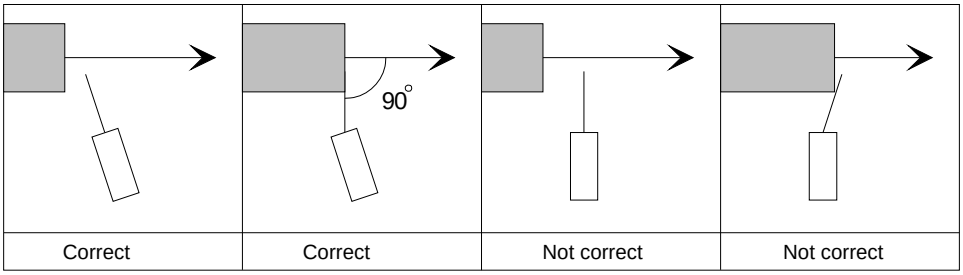
Initiator Mounting

If an initiator is used, the initiator should be installed to detect the object directly, or detecting the object suspension (a flag on the suspension) etc.

'Normal' Switch Mounting

If a 'normal' switch is used, the switch arm must be in a perpendicular position in relation to the work object when the switch is activated. If the switch is installed as indicated in the two illustrations at the right, there is a risk that the work object (or suspension) will slide on the switch arm, causing inaccurate switching.

Figure 43 Sync switch mounting



Sync Switch Connection - General Information

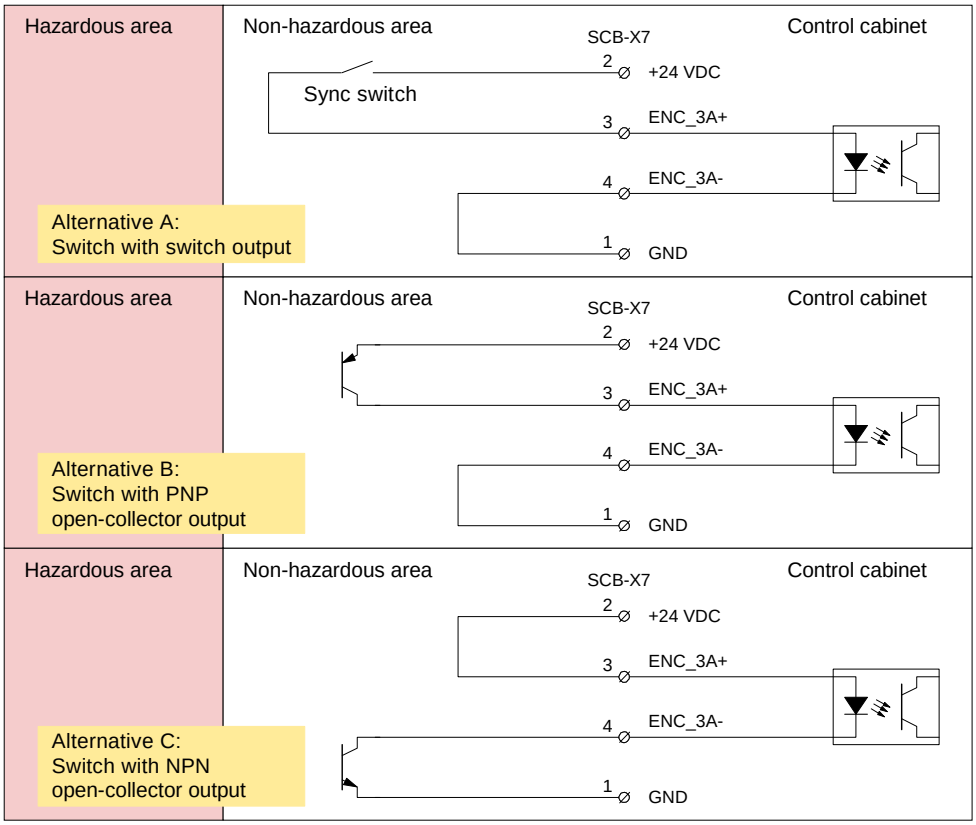
The sync switch should be connected to a digital input on the SCB board in the control cabinet (non-ex connection) as described in the following.

The system has connections for 2 sync switches (non-ex connection only), where switch 2 may be used in the rare cases when the robot works with ‘check point functionality’ enabled. The following descriptions show connections for sync switch 1.

Non-Ex Connection

A non-ex sync switch can be connected directly to a digital input in the control cabinet according to one of the following alternatives:

Figure 44 Non-ex sync switch connection alternatives



If a ‘normal’ switch, photocell or initiator with a switch output is used, the switch must be connected as shown in Alternative A.

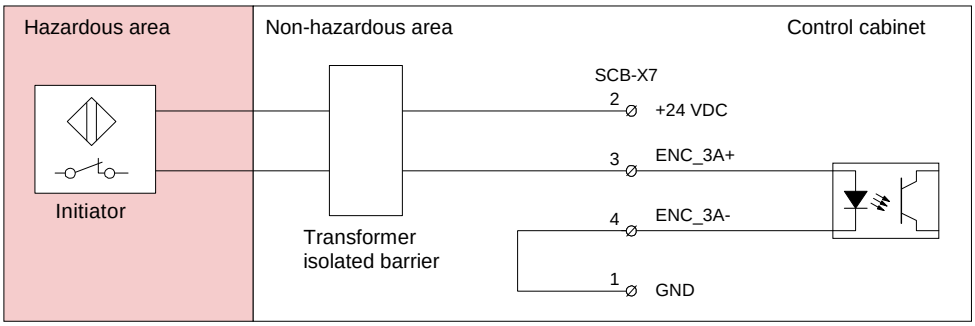
If a switch with open-collector transistor output is used, the output from the switch should be connected as shown in Alternative B (PNP) or Alternative C (NPN).

Ex Connection

An ex sync switch must be connected via a transformer isolated barrier to avoid violating the explosion safety for the spray booth.

CAUTION! Placing the switch in the hazardous area means that the switch and its connection MUST comply with the ex-regulations. Observe that the hazardous area also includes areas just outside any spray booth opening as shown in Figure 42.

Figure 45 Ex sync switch connection



An ex type initiator may be used as alternative to a switch. Such a switch device in conjunction with a transformer isolated barrier can be installed as shown in Alternative B.

5.7 Misc. System Connections

5.7.1 Introduction

About this Section

This section provides information on how to connect various external functions and systems to the controller. Which connections that are to be made will depend on the installation.

Following external connections are described:

- ’Digital I/O Connection’ on page 98
- ’Remote Panel Connections’ on page 99
- ’Ethernet Communication’ on page 101
- ’Pendant Connection’ on page 103
- ’Cabinet Cooler Installation’ on page 105
- ’Servo Disconnect’ on page 109
- ’Home Position Switch’ on page 110
- ’Purge Unit w/Connector Box’ on page 111

5.7.2 Digital I/O Connection

General

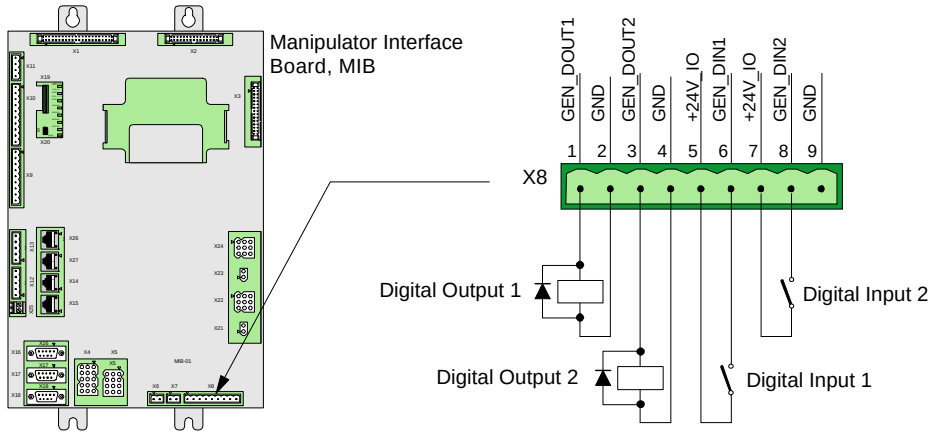
In most installations, various digital (and analog) inputs and outputs will be needed to control functions such as applicator control, color change etc. These inputs and outputs are provided via various types of field bus nodes.

The control system offers also 2 digital inputs and 2 digital outputs which can be used for test purposes or in simple robot installations where a greater number of I/O is not required. Following description provides information for connections of these inputs and outputs.

Connector Description

Connections for the standard 2 digital inputs and outputs are available in connector X8 on the MIB board as shown in the illustration below.

Figure 46 Standard digital I/O



Connection

Install 1 or 2 digital input switches in MIB board connector X8 pin 5-6 and 7-8 as shown in illustration above. For location of the MIB board, see 'Controller Connections Overview' on page 42.

Install 1 or 2 digital output loads in MIB board connector X8 pin 1-2 and 3-4 as shown in illustration above. Max. output current 100 mA (overload protection).

CAUTION! If an inductive load is connected to an output, a voltage suppression diode as shown in Figure 46 must be installed to protect the control electronics from voltage transients.

For information on tightening torque for terminal connections, see 'Tightening Torques' on page 216.

For information on cable dimension and screening, see 'Cable Information' on page 208 and 'Bonding Information' on page 211.

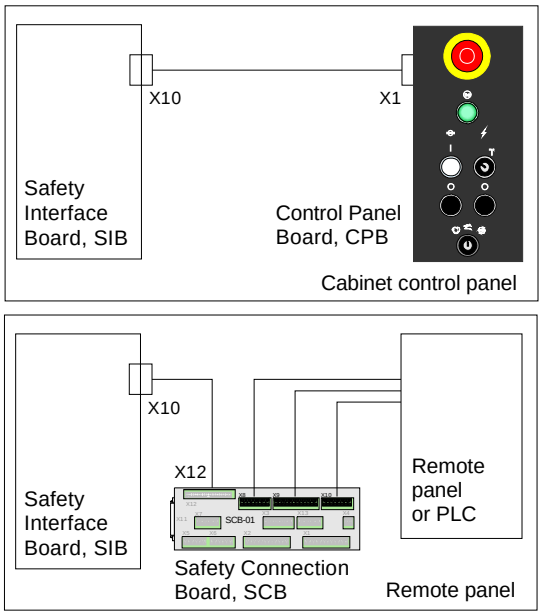
For information on how to setup the digital inputs and outputs in the control system, see 'Operator's Manual, IRC5P, chapter 'Installation and Commissioning'.

5.7.3 Remote Panel Connections

General

The remote panel connections are used when the robot is to be controlled from an external panel or PLC instead of the standard control panel on the control cabinet front, as shown in the illustration below.

Figure 47 Cabinet control panel- / remote panel connections



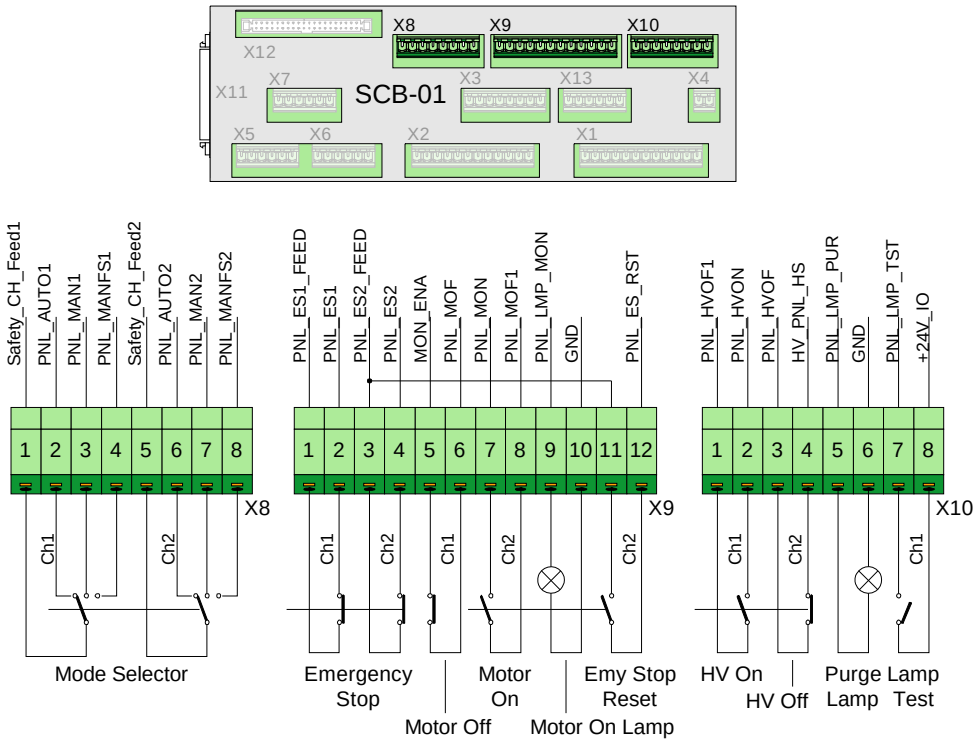
All main control panel functions are available in connectors on the Safety Connection Board, SCB.

Note: The robot can not be operated without cabinet control panel or remote panel / PLC installed.

Remote Panel Connections

The following illustration shows the connections for remote panel.

Figure 48 Remote panel connections



References

For more details on the function of the switches, see ’Control Panel Description’ on page 27. For control cabinet internal wiring information on the remote panel functions, see circuit diagrams supplied with the robot.

5.7.4 Ethernet Communication

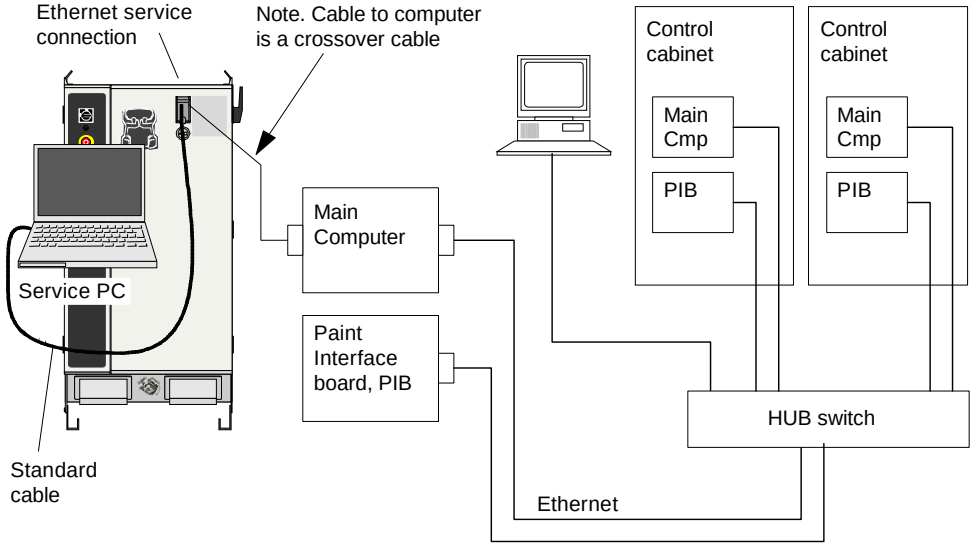
General

Ethernet communication is a standard function in the IRC5P control cabinet and may be used for communication between the robot control cabinet and an external PC etc., or for including one or more robots in an Ethernet network.

Several Ethernet connections are available; on the front door of the cabinet and directly on the main computer unit as shown in Figure 49.

The connection on the cabinet front is used for services purposes such as connecting an external PC for down-loading of programs, program backup etc. The connections inside the control cabinet may be used for including the robot in an Ethernet network.

Figure 49 Ethernet communication concept



Cable Information

The cable used must be twisted-pair Ethernet (TPE), or as defined in IEEE 802.3 : 10BASE-T. Local conditions such as electric environment determines how cable layout is to be performed. The Ethernet connection has no termination for cable screen. 10BASE-T is a point-to-point net, connected via a HUB switch.

Different transmission rates and cable lengths require different ethernet cables:

- 10 Mbit/s: Shielded twisted pair (10 Base T STP)
- 100 Mbit/s (<10 m): CAT5E, 100 Base T STP
- 100 Mbit/s (10-100 m): CAT6, 100 Base T STP

References

See Ethernet documentation.

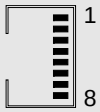
Setup

Setting up the Ethernet is performed on the pendant.

Note: External computer for service purposes is connected to the cabinet service connection using a standard Ethernet cable. The required crossing of the signals is performed by the internal cable.

Ethernet TPE Connector

Ethernet TPE Connector

Connector	#	Signal name	Description
	1	TX+	Transmit data line +
	2	TX-	Transmit data line -
	3	RX+	Receive data line +
	4	NC	Not connected
	5	NC	Not connected
	6	RX-	Receive data line -
	7	NC	Not connected
	8	NC	Not connected

5.7.5 Pendant Connection

Installation

Connect pendant cable to the pendant connector.

Important: If the pendant is not connected, a dummy connector must be installed in its place to avoid braking the emergency stop chain.

Following configurations are available:

Standard Connection

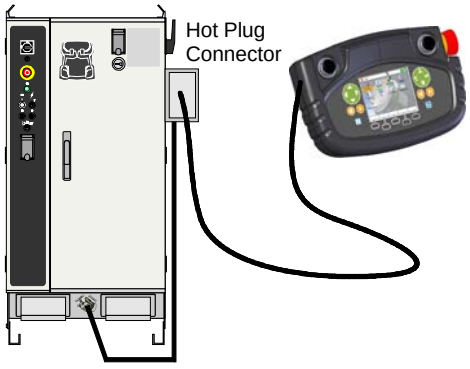
The pendant is connected to the control cabinet via pendant connector X20 at the bottom front of the cabinet.

Figure 50 Pendant standard connection

Hot Plug Connection

The hot plug connection is an optional connector located on the side of the cabinet, to enable connecting and disconnecting the pendant during operation of the cabinet without breaking the emergency stop chain.

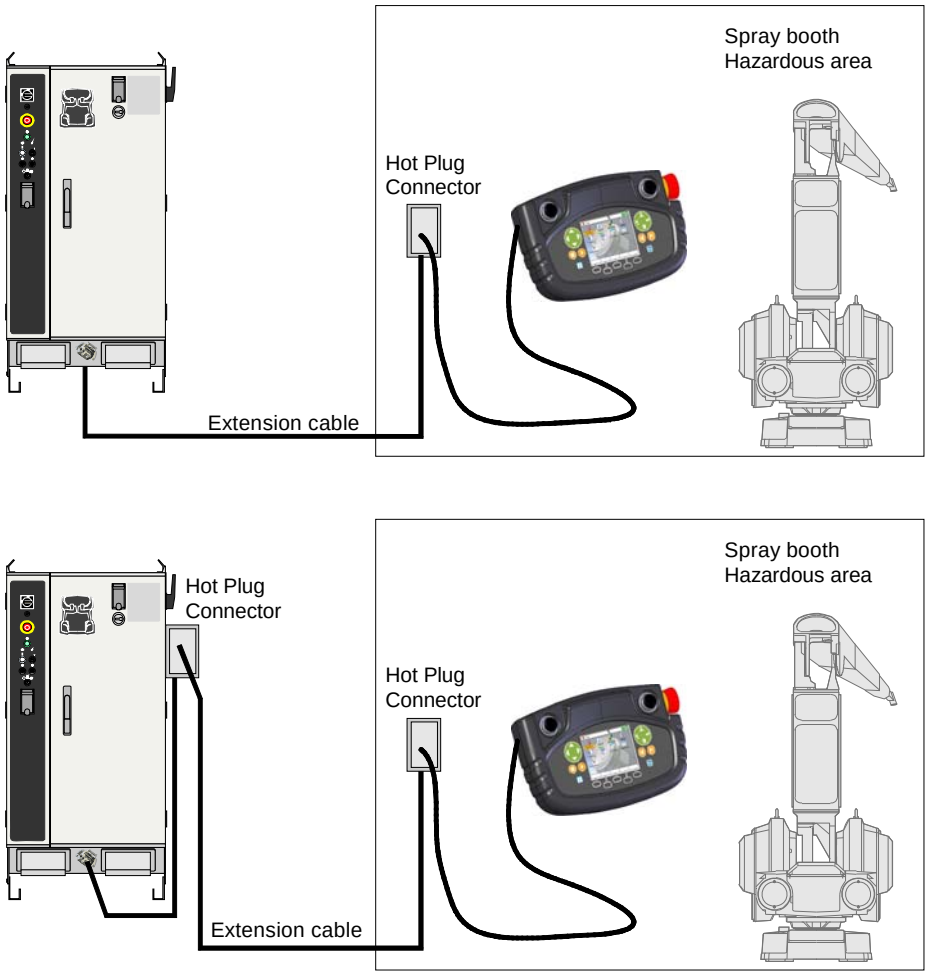
Figure 51 Pendant hot plug connection



External Connection

The external pendant connection is an optional hot plug connector which may be installed to provide connection for the pendant inside the spray booth.

Figure 52 External pendant connection



The connector should be installed inside the spray booth at a convenient location for connection of the pendant. A common location is just inside the spray booth entrance door.

The connector is supplied with the extension cable. Connect other end of cable to the pendant connector X20 at the bottom front of the cabinet, or to an optional hot plug connector at the side of the cabinet.

Check that connector is connected to PE-ground as described in ’IS-Ground Connection’ on page 59.

For information on the hot plug function, see ‘Operator’s Manual, IRC5P’, Installation and Commissioning / Connections / Connecting the Paint Teach Pendant Unit.

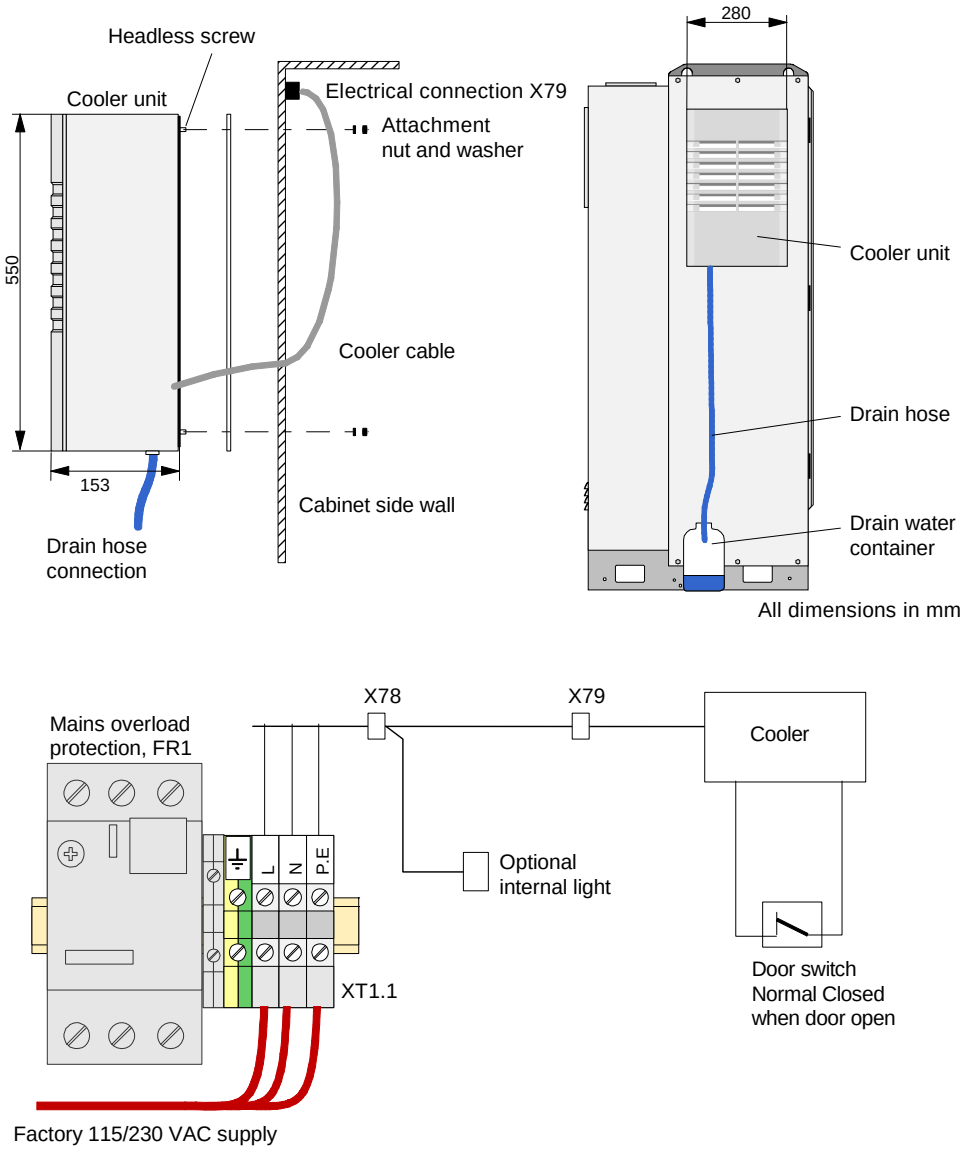
5.7.6 Cabinet Cooler Installation

General

If the controller is to operate at higher temperatures (up to 55°C), a cooler may be installed.

If the cooler is ordered at a later stage than the control cabinet, the installer must prepare the cut-outs for the location of the cooler shown below. For drawing of cut-out and holes, see manufacturer's documentation, supplied with the cooler.

Figure 53 Cooler installation



Installation Procedure

This procedure describes how to install the cooler on the control cabinet.

If the cooler is ordered together with the robot and control cabinet, the cooler is already installed and this installation procedure can be skipped. Continue with 'Installation Checks' on page 106.

1. Remove cooler from box. Be careful when lifting cooler.
2. Remove paper on gasket adhesive surface. Place gasket on cabinet mounting surface with adhesive side facing cabinet. Pay attention to get gasket correctly positioned.
3. Place cooler on its side and install 8 supplied headless screws.
4. Open cabinet front door. Lift cooler onto side of cabinet. Guide headless screws into attachment holes.
5. Install washers and nuts on screws from inside cabinet. Tighten nuts.
6. As the air inside the cabinet is cooled down, condensation arises in the cooler. It is therefore important to make an arrangement as shown in the illustration to lead the condensate from the cooler to the outside of the cabinet.

Important: To minimize condensation, it is important to set the internal temperature (default 38°C) not lower than actually needed. To prevent condensation inside the control cabinet, ensure that the control cabinet is a sealed enclosure, especially watch cable inlets and door seals.

7. Install door switch. Cooling is switched off when control cabinet door is open.
8. Install connector X79 and terminal X78. The external 115 or 230 VAC is connected to terminal board XT1.1, located beside the mains overload protection, FR1, in the lower left bottom of the controller as shown in Figure 17. See also 'Supply for Internal Light' on page 118.
9. Insert electrical connector of the cooler into X79.

Installation Checks

After the installation has been performed, and if the cooler has been installed before shipment, it is important to check the following:

- To prevent condensation inside the control cabinet, ensure that the control cabinet is a sealed enclosure, especially watch cable inlets and door seals.
- Ensure that the condensate from the cooler is lead to the outside of the control cabinet.
- Ensure that the door switch is open when the control cabinet door is open. To minimize condensation inside the control cabinet, cooling is switched off when control cabinet door is open.

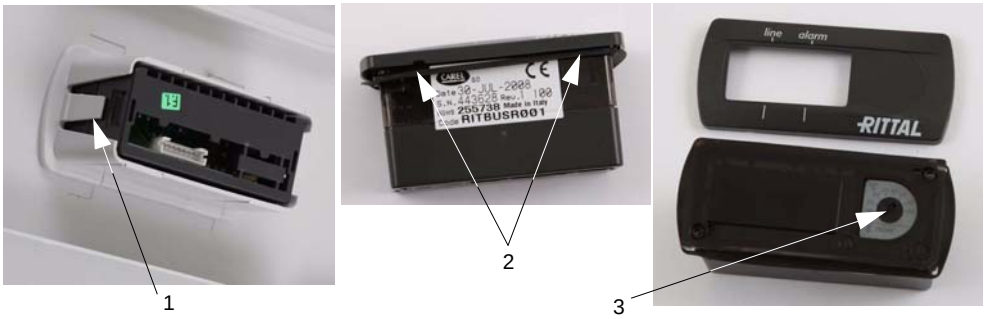
Temperature Adjustment

This procedure describes how to change the temperature setting.

Important: To minimize condensation, it is important to set the internal temperature not lower than actually needed.

1. Switch off power supply for cooler.
2. Remove louvred grill.
3. Release display lock (54/1) from behind and pull the display slightly forwards.

Figure 54 Display removal



4. Carefully raise cooler controller trim panel, e.g. using your thumb or a flat screwdriver (54/2), and remove it.
5. Set required temperature on temperature setting device (54/3).
6. Carefully push cooler controller trim panel onto display until it snaps into place.
7. Re-insert display into louvred grill.
8. Install louvred grill on cooler.

LED Indicators

The following provides a description of the LED indicators on the cooler controller trim panel.

Description	Remedy / Source of fault
line Green - Power supply on, OK Blinking green - Door switch detects open control cabinet door.	In order to avoid condensation, close door. If door is closed, check door switch.
alarm Red - The enclosure internal temperature is 5K above the set temperature. Blinking red - High pressure alarm in the cooling circuit.	Check temperature setting. Check condenser and clean if necessary. Check filter and replace if necessary. Check that the dissipated heat loss does not exceed the useful cooling output of the cooler. After rectifying the fault, you need to reset the cooler controller manually, ref 'Resetting Cooler Controller' on page 108.

Resetting Cooler Controller

After rectifying a high pressure alarm, the cooler controller needs a manual reset.

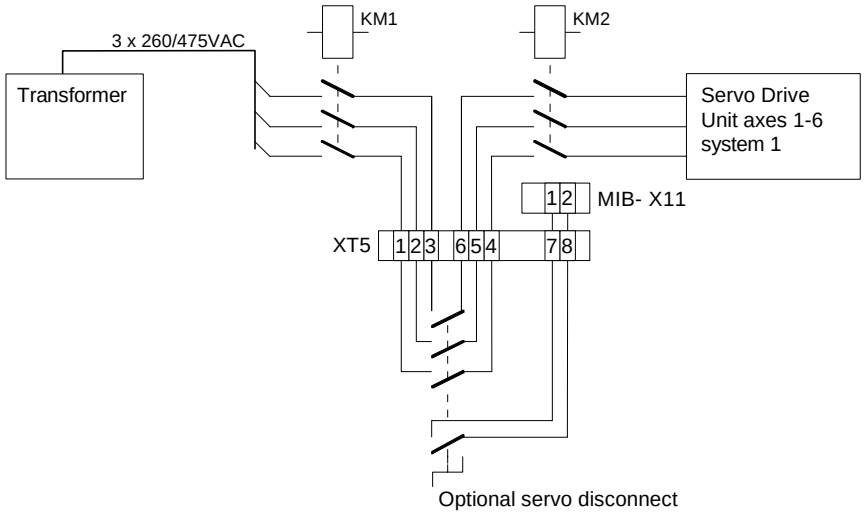
1. Remove cooler controller trim panel as described in ’Temperature Adjustment’ on page 107.
2. Press reset button for at least 3 seconds.
3. The red LED is extinguished.
4. Reinstall the cooler controller trim panel, as described in ’Temperature Adjustment’ on page 107.

5.7.7 Servo Disconnect

General

Servo disconnect remote on terminal is an option to remotely switch off the power to the robot motors, while all other functions of the controller are still powered. The principle diagram is shown in following illustration.

Figure 55 Servo disconnect remote on terminal, principle diagram



The terminal XT5 is located at the bottom of the controller, see Figure 17.

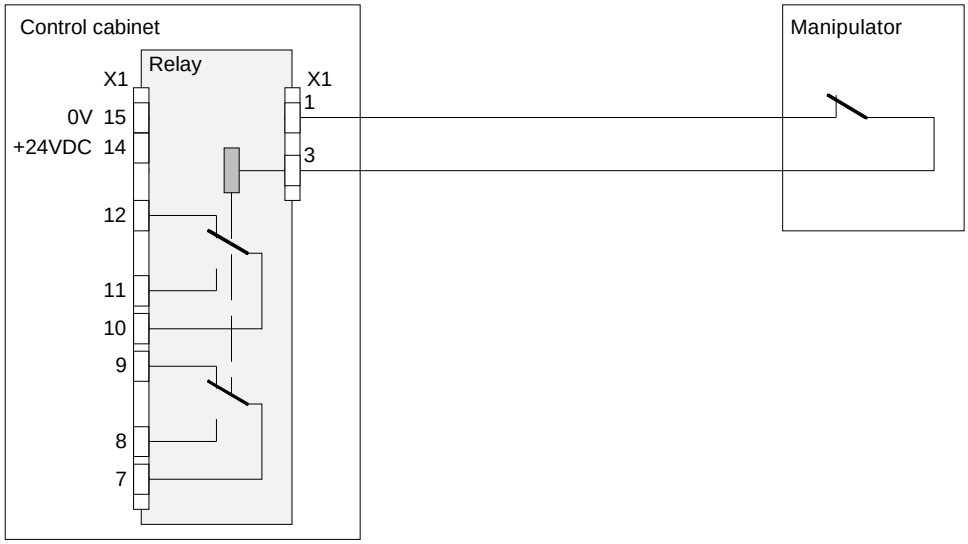
Max. cable length from control cabinet to external switch is 25 meter.

5.7.8 Home Position Switch

General

Home position switch is an option that shows when the manipulator axis 1 is in a determined home position. The manipulator is equipped with a namur switch on axis 1. A relay is located in the control cabinet. The principle diagram is shown in following illustration.

Figure 56 Home position switch, principle diagram



The relay with terminal X1 is located at the bottom of the controller, see Figure 17.

5.7.9 Purge Unit w/Connector Box

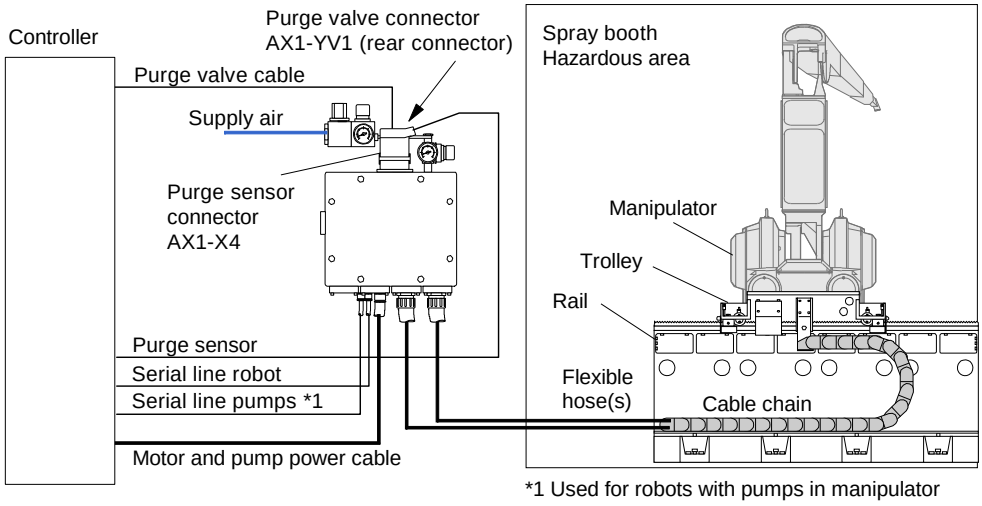
General

The ‘Purge Unit w/Connector Box’ is a special purge unit used for robots mounted on a trolley. The reason for the special purge unit is the special type of flexible cable routed via the cable chain to the trolley and robot.

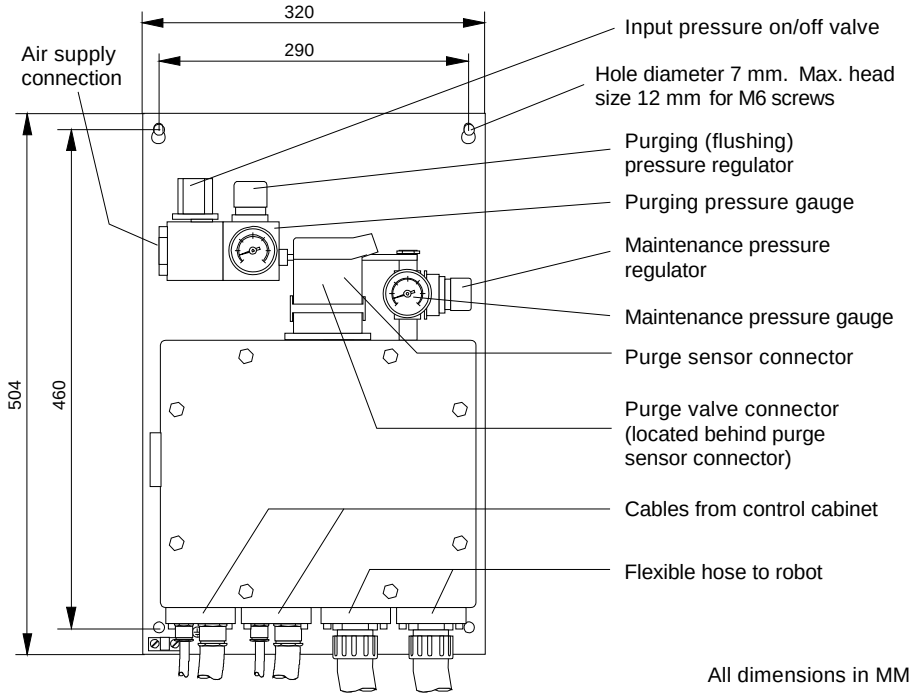
Installation

Install purge unit on a convenient location, e.g. the cabin wall. Then connect cables inside purged chamber as described in the following. For general installation information see description of standard purge unit in section ’Purge Unit Installation’ on page 49.

Figure 57 Purge unit location and connections



*1 Used for robots with pumps in manipulator



All dimensions in MM

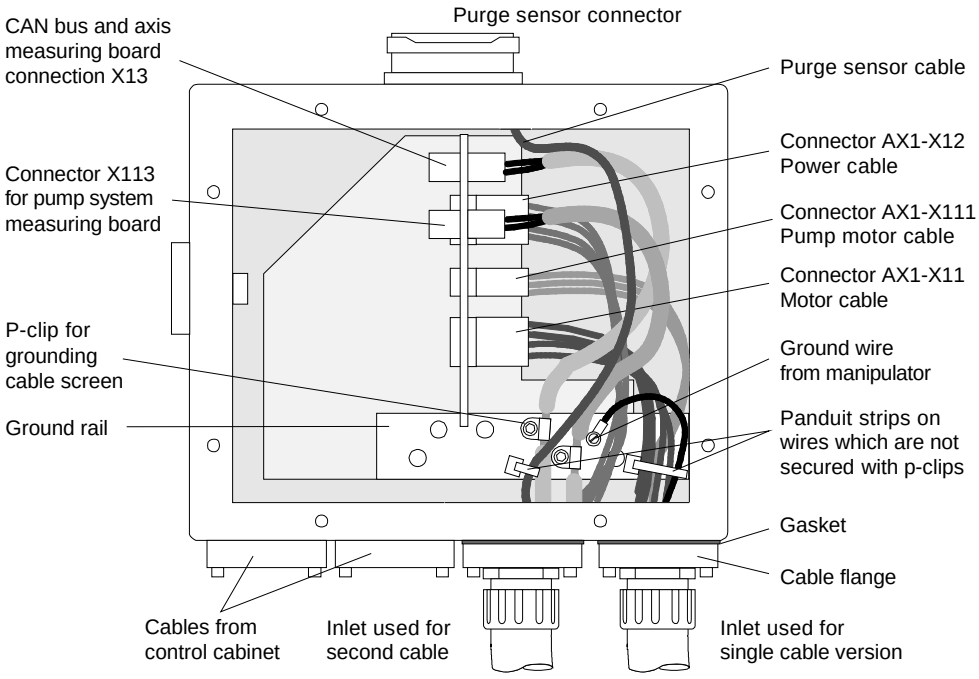
Connecting Manipulator to Purge Unit

The following procedure describes how to connect 1 or 2 flexible cables in the purged chamber. The robot may have 1 or 2 flexible cables. Differences between the single cable version and dual cable version will be pointed out throughout the procedure.

Different number and types of connectors may be used, depending on robot type and equipment installed in the robot. All these variants are not described in the following, but correct connection is obtained by connecting the connectors according to markings on connectors and receptacles.

CAUTION! All types of cables, including the flexible hose (hose with internal wires) between purge unit and manipulator, must be laid in such a manner that they will not be continuously exposed to solvent, e.g. by laying the cables in a conduit which will drain solvent entering into it etc.

Figure 58 Purge unit connection box, front view



1. Route the flexible hose(s) from the manipulator through the spray booth wall etc. to the purge unit.

   Note: The lead-through for the cable in the cabin wall must be made in accordance with the cabin safety regulations and ex-regulations, etc.

   Note: The flexible hose must not be bent to a radius smaller than 250 mm.

2. Remove cover for purge unit connection box. Retain cover, screws and gasket for later re-installation.

3. Enter flexible hose into the right inlet on the purge unit for the single cable version. For the dual cable version, enter motor cable in right inlet and signal cable in the second inlet from the right as shown in Figure 58 (the signal cable is the cable which includes screened cables).
4. Check that gasket(s) for the cable attachment is properly positioned and secure cable flange(s) with 4 screws.
5. Route purge sensor cable and connector to hole on top of the purge unit connection box. Enter connector through hole and secure with 4 screws.
6. Insert connectors from flexible hose(s) in receptacles for cables from control cabinet according to markings on connectors and Figure 58.
7. The screened cables include a p-clip at a stripped-off section of the cable insulation. Secure these p-clips to the ground rail as shown in Figure 58.
8. Secure loose wires using Panduit strips. Check that the wires are properly secured so that they will not apply strain to the connectors.
9. Connect ground wire from manipulator to ground rail (not used on all versions).
10. Make sure that the gasket for the purge unit cover is properly positioned, install cover and tighten attachment screws. Make sure that all screws are in place to prevent air leakage.

5.8 Power Connections

5.8.1 Introduction

About this Section

This section provides information on how to connect the robot to the mains power, including checking transformer wiring for correct voltage, connections for service outlet, etc.

Following connections are described:

- ’Mains Power Connection’ on page 115
- ’Transformer Wiring’ on page 117
- ’Supply for Internal Light’ on page 118
- ’Internal Supply for Service Outlet’ on page 119
- ’24 VDC for External Use’ on page 120

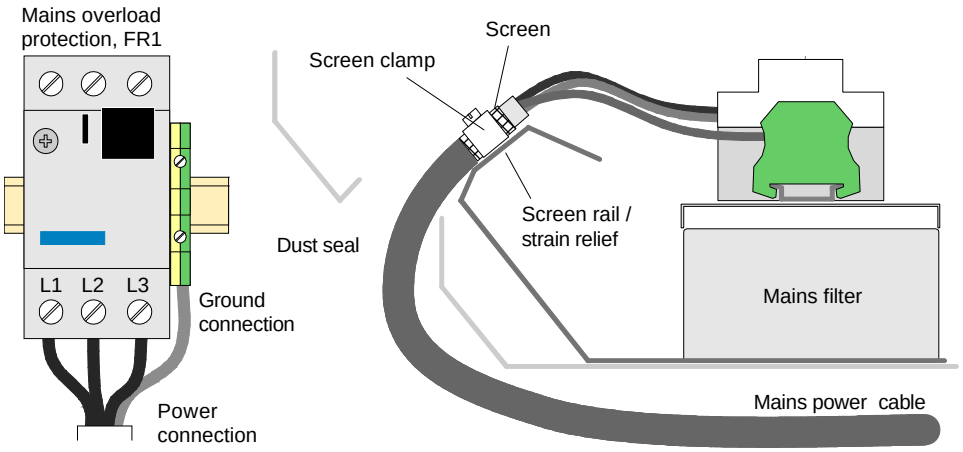
5.8.2 Mains Power Connection

General

This procedure describes how to connect the robot to the factory mains power.

WARNING! Before starting to connect the mains, make sure that the other end of the cable is disconnected from the line voltage.

Figure 59 Mains power connections



Procedure

1. Check on transformer terminals that the transformer is wired for correct voltage as noted in the ‘Documents on Delivery’ folder. If not correct, rewire transformer as described in ’Transformer Wiring’ on page 117.
2. Check that the mains overload protection is set to correct current in accordance with supply voltage as shown below.

Voltage	Current setting	Overload protection type
200VAC	18A	13-18A
230VAC	16.8A	
400VAC	9.6A	6.3-10A
440VAC	8.8A	
475VAC	8.1A	
525VAC	7.3A	
600VAC	6.4A	

3. Make sure that the mains switch is ‘off’. Remove mains fuses for robot supply.

WARNING! Make sure that mains fuses are removed before continuing.

4. Route mains power cable as shown in Figure 59. Dismantle cable and install cable clamp. For location of power connection, see ’Controller Connections Overview’ on page 42

5. Connect mains power L1, L2, L3 to mains overload protection and PE ground to ground terminal. For information on tightening torque for terminal connections, see 'Tightening Torques' on page 216.

– Mains: Iks10kA. Breaking capacity of cabinet = 100 kA (400-600V) / 50kA (200-230V).
– Fuses: Min. I_n 16 Amp. D-Curve (slow blow). 10-20 x I_n or similar overload protection with same slow blow characteristics.
– The mains cable must be min. 3 x 2.5mm² + PE (AWG 14)
– By mains 200V max length 85 meter (by 2.5mm²)
– By mains 400V max length 174 meter (by 2.5mm²)
– By longer supply lines, cable area must be increased, or fuse size reduced

6. Install mains fuses.

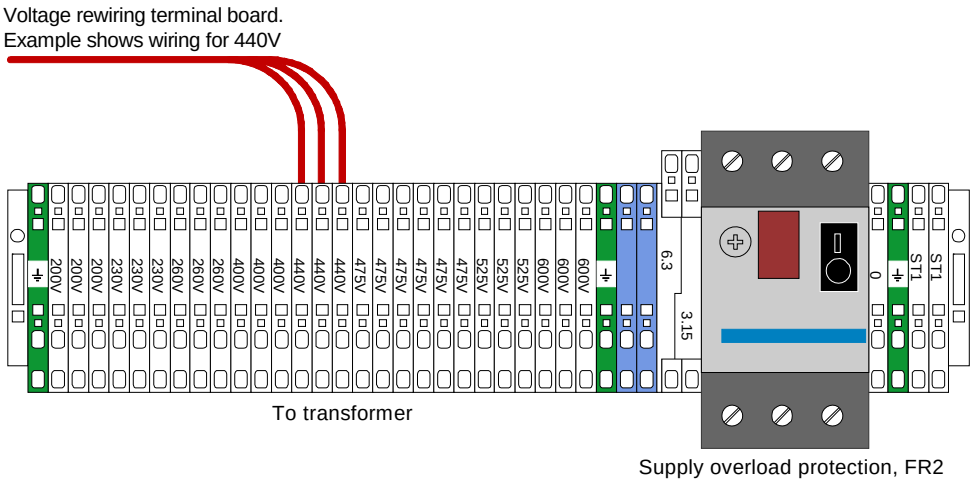
Important: Due to the autotransformer / drive system / mains filter configuration in the IRC5P controller, an imbalance between the supply phases to the system can occur during operation of the robot, and especially when switching the system 'on' and when applying power to the robots drive system (Motor On). This may cause the earth fault protection to trip if a protection with too low release current is used, and especially if more robots share the same earth fault protection.

5.8.3 Transformer Wiring

General

Before connecting the robot to the mains power, it must be checked that the transformer connection corresponds to the mains voltage to which the robot is to be connected.

Figure 60 Transformer terminal board



Procedure

This procedure describes how to check/change the connection of the transformer and auto breaker setting.

1. Open the control cabinet front door.
2. Locate the transformer terminal board, located on the back wall inside the controller as shown in ’Controller Connections Overview’ on page 42.
3. Check connection of transformer as shown in Figure 60.
4. If wiring is not correct, move wires for phase 1, 2 and 3 to correct terminal. For information on tightening torque for terminal connections, see ’Tightening Torques’ on page 216.
5. Check that supply overload protection is set to 16 A.

5.8.4 Supply for Internal Light

General

The controller may include a connection for a single phase 115/230 VAC for internal light. This supply can also be used to supply an optional cooler unit.

The internal light includes a rectifier which makes it operate on supply voltages from 90V to 250V.

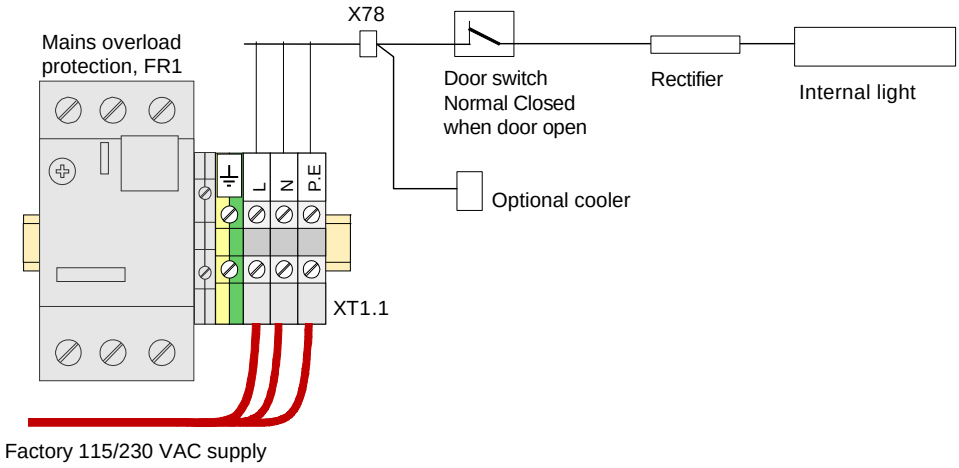
Specification

Voltage	115 or 230 V
Supply line fuses	Max. 10A

Connections

The external 115 or 230 VAC is connected to terminal board XT1.1, located beside the mains overload protection, FR1, in the lower left bottom of the control cabinet as shown in Figure 17. The AC power is connected to the rectifier via a door switch. The light is switched on when the cabinet door is open.

Figure 61 115/230 VAC terminal board



Optionally the power may be connected to the control cabinet internal power supply, which means that the light can only be switched on when the control cabinet is switched on.

For information on tightening torque for terminal connections, see 'Tightening Torques' on page 216.

For connection for cooler, see 'Cabinet Cooler Installation' on page 105.

5.8.5 Internal Supply for Service Outlet

General

The robot has an AC supply available for external and internal use.

This voltage is used in the robot for supply of optional electric outlet, normally located on the front of the control cabinet.

The AC supply is not galvanically separated from the rest of the controller voltages (Common Neutral).

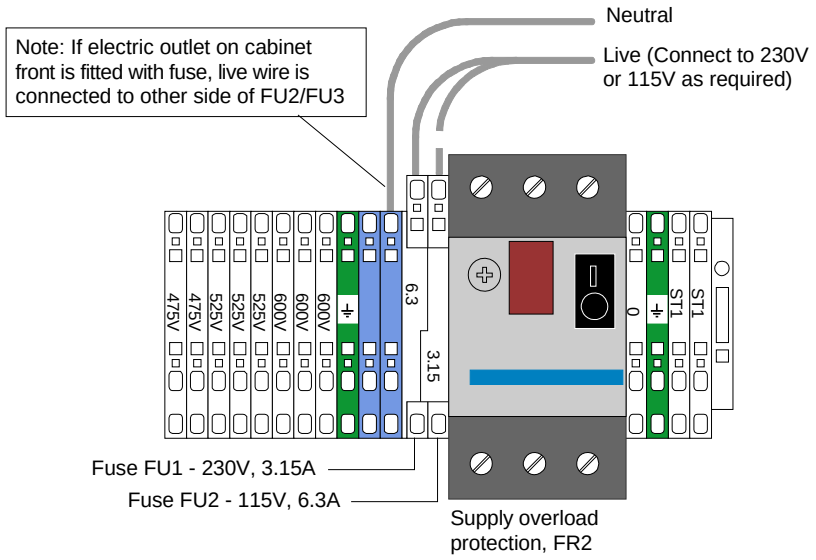
Specification

Voltage	115 or 230 V
Permitted customer load	Max. 700 VA
Fuse size	3.15 A (230 V), 6.3 A (115 V)

Connections

AC supply is available for customer on the transformer terminal board as shown in the illustration below.

Figure 62 115/230 VAC terminals



For information on tightening torque for terminal connections, see ’Tightening Torques’ on page 216.

5.8.6 24 VDC for External Use

General

The robot has a 24VDC supply available for customer connections called 24V I/O. The supply is a general purpose supply which can be used to supply digital inputs and outputs or other external units connected to the robot control cabinet.

Specifications

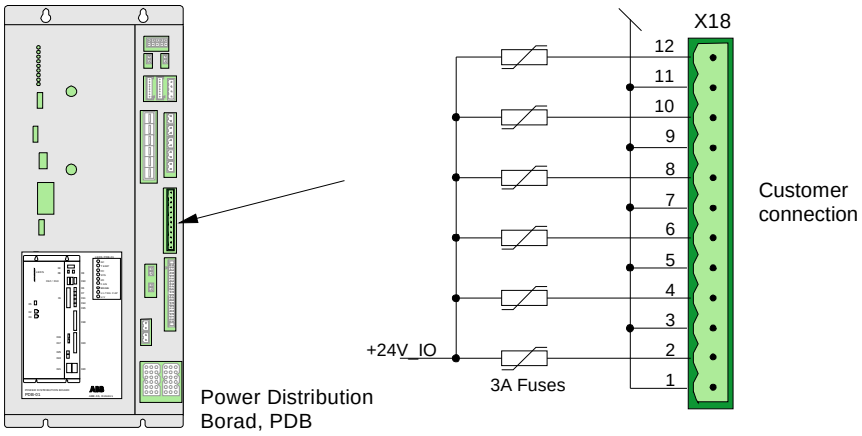
Voltage:	24.0 - 26.4V
Ripple:	Max. 0.2V
Permitted customer load:	Max. 5A - Max. 3A/channel
Current limit:	Max. 10A ±20%
Short-circuit current:	Max. 13A

24V I/O is not galvanically separated from the rest of the controller voltages

Connection

Connections are available on circuit board PDB, connector X18 as shown below. For location of the PDB board, see 'Controller Connections Overview' on page 42.

Figure 63 24V I/O terminal board, +2-XT2



External 24 VDC Supply

The internal supply can not be used in the following cases:

- When more power is needed than can be supplied by the internal supply.
- When the emergency stop circuits are to be independent of whether or not the robot is powered.
- When there is a risk that major interferences can be carried over into the internal 24V supply.

An external supply is recommended to make use of the advantages offered by the galvanic insulation on the I/O units.

The neutral wire in the external supply must be connected in such a way to prevent the maximum permitted potential difference in the chassis earth from being

exceeded. For example, a neutral wire must be connected to the chassis earth of the controller, or some other common earthing point. External supply must confirm to following specifications.

Potential difference to chassis earth:	Max. 60 V continuous
Permitted supply voltage:	19 - 35 V including ripple

5.9 Concluding Activities

Description

The controller is now installed and all required connections correctly made. Before continuing the installation activities such as installing the manipulator and starting up the system, all connections should be verified as required and the ‘Installation Checklist’ supplied with the robot should be filled in.

6 Preventive Maintenance

6.1 Introduction

About this Chapter

This chapter provides instructions for performing scheduled preventive maintenance on the control cabinet.

The preventive maintenance is based on a maintenance chart with information about required maintenance activities including intervals, and references to procedures for the activities.

Note that the intervals described are recommended intervals. The intervals needed for your installation may vary, depending on environmental conditions, number of working hours etc. The maintenance routines in this description must be seen in relation to the plant's own maintenance routines for the paint equipment.

Safety Information

Before any work described in this chapter is commenced, it is extremely important that all information concerning safety is carefully studied.

There are general safety aspects that must be read through, as well as more specific safety information that describes danger and safety risks when performing the procedures. Read the Safety Manual before performing any service work.

WARNING! No maintenance work must be performed on the controller before the safety guidelines in the 'Safety Manual' have been read and understood. Work must only be performed by skilled personnel with the proper training.

General Considerations

The prime objective of any preventive maintenance program is to ensure maximum system availability. Each scheduled and properly performed preventive maintenance activity should assist in realizing this objective. Preventive maintenance that does not reduce system downtime is unnecessary and costly.

The robot and paint system is designed to be able to work under very demanding conditions with a minimum of maintenance. Nevertheless, certain routine checks and preventative maintenance must be carried out at given periodical intervals.

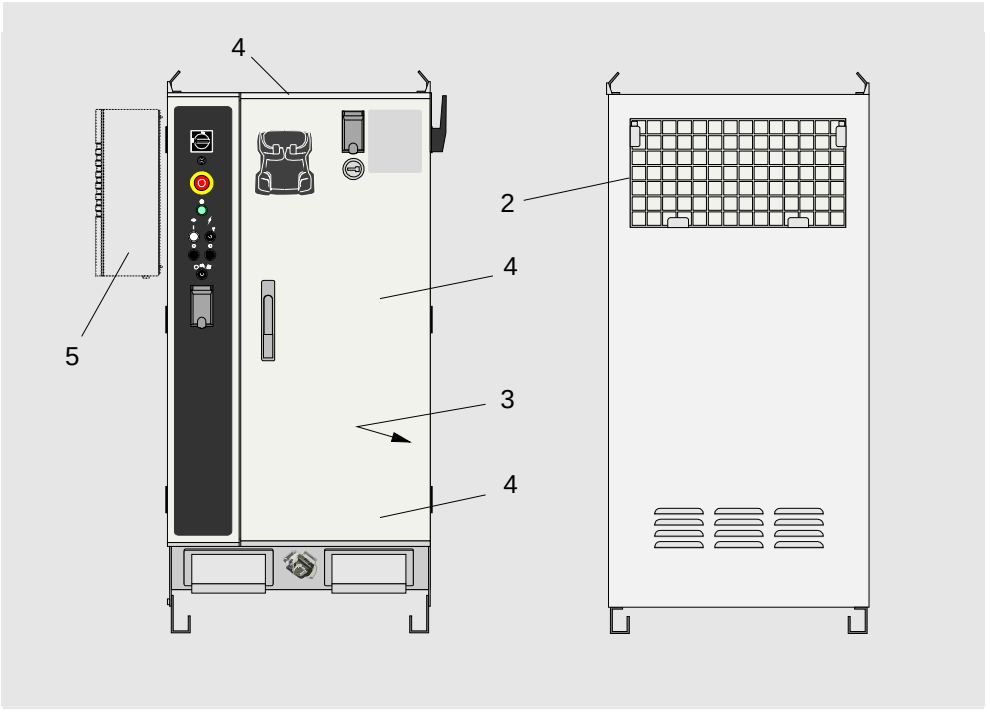
When performing routine maintenance or repair work, a number of precautions must be kept in mind to avoid introducing additional errors into the system.

- Do not perform more than recommended preventive maintenance on equipment which is working satisfactorily.
- Wipe all surfaces clean before starting maintenance procedures.
- To avoid unnecessary contamination by dust etc., always clean outside of control cabinet and manipulator before opening the cabinet door.

6.2 Maintenance Chart

Maintenance Activity Overview

Perform activities described in the list.



No.	Activity and reference	Interval	Sign.
1	'General Maintenance' on page 125.	Daily *1	
2	'Clean/Replace Filter' on page 126.	500 hours*1	
3	Replace the measuring system battery, as described in 'Replacement of Measuring System Battery' on page 167. For more information, see 'Checking the Measuring System Battery' on page 127.	7,000 hours*2	
4	Replace fan units in control cabinet, as described in 'Replacement of Door Fan Unit' on page 135, 'Replacement of Computer Fan Unit' on page 153 and 'Replacement of Servo Fan Unit' on page 159.	50,000 hours*1	
5	'Check the Cooler' on page 128, if cooler is fitted.	Monthly*1	

*1 Interval strongly dependent on environmental conditions.
*2 Depending on robot operating hours and temperature.

6.3 General Maintenance

General

Following points should be checked / attended to as often as required. The necessity of maintenance is strongly dependent on the operating environment for the robot, the type of operation performed, etc.

Cleaning the Controller

The control cabinet should be cleaned as often as required. Strong and/or flammable solvents such as acetone etc. should be avoided.

Check Controller Heat Emission

Check that controller heat emission is not restricted by any of the following:

- The controller is covered with plastic or other material.
- The controller does not have sufficient clearance at the back and sides.
- The controller is located close to a heat source.
- Items are placed on top of the controller.
- The controller is dirty.
- One or more cooling fans are not running.
- The fan air inlet and/or outlet is blocked.
- The air filter is dirty.

Important: The controller front door must always be kept closed when no work is being performed inside the controller.

Cleaning the Pendant

The pendant must be cleaned as often as required. Although the panel film is resistant against most solvents, strong solvents such as acetone etc. should be avoided. If practical, pendant should be disconnected and taken to a clean place when not in use.

Indicator Lamps

Replace defective light bulbs. If the plastic lens is cracked or worn, replace lens.

Cooler

If the robot is fitted with cooler, empty drain water container as required. For complete maintenance instructions for the cooler, please see producer’s documentation, supplied with the cooler.

Cleaning the Controller Interior

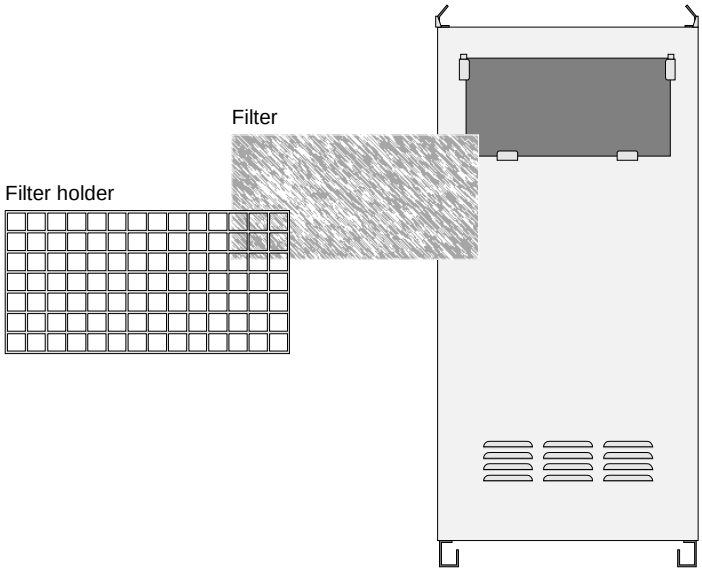
The inside of the controller should be cleaned from time to time e.g. once a year depending on environmental conditions. It is especially important that cooling fans and air inlet / outlet are kept clean. When cleaning, use a dusting brush and a vacuum cleaner to collect the dust brushed off. Do not clean components directly with the vacuum cleaned as this may cause ESD discharge which may damage components.

6.4 Clean/Replace Filter

Location

The filter is located on the rear side of the cabinet.

Figure 64 Location of drive system cooling unit filter



Tools and Items

– Filter (alternatively clean old filter).

Procedure

1. Locate filter on back of cabinet.
2. Lift filter holder up and out.
3. Remove old filter from filter holder.
4. Insert new filter in filter holder.

   As an alternative to replacing the filter, the filter may be cleaned. Clean the filter three or four times in 30-40°C water with washing-up detergent. The filter must not be wrung out, but should be allowed to dry on a flat surface. Alternatively, the filter can be blown clean with compressed air from the clean-air side.
5. Slide filter holder with new filter in and down into position.

The cabinet can be operated without filter if the environment is clean.

6.5 Checking the Measuring System Battery

Description

The measuring system battery is a disposable (non-rechargable) battery. When the battery is due for replacement a message will appear in the message log. Life time after this message is approx. 1800 hours. The battery is only used when the control cabinet is switched ‘off’. The battery service life time is approx. 7000 hours.

It is recommended to replace the battery when the message appears. For information on how to replace the battery, see ’Replacement of Measuring System Battery’ on page 167.

Note: If the control cabinet controls a CBS unit in addition to the robot, or if the robot is an 8 axis robot, the life time for the battery will be half the time described above (2 e.a. SMU units are used).

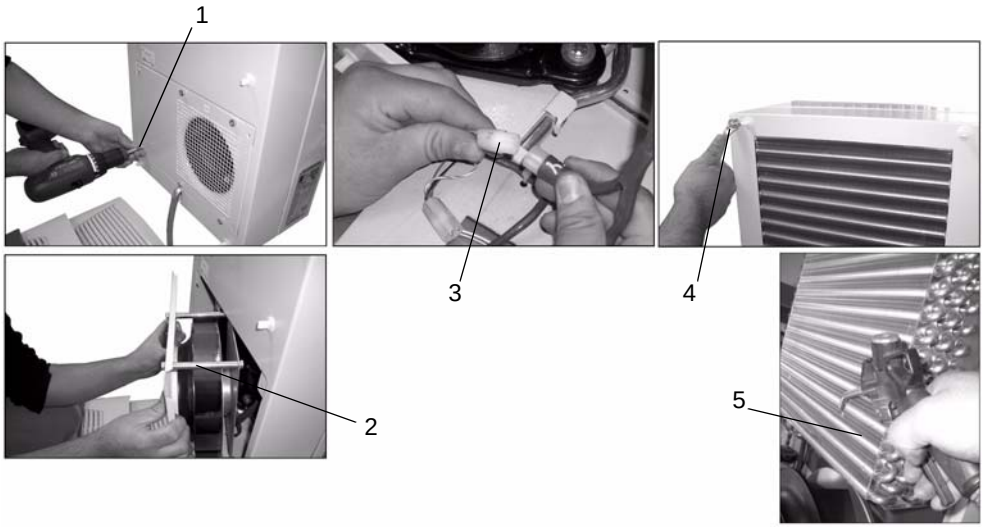
6.6 Check the Cooler

Description

The cooling circuit is designed in the form of a maintenance free, hermetically sealed system. Periodically the components of the external air circuit must be checked and cleaned as required.

With high ambient humidity check that water is running regularly out of the drain.

Figure 65 Cooler disassembly



Procedure

1. Remove louvered grill from the cooler enclosure and disconnect connector from the display.
2. Remove filter from louvered grill, if installed. Clean filter with a vacuum cleaner, or replace as required.
3. Remove the external circuit fan by removing 4 e.a. screws (65/1).
4. Remove the fan (65/2).
5. Disconnect the fan connectors (65/3).
6. Remove the cover by removing 4 e.a. screws (65/4).
7. Push back the display cable through the cable gland.
8. Remove the cover from the cooler enclosure.
9. Remove the earth cable, connecting the cover to the enclosure, from the enclosure.
10. Clean the louvered grill, cover, fan, heat exchanger coil (65/5) and compressor chamber, using a vacuum cleaner or compressed air. Any stubborn oil stains may be removed using a nonflammable detergent, such as a degreaser.

For more information, see manufacturer’s documentation.

7 Repair

7.1 Introduction

About this Chapter

This chapter details all repair activities recommended for the controller.

It is made up of separate procedures, each detailing a specific repair activity. Each procedure contains all information required to perform the activity, such as required tools and items.

Safety Information

Before any work described in this chapter is commenced, it is extremely important that all information concerning safety is carefully studied.

There are general safety aspects that must be read through, as well as more specific safety information that describes danger and safety risks when performing the procedures. Read the Safety Manual before performing any service work.

WARNING! No repair work must be performed on the robot before the safety guidelines in the Safety Manual have been read and understood. Work must only be performed by skilled personnel with the proper training.

Organization of Procedures

The procedures are divided into a procedure for removal and a procedure for refitting. At the start of each procedure, a reference list shows information located other places in the manual than in the procedure. If you want to print out a procedure, you should also print the information referred to under reference to get all information you need to perform the repair operation.

The manual describes the type of service work that can be carried out by the Customer´s own service staff on site. Certain types of work, requiring special experience or special aids, are not dealt with in the manual. In such cases, the defective module or component should be replaced on site. The faulty item should be sent to your local ABB organization for service.

Replacement Items

Make sure that any replacement items are available before performing any repair procedures. Use only replacement items listed in the spare parts catalogue.

Purge System

During operation, the manipulator is supplied by compressed air (ex-version). For this reason, the robot can not operate unless all covers are in place and properly sealed. Missing screws will cause air leaks and result in increased air consumption or failure in the purge system. This does not apply for non-ex robots.

Tightening Torque

Generally, all screws must be tightened with correct torque, as described under ’Tightening Torques’ on page 216.

Tools

All repair activities on the control cabinet can be performed with normal hand tools.

Illustration References

References to illustrations are placed in brackets ( ) indicating figure number and position in the figure. Example: (15/3) means figure 15 position 3.

Calibration

Calibration of the robot must be performed after replacing mechanical parts, when a resolver error has occurred or when the power supply between a measuring board and resolver has been interrupted etc.

Calibrating the robot means to place the robot arm and wrist in a specific position and enter resolver data for this position into the control system. To place the arm and wrist in this position, a calibration fixture must be available.

For description of the calibration function and procedure for entering calibration data, see ‘Operator’s Manual - IRC5P’.

ESD Precautions

Electronic devices are sensitive to static electricity. If handled incorrectly, the unit may be permanently damaged. Following precautions should be taken at all times when handling sensitive electronic units.

- ALWAYS keep electronic units protected in static shielded plastic bags when not installed in the robot. These bags are made from a special conductive material which will prevent build-up of static electricity.
- ALWAYS wear wrist strap when installing or removing electronic units in the controller. The strap is grounded on the control cabinet. The wrist strap includes a 1 Mohm resistor and is of no danger with respect to electric shock hazards. The wrist strap is located inside the controller on the cabinet front door on left hand side of the computer unit.
- NEVER place electronic components on a conductive surface such as an iron plated table or the control cabinet top etc.
- NEVER store or place sensitive electronic devices near strong electrostatic, magnetic or radioactive fields.

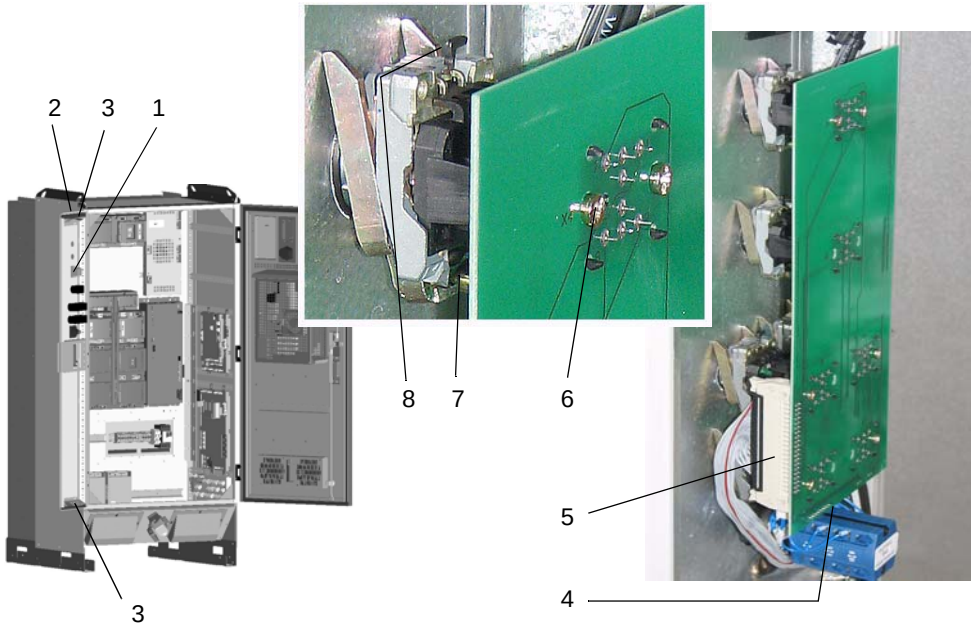
See also information on ESD precautions in the ‘Safety Manual’.

7.2 Replacement of Control Panel Board, CPB

Location

The Control Panel Board is located on the panel door on the left side of the controller front as shown below.

Figure 66 Control panel board, CPB



1	Control Panel Board, CPB	5	Panel board connector
2	Panel door	6	Panel attachment screws
3	Panel door clamps	7	Button attachment screw
4	Mode selector connector	8	Button locking pin

References

– For information on the CPB board, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the control panel board.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

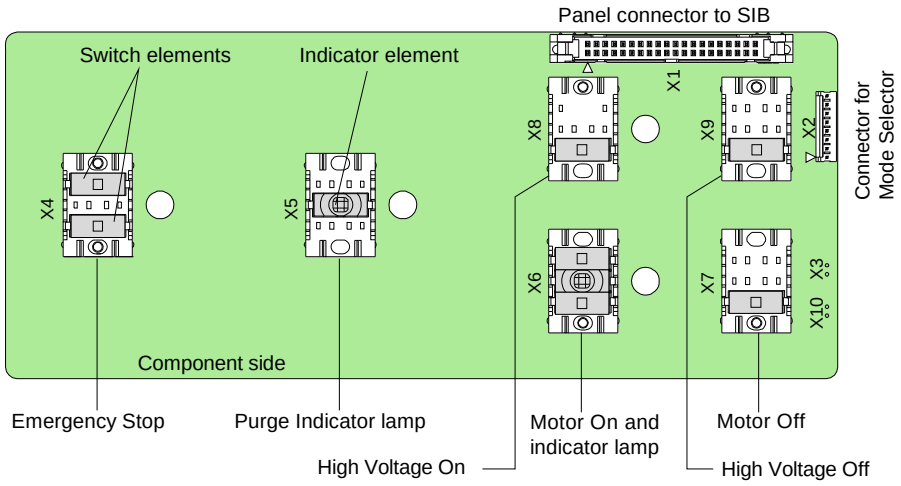
1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door.
3. Open panel door (66/2) by lifting upper- and lower door clamps (66/3).

4. Locate the control panel board (66/1).
5. Disconnect panel board connector (66/5).
6. Remove screws (66/6) securing panel board to panel button bodies.
7. Carefully release panel board from button bodies.
8. Disconnect mode selector connector (66/4) and remove panel board.
9. If a panel button is to be replaced, loosen button attachment screw (66/7). Lift button locking pin (66/8) and remove button.
10. If any of the button- or lamp elements located in the panel board connectors are defective, replace element. Make sure that the new element is located in correct position as shown in the illustration below.

Figure 67 Panel board, location of switches and lamps



Refitting

The procedure describes how to re-install the control panel board.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

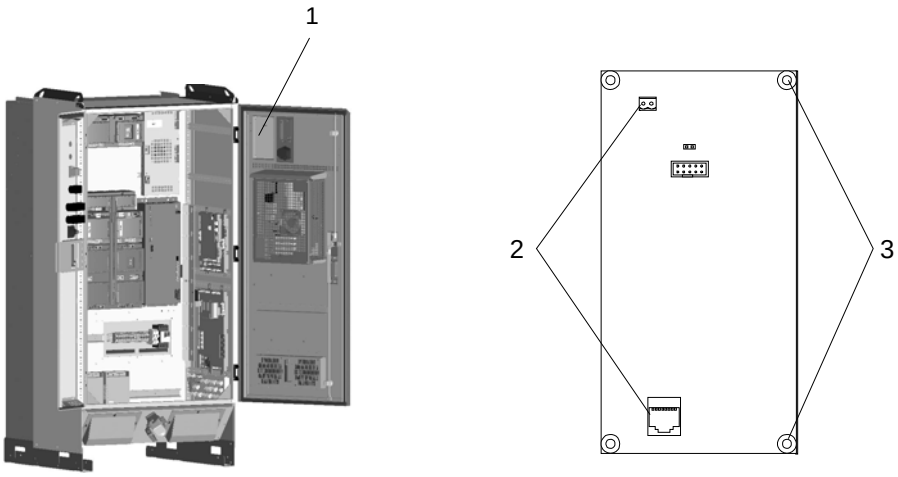
1. If a panel button was removed, install new button and tighten attachment screw.
2. Connect mode selector connector to board.
3. Place new panel board in position on panel button bodies and carefully push panel into position.
4. Install panel attachment screws and tighten.
5. Connect panel board connector.
6. Close panel door and controller front door.

7.3 Replacement of System LED Board, ALED

Location

The System LED Board is located at the upper right corner (front view) of the controller front door as shown below.

Figure 68 System LED board, ALED



1	System Led Board, ALED
2	Connectors
3	Attachment screws

References

– For information on the ALED board, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the system LED board.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the system LED board (68/1).
3. Disconnect connectors.
4. Remove 4 attachment screws. Retain screws for installation of new board.
5. Remove board. Note orientation of board.

Refitting

The procedure describes how to re-install the system LED board.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

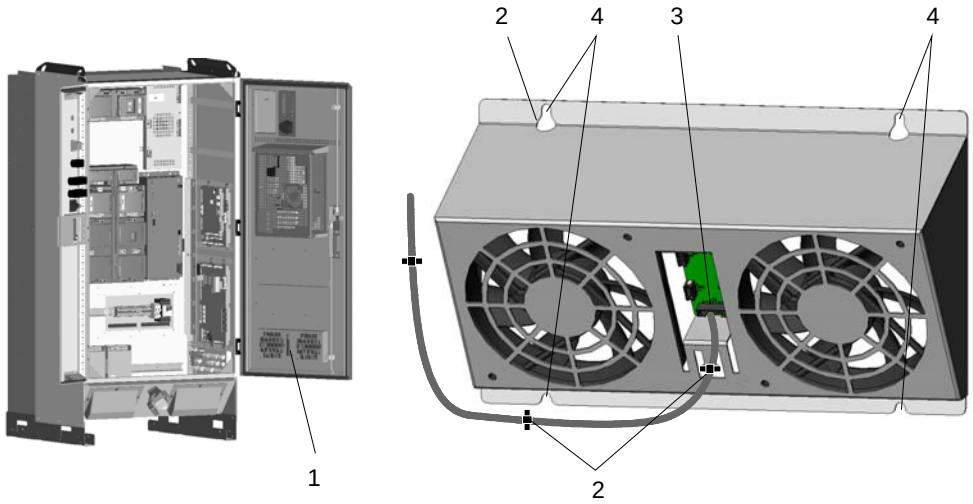
1. Place the board in position over the attachment holes. Make sure the orientation of the board is correct.
2. Install attachment screws and tighten.
3. Insert connectors.
4. Close controller front door.

7.4 Replacement of Door Fan Unit

Location

The Door Fan Unit is used for internal circulation in the controller. The unit is located at the lower end of the controller front door as shown below.

Figure 69 Door fan unit



1	Door Fan Unit
2	Cable strap
3	Connector
4	Upper and lower attachment screws

References

– No references

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the fan unit on the front door.

WARNING! No repair work must be performed on the robot before the safety regulations in 'Safety' on page 13 have been read and understood.

1. Turn the electrical disconnect switch 'off' and lock switch in 'off' position.

WARNING! Make sure that the mains switch is 'off' and locked in 'off' position before continuing. Also make sure that possible other connected systems are 'off'.

2. Open controller front door and locate the fan unit (69/1).
3. Cut cable strap (69/2) securing cable to fan unit.
4. Disconnect connector (69/3).

5. Loosen upper and lower attachment screws (69/4) a little.
6. Pull fan unit up and out.

Refitting

The procedure describes how to re-install the fan unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

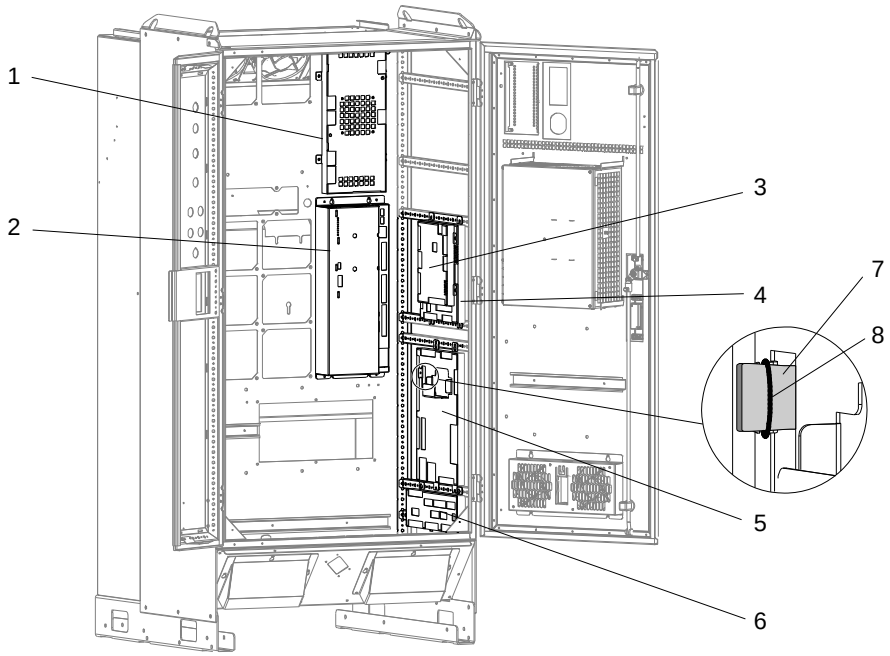
1. Place the fan unit in position over the attachment screws.
2. Slide the unit into position and tighten attachment screws.
3. Insert connector.
4. Secure cable with a new cable strap.
5. Close controller front door.

7.5 Replacement of Axis Computer, PDB, PIB, SIB, MIB, SCB

Location

The following procedure applies for several units which are all replaced in the same manner. The illustration below shows the location of the included units.

Figure 70 Axis computer, PDB, PIB, SIB, MIB, SCB boards



1	Axis Computer	5	Manipulator Interface Board, MIB
2	Power Distribution Board, PDB	6	Safety Connection Board, SCB
3	Paint Interface Board, PIB	7	Purge timer on MIB board
4	Safety Interface Board, SIB	8	Purge timer attachment o-ring

References

– For information on the boards, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove any of the above mentioned units.

Note: When replacing the PIB board, the key chip must be moved to the new PIB board. For information on the key chip, see ‘Unit Description, IRC5P’, section Paint Control Module / Paint Interface Board, PIB.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the unit to be replaced as shown in Figure 70.

   Note: The PIB board is mounted on top of the SIB board. Therefore, if the SIB board is to be replaced, the PIB board must be removed first.

3. Disconnect all connectors. Note location of connectors to simplify re-connection.
4. Slightly loosen attachment screws securing the board to the cabinet back- or side panel. For the axis computer, the two screws on the left must be fully removed.
5. Remove unit from controller.

Refitting

The procedure describes how to re-install the board.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

Note: Make sure that the new unit is of the same type as the old unit. For information on the different types used, see ‘Unit Description, IRC5P’.

1. Place new unit in position over the attachment screws.
2. Slide the unit into position and tighten attachment screws.
3. Insert connectors.

   Note: If the SIB board was replaced, re-install PIB on top of the SIB board.

   Note: If the MIB board was replaced, move battery unit from old MIB to new MIB as required. For information, see ’Replacement of Measuring System Battery’ on page 167. Also move purge timer (70/7) from old to new MIB board. For more information, see ‘Unit Description, IRC5P’ manual.

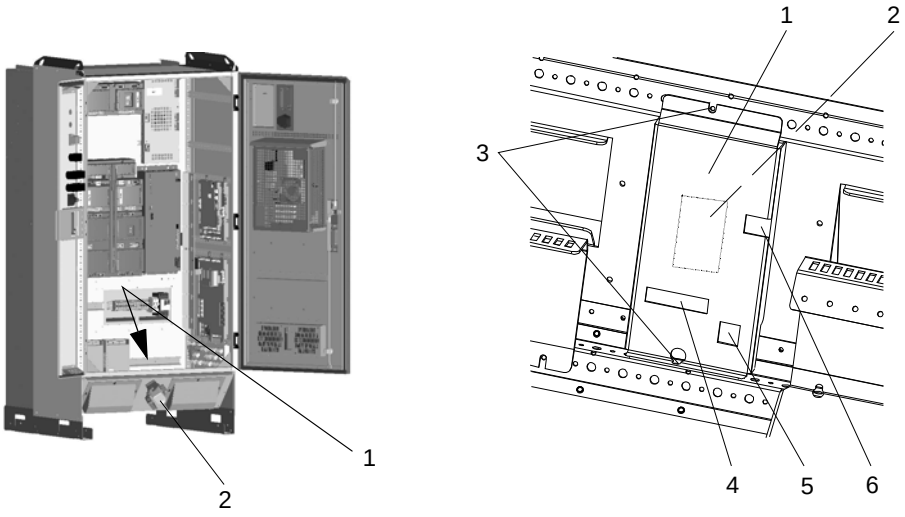
4. Close controller front door.

7.6 Replacement of Pendant Interface Board, TIB

Location

The Pendant Interface Board assembly (TIB board and mounting plate) is located on the cable entrance panel at the lower part of the controller front as shown below.

Figure 71 Pendant interface board, TIB



1	Pendant Interface Board assembly, TIB
2	Pendant connector
3	Upper and lower attachment screws
4	TIB ribbon connector
5	Ex sync signal connection
6	Ground connection

References

– For information on the TIB board, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the TIB board.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the TIB board assembly (71/1).

3. Disconnect TIB ribbon cable (71/4), ex sync switch connection (71/5) (if used) and ground wire connection (71/6).
4. Remove upper and lower attachment screws (71/3) securing TIB assembly (cover and TIB board) to cabinet frame. Retain screws for re-installation. The screws are accessed from the inside.
5. Remove TIB assembly by carefully moving board assembly out.

   Note: The TIB board is inserted in the rear of the pendant connector (71/2) and may therefore be a bit hard to remove.

Refitting

The procedure describes how to re-install the TIB board.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

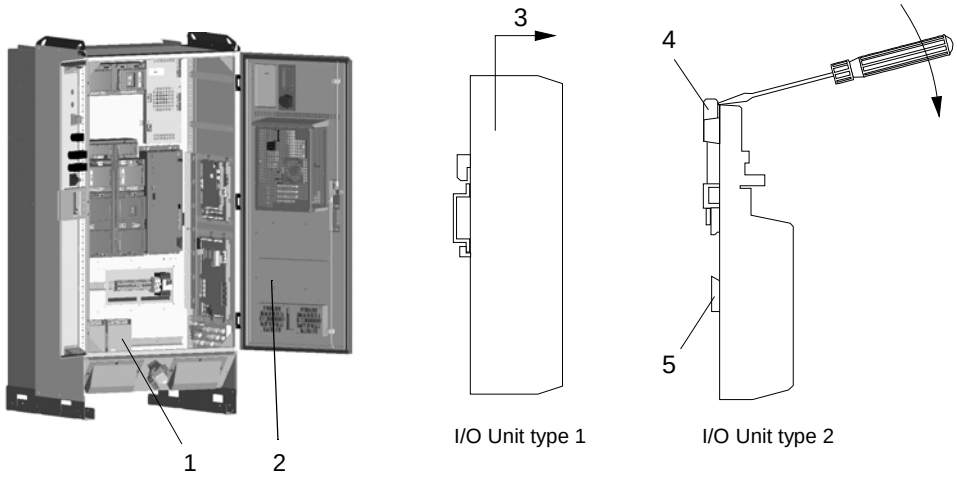
1. Place new TIB board assembly in position over the pendant connector inside the cabinet.
2. Carefully press the unit into position on the connector.
3. Install attachment screws and tighten screws.
4. Insert connectors and connect ground wire.
5. Close controller front door.

7.7 Replacement of I/O Units

Location

A number of I/O units may be installed in the controller. The I/O units are located on the door and/or lower part of the back wall inside the controller as shown below.

Figure 72 Distributed I/O units



1	Location of I/O units
2	Alternative location of I/O units
3	Removing I/O unit type 1
4	I/O unit type 2 spring loaded locking device
5	I/O unit type 2 mounting rail

References

– For information on connections of the I/O unit, see ‘Unit Description, IRC5P’, Distributed I/O.
– For information on configuration of the I/O units, see ‘Operating Manual, RobotStudio’.

Tools and Items

– Hand tools

Removal

The procedure describes how to remove an I/O unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the I/O unit to be replaced (72/1,2).

3. Disconnect all connectors from the unit. Note location of connectors to simplify re-connection.
4. To remove I/O unit type 1, simply lift the unit up and out (72/3).
5. To remove I/O unit type 2, lift the spring loaded locking device with a screwdriver until the upper claw (72/4), that holds the unit to the rail, is released.
6. With the upper claw released, tip the unit away from the mounting rail (72/5) and remove it.

Refitting

The procedure describes how to re-install the I/O unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

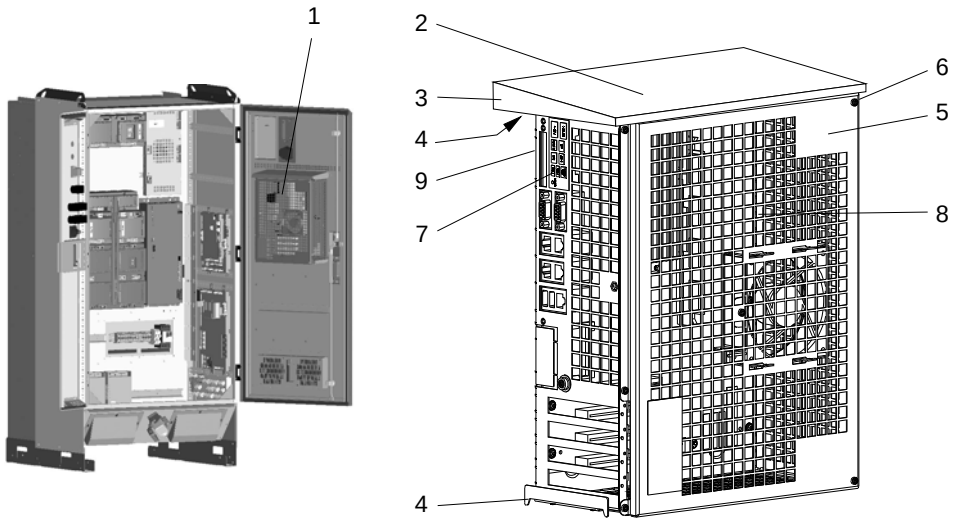
1. Hook the unit back onto the mounting rail and snap it gently into position.
2. Reconnect all connectors disconnected during removal.
3. Close controller front door.

7.8 Replacement of Computer Unit

Location

The Computer Unit is located on the inside of the controller door as shown below.

Figure 73 Computer unit



1	Computer Unit	6	Cover attachment screws
2	Computer unit top cover	7	Connectors
3	Top cover attachment screws	8	Cooling fan connector
4	Attachment hooks	9	Compact Flash card
5	Computer unit cover		

References

– ’Replacement of Compact Flash’ on page 151

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the complete computer unit, either to replace the unit itself, or for replacing components inside the computer unit.

Note: For all procedures describing replacement of internal components, the computer unit cover needs to be removed. This is performed by removing 4 attachment screws (73/4), lift off the cover (73/3) and disconnect the fan connector (73/6).

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open the controller front door and locate the computer unit on the inside of the door (73/1).
3. Remove computer unit top cover (73/2) by loosening cover attachment screws (73/3).
4. Disconnect all connectors (73/7) from the computer unit. Note position of connectors to simplify re-connection.
5. Remove Compact Flash card from computer unit (73/9). For description, see ’Replacement of Compact Flash’ on page 151.
6. Lift the complete computer unit up and out.
7. If further activities are to be performed, such as replacing a PCI card, place the computer unit on a clean work bench and continue to the relevant procedure.

Important: When placing the computer unit on a table etc., pay attention to the attachment hooks to avoid bending the hooks or scratching the table.

Refitting

The procedure describes how to re-install the computer unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

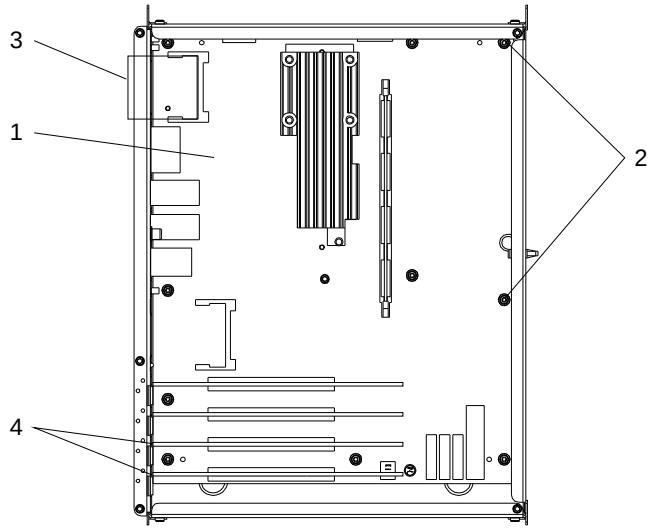
1. Lift the computer unit into position.
2. Guide the attachment hooks (73/4) of the computer unit into the slots in the controller door.
3. Lower the unit into position.
4. Re-install Compact Flash card. For description, see ’Replacement of Compact Flash’ on page 151.
5. Reconnect all connectors to the computer unit.
6. Re-install top cover.
7. Close controller front door.

7.9 Replacement of Computer Unit Mother Board

Location

The Mother Board is located inside the computer unit as shown below.

Figure 74 Computer unit, location of mother board



1	Computer Unit Mother Board
2	Mother board attachment screws
3	Compact Flash card
4	PCI boards

References

- ’Replacement of Computer Unit’ on page 143
- ’Replacement of PCI Boards in Computer Unit Slots’ on page 147
- ’Replacement of Compact Flash’ on page 151

Tools and Items

- Hand tools

Removal

The procedure describes how to remove the mother board from the computer unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Remove the Computer Unit assembly as described in procedure ’Replacement of Computer Unit’ on page 143.

3. Remove cover attachment screws, remove cover and disconnect fan unit.
4. Remove Compact Flash card from computer unit (74/3). For description, see ’Replacement of Compact Flash’ on page 151.
5. Remove any PCI cards (74/4) fitted to the mother board as described in procedure ’Replacement of PCI Boards in Computer Unit Slots’ on page 147.
6. Remove mother board attachment screws (74/2).
7. Gently lift the mother board (74/1) out, gripping the board around the edges to avoid damaging the board or its components.

   Note: Immediately put the board in an ESD safe bag or similar.

Refitting

The procedure describes how to re-install the computer unit mother board.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

1. Gently lift the mother board out of the ESD safe bag and place it into position in the computer module.

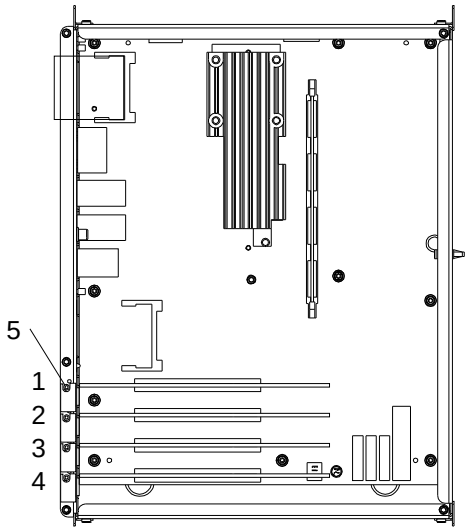
   Note: Be careful not to bend the LEDs when inserting the board.
2. Secure the board with the attachment screws.
3. Refit any PCI boards to the mother board as described in procedure ’Replacement of PCI Boards in Computer Unit Slots’ on page 147.
4. Refit the computer unit cover by connecting fan unit connector, placing cover in position and installing attachment screws.
5. Re-install Compact Flash card. For description, see ’Replacement of Compact Flash’ on page 151.
6. Re-install the computer unit as described in procedure ’Replacement of Computer Unit’ on page 143.
7. Close controller front door.

7.10 Replacement of PCI Boards in Computer Unit Slots

Location

The PCI boards, if used, are located in slots inside the computer unit as shown below. In most cases no PCI boards are installed.

Figure 75 Computer unit, location of PCI boards



1-4	PCI board slot 1 - 4
5	Board attachment screw

References

– 'Replacement of Computer Unit' on page 143
– For information on the PCI boards, see 'Unit Description, IRC5P' manual

Tools and Items

– Hand tools

Removal

The procedure describes how to remove a PCI board.

WARNING! No repair work must be performed on the robot before the safety regulations in 'Safety' on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in 'ESD Precautions' on page 130.

1. Turn the electrical disconnect switch 'off' and lock switch in 'off' position.

WARNING! Make sure that the mains switch is 'off' and locked in 'off' position before continuing. Also make sure that possible other connected systems are 'off'.

1. Remove the Computer Unit assembly as described in procedure 'Replacement of Computer Unit' on page 143.
2. Remove cover attachment screws, disconnect fan unit connector and remove cover.

3. Identify the card to be replaced.

   The barcode sticker contains information on type designation.

4. Disconnect any cables on the card. Note position of connectors to simplify re-connection.

5. Remove the attachment screw on top of the card bracket.

6. Gently lift the card out, gripping the card around the edges to avoid damaging the card or its components.

   Note: Immediately put the board in an ESD safe bag or similar.

Refitting

The procedure describes how to re-install the computer unit power supply.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

1. Fit the card in position by pushing the card into the socket on the mother board. Secure it with its attachment screw.

2. Connect any additional cables to the card. Reconnect as noted on disassembly.

3. Refit the computer unit cover by connecting fan unit connector, placing cover in position and installing attachment screws.

4. Refit the computer unit as described in procedure ’Replacement of Computer Unit’ on page 143.

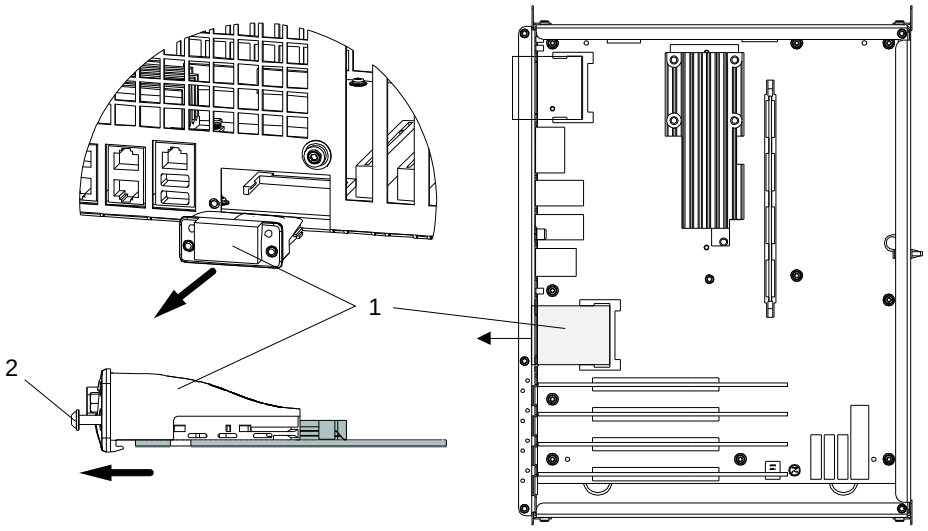
5. Close controller front door.

7.11 Replacement of Fieldbus Adapter

Location

The EtherNet/IP or Profibus fieldbus adapter, if used, is located in the compact flash slot inside the computer unit as shown below.

Figure 76 Computer unit, location of fieldbus adapter



1	Fieldbus adapter
2	Attachment screws fieldbus adapter

References

– ’Replacement of Computer Unit’ on page 143

Tools and Items

– Hand tools

Removal

The procedure describes how to remove a fieldbus adapter.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

1. Remove the Computer Unit assembly as described in procedure ’Replacement of Computer Unit’ on page 143.
2. Remove cover attachment screws, disconnect fan unit connector and remove cover.

3. Identify the fieldbus adapter to be replaced.

   The barcode sticker contains information on type designation.

4. Disconnect the cable from the fieldbus adapter.
5. Loosen the 2 e.a. attachment screws from the fieldbus adapter to release the fastening mechanism.

   Note: Only loosen the attachment screws. Do not remove them.

6. Grip the loose attachment screws and gently pull the fieldbus adapter out, in the arrow direction.

CAUTION! Always grip the fieldbus adapter around the edges to avoid damage to the adapter or its components.

Refitting

The procedure describes how to re-install the fieldbus adapter in the computer unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

1. Grip the fieldbus adapter around the edges.

CAUTION! Make sure that the adapter is pushed straight onto the rails.

2. Fit the fieldbus adapter in position by pushing the fieldbus adapter along the rails on the mother board.

   Note: Push carefully so no pins are damaged.

3. Secure it with its attachment screws on the front.
4. Connect the cable to the fieldbus adapter.
5. Refit the computer unit cover by connecting fan unit connector, placing cover in position and installing attachment screws.
6. Refit the computer unit as described in procedure ’Replacement of Computer Unit’ on page 143.
7. Close controller front door.

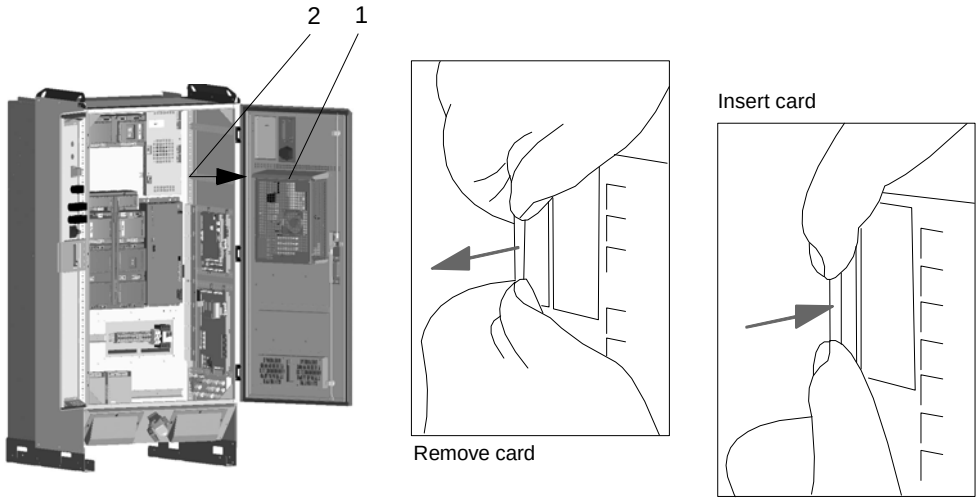
7.12 Replacement of Compact Flash

Location

The Compact Flash card is located on the computer unit mother board as shown below. The card is accessible without removing the computer unit cover.

Important: The compact flash card supplied by ABB is an Industrial Standard card which includes software to enable it to work with the robot system. Cheaper Consumer Standard cards will not work with the robot.

Figure 77 Computer unit, location of compact flash



1	Computer unit
2	Compact Flash card location

References

– No references.

Tools and Items

– No tools required.

Removal

The procedure describes how to remove the compact flash from the computer unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the computer unit (77/1). Locate the compact flash card at the upper left corner of the computer unit (77/2).

3. Make sure that the two status LEDs on the computer unit just above the flash disk are extinguished.
4. Grip the compact flash card as shown in Figure 77.
5. Carefully pull out the card.

Refitting

The procedure describes how to install the compact flash in the computer unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

1. Carefully position the compact flash card in the guides which are located at the inner end of the compact flash slot.

Important: Be careful when inserting the compact flash. If you loose the grip, the card may fall down, inside the computer unit.

2. Gently glide the card into position against the connector.

CAUTION! Be careful when performing next step as you may damage the contact pins in the connector.

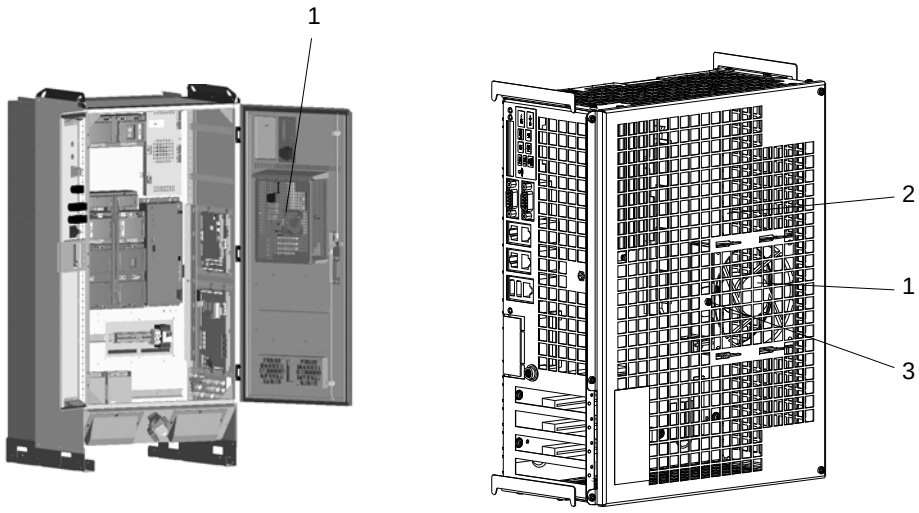
3. Make sure that the card is correctly positioned and then place one finger at each end of the card as shown in Figure 77. Then press the card carefully into the connector.
4. Close controller front door.

7.13 Replacement of Computer Fan Unit

Location

The Computer Fan Unit is located inside the computer unit as shown below.

Figure 78 Computer unit, location of fan unit



1	Computer fan unit
2	Fan connector
3	Fan attachment screws

References

– ’Replacement of Computer Unit’ on page 143

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the computer fan unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Remove the Computer Unit assembly as described in procedure ’Replacement of Computer Unit’ on page 143.
3. Remove cover attachment screws, disconnect fan unit connector (78/2) and remove cover.

4. Remove fan unit attachment screw (78/3).
5. Remove fan unit (78/1).

Refitting

The procedure describes how to re-install the fan unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

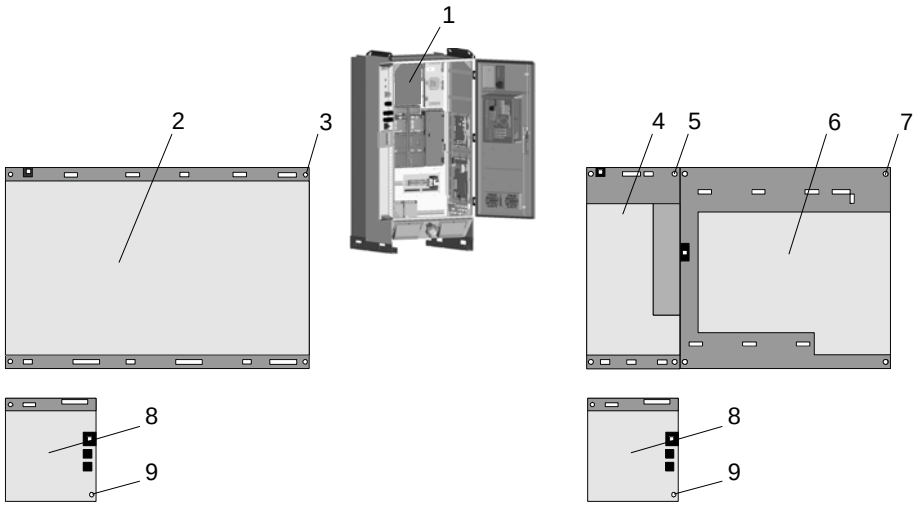
1. Install new fan unit.
2. Refit the attachment screw.
3. Refit the computer unit cover by connecting fan unit connector, placing cover in position and installing attachment screws.
4. Refit the computer unit as described in procedure ’Replacement of Computer Unit’ on page 143.
5. Close controller front door.

7.14 Replacement of Drive System 09 Components

Location

The drive units, consisting of motor drive units for the robot axis motors and possible rectifier, are located on the back panel in the controller.

Figure 79 Motor drive unit assembly



1	Motor drive unit assembly	6	Main drive unit MDU430A
2	Main drive unit MDU790A	7	MDU430A attachment screw
3	MDU790A attachment screw	8	Additional drive unit ADU
4	Additional rectifier unit ARU	9	ADU attachment screw
5	ARU attachment screw		

References

– For information on drive unit types etc, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove a drive unit or the rectifier unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the unit to be replaced.
3. Remove connectors from the unit that shall be removed.

4. Unscrew attachment screws for drive unit (79/3,7,9) or rectifier (79/5).
5. Remove unit.

WARNING! Drive units and rectifier (depending on robot type) may contain residual power. These units must only be opened by qualified personnel.

Refitting

The procedure describes how to re-install a drive unit or the rectifier unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

Note: Make sure that the new unit is of the same type as the old unit. For information on the different types used, see ‘Unit Description, IRC5P’.

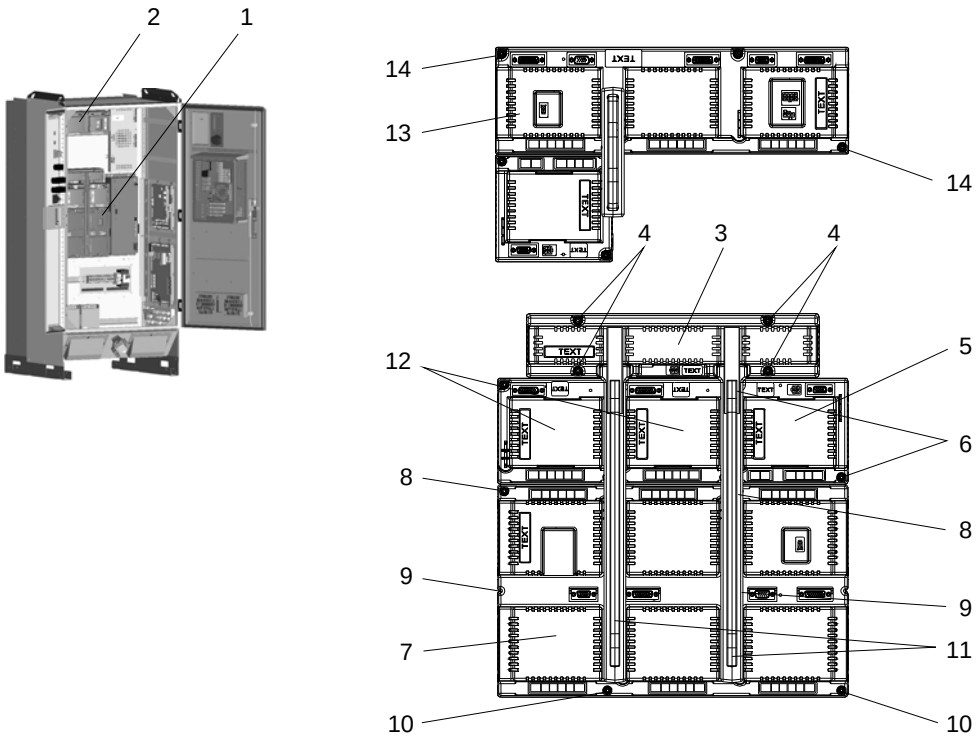
1. Fit the new unit in its intended position and orientation.
2. Secure unit with attachment screws.
3. Reconnect connections removed during removal.
4. Close controller front door.

7.15 Replacement of Drive System 04 Components

Location

The drive unit assembly, consisting of motor drive units for the robot axis motors, rectifier and capacitor, is located on the back panel in the controller as shown below. An additional drive unit, located above the drive unit assembly includes drivers for paint pump motors and CBS if used.

Figure 80 Controller and drive unit assembly



1	Motor drive unit assembly	8	Motor drive 6 pack attachment screws
2	Pump drive unit assembly	9	Motor drive 3 pack attachment screws
3	Capacitor unit	10	Motor drive 3 & 6 pack attachment screws
4	Capacitor unit attachment screws	11	Bus bars
5	Rectifier unit	12	Axis 7/8 drive units, dummy or cover plate
6	Rectifier unit attachment screws	13	Pump motor / CBS drive units
7	Motor drive units	14	Pump motor / CBS drive unit attachment screws

References

– For information on location of the individual drive units, drive unit types etc, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove a drive unit, the rectifier unit or the capacitor.

WARNING! No repair work must be performed on the robot before the safety regulations in 'Safety' on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in 'ESD Precautions' on page 130.

1. Turn the electrical disconnect switch 'off' and lock switch in 'off' position.

WARNING! Make sure that the mains switch is 'off' and locked in 'off' position before continuing. Also make sure that possible other connected systems are 'off'.

2. Open controller front door and locate the unit to be replaced.
3. Remove connectors from the unit that shall be removed.
4. Remove busbar (79/11) between units.
5. Unscrew attachment screws for drive unit (79/8,9,14), rectifier (79/6) or capacitor (79/4).
6. Remove unit.

WARNING! Capacitor or Capacitor-Rectifier units (depending on robot type) may contain residual power. These units must only be opened by qualified personnel.

Refitting

The procedure describes how to re-install a drive unit, the rectifier unit or the capacitor.

WARNING! Refitting activities must only be performed when controller is switched 'off' and all safety precautions under 'Removal' have been read.

Note: Make sure that the new unit is of the same type as the old unit. For information on the different types used, see 'Unit Description, IRC5P'.

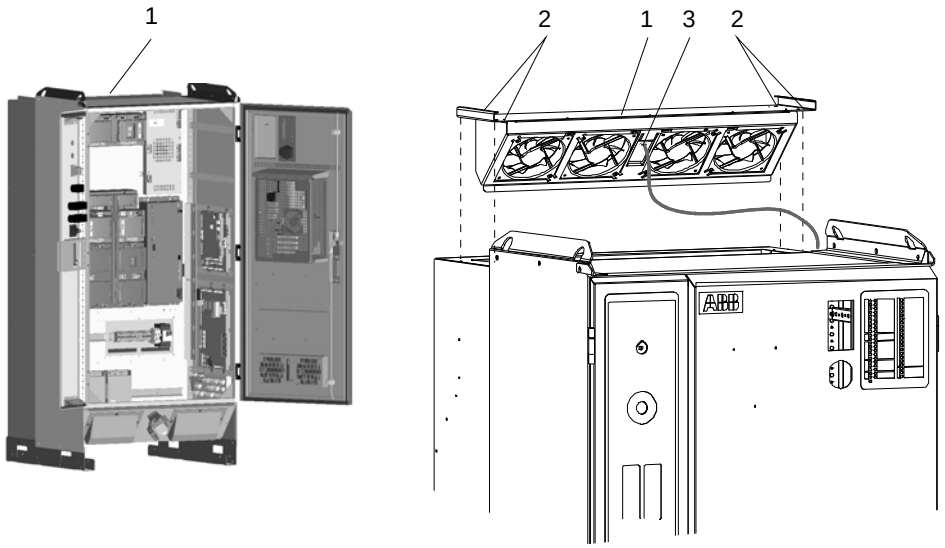
1. Fit the new unit in its intended position and orientation.
2. Secure unit with attachment screws.
3. Reconnect busbar between units.
4. Reconnect connections removed during removal.
5. Close controller front door.

7.16 Replacement of Servo Fan Unit

Location

The Servo Fan unit is located on the back panel in the controller as shown below.

Figure 81 Servo fan unit



1	Fan Unit Servo
2	Attachment screws
3	Connector

References

– No references

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the fan unit servo.

WARNING! No repair work must be performed on the robot before the safety regulations in 'Safety' on page 13 have been read and understood.

1. Turn the electrical disconnect switch 'off' and lock switch in 'off' position.

WARNING! Make sure that the mains switch is 'off' and locked in 'off' position before continuing. Also make sure that possible other connected systems are 'off'.

2. Locate fan unit servo (81/1) located on the top of the cabinet rear housing.
3. Remove attachment screws (81/2) securing fan unit to cabinet. Retain screws for installation of new unit.
4. Pull fan unit assembly up.
5. Disconnect connector (81/3).

6. Remove fan unit.

Refitting

The procedure describes how to re-install the fan unit servo.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

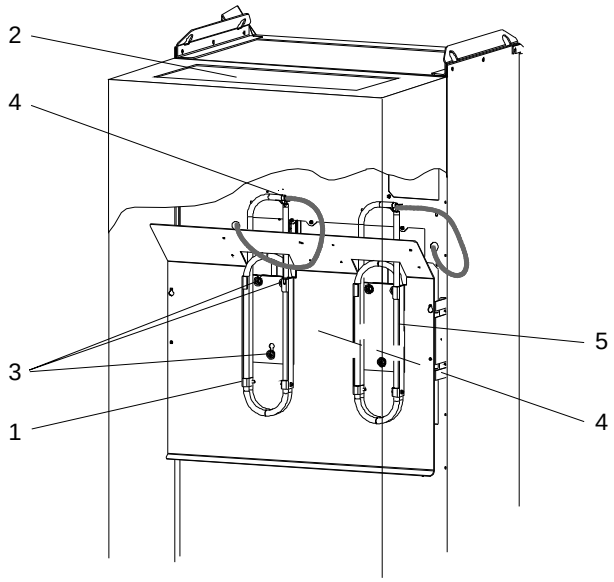
1. Insert fan unit connector.
2. Slide fan unit into position. Make sure that the unit is installed in correct orientation as shown in Figure 81.
3. Install attachment screws and tighten.

7.17 Replacement of Brake Resistor Bleeders

Location

One or two Brake Resistor Bleeders are located on the rear side of the controller as shown below.

Figure 82 Brake resistor bleeders, controller rear view



1	Brake resistor bleeder 1
2	Servo fan unit access hole
3	Attachment screws and slots
4	Connector (inside cabinet)
5	Location for brake resistor bleeder 2 (used for pumps or CBS)

References

– ’Replacement of Servo Fan Unit’ on page 159

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the brake resistor bleeders.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Remove servo fan unit as described in ’Replacement of Servo Fan Unit’ on page 159.

3. Locate bleeder (82/1) to be replaced through hole (82/2) left by removed fan unit (normally, only bleeder 1 is used).
4. Remove rectifier unit (to replace bleeder 1) as described in ’Replacement of Drive System 09 Components’ on page 155. You may also need to remove drive unit pack below rectifier to get access to all bleeder attachment screws.
5. Disconnect electrical connection (82/4) for bleeder. The connector is located on the front side of the cabinet back wall.
6. Remove wires from connector using a pin extraction tool or a small screwdriver.
7. Pull wires through hole in cabinet back wall.
8. Loosen bleeder attachment screws (82/3) a little.
9. Lift bleeder up and out.
10. Remove bleeder.

Refitting

The procedure describes how to re-install the brake resistor bleeders.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

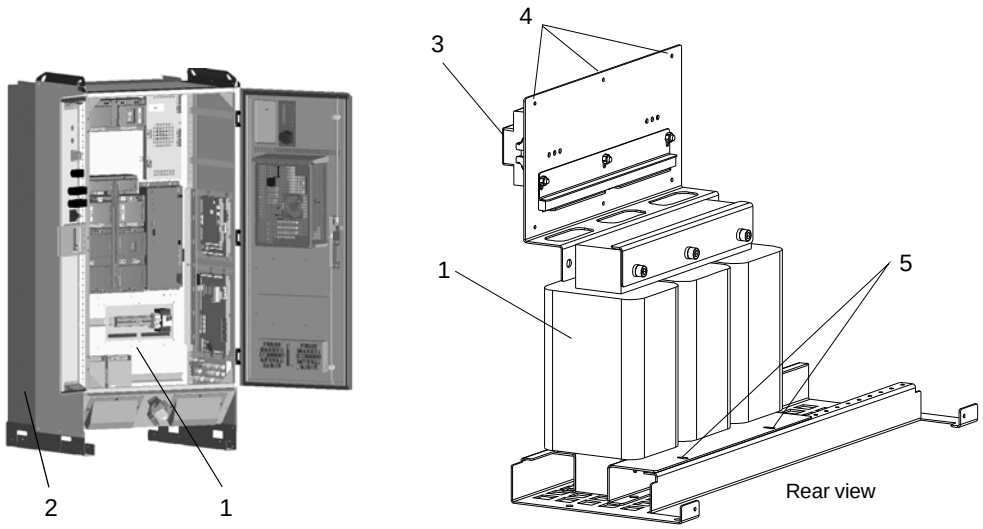
1. Slide new bleeder into position in the attachment screw holes.
2. Tighten attachment screws.
3. Route wires through hole in cabinet back wall.
4. Insert wires into connector.
5. Reconnect connector.
6. Re-install rectifier unit (and possibly drive units) as described in ’Replacement of Drive System 09 Components’ on page 155.
7. Re-install fan unit as described in ’Replacement of Servo Fan Unit’ on page 159.

7.18 Replacement of Transformer

Location

The Transformer is located on the rear side of the controller as shown below.

Figure 83 Transformer



1	Transformer (on rear side)
2	Cabinet rear housing
3	Transformer connections and supply overload protection
4	Transformer bracket attachment screws
5	Transformer attachment screws

References

– For information on the transformer, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the transformer unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in ’ESD Precautions’ on page 130.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Remove control cabinet rear housing (83/2).

3. Open controller front door and disconnect all electrical wires connected to the top of the transformer terminal board and overload protection (83/3). Note position of wires and main supply voltage to ensure correct re-connection. See also 'Transformer Wiring' on page 117 and 'Internal Supply for Service Outlet' on page 119.
4. Remove 6 transformer bracket attachment screws (83/4) from inside of the cabinet.
5. Remove 2 transformer attachment screws (83/5) at the back securing the transformer to the cabinet bottom plate or use alternative method described below.

CAUTION! The transformer is heavy (approx. 60 kg). For this reason, be careful when performing the next step.

6. Remove transformer.

Refitting

The procedure describes how to re-install the transformer unit.

WARNING! Refitting activities must only be performed when controller is switched 'off' and all safety precautions under 'Removal' have been read.

1. Lift transformer into position on the cabinet rear bottom plate. Be careful not to damage terminal board and overload protection while guiding through hole in cabinet back wall.
2. Insert 2 transformer attachment screws and tighten.
3. Insert 6 transformer bracket attachment screws. Tighten screws.
4. Connect electric wires to terminal board and overload protection.

CAUTION! Make sure that the wiring is correct in relation to mains supply voltage.

5. Re-install control cabinet rear housing.
6. Check that the supply overload protection is set to 16 A.
7. Close controller front door.

Alternative method

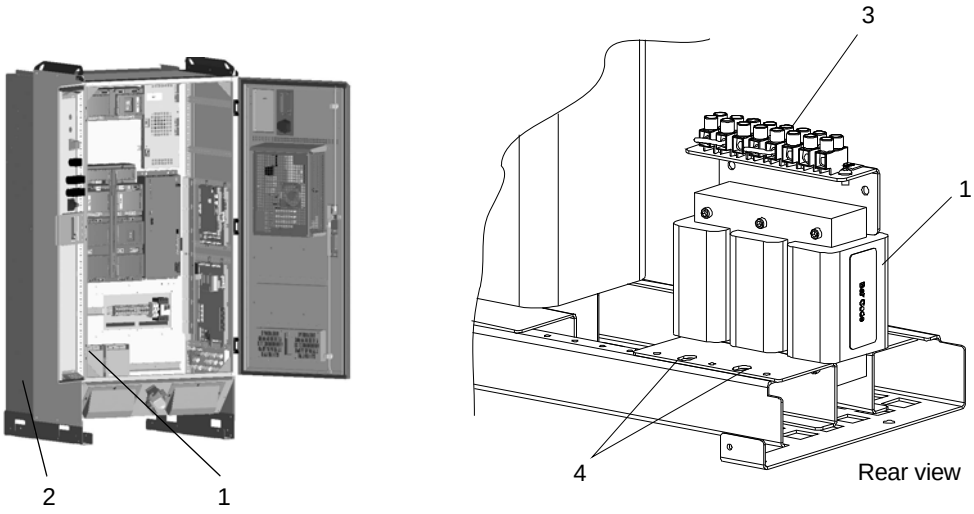
If there is room behind the controller for a pallet truck, a better way to replace the transformer is to position the pallet truck under the transformer assembly, remove the 4 attachment screws for the complete assembly and pull the assembly backwards. The transformer can then be easily replaced with less risk of damaging the transformer bracket. If a choke filter is installed beside the transformer, the wires for the choke filter must be disconnected before the assembly can be removed.

7.19 Replacement of Choke Filter

Location

The Choke Filter is used if the controller is equipped with ‘high voltage’ drive system (IRB 5500). The filter (if used) is connected between the power relay and the rectifier AC power inlet. The filter is located beside the transformer on the rear side of the controller as shown below.

Figure 84 Transformer



1	Choke filter (on rear side)
2	Cabinet rear housing
3	Choke filter connections
4	Choke filter attachment screws

References

– For information on the choke filter, see ‘Unit Description, IRC5P’

Tools and Items

– Hand tools

Removal

The procedure describes how to remove the choke filter unit.

WARNING! No repair work must be performed on the robot before the safety regulations in ’Safety’ on page 13 have been read and understood.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Remove control cabinet rear housing (84/2).

3. Disconnect electrical wires connected to terminal board (84/3) on top of the choke filter. Note position of wires and main supply voltage to ensure correct re-connection.
4. Disconnect ground connection.
5. Remove 2 choke filter attachment screws (84/4) securing the unit to the cabinet bottom plate.
6. Remove choke filter.

Refitting

The procedure describes how to re-install the choke filter unit.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

1. Lift choke filter into position on the cabinet rear bottom plate.
2. Insert 2 filter attachment screws and tighten.
3. Connect electric wires to terminal board.
4. Connect ground wire.
5. Re-install control cabinet rear housing.
6. Close controller front door.

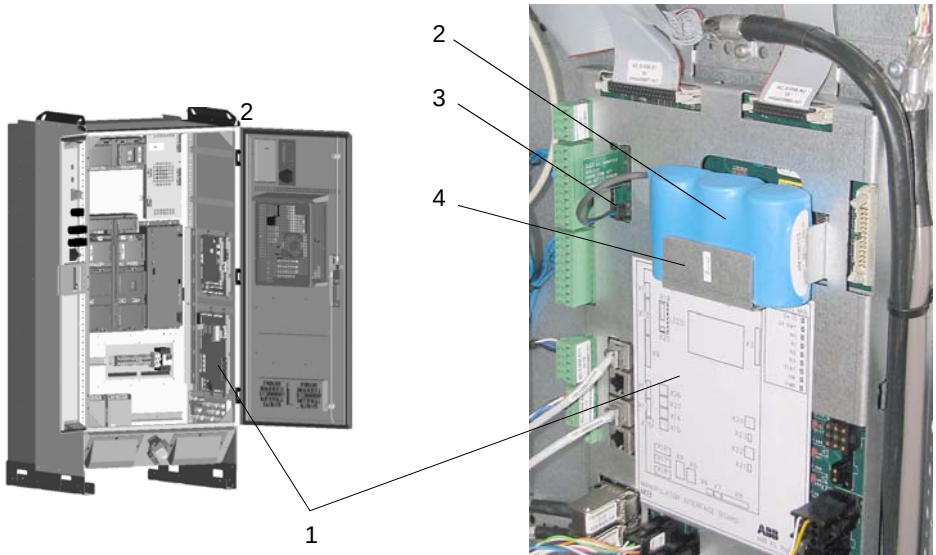
7.20 Replacement of Measuring System Battery

Location

The Measuring System Battery is located on the MIB board inside the control cabinet as shown in the illustration below.

For information on the measuring system battery life time, see 'Checking the Measuring System Battery' on page 127.

Figure 85 Location of battery



1	Manipulator Interface Board, MIB
2	Battery
3	Connector
4	Battery holder

Tools and Items

- 13Ah litium battery
- Hand tools

Removal

The procedure describes how to remove the measuring system battery.

Note: Before performing this procedure, it is recommended to place the robot into calibration position (markings on the axes).

WARNING! No repair work must be performed on the robot before the safety regulations in 'Safety' on page 13 have been read and understood.

CAUTION! The unit is sensitive to ESD. Before handling the unit, please observe the safety information in 'ESD Precautions' on page 130.

Note: The battery may also be replaced in 'power on' mode. It is then not necessary to perform any calibration. Necessary safety precautions must be observed.

1. Turn the electrical disconnect switch ‘off’ and lock switch in ‘off’ position.

WARNING! Make sure that the mains switch is ‘off’ and locked in ‘off’ position before continuing. Also make sure that possible other connected systems are ‘off’.

2. Open controller front door and locate the battery (85/2) on the manipulator interface board (85/1).
3. Disconnect the battery connector (85/3).
4. If a strap is used to secure the battery, remove strap.
5. Lift the old battery (85/2) out of the battery holder (85/4).

Refitting

The procedure describes how to re-install the measuring system battery.

WARNING! Refitting activities must only be performed when controller is switched ‘off’ and all safety precautions under ‘Removal’ have been read.

1. Place the new battery in the holder.
2. Connect the battery connector.
3. Close controller front door.
4. Perform calibration as described in ‘Operator’s Manual, IRC5P’.

WARNING! Only batteries specified by ABB must be used. Old batteries must always be handled as hazardous waste. A battery may explode if damaged or disposed off in fire. Do not short-circuit battery.

8 Trouble Shooting

8.1 Introduction

About this Chapter

This chapter contains information, procedures and descriptions for trouble shooting IRC5P based robot systems. The information should be used when the robot operation is interrupted by malfunction, regardless of whether an error event log message is issued or not.

The chapter is divided into 4 sections as follows:

- General description of trouble shooting routines and valuable hints on how to perform trouble shooting.
- Listing of some relevant fault symptoms and malfunctions.
- Trouble Shooting instructions for some individual units.
- Description of the LED indicators on the controller front.

For description of the LED indicators on the separate units inside the controller, see descriptions of the different boards and units in ‘Unit Description, IRC5P’.

Note: The trouble shooting described in this chapter must be used in combination with the event messages described in the ‘Operating Manual, Trouble Shooting’.

8.2 General Description and Hints

8.2.1 Trouble Shooting Strategies

General

Trouble shooting complex technical systems such as robot systems requires a systematic approach. The personnel must be trained and qualified to perform the task, and will be helped by using the correct tools and methods.

Isolate the Fault

Any fault may give rise to a number of symptoms, for which error event log messages may or may not be created. In order to effectively eliminate the problem, it is vital to distinguish the original symptom from the consequential ones.

A help in isolating the fault may be creating a historical fault log as specified in section ’Keep Track of History’ on page 173.

Split the Fault Chain

When trouble shooting any system, a good practice is to split the event chain in two. This means:

- Identify the complete chain of events.
- Decide and measure the expected value at the middle of the chain.
- Use this to determine in which half the fault is caused.
- Split this half into two new halves, etc.
- Finally, a single component may be isolated, the faulty one.

Check Communication Parameters and Cables

The most common causes of errors in serial communication are:

- Faulty cables (e.g. send and receive signals are mixed up).
- Transfer rates (baud rates).
- Data widths that are incorrectly set.

Check Software Versions

Make sure the RobotWare and other software are the correct versions. Some SW versions are not compatible with certain hardware components.

Also, make a note of all software versions, since this will be useful information for service and support.

8.2.2 Documentation and References

General	A great deal of effort was put into writing the event log messages as well as the technical documentation. The messages can never be perfect, but they may give vital clues. They are also constantly being upgraded.
Read the Documentation	Reading the manual should be done not only as a last resort. Product documentation is available electronically as pdf files on the DVD-ROM supplied with the robot.
Study the Circuit Diagram	The complete electrical circuitry of the controller and manipulator is available on the DVD-ROM shipped with the robot. These circuit diagrams contain a lot of useful, or even essential, information to a trained trouble shooter.
Read the Logs.	The event logs contain lots of information about operations and malfunctions detected by the system. For information on operating the logs, see the ‘Operator’s Manual IRC5P’, section ‘Running in Production’ / ‘Logging and Diagnostics’.
Check LED Indicators	Check the LED indicators on the LED panel on the controller front for information on possible malfunction. Faults caused by electronic units are indicated by the LEDs on the unit front. These LEDs are described under the different boards and units in ‘Unit Description, IRC5P’.

8.2.3 Work Systematically

Do Not Replace Units Randomly

Before replacing any part at all, it is important to establish a probable cause for the fault, thus determining which unit to replace.

Randomly replacing units may sometimes solve the acute problem, but also leaves the trouble shooter with a number of units that may or may not be perfectly functional.

Replace one Component at a Time

When replacing a presumably faulty unit that has been isolated, it is important that only one unit is replaced at a time.

Always replace components according to procedures in the Repair chapter of the product manual for the manipulator and controller at hand.

Test the system after replacing to see if the problem has been solved.

If replacing several units at once:

- It is impossible to determine which of the units was causing the fault.
- It greatly complicates ordering a new spare part.
- It may introduce new faults to the system.

Take a Look Around

Often, the cause may be evident by visual inspection. In the area of the unit acting erroneously, be sure to check:

- Are the attachment screws secured?
- Are all connectors secured?
- Are all cabling free from damage?
- Are the units clean (especially electronic units)?
- Is the correct unit fitted?

Check for Tools Left Behind

Some repair and maintenance work require use of special tools to be fitted to the robot equipment. If these are left behind (e.g. a signal cable to a computer unit used for measuring purposes), they may cause erratic robot behavior.

Make sure all tools are removed when maintenance work is completed.

8.2.4 Keep Track of History

Make a Historical Error Log

In some cases, a particular installation may give rise to faults not encountered in others. Therefore, a log of each installation may give valuable assistance to the trouble shooter.

To facilitate trouble shooting, a log of the circumstances surrounding the fault gives the following advantages:

- It enables the trouble shooter to see patterns in causes and consequences not apparent at each individual fault occurrence.
- It may point out a specific event always taking place just before the fault, for example a certain part of the work cycle being run.
- When an error occurs, keep track of the last operations done by the robot.

Check Up the History

Make sure you always consult the historical log if it is used. Also remember to consult the person who was observing the problem.

At What Stage did the Fault Occur

What to look for during trouble shooting depends greatly on when the fault occurred: Was the robot just freshly installed? Was it recently repaired?

The table gives specific hints to what to look for in specific situations:

If the system has just:	then:
been installed	Check: – the configuration files – connections – options and their configuration
been repaired	Check: – all connections to the replaced part – power supplies – that the correct part has been fitted
had a software upgrade	Check: – software versions – compatibilities between hardware and software – options and their configuration – memory requirements
been moved from one site to another (an already working robot)	Check: – connections – mechanical damage

8.2.5 Upgrading, Downgrading and Compatibilities

Overview

Each part of the system is of a specific release, software as well as hardware. Changing to a later release is called upgrading and changing to an earlier is downgrading.

Upgrading and downgrading may cause compatibility problems, for instance a specific circuit board may work well with one release but not with another.

Since the robot system is complex, and since the system often works in connection with a large number of additional equipment, keeping track of each hardware/software combination is difficult.

Technical Service Information

Each software release is accompanied by a Technical Service Information, TSI, which includes a description of how to perform an upgrade/downgrade, and a list of known incompatibilities.

For information about a specific TSI, please contact your local ABB organization.

8.3 Fault Symptoms and Malfunctions

8.3.1 Types of Symptoms

Symptoms

A fault in the robot system first appears as a symptom, which may be:

- An event log message, which may be viewed using the pendant, RobView 5 or RobotStudio. A complete listing of these messages is presented in ‘Operating Manual, Trouble Shooting’ / Event Log Messages.
- The system performing poorly or displaying mechanical disturbances. These faults are described in section ’Start-Up Failures’ on page 177.
- The system does not start or displays irrational behavior during startup. These faults are described in section ’Start-Up Failures’ on page 177. A normal start-up sequence is described in section ’Normal Start-Up Sequence’ on page 176.
- Indications on the LED panel indicators on the front of the control cabinet. The significance of each LED is described in chapter ’LED Indicator Panel’ on page 197.
- Indications on the hardware components, such as LEDs. The significance of each LED in the controller is described under the different boards and units in ‘Unit Description, IRC5P’.
- Production stops caused by e.g. work envelope limitations.
- Rapid execution errors, e.g. unknown program requested in the job queue.

8.3.2 Normal Start-Up Sequence

Description

This section describes a normal start-up sequence as shown on the indicators on the LED indicator panel on the front of the control cabinet. For information on the general start-up procedure, see ‘Operator’s Manual, IRC5P’, Installation and Commissioning / Switch on Mains Power.

Start-Up Sequence

When the mains power switch is switched ‘on’, power is supplied to the robot system.

1. The robot performs its self-test on both the hardware and software. The LEDs are flashing alternating red and green.
2. The Enable PIB LED is blinking red during loading of the FPGA.
3. The SPI LED is red during SPI initialization.
4. The indicators on the LED indicator panel show the normal status, LEDs are green, and the robot is up and running.

8.3.3 Start-Up Failures

Description

This section details possible faults at start-up, and specifies recommended actions for each case.

Consequences

The system does not start, or starts incorrectly.

Symptoms and Causes

A number of symptoms are possible:

- No LED indicators are lit on the LED indicator panel and on any unit.
- The system software does not load properly.
- The pendant is ‘dead’.
- The pendant starts up, but does not respond to any input.

Recommended Actions, No LED Indications

Step	Action	Comment
1	Make sure the main transformer is correctly connected for the mains voltage levels at hand.	How to connect the transformer is found under ’Mains Power Connection’ on page 115.
2	Make sure the mains switch is switched on.	
3	Make sure the mains power supply to the system is present and within specified limits.	The installation documentation may provide this as well as other vital information.
4	Make sure that the supply voltages from the PDB board are present and within the specified limits.	If required, trouble shoot PDB, described in ’Trouble Shooting Power Supply, PDB’ on page 193, and associated systems. For information, see ‘Power Distribution Board, PDB’ in ‘Unit Description, IRC5P’.
5	If the system seems to be totally ‘dead’.	Proceed as described in section ’Controller Dead’ on page 178.
6	The pendant appears to be ‘dead’.	Proceed as described in section ’Pendant Dead’ on page 180.
7	If the pendant starts, but does not seem to communicate with the controller.	Proceed as described in section ’Pendant does not Communicate’ on page 181.
8	If you encounter problems trying to download system software, please proceed to the ‘Operators Manual, IRC5P’.	

8.3.4 Controller Dead

Description

The robot controller is completely or intermittently ‘dead’.

No indicators are lit and no operation is possible.

Consequences

The system can not be operated.

Possible Causes

The symptom may be caused by (the causes are listed in order of probability):

- The controller is not connected to the mains power supply.
- The main transformer is malfunctioning or not connected correctly.
- The mains overload protection (FR1) may have tripped.

Recommended Actions

Step	Action	Comment
1	Make sure the mains power supply in the shop is working and that the voltage level matches that of the controller requirement.	The installation documentation may provide this as well as other vital information.
2	Make sure the main transformer has been correctly connected for the mains voltage level at hand.	How to connect the transformer is found under ’Mains Power Connection’ on page 115..
3	Make sure the mains overload protection, FR1 has not tripped. If it has, reset it.	For information, see ‘Unit Description, IRC5P’, Power Module / Fuses and Overload Protections.
4	Check that the other fuses in the power supply system are OK.	For information, see ‘Unit Description, IRC5P’, Power Module / Fuses and Overload Protections.
5	If the system does not start although the controller seems to be working, make sure all connections have been made correctly between the modules.	

8.3.5 Controller Performance Slow

Description

The controller performance is slow, and seems to work irrationally.

The controller it not completely ‘dead’. If it is, please proceed as described in section ’Controller Dead’ on page 178.

Consequences

These symptoms may be observed:

- Program execution is sluggish, seemingly irrational and sometimes stalls.

Possible Causes

The computer system is experiencing too high load, which may be due to one or more of the following:

- Programs containing too many logical instructions without Wait or Move-instructions, causing too fast program loops and in turn, overload the processor.
- The poll rate of the I/O units is set too low, overloading the I/O system.
- Internal system cross connections and logical functions are used too frequently.
- An external PLC, or other supervisory computer, is addressing the system too frequently, overloading the system.

Recommended Actions

Step	Action	Comment
1	Check whether the program contains almost only logical instructions (or other instructions that take ‘no time’ to execute), since such programs may cause the execution to loop if no conditions are fulfilled. To avoid such loops, you may test by adding one or more WAIT instructions. Use only short WAIT times, to avoid slowing the program down unnecessarily.	Suitable places to add WAIT instructions may be: – In a WHILE/FOR/GOTO loop, preferably at the end, close to the ENDWHILE/ENDFOR etc. part of the instruction. – In an auto-looping background task, ref. Rapid OverView/Multitasking
2	Make sure the poll rate value for each I/O board is not too low. These values are changed using RobotStudio. I/O units not requiring to be polled regularly may be switched to ‘change of state’ operation as described in the RobotStudio manual.	ABB recommends these poll rates [ms]: – DSQC 651: 1000 – DSQC 652: 1000 – DSQC 653: 1000 – DSQC 377: 20-40 – All others: >100
3	Check whether there is a large amount of cross connections or I/O communication between PLC and robot system. If required, try to reduce the communication.	Too much communication with PLCs or other external computers will load the robot system main computer.
4	Make sure there is little unnecessary communication between any supervisory PLCs or other computer. Make sure the PLC is programmed in such a way that it does not, for example, request robot system state changes that are not allowable, by letting the PLC monitor robot system state through a digital input. Also make sure, that such state change requests are not issued too often.	The robot system have a number of fixed system inputs and outputs that may be used for this purpose. Too much communication with PLCs or other external computers will load the robot system main computer.

8.3.6 Pendant Dead

Description

The robot pendant is completely or intermittently ‘dead’.

No entries are possible, and no functions are available.

If the pendant starts up, but does not display any screen, proceed as described in section ’Pendant does not Communicate’ on page 181.

Consequences

The system may not be operated using the pendant.

Possible Causes

The symptom may be caused by (the causes are listed in order of probability):

- The system has not been switched on.
- The pendant is not connected to the controller.
- The cable from the controller is damaged.
- The cable connector is damaged.
- The pendant is faulty.
- Pendant power supply from controller is faulty.

Recommended Actions

Step	Action	Comment
1	Make sure the system is switched on and that the pendant is connected to the controller.	How to connect the pendant to the controller is described in ’Pendant Connection’ on page 103.
2	Inspect the pendant cable for any visible damage. If possible, test by connecting a different pendant to eliminate the pendant and cable as error sources. Also test the pendant at hand on a different controller if possible.	If faulty, replace the pendant.
3	Check that power is supplied to the pendant.	For information, see ‘Pendant Interface Board, TIB’ in ‘Unit Description, IRC5P’.

8.3.7 Pendant does not Communicate

Description

The pendant starts up, but does not display any proper screen.

No operator input is possible, and no functions are available.

The pendant is not completely ‘dead’. If it is ‘dead’, proceed as described in section ’Pendant Dead’ on page 180.

Consequences

The system may not be operated using the pendant.

Possible Causes

The symptom may be caused by (the causes are listed in order of probability):

- The main computer has lost its power supply.
- Communication lines between pendant and main computer not ok.

Recommended Actions

Step	Action	Comment
1	Make sure the pendant has been correctly connected to the controller.	How to connect the pendant is described in ‘Pendant Connection’ on page 103.
2	Make sure the power supply is OK and communication lines are OK.	Check power supply system and signal lines.
3	Check LED indicators on the front panel.	For description, see ’LED Indicator Panel’ on page 197.
4	Make sure all connections and supplies to the TIB board are OK.	For information, see ‘Pendant Interface Board, TIB’ in ‘Unit Description, IRC5P’.
5	Make sure the Ethernet cable between pendant and TIB is OK.	For information, see ‘Pendant Interface Board, TIB’ in ‘Unit Description, IRC5P’.
6	If all cables and supplies are OK, and nothing else seems to solve the problem: Check SIB board, PIB board and Main Computer.	How to replace the units are described in chapter ’Repair’ on page 129’.

8.3.8 Erratic Event Messages on Pendant

Description

The event messages displayed on the pendant are erratic and do not seem to correspond to any actual malfunctions of the robot. Several types of messages may be displayed, seemingly erroneously.

This type of symptom may occur after major manipulator disassembly or overhaul, if not performed correctly.

Consequences

Major operational disturbances due to the constantly appearing messages.

Possible Causes

The symptom may be caused by:

- Internal manipulator cabling not correctly performed. Causes may be: faulty connection of connectors, cable loops too tight causing the cabling to get strained during manipulator movements, cable insulation worn or damaged by rubbing short circuiting signals to ground.

Recommended Actions

Step	Action	Comment
1	Inspect all internal manipulator cabling, especially all cabling disconnected, connected re-routed or bundled during recent repair work.	Refit any cabling. See ‘Product Manual, Manipulator’.
2	Inspect all cable connectors to make sure these are correctly connected and tightened.	
3	Inspect all cable insulation for damage.	Replace any faulty cabling as required.
4	Inspect all grounding and shielding devices and check for proper operation.	

8.3.9 No Voltage in Service Outlet

Description

Some controllers are fitted with service voltage outlet sockets, and this information applies to these modules only.

No voltage is available in the controller service outlet for powering external service equipment.

Consequences

Equipment connected to the controller service outlet does not work.

Probable Causes

The symptom may be caused by (the causes are listed in order of probability):

- Blown fuse, FU2 (230VAC) or FU3 (115VAC).
- Mains power supply loss.
- Transformers incorrectly connected.

Recommended Actions

Step	Action	Comment
1	Make sure the fuse is not blown.	Make sure any equipment connected to the service outlet does not consume too much power, causing the fuse to blow.
2	Make sure the power supply to the robot system is within specifications.	Refer to the plant documentation for voltage values.
3	Make sure the transformer supply for the outlet is correctly connected.	See transformer wiring diagram under ‘Mains Transformer’ in ‘Unit Description, IRC5P’..

8.3.10 The Joysticks do not Work

Description

The system can be started but one or both of the joysticks on the pendant do not seem to work.

Consequences

The robot can not be jogged manually.

Possible Causes

The problem may be caused by:

- The system is not in Manual Mode (Key switch).
- The Live Handle is not operated properly.
- Run Chain is broken by Emy Stop, or the Motor On button has not been operated.
- Joysticks have not been calibrated.
- The pendant is not connected correctly or the cable is damaged.
- The power supply to the pendant does not work correctly.
- The pendant is malfunctioning.
- Joysticks are damaged.

Recommended Actions

Step	Action	Comment
1	Check that the system has been switched on.	Ref. ‘Operator’s Manual, IRC5P’.
2	Check that Key Switch is in Manual Reduced Speed Mode.	If NOT, proceed as described in the ‘Operator’s Manual, IRC5P’.
3	Check that all Emergency stop buttons are released and then Press Motor On-button to close Run Chain.	
4	Check that Live Handle is operated properly.	Ref. ‘Operator’s Manual, IRC5P’.
5	Check that the joysticks have been calibrated.	Ref. ‘Operator’s Manual, IRC5P’.
6	Does the pendant work at all?	If NOT, proceed as described in section ’Pendant Dead’ on page 180.
7	Make sure the pendant is connected correctly to the controller.	For information, see ’Pendant Connection’ on page 103.
8	Make sure the pendant cable has not been damaged.	Check cable.
9	Make sure the power supply is OK and communication lines are OK.	Check power supply system.
10	If nothing else works, replace the pendant.	

8.3.11 Reflashing Firmware Failed

Description

When reflashing firmware, the automatic process may fail.

Consequences

The automatic reflashing process is interrupted and the system stops.

Possible Causes

This fault most often occurs due to a lack of compatibility between hardware and software.

Consequences

Step	Action	Comment
1	Check the event log for a message specifying which unit failed.	For information on event log messages, see ‘Operating Manual, Trouble Shooting’ / Event Log Messages.
2	Was the relevant unit recently replaced? If YES, make sure the versions of the old and new unit is identical. If NOT, check the software versions.	
3	Check with your local ABB organization for a firmware version compatible with your hardware/software combination.	

8.3.12 Inconsistent Path Accuracy

Description

The path of the robot TCP is not consistent. It varies from time to time, and this may sometimes be accompanied by noise emerging from bearings, gearboxes or other locations.

Consequences

Production is not possible.

Possible Causes

The symptom may be caused by:

- Mechanical joint between motor and gearbox damaged, often causing noise.
- Bearings damaged or worn (especially if the path inconsistency is coupled with clicking or grinding noises from one or more bearings).
- The brakes may not be releasing correctly.

Recommended Actions

Step	Action	Comment
1	Locate a faulty bearing by tracking the noise.	Replace faulty bearing. See ‘Product Manual, Manipulator’.
2	Locate the faulty motor by tracking the noise. Study the path of the robot TCP to establish which axis, and thus which motor, may be faulty.	Replace the faulty motor/gearbox. See ‘Product Manual, Manipulator’.
3	Make sure the robot brakes work properly.	Proceed as described in section 'Robot Brakes do not Release' on page 191.

8.3.13 Consistent Path Inaccuracy

Description

The path of the robot TCP is consistently inaccurate.

Consequences

Production is not possible.

Possible Causes

- Robot not calibrated correctly.
- Robot TCP not correctly defined.
- Robot Base Frame, Object Frame or similar not correctly defined.
- Wrong robot type may be connected to the controller.

Recommended Actions

Step	Action	Comment
1	Make sure the robot Tool is correctly defined.	How to define the TCP is described in the ‘Operator's Manual, IRC5P’.
2	Check the revolution counter.	If required, update revolution counter as described in ‘Operator's Manual, IRC5P’.
3	If required, re-calibrate the robot axes.	Make sure the robot is calibrated as described in ‘Operator's Manual, IRC5P’.
4	Check that all Frames are correctly defined.	How to configure frames is described in ‘Operator's Manual, IRC5P’.
4	Make sure the correct robot type is connected as specified in the configuration files.	

8.3.14 Oil or Grease Stains on Motors and/or Gearboxes

Description

The area surrounding the motor or gearbox shows signs of oil leaks. This may be at the base, closest to the mating surface, or at the furthest end of the motor at the resolver.

Consequences

Except for the dirty appearance, in some cases there are no serious consequences. However, in some cases the leaking oil lubricates the motor brake, causing the manipulator to collapse at power-down.

Possible Causes

The symptom may be caused by (the causes are listed in order of probability):

- Leaking seal between gearbox and motor.
- Gearbox overfilled with oil.
- Gearbox oil too hot.

Recommended Actions

CAUTION! Parts of the manipulator may be hot and care must be taken to avoid touching these components before they have been allowed to cool down.

Step	Action	Comment
1	Inspect all seals and gaskets between motor and gearbox. The different manipulator models use different types of seals.	Replace seals and gaskets. See ‘Product Manual, Manipulator’.
2	Check the gearbox oil level.	Correct oil level . See ‘Product Manual, Manipulator’.
3	Too hot gearbox oil may be caused by: – Oil quality or level used is incorrect. – The robot work cycle runs a specific axis too hard. Investigate whether it is possible to program small ‘cooling periods’ into the application. – High pressure created inside gearbox.	Check the recommended oil level and type. See ‘Product Manual, Manipulator’.

8.3.15 Mechanical Noise

Description

During operation, no abnormal mechanical noise should be heard from motors, gearboxes, bearings or similar. A faulty bearing often makes scraping, grinding or clicking noises shortly before failing.

Consequences

Failing bearings cause the path accuracy to become inconsistent, and in severe cases, the joint may be completely damaged.

Possible Causes

The symptom may be caused by:

- Worn bearings.
- Contaminations have entered the bearing races.
- Loss of lubrication in bearings.
- Overheating (If the noise comes from a gearbox).

Recommended Actions

CAUTION! Parts of the manipulator may be hot and care must be taken to avoid touching these components before they have been allowed to cool down.

Step	Action	Comment
1	Determine which bearing is causing the noise.	
2	Make sure the bearing has sufficient lubrication, and is not contaminated.	See ‘Product Manual, Manipulator’.
3	If possible, disassemble the joint and measure the clearance.	See ‘Product Manual, Manipulator’.
4	Bearings inside motors are not to be replaced individually; The complete motor must be replaced.	Replace faulty motors. See ‘Product Manual, Manipulator’.
5	Make sure the bearings are fitted correctly.	See ‘Product Manual, Manipulator’ for general information on how to handle bearings.
6	Too hot gearbox oil may be caused by: – Oil quality or level used is incorrect. – The robot work cycle runs a specific axis too hard. Investigate whether it is possible to program small ‘cooling periods’ into the application. – High pressure created inside gearbox.	Check the recommended oil level and type as specified in ‘Product Manual, Manipulator’.

8.3.16 Manipulator Collapses on Power-Down

Description

The manipulator is able to work correctly while Motors ON is active, but when Motors are off, it collapses under its own weight.

The holding brake, integral to each motor, is not able to hold the weight of the manipulator arm.

Consequences

The fault may cause severe injuries or death to personnel working in the area or severe damage to the manipulator and/or surrounding equipment.

Possible Causes

The symptom may be caused by:

- Faulty brake.
- Grease or oil on brakes.
- Brakes worn causing dust to be accumulated on the brake discs.

Note: It is not normal for the brakes to become worn, as they shall become engaged only when the motor is not turning. Exception: Emergency stop. Therefore, do not use Emergency stop for normal stops.

Recommended Actions

Step	Action	Comment
1	Determine which motor(s) causes the robot to collapse.	
2	Check the brake power supply to the collapsing motor during the Motors OFF state.	For information, see relevant manipulator board in ‘Unit Description, IRC5P’.
3	Check brakes e.g. by moving robot arm manually.	If found faulty, the motor must be replaced as a complete unit. See ‘Product Manual, Manipulator’.

8.3.17 Robot Brakes do not Release

Description

When starting robot operation or jogging the robot, the internal robot brakes must release in order to allow for movements.

Consequences

If the brakes do not release, no robot movement is possible, and a number of error log messages may occur.

Possible Causes

The symptom may be caused by:

- Brake drivers do not work properly.
- The system does not go to status Motors ON correctly.
- Faulty brake on the robot axis.
- Supply voltage 24V_BRAKE missing.

Recommended Actions

Step	Action	Comment
1	Make sure the brake drivers on manipulator board are working properly.	For information, see relevant manipulator board in ‘Unit Description, IRC5P’.
2	Make sure the RUN Chain is closed.	Check run chain. For information, see ’Robot Safety System Connections’ on page 64.
3	Try to release brakes manually. If just one of the brakes malfunctions, the brake at hand is probably faulty and will have to be replaced. If none of the brakes work, there is probably no 24V_BRAKE power available.	For information on how to release the brakes manually, see ‘Product Manual, Manipulator’, Repair / Releasing Axis Brakes.
4	Check that brake power is available to manipulator board by measuring voltage in connector.	For information, see relevant manipulator board in ‘Unit Description, IRC5P’..
5	A number of other faults within the system may cause the brakes to remain activated. In such cases, event log messages will provide additional information.	For information on event log messages, see ‘Operating Manual, Trouble Shooting’ / Event Log Messages.

8.4 Trouble Shooting Instructions per Unit

8.4.1 Trouble Shooting the Pendant

General

The pendant communicates with the main computer via PIB, SIB and the Pendant Interface Board, TIB. The pendant is physically connected to the TIB board through a cable together with +12V supply, two emergency stop channels and enabling device chains.

Procedure

Step	Action	Comment
1	If the pendant is completely ‘dead’, proceed as detailed in section 'Pendant Dead' on page 180.	
2	If the pendant starts, but does not operate correctly, proceed as detailed in section 'Pendant does not Communicate' on page 181.	
3	If the pendant starts, seems to operate, but displays erratic event messages, proceed as detailed in section 'Erratic Event Messages on Pendant' on page 182.	
4	Check the cable for connections and damage.	
5	Check the power supply to the pendant.	
6	Read the error event log message and follow any instructions of references.	Communication errors between the pendant and the main computer may be viewed as event log messages either on the pendant, RobView 5 or RobotStudio.

8.4.2 Trouble Shooting Power Supply, PDB

Overview

This section details how to trouble shoot the electrical power supply board (Power Distribution Board, PDB) in the controller.

Procedure

Step	Action	Comment
1	Check the LED indicators on the power supply unit.	For description of the LED indicators, see ‘Power Distribution Board, PDB’ in ‘Unit Description, IRC5P’.
2	Disconnect the output connector of the power supply unit.	
3	Measure the output voltage of the unit.	If no voltage, or an incorrect voltage is detected, proceed with next step.
4	Measure the input voltage.	If the input voltage is correct, the power supply unit may be faulty.
5	If required, disconnect the loads from the power supply unit, one by one, to eliminate any overload.	
6	If the power supply unit is found faulty, replace it, and verify that the fault has been fixed.	How to replace the unit is detailed in chapter ’Repair’ on page 129..

8.4.3 Trouble Shooting Communications

Overview

This section details how to trouble shoot data communication between the different units in the controller.

Trouble Shooting Procedure

Step	Action	Comment
1	Faulty cables (e.g. send and receive signals are mixed up)	
2	Transfer rates (baud rates)	
3	Data widths that are incorrectly set	

8.4.4 Trouble Shooting I/O Units

Checking Function

The procedure detailed below is to be used when a certain I/O unit does not communicate through inputs and outputs as expected.

Step	Action	Comment
1	Check that the current I/O signal has the desired status using the I/O menu on the pendant display.	
2	Check the I/O unit's LED for the current input or output. If the output LED is not lit, check that the 24V I/O power supply is OK.	
3	Check on all connectors and cabling from the I/O unit to the process connection.	
4	Make sure the process bus, to which the I/O unit is connected, is working.	If a bus has stopped running, an event log message is usually stored in the event log. Also check the indication LEDs on the bus boards.

Checking Channel Communication

The I/O channels can be read and activated from the I/O menu on the pendant. In the event of an error in the I/O communication to and from the robot, check as follows:

Step	Action	Comment
1	Is I/O communication programmed in the current program?	
2	On the unit in question, the MS (Module Status) and NS (Network Status) LEDs must be lit with a steady green light.	

LED Indicators

All LEDs, and their significance, are described under each individual unit in 'Unit Description, IRC5P', Distributed I/O.

8.4.5 Intermittent Errors

Description

During operation, errors and malfunctions may occur, in a seemingly random way.

Symptoms

Operation is interrupted, and occasionally, event log messages are displayed, that sometimes do not seem to be related to any actual system malfunction. This sort of problem sometimes affects the Emergency stop or Enable chains respectively, and may at times be very hard to pinpoint.

Probable Causes

Such errors may occur anywhere in the robot system and may be due to:

- External interference.
- Internal interference.
- Loose connections or incorrectly connected cable screen, shielding and grounding connections.
- Thermal phenomena, e.g. major temperature changes within the workshop area.

Recommended Actions

Step	Action	Comment
1	Check all the cabling, especially the cables in the Emergency stop and Enable chains. Make sure all connectors are connected securely.	
2	Check that grounding and shielding are properly done.	
3	Check if any LED indicator may give some clue to the problem.	The significance of all LED indicators are specified under 'LED Indicator Panel' on page 197 and under the different boards and units in 'Unit Description, IRC5P'..
4	Check the messages in the event log. Sometimes specific error combinations are intermittent.	The event log messages may be viewed on the pendant, on RobView 5 or on RobotStudio.
5	Check the robot's behavior, etc., each time that this type of error occurs.	If possible, keep track of the malfunctions in a log plus any circumstantial events (Operator actions, PLC commands etc.) that may have anything to do with this behavior.
6	Check whether any condition in the robot working environment also changes periodically, e.g, interference from any electric equipment only operating periodically.	
7	Investigate whether the environmental conditions (such as ambient temperature, humidity, etc.) has any influence on the malfunction.	If possible, keep track of the malfunctions in a log or similar.

8.5 LED Indicator Panel

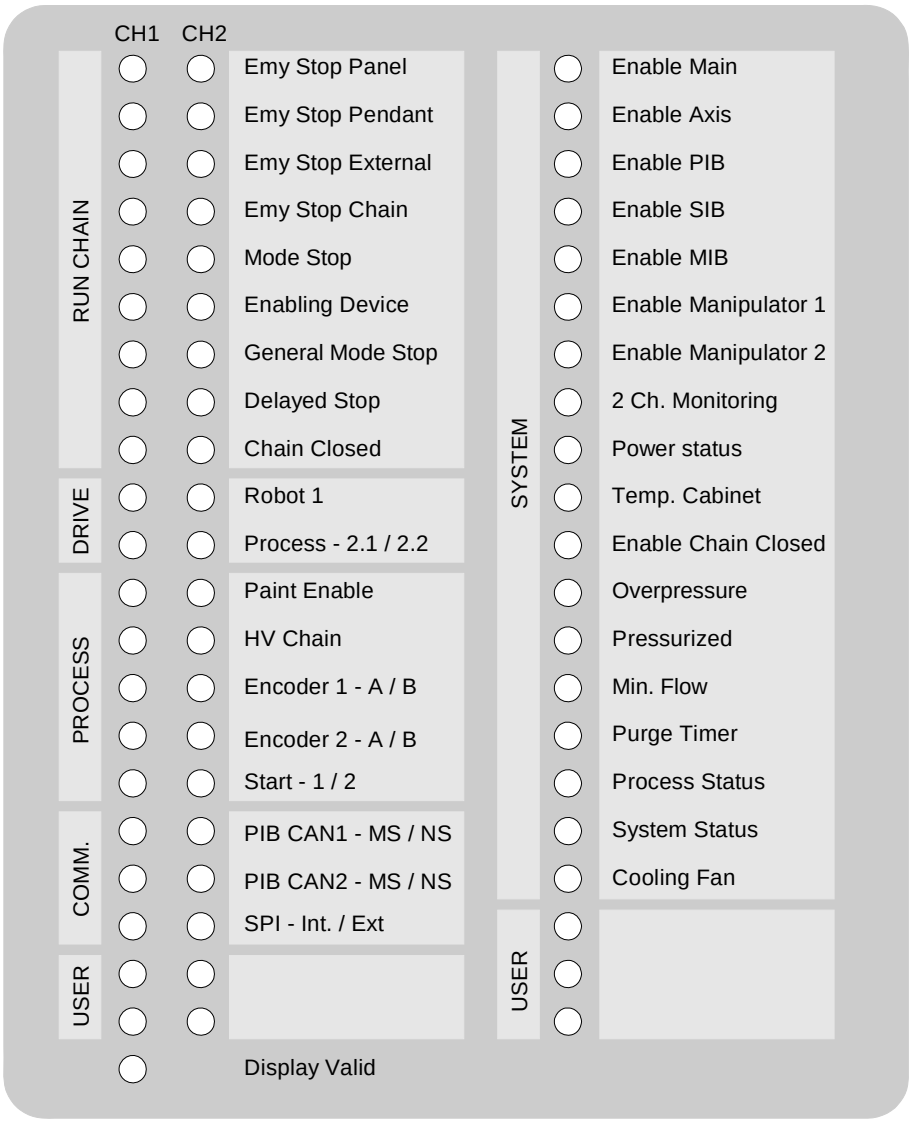
8.5.1 Panel Overview

General

The following provides description of the LED indicator panel.

Panel Overview

Figure 86 LED Indicator panel



8.5.2 LED Description

General

The following provides description of the LED indicators.

RUN CHAIN

LEDs showing the status of the emergency stop chain and run chain.

Description	Source of fault / Remedy
Emy Stop Panel (Chain 1-2) Green - OK. Off - Emergency stop button on the control cabinet is depressed.	The emergency stop chain is broken at the main panel emy stop switch or in the chain in front of the switch. – Check cause for emergency stop. If OK, pull out button. – Check emy stop chain 1 and/or 2 from +24VDC supply to main panel switch.
Emy Stop Pendant (Chain 1-2) Green - OK. Blinking Green - Hot plug activated. Blinking Green/Red - Hot plug time out and Emy stop chain closed. Blinking Red - Hot plug time out and Emy stop chain is broken. Off - Emergency stop button on the pendant is depressed.	The emergency stop chain is broken at the pendant emy stop switch or in the chain leading to the pendant switch. – Check cause for emergency stop. If OK, pull out button. – Use the Motor On-button to reset Run Chain. If not OK, proceed below. – Check emy stop chain 1 and/or 2 from main panel switch to pendant switch. – Check pendant cable and connector. (If the pendant is not connected, a dummy connector must be installed in its place). – Check I.S. barriers (TIB board) and wiring. – Check SIB board for malfunction. Replace as required.
Emy Stop External (Chain 1-2) Green - OK. Off - External emergency stop button(s) is depressed.	The emergency stop chain is broken at the external emy stop switch or in the chain leading to the external switch. – Check cause for emergency stop. If OK, pull out button. – Use the Motor On-button to reset Run Chain. If not OK, proceed below. – Check emergency stop chain 1 and/or 2 from pendant switch to the external switch.
Emy Stop Chain (Chain 1-2) Green - Chain closed. Off - when panel, pendant, emergency stop category 0 and category 1 is open. Blinking Red - Emy stop reset fail.	The emergency stop chain is broken after the external emy stop switch. – Check chain from external emy stop switch to 0V conn. for emy stop chain. The emergency stop reset function (pressing motor ‘on’, etc.) is stuck or has been held depressed for more than 4 seconds. – Check operation of emy stop switches. – Check that emy stop reset has not been blocked (does not have a continuous signal).

Description	Source of fault / Remedy
Mode Stop (Chain 1-2) Green - OK. Off - Auto mode stop is activated.	The run chain is broken at the auto mode stop switch (in Automatic mode) or test mode stop switch (in Manual Reduced Speed or High Speed mode) or in the chain in front of the switches. – For auto mode stop, check that the mode selector is in Automatic mode and that the cabin door(s) is closed. (The auto mode stop switch is typically used for cabin entrance door). – Use the Motor On-button to reset Run Chain. If not OK, proceed below. – For test mode stop, check that the mode selector is in manual mode and that the pendant enabling device (Enabling Device LED) and possible additional enabling device is pressed. (The test mode stop switch is typically used for an additional enabling device). – Check operation of the auto mode stop switch, enabling device and test mode stop switch. – Check operation of the mode selector. – Check run chain 1 and/or 2 from +24VDC supply via mode selector to the mode stop switches.
Enabling Device (Chain 1-2) Green - Enabling device is depressed. Off - Enabling device is released.	The run chain is broken at the pendant enabling device switch or in the chain in front of the switch. – Use the Motor On-button to reset Run Chain. If not OK, proceed below. – Check that the enabling device is depressed. – Check that mode selector is in manual mode. – Check pendant cable and connector. – Check I.S. barriers (TIB board) and wiring. – Check SIB board for malfunction. Replace as required. – Check run chain 1 and/or 2 from +24VDC supply via mode selector to pendant enabling device.
General Mode Stop (Chain 1-2) Green - OK. Off - General mode stop is activated.	The run chain is broken at the general mode stop switch or in the chain in front of the switch. – Check that the mode selector is in Automatic mode. – Use the Motor On-button to reset Run Chain. If not OK, proceed below. – Check operation of the general mode stop switch. (General mode stop act as an emergency stop and is normally used in more complex installation where the robot emy stop system is integrated with the factory emy stop system).
Delayed Stop (Chain 1-2) Green - OK. Off - Delayed stop is activate.	The motor chain is broken by delayed stop (emergency stop category 1). – Use the Motor On-button to reset Run Chain. If not OK, proceed below. – Check that cabin door(s) is closed. (Delayed stop may be used for entrance doors located at a distance from the robot). – Check switches and wiring.
Chain Closed (Chain 1-2) Green - OK. Ch1 Blinking Red - Servo disconnect system 1 Ch2 Blinking Red - Servo disconnect system 2 Off - Run chain is broken.	The run chain is broken. – Check that LEDs for Mode Stop, Enabling Device, General Mode Stop and Delayed Stop are lit. – Check that purging is OK. – Check that emergency stop chain is OK (Emergency Stop Chain LED is lit). – Check complete run chain.

DRIVE

LEDs showing status of the motor drive system for the manipulator and paint pumps.

Description	Source of fault / Remedy
Robot 1 Green - Power relay for robot motor drive system is activated. Ch1 Red - Relay KM1 error. Ch2 Red - Relay KM2 error. Off - Relay not activated.	If LED is extinguished when it should have been lit: – Check hat Motor On switch has been pressed. – Check that Mode Selector is in Automatic mode or that Enabling Device on pendant is pressed when Mode Selector is in Manual mode. – Check that Emy chain is closed. – Check wires between power relay and MIB. – Replace power relay. – Replace MIB
Process - 2.1 / 2.2 Green - Chain closed - Relay for process equipment 2.1 (e.g. pump) or motor drive system 2.2 (e.g. CBS motion) is activated. Blinking green: Hardware chain closed - Waiting for RID. Blinking Red: Aux. chain open (Process 2.1) / System 2 interlock open (Process 2.2). 2.1 Red - Relay KM101 error. 2.2 Red - Relay KM102 error. Off - Chain open.	If LED is extinguished or blinking red: – Check that enable chain is closed. – Check that paint enable is activated. – Check that cabin safety switches are closed. – Check cables between power relay and MIB. – Replace power relay. – Replace MIB.

PROCESS

LEDs showing the status of functions related to the spray booth and paint process.

Description	Source of fault / Remedy
Paint Enable (Chain 1-2) Green - Chain closed Blinking Green: Process interlock open - cabin interlock closed. Blinking Red - Divergency in process interlock chain. Off - Cabin interlock chain is broken.	The cabin interlock chain is broken. This chain includes a safety switch on the cabin door, and a cabin interlock switch for the cabin ventilation to disable the paint control system when the cabin door is open and/or ventilation fans not running. – Check that equipment connected in the cabin interlock chain is closed.
HV Chain (Chain 1-2) Green - Chain closed. Off - Chain open. Blinking Red: HV Interlock broken.	The High Voltage interlock chain is broken. – Check external HV interlock chain. – Check cabin interlock chain. – Check position of HV on/off switch on panel.
Encoder 1 - A / B (Phase 1-2) Green - Flashes to indicate phase 1 and 2 from Encoder 1, normally conveyor encoder. By encoder frequency below 10Hz, the LEDs will blink: off-off, on-off, off-on, on-on. A stopped encoder shows one of these combinations. By frequencies above 10Hz, both LEDs will be constantly lit.	Flashes by each encoder pulse. By frequencies higher than a few Hz, blinking can no longer be observed (light will appear weaker). No light in one LED indicates fault in one encoder phase. – Check that the conveyor is running. – Check that the encoder rotates as it should. – Check power supply for encoder. – Check encoder, wiring and connectors. – Check encoder circuit on PIB unit.
Encoder 2 - A / B (Phase 1-2) Green - As Encoder 1. Encoder 2 may be used as backup for encoder 1 etc.	As encoder 1.

Description	Source of fault / Remedy
Start 1 / 2 Green - Lit when digital input is active. Normally Start 1 input is used as Sync Switch for conveyor tracking and Start 2 is not used.	Faulty limit switch, photocell etc. External wiring or connectors, short circuit or broken wire. Faulty power supply for input circuit (internal or external). Defective input circuit on board. If Exi input on TIB is used, check I.S. barrier.

COMM.

LEDs showing the status of the CAN and SPI communication.

Description	Source of fault / Remedy
PIB CAN1 - MS / NS Green - OK. Any other status, see ‘Unit Description, IRC5P’, Distributed I/O.	CAN1 bus is used for communication between the robot controller (PIB) and external field bus units (CAN1.1) and manipulator (CAN1.2). – Check CAN bus from PIB to internal I/O nodes. – Check CAN bus from PIB via MIB to robot. – Check CAN bus from PIB to external I/O nodes.
PIB CAN2 - MS / NS Green - OK. Any other status, see ‘Unit Description, IRC5P’, Distributed I/O.	CAN2 is normally not used. – If used, check CAN bus from PIB to external I/O nodes
SPI - Int. / Ext Green: OK Red: During SPI initialization. SPI bus communication between PIB and SIB, MIB (SPI - Int) and between PIB and external I/O units (SPI - Ext).	If LED is Off, blinking green, red or blinking red, check: – That nodes are initialized. – Cables and connections. – PIB board and units connected to SPI bus. – For more information, see description of LEDs Ext SPI1 / Ext SPI2 under ‘Paint Interface Board PIB’ in ‘Unit Description, IRC5P’.

SYSTEM

LEDs showing status of the different control systems, power supply, purge system, temperature etc.

Description	Source of fault / Remedy
Enable Main Green, blinking each 8 ‘th second - Main Computer OK. Off - No communication Blinking Red - Failure	– Check cable for communication from Axis Computer to Main Computer. – Check communication cable from PIB to Main Computer. Note. To remove message, acknowledge must be issued (e.g. pressing Motor On button).
Enable Axis Green, blinking each 8 ‘th second - OK. Enable signal from axis computer active. Blinking Red - Failure, signal not active.	– Try to reset by pressing Motor On. If persistent, check: – Check Power LED on Axis Computer. – Check cable for feedback from Axis Computer to MIB. – Check cable for control from Axis Computer to Drive Unit. – Check cable for communication from Axis Computer to Main Computer. – Replace Axis Computer board. Note. To remove message, acknowledge must be issued (e.g. pressing motor on button).

Description	Source of fault / Remedy
Enable PIB Green - Enable signal from PIB OK Blinking Green/Red - Software deactive and Enable Chain - HW OK. Blinking Red during start up - Waiting for loading of FPGA. Off - Enable signal lost Blinking Red - Failure	– Check communication cable from PIB to Main Computer. – Check communication cable to SIB and MIB.
Enable SIB Green - Enable signal from PIB OK. Communication between SIB and PIB is OK. Off - Communication lost. Blinking Red - Failure	– Check communication cable from SIB to PIB. – Check Power LED on SIB.
Enable MIB Green - Communication between MIB and SIB is OK (MIB OK). Off - Communication lost. Blinking Red - Failure	– Check communication cable from MIB to SIB. – Check Power LED on MIB.
Enable Manipulator 1 Green - OK. MCOB is operative. Blinking Red - Failure, MCOB not ready. Indicator lights red during purging sequence.	Enable signal from MCOB or robot temp. sensor chain. – Check Temp. Motors LED. – If used, check working area limit switches for manipulator axes, wiring and connectors. – If used, check collision protection, wiring and connectors.
Enable Manipulator 2 Same as Enable Manipulator 1 but for 2nd manipulator such as CBS.	
2 Ch. Monitoring Green - OK. Blinking Red - Failure, divergency in switches and/or relays in safety chain.	– Check Run Chain LEDs for divergency. – Check safety chain switches and relays for malfunction. – Check wiring and connections for Emy Stop buttons. – Safety element not tested after divergency failure.
Power Status Green - OK. Blinking Green - Low voltage on measuring system battery. Blinking Red - One or more supply voltages faulty, e.g. emy stop chain supply.	If LED is blinking green, – Replace the battery. If LED is blinking red, – Check 24V supply to PDB. – Check PDB power status LEDs – Check Purging status. – Check Fuses for rectifier (DC Link). – Emy stop chain supply.
Temp Cabinet Green - OK. Blinking Red - Temperature in control cabinet or transformer too high.	– Check cause of increased temperature in cabinet. Take necessary measures to reduce temperature. (By excessive ambient temperature cooler may be installed). – Check PTC on mains transformer and wiring.
Enable Chain Closed Green - OK. Enable chain is active. Blinking Red - Chain is not active.	The ‘Enable Chain Closed’ LED indicates that all elements in the enable chain are active. – Check that all SYSTEM LEDs above the ‘Enable Chain. Closed’ LED are OK. If not, correct error as required.

Description	Source of fault / Remedy
Overpressure Green - OK. Purging pressure below maximum pressure limit. Blinking Red - Pressure is above maximum limit. Note: If 2 purge systems are used, LED applies for both systems.	Indicates the state of the maximum pressure sensors. – Check that purge air exhaust on robot is not blocked. – Check the air supply pressure. – Check purge sensor. – Check cables and wiring. – Check that purge air supply to robot is not blocked.
Pressurized Green - OK. Purging pressure is above minimum limit. Blinking Red - Pressure is below minimum limit. Note: If 2 purge systems are used, LED applies for both systems.	Indicates the state of the minimum pressure sensors. – Check for leaks in the manipulator. – Check cables and wiring. – Check purge sensor. Note: Indicator will be red in a short period while pressure is being established.
Min. Flow Green - OK. Flow is OK. Blinking Green - No flow. Red - Mismatch between purge valve and high flow. - Ref: ‘Manipulator Interface Board, MIB’, Purge Sequence, in ‘Unit Description, IRC5P’, Note: If 2 purge systems are used, LED applies for both systems. Off - No high flow.	Indicates the state of the flow sensors. – Check the air supply. – Check purge sensor. – Check cables and wiring. – Check LEDs Purging P1 and P2 (should be lit). Note: Indicator will be red in a short period while pressure is being established.
Purge Timer Blinking Green - Purge sequence in progress. Off - Purge sequence not started or sequence completed.	Indicates status of purge sequence – Check purge LEDs: Overpressure, Pressurized and Min. Flow (should be lit).
Process Status Green - 2 channel supervision of process chain OK Blinking Red: Chain broken. Off - Supervision not OK.	If LED is extinguished or blinking red, check – Check that enable chain is closed. – Check that paint enable is activated. – Check that cabin safety switches are closed. – Check for divergency in LEDs Paint Enable and HV Chain. – Check cables between power relay and MIB. – Replace power relay. – Replace MIB.
System Status Green - System OK. Blinking Red - System fault.	If LED is blinking red, after installed new software, – Configuration failure, consult error log. If LED is blinking red, after normal operation, – Failure status, consult error log. Requires restart: Cycle power by switching cabinet mains switch off-on. – Check voltages. – Check power related wiring and connectors.
Cooling Fan Green - OK. Blinking Red - Cooling fans not running or running with low speed.	Control cabinet cooling fans are not running and a warning is displayed on the pendant. – Check cause and reset from pendant. – Check cooling fans and wiring.

MISC.

LEDs showing status of the LED board and LEDs which can be defined by the user.

Description	Source of fault / Remedy
USER 4 + 3 user definable LEDs.	These LEDs can be specified by the user in the software.
Display Valid Green - OK. System indicator board, ALED is active. Off - ALED board not active. Note that LED is blinking red/green during initialization until communication with PIB is started.	– Check communication cable between PIB and ALED. – Try to reset board by momentary disconnecting power connector to ALED. – Check ALED board. Replace board as required.

9 Decommissioning

General

The components of the robot are manufactured from many different materials. Some of them are listed below to facilitate scrapping, i.e. so that the components can be disposed of in a way that does not have a detrimental effect on anyone's health or the environment.

CAUTION! Decommissioning must always be performed in accordance with standards and regulations of the country where the robot is installed.

Manipulators

Material	Examples of components	Part of
Copper	Cables, motors	All robot types
Cast iron/nodular iron	Foot unit, base unit, vertical arm (axis 2 arm) lower part	IRB 5400 / IRB 540 / IRB 580
	Foot unit	IRB 5500
	Foot unit, base, arm assembly	IRB 52
	Foot unit, base, inner arm	IRB 5300
Steel	Gears, screws, base-frame, etc.	All robot types
	Foot unit, axis 7 arm/axis 8 arm	IRB 5500 w 2 axis swing arm
Samarium-Cobalt	Brakes, motors	All robot types
Plastic/rubber (PVC)	Cables, connectors, drive belts etc.	All robot types
Oil, grease	Gearboxes	All robot types
Aluminium	Covers, sync. brackets	All robot types
	Vertical/horizontal arm (axis 2 arm/axis 3 arm)	All robot types except IRB 52
	Base unit	IRB 5500
	Outer arm and tower	IRB 5300
	Castings in wrist, arms	All robot types

Control Cabinet

Material	Examples of components
Copper	Transformers, cables
Tin	Cables
Alu-Zinc sheets	Control cabinets, various sheet material parts
Iron	Transformers
Polyester	Circuit boards
Plastic/rubber (PVC)	Cables, connectors, pendant, covers (drive units, I/O units) etc.
Lithium	Batteries

Scrapping

Following warning must be observed before disassembling.

WARNING! Before removing any parts from the manipulator, study the removal instructions for the component in question.

Oil and Grease

Where possible, arrange for the oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

– Spills may form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
– Spillage may penetrate the soil causing ground water contamination.

Balancing system

If the robot includes balancing springs, special care is needed when removing the balancing system.

The balancing system contains 2 preloaded spiral springs. Before scrapping (melting down, or other form of destruction) the springs must be unloaded in a safe way.

10 Reference Information

General

This chapter includes information complementing the more specific information in the product manual.

10.1 Cable Information

General

This section includes information on cables which should be used for the installation.

Signal Classes

Power Supplies external motors and brakes.

Control signals Digital operating and data signals (digital I/O, safety stop, etc.).

Measuring signals Analog measuring and control signals (resolver and analog I/O).

Data communication signals Gateway (field bus) connection, computer link.

Different rules apply to the different classes when selecting and laying cable. Signals from different classes must not be mixed.

Selecting Cables

All cables laid in the controller must be capable of withstanding 70°C. In addition, the following rules apply to the cables of certain signal classes:

Power Signals Shielded cable with an area of at least 0.75 mm² or AWG 18. Note that any local standards and regulations concerning insulation and area must always be complied with.

Control Signals Shielded cable.

Measuring Signals Shielded cable with twisted pair conductors.

Data Communication Signals Shielded cable with twisted pair conductors. A specific cable should be used for Gateway (field bus) connections and Ethernet.

CAN bus with DeviceNet for Distributed I/O units Thin cable according to DeviceNet specification release 1.2, must be used. The cable is shielded and has four conductors, two for electronic supply and two for signal transmission. Note that a separate cable for supply of I/O loads is required.

Allen Bradley Remote I/O Cables according to Allen Bradley specification, e.g. so called ‘Blue hose’ should be used for connection between DSQC 350 and Allen Bradley PLC bus.

Interbus-S Cable according to Phönix specification, e.g. so called ‘Green type’ should be used between the I/O unit, DSQC 351 and external Interbus-S units.

Profibus DP Cables according to Profibus DP specification should be used for connections between the I/O unit DSQC 352 and the external Profibus DP bus.

Ethernet Shielded twisted pair conductors (10 Base T STP).

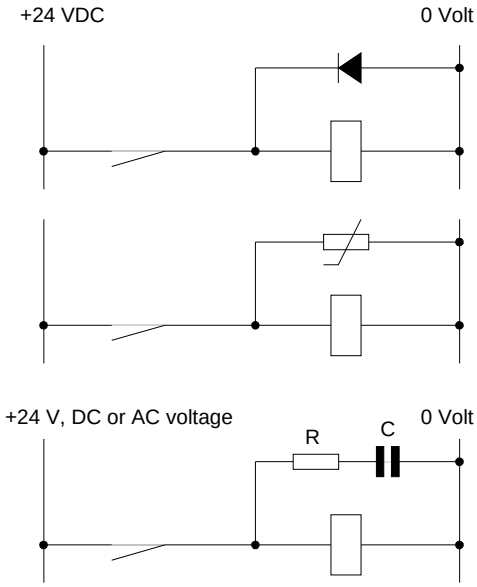
CCLink Cables according to Mitsubishi specification should be used for connections between the I/O unit DSQC 378 and the external CCLink bus.

Interference Elimination

Internal relay coils and other units that can generate interference inside the controller are neutralized. External relay coils, solenoids and other units must be clamped in a similar way. The illustration in Figure 87 shows how this can be done.

Note that 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.

Figure 87 Examples on how peripheral equipment can be neutralized



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

The varistor is to be dimensioned for the same energy as the relay coil, and a voltage of twice the supply voltage.

R 100 ohm, 1W
C 0.1 - 1 µF (typically 0.47 µF
> 500 V max. voltage
125 V nominal voltage

10.2 Connection Types

General

Inter-connections between the different components of the robot system, and external connections may be performed using connectors, connectors with screw terminals, terminal boards with screw terminals or spring terminals, depending on how the robot is specified etc. The following sections provide general information on the different types of connections which are- or may be used in the system.

Note: Bend unused conductors backwards and attach them to the cable using a clasp etc. In order to prevent interference, ensure that such conductors are not connected at the other end of the cable (antenna effect). In environments with much interference, disconnected conductors should be grounded (0 V) in both ends.

Connection to Screw Terminals

The robot may include terminal boards or connectors with screw terminals for connection of wires with area between 0.25 - 1.5 mm^2. A maximum of two wires can be connected to each terminal provided that a protection sleeve is installed on the two wire ends. The cable screen must be connected at the lead-through in the cabinet, - Ref: ’Clamping Cables’ on page 213.

Connections to Spring Terminals

The robot may include terminal boards with spring connection of wires with area between 0.25 - 1.5 mm^2. Only one wire can be connected to each of these terminals. The cable is released from the connection by inserting a screwdriver in a slot beside the connection point. The cable screen must be connected at the lead-through in the cabinet, - Ref: ’Clamping Cables’ on page 213.

Connection to Connectors

Industrial connectors with varying number of pins for contact crimping are used in the robot. Some options installed in the cabinet may also use these types of connectors.

When contact crimping industrial connectors, the following applies:

Using special tongs, press a pin or socket on to each non-insulated conductor.
The pin can then be snapped into the actual contact.
Push the pin into the connector until it locks.

Also, see instructions from contact supplier.

A special extractor tool must be used to remove pins from industrial connectors.

When two conductors need to be connected to the same pin, both of them are pressed into the same pin. A maximum of two conductors may be pressed into any one pin.

10.3 Bonding Information

General

Grounding or PE ground means the connection to protective earth. IS ground is ground connection for the ex-systems. Bonding means additional ‘grounding’ to protect sensitive signals from RF noise etc.

When the PE ground and IS ground connections of the robot components have been performed in accordance with the description in this manual, the electronics components in the shielded environment of the cabinet and manipulator are well protected against electric noise.

To ensure proper operation of the robot system when electronic devices such as external PLC, communication nodes, external cabinets etc. are placed outside these protected environments, it is extremely important that proper bonding is provided for the external units and corresponding communication cables.

In the following you will find information and hints on how proper bonding can be obtained. For more information on protecting of signal cables etc., books describing the subject are available on the market.

Bonding Connections

When the robot is installed in accordance with the description in this manual, all components of the robot system; control cabinet, manipulator, purge unit and possible external cabinets etc. will be connected by a firm bonding wire as part of the robots design. Additional external equipment installed must be connected by a bonding wire of minimum 16 mm^2 (AWG 4). The wire must be firmly connected to the bare metal of the component with a solid screwed connection. A solid connection like this will ensure that no voltage potential can be built up between the different units.

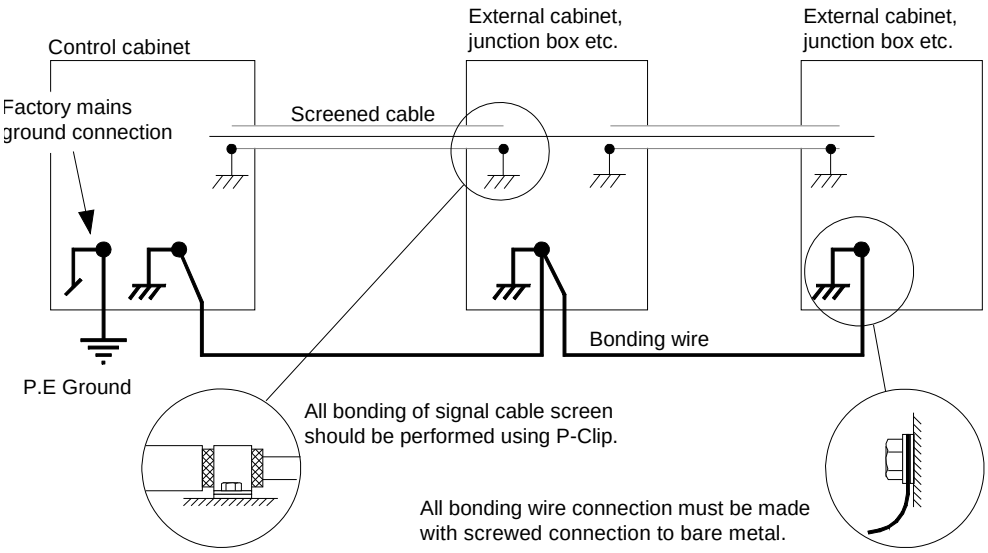
If the robot, control cabinet, purge unit, spray booth door switch or any other device in the robot system is mounted on a metal surface, the user must make sure that these surfaces are properly grounded.

CAUTION! No components in the robot system must be mounted on metal surfaces which are not properly grounded.

Signal Cable Screen Connections

All signal cables used in the system must be screened cables and all screens on all signal cables are best connected to a good ground connection at both ends. An example of a grounding system like this is shown in Figure 88.

Figure 88 Bonding connections in the robot system

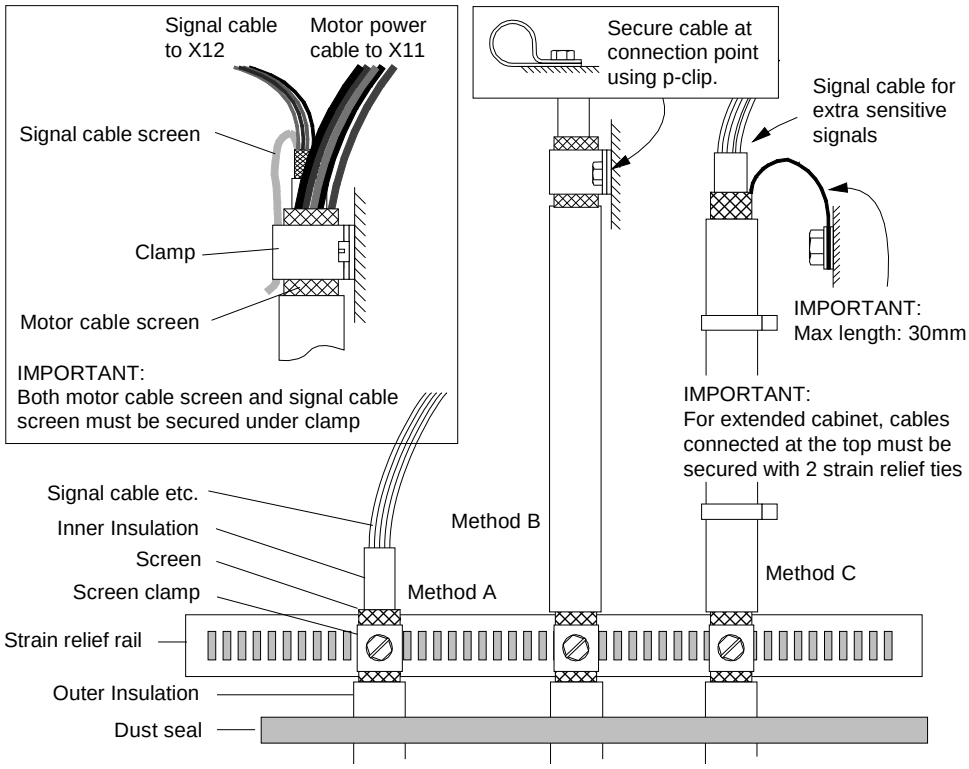


Note: The bonding wire may be omitted. The use of this wire depends on the size of the components (the amount of noise which can be induced in the component casing), the distance to the component, the signals sensitivity to noise and present noise in the installation etc.

Clamping Cables

All cables entered into the control cabinet must be clamped to the screen rail at the bottom of the cabinet as shown in Figure 89 and if necessary clamped at the connector where it is connected. Different methods are used for different types of connections as follows:

Figure 89 Screen clamping



Method A - Cables connected to connectors near the strain relief rail

Cable screen must be clamped to the strain relief rail and wires / connector routed to the connection point as shown in Figure 89 left.

Method B - Cables connected to connectors away from the strain relief rail

A section of the cable must be dismantled and clamped to the strain relief rail. The cable is then routed to the connection point where the screen is clamped to the cabinet frame using p-clip as shown in Figure 89 center. For the motor/signal cable connected to X11 and X12, it must be observed that both the outer screen for the motor cable and the inner screen for the signal cable must be secured under the clamp. Ref. Figure 89 inset.

Method C - Cables for sensitive signals

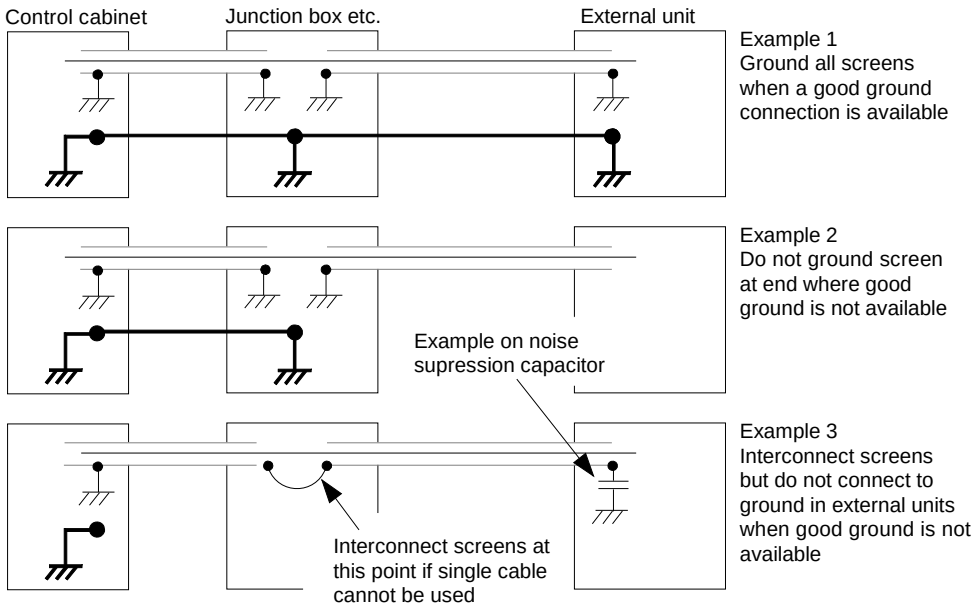
Cable for extra sensitive signals such as analog signals must be grounded at the component where it is connected in addition to the ground connection on the strain relief rail as shown in Figure 89 right.

CAUTION! Do not use excessive force when tightening clamps. Tightening clamps too hard may damage cable and signal wires.

Alternative Bonding Methods

The following shows 3 examples on how the signal cable screens can be bonded:

Figure 90 Bonding examples



Example 1

Where a good bonding is available on all units, the best shielding is obtained by bonding all screens at both ends on all units.

Example 2

If a solid bonding connection can not be provided e.g. for an external unit such as a communication node, I/O unit, PLC or a sensor etc., the screen for the cable must not be bonded at the unit without a good bonding connection. This situation is shown in Figure 90, example 2. If the cable is routed and terminated in a junction box etc. and the junction box has a good bonding connection, the screens for both cables must be bonded at this point.

Example 3

If the cable is terminated in a junction box or other unit where a good bonding is not available, the screens of the 2 cables must be connected as shown in Figure 90, example 3, but not connected to the chassis of the unit.

Hints

- You may check that the bonding is good by using an oscilloscope with an EMI probe (Electro Magnetic Interference). By setting the oscilloscope to a relatively high frequency and measuring on the screens and chassis of the different units in the system, possible noise can be seen on the oscilloscope screen.
- If noise is present in the situations shown in Figure 90 example 2 and 3, a ceramic capacitor of e.g. 0.22 µF can be installed between the screen and chassis as shown in example 3.
- Cables of different types such as signal cables and power cables must not be routed together as the power cables may introduce noise in the signal cable.
- If the bonding has been performed according to the general guidelines given here but noise is still present, there is a good chance that the bonding wire used are of too small square in relation to the length of the wire or that the connections between the bonding wire and/or screens are not good enough.

10.4 Tightening Torques

General

All screws on the robot except screws for covers and adjusting screws should be tightened with torque according to the tables below unless otherwise specified.

Galvanized screws are of 8.8 quality and untreated screws (black oxide) are of 12.9 quality. Torques apply to lightly lubricated screws.

Torque Tables for Screws with Hexagon Socket Heads

The table below shows tightening torques for screws used

Table 1

	Screw quality	
Nominal Diameter	**8.8 Nm**	**12.9 Nm**
M4	2.9	4.9
M5	5.9	10.0
M6	9.9	16.5
M8	24.0	40.0
M10	47.0	79.0
M12	82.0	140.0
M14	130.0	220.0
M16	200.0	340.0

Torque Table for Slotted or Cross Recessed Head

The table below shows tightening torques to be used for electrical connections, terminal board screws etc.

Table 2

Nominal Diameter	**Tightening torque - Nm class 4.8 “Dry”**
M 2.5	0.25
M 3	0.5
M 4	1.2
M 5	2.5
M 6	5.0

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Graphic files imported in manual:

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18	t0264407.wmf
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22	T0264406.wmf
23	T0264410.wmf
23	T0264411.wmf
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28	Icon_Auto.wmf
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111	T0260850.wmf
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