

ROBOTICS

Product specification

Ultrasonic Spot Welding Quality Inspection



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Product specification
Ultrasonic Spot Welding Quality Inspection

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Overview of this specification

About this product specification

This product specification describes the various hardware and software modules that together form the Function Package type Si.

The specification describes how the modules are related to each other and special characteristics of each module in terms of:

- Function
- Structure
- Important technical data
- The specification of variants and options available

Usage

This product specification is meant to be an overview of the Function Package type Si solution. It can be used to obtain basic information and data of each module and how the modules are related to each other. It can also be used as a guidance for where to find more information.

Users

This specification is intended for:

- Customers
- Product managers and product personnel
- Sales and marketing personnel
- Order and customer service personnel
- Project leaders
- Design engineers

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Overview of this specification

Continued

References

Documentation referred to in the manual, is listed in the tables below.

IRB 6700	Manufacturer	Document ID
<i>Product specification - IRB 6700</i>	ABB	<i>Document.ID-1</i>
<i>Product manual - IRB 6700</i>	ABB	<i>3HAC044266-001</i>
<i>Product manual, spare parts - IRB 6700/IRB 6700Inv</i>	ABB	<i>3HAC044268-001</i>
<i>Circuit diagram - IRB 6700 / IRB 6790</i>	ABB	<i>3HAC043446-005</i>
<i>Product manual - IRB 6700Inv</i>	ABB	<i>3HAC058254-001</i>

DressPack Lean ID	Manufacturer	Document ID
<i>Circuit diagram - DressPack 6700</i>	ABB	<i>3HAC044246-002</i>
<i>Circuit Diagram DressPack IRB 6650S, IRB 7600 LeanID</i>	ABB	<i>3HAC022327-002</i>

IRC5	Manufacturer	Document ID
<i>Product manual - IRC5</i>	ABB	<i>3HAC047136-001</i>
<i>Circuit diagram - IRC5</i>	ABB	<i>3HAC024480-011</i>
<i>Application manual - Controller software IRC5</i>	ABB	<i>3HAC050798-001</i>

Function Package type Si	Manufacturer	Document ID
<i>Product manual - FP Ultrasonic spot welding quality inspection</i>	ABB	<i>3HAA010018</i>
<i>Software manual - FP Ultrasonic spot welding quality inspection</i>	ABB	<i>3HAA010017</i>

Water and air unit	Manufacturer	Document ID
<i>Product Manual - Water and Air unit</i>	Festo	-

FlexPendant	Manufacturer	Document ID
<i>Operating manual - IRC5 with FlexPendant</i>	ABB	<i>3HAC050941-001</i>

Revisions

Revision	Description
A	First edition.

1 What is a Function package

Overview

A Function Package is a complete hardware and software proven solution ready to use for a tailor made process application. The package includes robot, process equipment and electrical modules for a complete functionality. With an excellent interface between hardware and software for a seamless integration.

The package is delivered tested, configured and validated. It is a ready to use package, allowing a short start up and commissioning ready for production. Virtual controller and simulation models are available from the beginning of the project.

Main benefits

The Function Package solution offers several benefits compared to buying components separately. Some of the main benefits are listed below.

- Provides a complete functionality with a fully integrated hardware and software solution.
- Configured and tested equipment for a fast and easy commissioning.
- Includes a highly valuable complete operational software platform for specific application.
- Single supplier for all components guarantees simultaneous delivery and verified system functionality.
- ABB standard solutions with verified suppliers guarantees fast and accurate spare part deliveries.
- Optimized and feasible solution available in early project stage through virtual controller, simulation models and documentation.

Function Packages provides the following programming benefits:

- Fast start up ready-to use.
 - Prepared for off-line programming.
 - Simplifies the daily work for the operator.
 - Simplifies the process of introducing a new product or taking an old one out of production.
 - Minimizes robot individual specific solutions which simplifies most maintenance work.
-

Hardware

All hardware modules are integrated and connected before delivery. Application unique equipment is integrated based on the chosen Function Package type.

Hardware documentation

Hardware manuals together with recommended spare part lists for the complete function package, will be provided in your unique documentation project delivery via swacdocabb.com.

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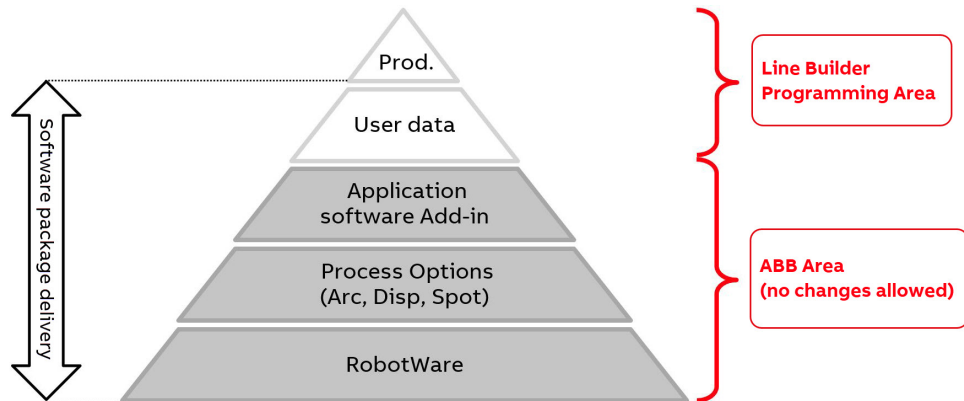
1 What is a Function package

Continued

Software

The Function Package software platform is built on a modular architecture with 5 layers, divided into 2 working areas.

The software package base is the standard RobotWare combined with process options from ABB Robotics. Process unique application software add-ins and user data on top of this, makes it a complete process software package (see illustration below).



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- RobotWare supports every aspect of the robot system, such as motion control, development and execution of application programs, communication etc.
- The process options contains the basic functionality for the system's process control.
- The process application software add-in implements customer specific software for each process.
- The User data for each function package is delivered as a template for customization of pre-defined data and paths.
- The production layer is reserved for programming production of parts and is not included in the ABB delivery.

The function package software is created to support both online as well as offline programming. All robots will be booted with the correct required modules from ABB. There are three different types of modules involved in the application part of the software: device module, handler module and library module. These module are explained further in the Application software add-in manuals.

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Software documentation

RobotWare manuals for user information, RAPID language and process options are available via [myABB Business Portal](#).

Application software add-in manuals is provided in your project documentation delivery via [swacdocabb.com](#).

Simulation models

3D models for complete solution are available upon request.

Pre-delivery preparations

Before delivery, the Function Package is prepared and tested as an integrated system.

- Software Add-In is loaded.
- All operations are tested. Including production routines within specific application.

The pre-delivery preparations enable the system to be fully functional and executable when delivered. All that needs to be done is to adapt the system to the actual layout of the user's site.

List of function packages types and designations

Function package type	Abbreviation	Process
Handling	H	Robot carried gripper and automatic tool change.
	H_ext	Robot carried gripper with hardware interface to external equipment.
Robot carried Spot welding	Se	Robot carried spot welding gun.
	Se_atc	Robot carried spot welding gun and automatic tool change.
	SeH	Robot carried spot welding gun with a gripper attached.
Stationary Spot welding	HSe	Handling and one stationary spot welding gun.
	HSeSe	Handling and two stationary spot welding gun.
	HSeD	Handling and one stationary dispenser and one stationary spot welding gun.
Nut welding	HN	Handling and one stationary nut weld equipment.
	HNN	Handling and two stationary nut weld equipment.
	HNSe	Handling and one stationary nut weld equipment and one stationary spot welding gun.
Dispense	D	Robot carried dispenser.
	HD	Handling and one stationary dispenser.
	HDD	Handling and two stationary dispenser.

Continues on next page

1 What is a Function package

Continued

Function package type	Abbreviation	Process
Arc welding	A	Robot carried arc welding gun.
Stud welding	T	Robot carried stud welding gun.
	HT	Handling and one stationary stud welding gun.
Riveting	Spr	Robot carried riveting gun.
	HSpr	Handling and one stationary riveting gun.
	HSprD	Handling and one stationary riveting gun and one stationary dispenser.
FlowDrill	F	Robot carried flow drill equipment.
Nutrunner	NRe	Robot carried nutrunner equipment.
PUR	HDp	Handling and one stationary dispenser with PUR.
Bolt welding	HB	Handling and stationary bolt weld gun.
	HBB	Handling and two stationary bolt weld gun.
	HNB	Handling and one stationary nut welding equipment and one stationary bolt welding gun.
Sealing	Sealing	Robot carried sealing.
Ultrasonic Spot Inspection	Si	Robot carried ultrasonic spot welding quality inspection equipment.

2 Function Package type Si

2.1 Introduction

2.1.1 Description and functionality

Functional overview

Ultrasonic Spot Welding Quality Inspection Function Package Si is a ready-to-use automated and integrated solution, which include all essential functionalities for a fast and accurate spot welding quality inspection. The package incorporates an all-in-one compact tool which recognizes spots, removes spatter and inspects spot welds.

The result of the a measured spot weld is present in a web-based application called *UltraReporter*. All data will be stored here, which allow simple and efficient analyze of statistics, formulation of trends, detect and report of suspicious spot welds etc.

The Function Package Si modules works together in the following way. The manipulator movements are controlled from the control cabinet. These components together form the robot. The ultrasonic tool is installed on the manipulators 6th axis flange and is controlled by the ultrasonic control cabinet.

The tool detects spot welds with a combination of the camera and the ultrasonic sensor. Before initiating a measurement the tool can automatically detects and removes spatter or hard knobs that could interfere with the quality of the measurement. The probe and grinder then interacts with the spot weld during a measurement sequence. Pneumatic cylinders control their linear movement and the applied pressure needed to perform precise measurements.

Media, such as water and air, are transported to the ultrasonic spot inspection tool via the media panel and through the DressPack.

The Function Package Si comes with an excellent supporting software package that helps for an easy start, operation and system tuning.

Main benefits

- High accessibility on inspection workpieces
- Typical cycle time to inspect* 3-6 seconds
- Ultrasonic automated inspection gives 10 times increased capacity relative operator**

**Depending on spot weld quality and according to lab tests*

***Estimation measurements based in 1 operator over one year*

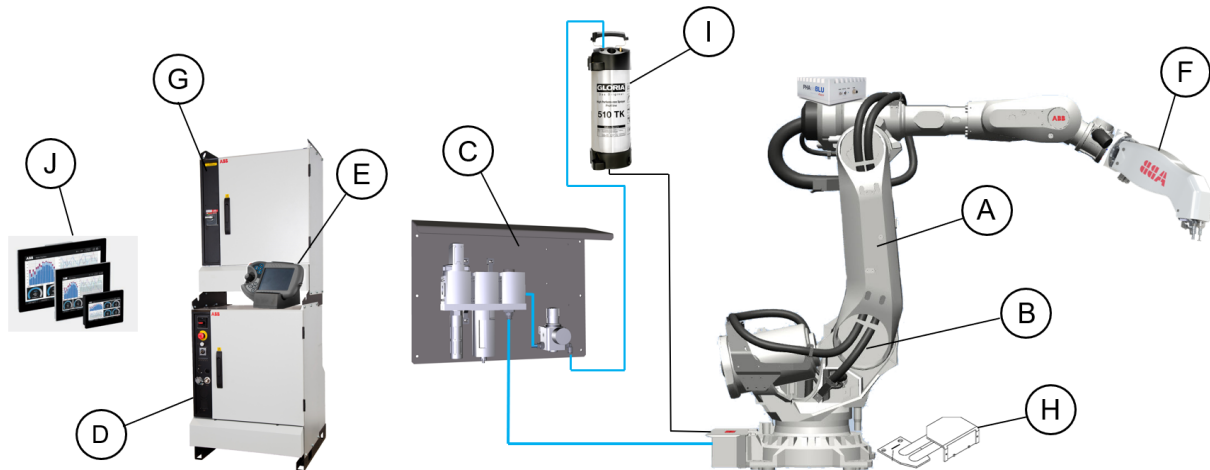
2 Function Package type Si

2.1.2 Hardware

2.1.2 Hardware

Overview

Overview of included modules in Ultrasonic Spot Welding Quality Inspection Function Package Si are shown in below figure.



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Position	Description
A	Manipulator
B	DressPack - Lean ID
C	Media panel
D	IRC5 control cabinet
E	FlexPendant
F	Ultrasonic spot inspection tool
G	Ultrasonic spot inspection control cabinet
H	Tool check plate
I	Water tank
J	Screen

The figure above shows the standard Function Package Si components and should be seen as an illustration of principle.

The Function Package Si also includes all hardware components needed to connect the modules above, such as cables and hoses. If the Function Package Si is customized or the modules are placed far from each other, additional and adapter cables could be needed. If that is the case, additional components can be ordered. For more information see [Floor cables on page 30](#).

2.1.3 Software

Overview

The software package is built to supervise the measurement process and hosts the two FP Si unique web applications, *UltraReporter* and *SetupWizard*. These are easily accessed from any device connected to the same network.

The Function Package Si contains the following software:

- Standard RobotWare from ABB Robotics
- Ultrasonic spot inspection Si Software Add-In
 - Software for all the specific functional features included in the Function Package Si .
 - SetupWizard, web-based tool for interactive parameter configuration.
 - UltraReporter, web-based tool for viewing/handling reports and statistics.

For more information about the included software and how to use it, see the [Software manual - FP Ultrasonic spot welding quality inspection](#).

2 Function Package type Si

2.2.1 Manipulator

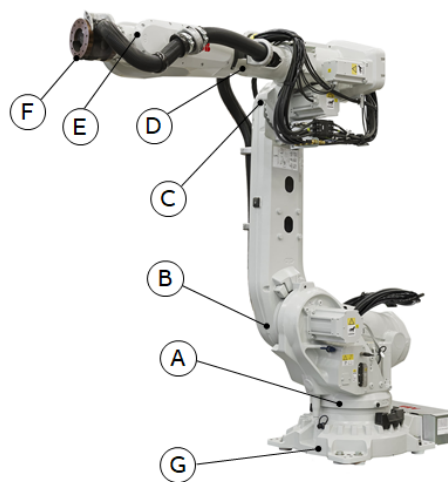
2.2 Hardware basic specification

2.2.1 Manipulator

Overview

The IRB 6700 series are ABB Robotics 7th generation of high payload, high performance industrial robots. Significant for ABB's robots is the large working range, the very high wrist torque, the service friendly modular built up and the availability.

Components



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Position	Description
A	Axis 1
B	Axis 2
C	Axis 3
D	Axis 4
E	Axis 5
F	Axis 6
G	Base

Continues on next page

2.2.1.1 IRB 6700

Overview

The IRB 6700 robot family goes even further with focus on high production capacity, compact design and low weight, simple service and low maintenance cost.

For further information about the IRB 6700 and how to handle it, see *Product Specification - IRB 6700* and *Product Manual - IRB 6700*.

For information about spare parts, see *Product manual, Spare parts, IRB 6700/IRB 6700Inv*. For electrical information, see *Circuit Diagram - IRB 6700*.

Robot versions

The standard versions of the IRB 6700 differs in the working range, handling capacity and wrist torque. For further information about mechanical drawings, see *Product Manual - IRB 6700* and *Product manual IRB 6700Inv*. All standard robot versions available are listed in below table.

Robot type	Handling capacity (kg)	Handling capacity for LeanID (kg)	Reach (m)
IRB 6700-220/2.65	235 kg	220 kg	2.65 m
IRB 6700-175/3.05	175 kg	155 kg	3.05 m
IRB 6700-150/3.20	150 kg	145 kg	3.20 m
IRB 6700-205/2.80	205 kg	200 kg	2.80 m
IRB 6700-300/2.70	300 kg	270 kg	2.70 m
IRB 6700-245/3.00	245 kg	220 kg	3.00 m

Continues on next page

2 Function Package type Si

2.2.1.1 IRB 6700

Continued

Technical data and requirements

Parameter	Value
Number of axes	6
Mounting	Floor, inverted
Supply voltage	200-600 V, 50/60 Hz
Energy consumption	2.8 kW
Dimensions robot base	1004x720 mm
Weight (without DressPack)	1,250 kg- 1,705 kg
Ambient temperature mechanical unit (during operation)	5 °C to +50 °C
Relative humidity	Max. 95%
Noise level	Max. 71 dB
Safety	Double circuits with supervision, emergency stops and safety functions, 3-position enable device
Emission	EMC/EMI-shielded
Protection	Std: IP67. Option: Foundry Plus 2

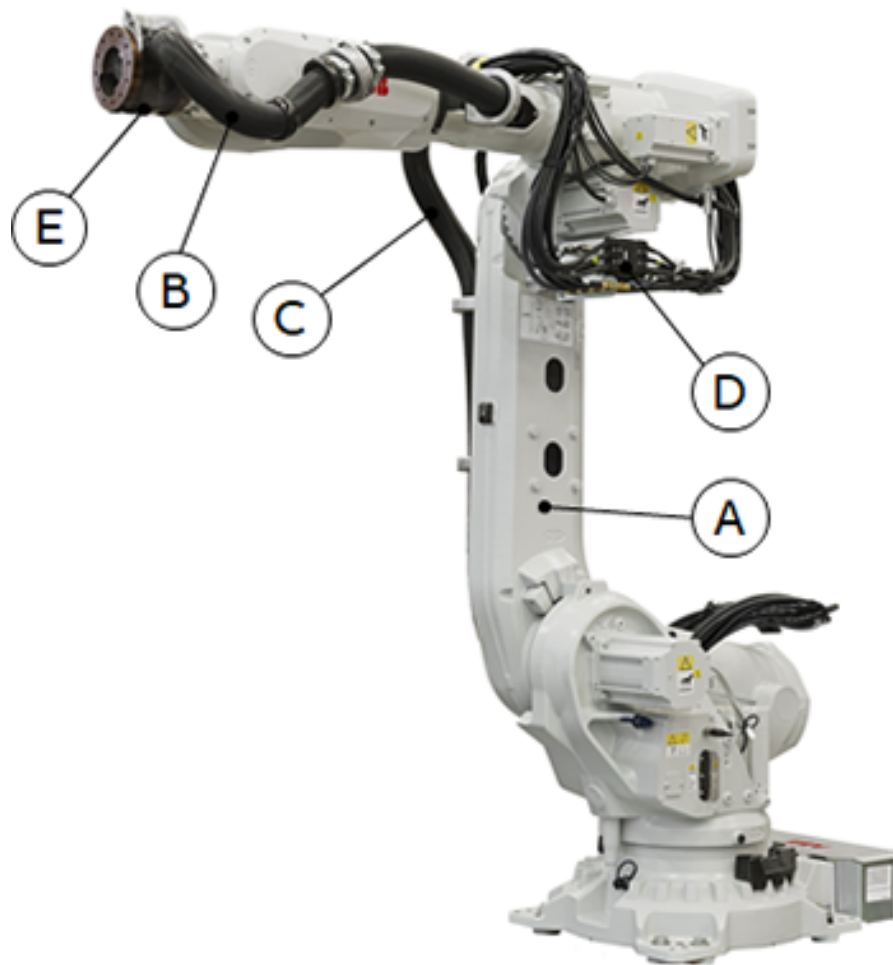
2.2.2 DressPack - Lean ID

Overview

DressPack Lean ID is a packaging solution of the cabling and hoses which transports power, signals and distilled water to the ultrasonic tool. Lean ID is partly integrated in the manipulator which makes it secure and flexible and minimize the wear on the cables. The DressPack for Ultrasonic spot inspection Function package consists of a Handling DressPack with additional hoses and cables.

For electrical information, see *Circuit Diagram - IRB 6700 DressPack LeanID*.

Components



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Position	Description
A	Manipulator
B	Upper arm DressPack
C	Lower arm DressPack
D	Connection point DressPack
E	Lean ID bracket

2 Function Package type Si

2.2.3 Media panel

2.2.3 Media panel

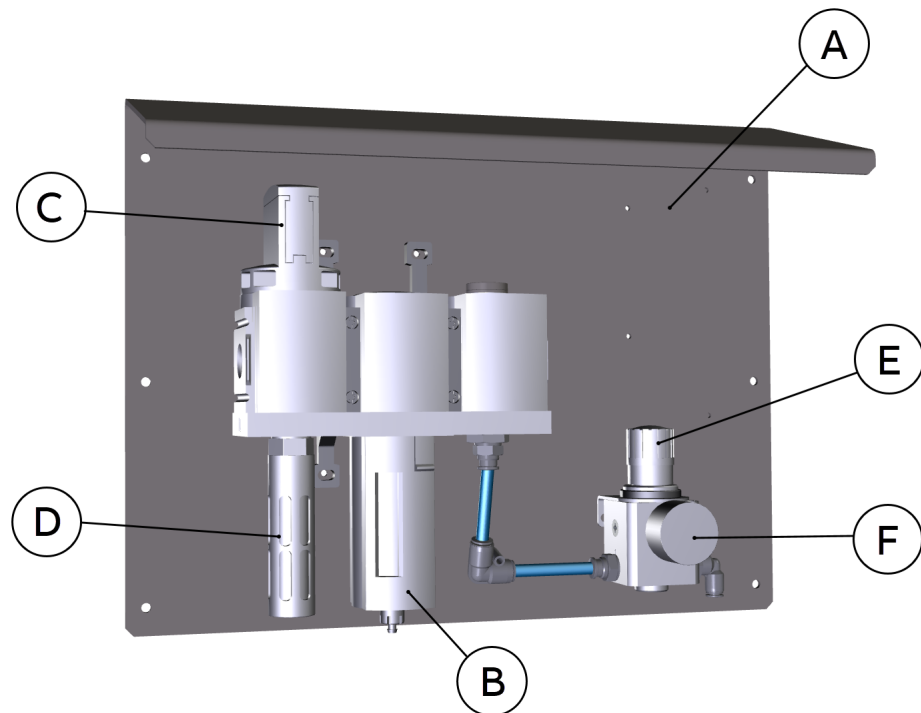
Overview

The media panel connects all incoming media to the robot. The unit includes a pressure switch, valves, hoses, connectors and interface points.

The media panel solution is designed to fit several different robot types, including the IRB 6700, IRB 6650S, IRB 7600 and 8700. It can be installed on the robot base or hung on a fence.

For further information about spare parts and how to install the media panel, see specific manuals for the media panel included in the Function package documentation delivery. Interfaces are found in *Product Specification - IRB 6700*, *Product Specification - IRB 6650S*, *Product Specification - IRB 7600* and *Product Specification - IRB 8700*.

Components



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Position	Description
A	Mounting plate assembly
B	Air filter
C	ON/OFF pressure relief valve
D	Silencer
E	Regulator
F	Pressure gauge

Continues on next page

Technical data and requirements

Parameter	Value
Maximum air pressure	10 bar
Minimum air pressure	6 bar
Required air quality	5 μm
Air quality filtration grade	0.01 - 40 μm

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2 Function Package type Si

2.2.4 Control cabinet - IRC5 single cabinet controller

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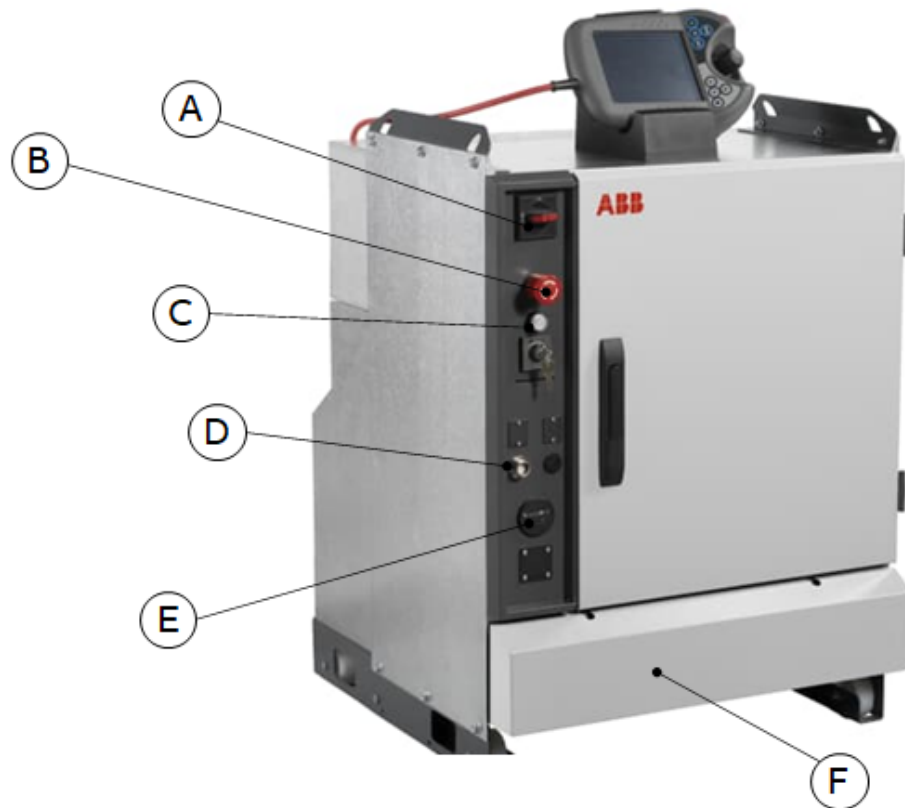
2.2.4 Control cabinet - IRC5 single cabinet controller

Overview

IRC5 Single Cabinet Controller is the controller to the manipulator. IRC5 automatically optimizes the performance of the robot by reducing cycle times and providing precise path accuracy. Thanks to ABB's IRC5 technology, a robot's motion is predictable and its performance high, with no tuning required by the programmer.

For further information about handling and spare parts, see *Product Manual - IRC5*. For electrical information, see *Circuit Diagram - IRC5*.

Components



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Position	Description
A	Main switch
B	Emergency stop button
C	Motor ON button
D	FlexPendant connector
E	Duty time counter (option)
F	Connector cover (option)

Continues on next page

Technical data and requirements

Parameter	Value
Supply voltage	3 phase, 200-600 V, 50-60 Hz
Dimensions	970 x 725 x 710 mm
Weight	150 kg
Ambient temperature	0 °C to +45 °C
Relative humidity	Max. 95% non condensing
Protection class electronics	IP54*
Protection class air cooling ducts	IP33

*To comply with IP54 all openings to the controller cabinet, including door, must be covered / closed during production. This includes unconnected connectors which must be fitted with covers.

2 Function Package type Si

2.2.5 FlexPendant

2.2.5 FlexPendant

Overview

The FlexPendant is a hand held control unit used to perform many of the tasks involved when operating a robot.

The FlexPendant consists of both hardware and software and is a complete computer in itself. It is an integral part of IRC5, connected to the controller by an integrated cable and connector.

For further information about the FlexPendant and how to handle it, see *Operating manual - IRC5 with FlexPendant*.

Components



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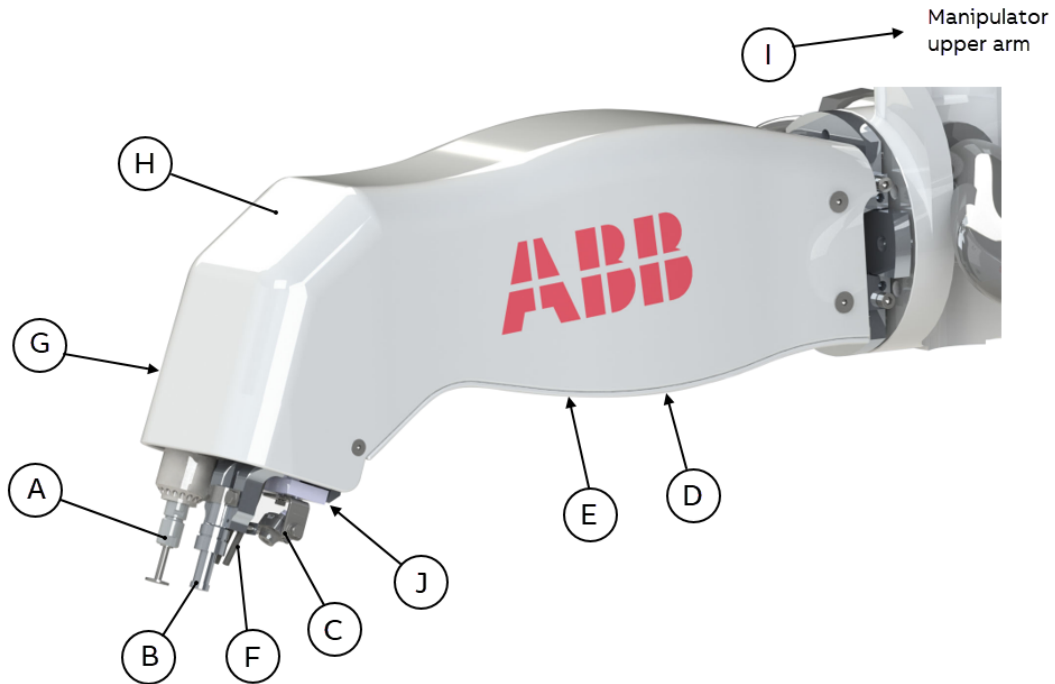
Position	Description
A	Joystick
B	Push buttons
C	Emergency stop
D	Screen
E	Three-positioning enabling device

2.2.6 Ultrasonic Spot Welding Quality Inspection tool

Overview

The Ultrasonic Spot Welding Quality Inspection tool is robot-mounted and includes all hardware tools needed to perform an automatic spot weld inspection.

Components



xx2000002301

Position	Description
A	Grinder for spatter removal
B	Ultrasonic probe
C	Camera
D	CPX - Pneumatic control unit
E	Ejector
F	Blow tubes
G	Pneumatic cylinders
H	Protective cover
I	Ultrasonic control unit
J	Spot LED light

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2 Function Package type Si

2.2.6 Ultrasonic Spot Welding Quality Inspection tool

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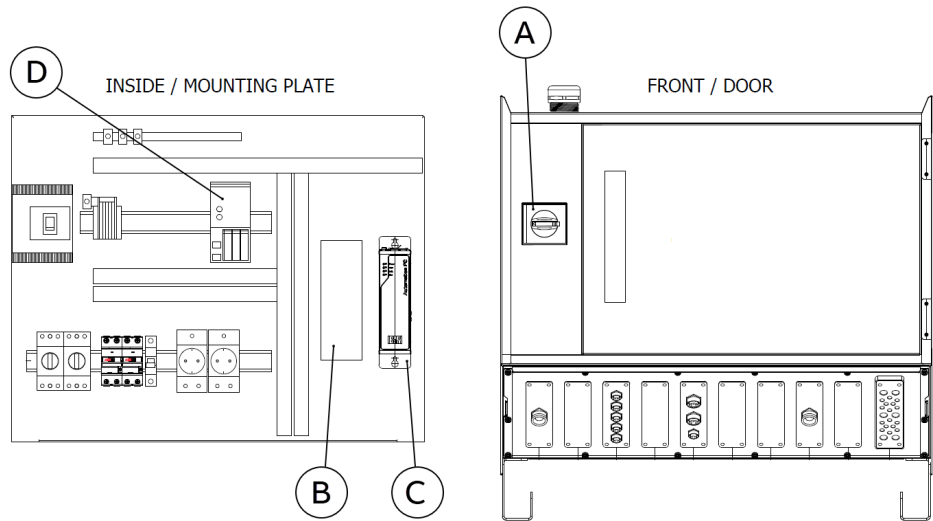
Technical data and requirements

Parameter	Value
Maximum air pressure	10 bar
Minimum air pressure	6 bar
Required air quality	5 micrometer filter
Ambient temperature (operating)	0°C-45°C
Maximum grinder speed	25 000 rpm (clockwise oriented)
Maximum continuous grind time	30 s
Minimum camera resolution	1 MPix
Camera shutter	Rolling

2.2.7 Ultrasonic Spot Welding Quality Inspection control cabinet

Overview

The Ultrasonic Spot Welding Quality Inspection control cabinet contains all the hardware required to control the Ultrasonic Spot Welding Quality Inspection tool and included applications.



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Components

Position	Description
A	Main switch
B	ACS355 ABB frequency converter
C	EDGE computer
D	I/O module

Technical data and requirements

Parameter	Value
Supply voltage (AC)	230 V
Ambient temperature (operating)	0 °C-45 °C
Relative humidity	Max. 95% non condensing
Protection class electronics	IP54
Protection class air cooling ducts	IP33

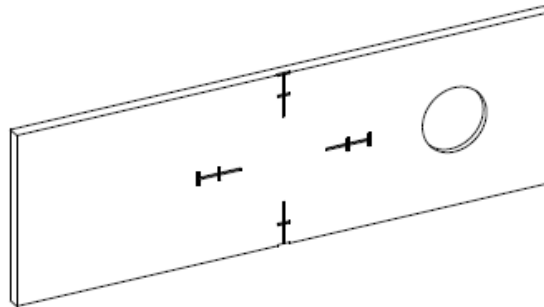
2 Function Package type Si

2.2.8 Tool check plate

2.2.8 Tool check plate

Overview

The tool check plate works as a reference plate, making sure that the Ultrasonic Spot Welding Quality Inspection tool is fully functioning. Between cycles the tool can access the tool check plate and do a self-inspection to control that it fulfill all expected conditions. It checks the position and rotation of the probe, membrane condition and that the ultrasonic control unit performs accurate measurements. Camera position, rotation and presence of dirt on lens is also controlled during this sequence.



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2.2.9 Water tank

Overview

The water tank holds the distilled water for the complete system. The tank is pressurized from a regulator on the media panel. The water will thereafter be transported to the tool ejector which is connected to the blow tubes.



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Technical data and requirements

Parameter	Value
Maximum air pressure	10 bar

2 Function Package type Si

2.3 Floor cables

2.3 Floor cables

Standard delivery

The Function Package Si standard delivery includes complete pre-manufactured and ready to plug in set of cables:

- Controller connection cable 7 m long (cabling between IRC5 controller unit and IRB manipulator). Includes: Customer power/customer signals; control cable power; control cable signal; ProfiNet cable; 24V Power cable (media panel) and ProfiNet cable (media panel).
- FlexPendant 10 m long (cable connecting the FlexPendant and the IRC5 cabinet).
- Couplings connections between ultrasonic tool and DressPack axis 6.

Options

For a custom Function Package Si is possible to order additional and adapter cables upon request:

- Controller connection cable 15 m.
- FlexPendant cable 30 m.
- FlexPendant external cable 15, 22, 30 m (for permanent extension of FlexPendant connection point).

2.4 Basic software Si package

2.4.1 FP Si Software Add-In

Overview

The Function Package Si solution is an integrated system, not just a collection of independent components. The integration of all layers is achieved by the FP Si Software Add-In. Together with the pre-delivery preparations it gives a ready to run system allowing a simple and quick commissioning.

For more information about basic RobotWare and RobotWare Spot see *Application manual - Controller software IRC5* and *Application manual - Spot options*.

Functionality

The FP Si Software Add-In is added on top of the basic RobotWare.

Functional features of the FP Si Software Add-In are:

- Handling of the Ultrasonic Spot Welding Quality Inspection tool
- Pneumatic equalizing
- Spot localization using vision and the C/D-scan from ultrasonic control unit
- AI based spatter detection
- Tool check routines
- Communication software between all components
- Handling of the camera
- Handling of the ultrasonic control unit
- Water dispense control
- Software and user interface for interactive parameter configuration (SetupWizard)
- Software and user interface for viewing/handling reports and statistics (UltraReporter)
- Complete and executable RAPID code for starting production orders and service actions through the Production Manager interface. As standard, production part selection and start of production order is done by operator but it could also be done by an external PLC.

For full description of the Add-In features, see [Software manual - FP Ultrasonic spot welding quality inspection, type Si](#).

Standard delivery includes also:

- Ultrasonic inspect configuration tool
- A Docker container running the AI software

Errors occurring during the Add-In controlled operations are indicated by dialogs on FlexPendant or ultrasonic control unit. All application events are exposed as an MQTT API, so external programs can connect to the application.



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