System Settings

Welding Robot Station

M2004, IRC5

3HEA 801233-001 Rev.-, 2005-08

ABB Automation Technologies AB
Robotics & Manufacturing
SE-69582 Laxå
Sweden

Contents

1 Safety instructions

A robot is heavy and extremely powerful regardless of its speed. A stoppage or longer stop can be followed by rapid, dangerous movements. Even if the robot's pattern of movement is predetermined, an external signal can affect the movement sequence, resulting in unanticipated movement.

It is therefore important that all safety instructions are observed when entering a safety supervised area.

1.1 Description

Safety instructions can be found under tab 1 in the AW system manual for all steps that involve risk for personal injury or material damage. In addition, they are included in the instructions for each step.

General warnings, where the intention is to avoid problems, are only included in the pertinent instructions.

All personnel working with the welding robot system must have full understanding of the applicable safety instructions.

Reference document

Document	Described in:
Related safety instructions.	AW System manual, chapter introduction and safety

1.2 Warning symbols (signals)

Symbol explanations

The different types of warnings are set out in the following chapters according to the table below:

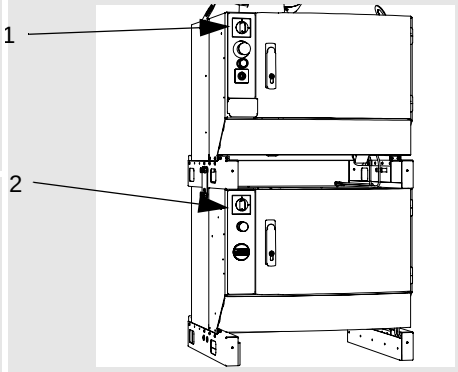
Symbol	Name	Meaning
	Danger	Warning that serious or life-threatening personal injury and/or serious damage to the product will occur if the instructions are not followed.
	Warning	Warns of the risk of personal injury or serious damage to the product. Always follow the instructions that accompany this symbol.
	Electric shock	Warns of possible electric shock that can cause life-threatening or serious personal injury. Always follow the instructions that accompany this symbol.
	Caution	Draws your attention to the fact that damage to the product may occur if an action is not performed or is performed incorrectly.
	Static electricity ESD	The ESD symbol indicates a risk of static electricity that may cause serious damage to the product.
	Note	Information about important parts.
	Tips	This symbol refers to an instruction providing further information on a particular step.

1.2.1 DANGER – Ensure that the main power switch is turned off.

Description

Work with high voltage entails a potential lethal hazard. Persons subjected to high voltages can suffer heart failure, burns or other serious injuries. To avoid such injuries, never begin a job without first eliminating the risks to safety. These are descried below.

Elimination

	Action	Info/Illustration
1.	Turn off the main power switch at the control module. The main power switch on the control module switches off the control voltage to all the drive modules.	
2.	Turn off the main power switch (work switch) on the respective drive module to switch off the feed voltage.	
3.	Single robot stations	All voltage is lost when the main switch on the drive module (DM1) is switched off.

1.2.2 WARNING – The unit is sensitive to ESD.

Description

ESD (electrostatic discharge) is the transfer of electrostatic charges between two objects with varying charges, either through direct contact or through an electrical field.

The discharge contains very little electricity and is therefore not hazardous to humans, however, electronics can be damaged by the high voltages.

Elimination

	Action	Info/Illustration
1.	Use an ESD bracelet.	The bracelet must be regularly tested to ensure that it is undamaged and functions properly.
2.	Use an ESD-protected floor mat.	The mat must be grounded through a voltage regulating resistor.
3.	Use an ESD-protected table mat.	The mat shall produce a controlled discharge of static electricity and must be grounded.

Location of attachment point for ESD bracelet

Button (A/B) for the ESD bracelet is located on the computer unit in the control module/drive module. The location is shown in the following figure.

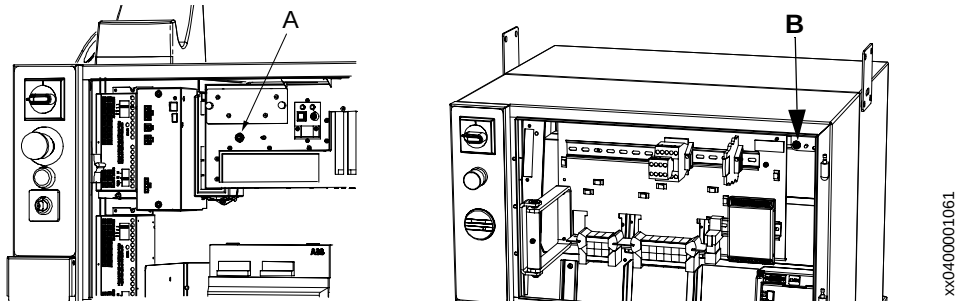


Figure 1 Location of attachment point for ESD bracelet

Item	Name
A	Attachment point for ESD bracelet in the control module.
B	Attachment point for ESD bracelet in the drive module.

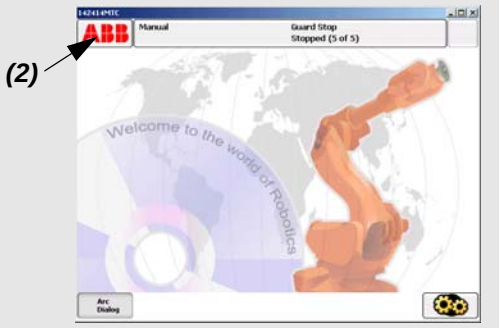
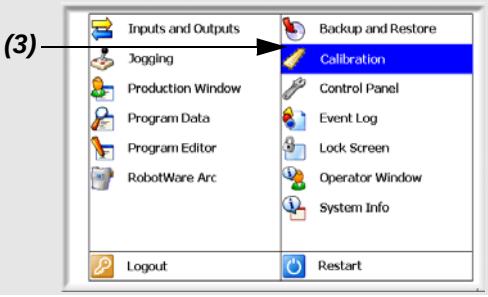
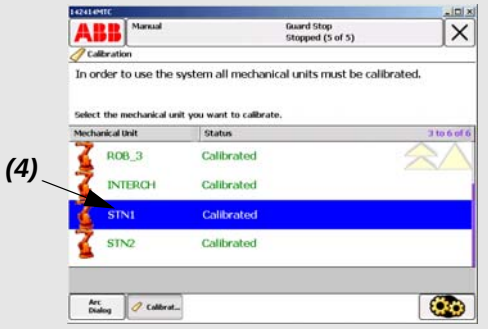
2 Calibrating the robot and the additional axes

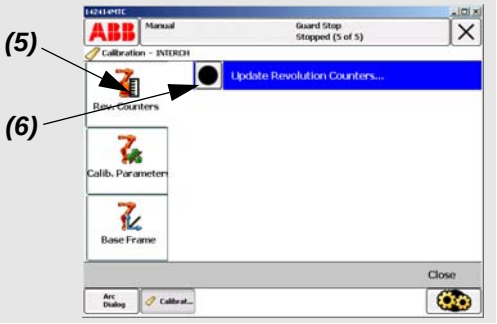
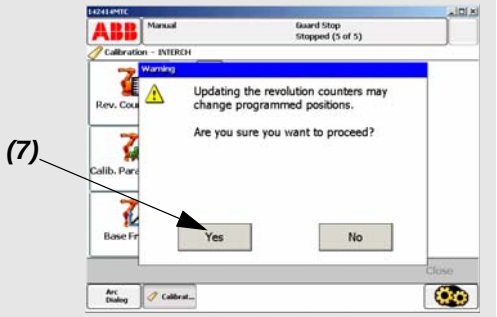
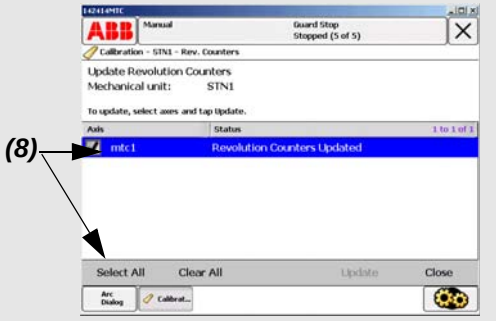
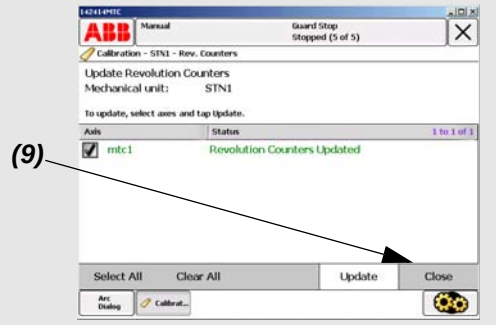
This chapter describes how you update the revolution counter, make manual settings for calibration values and recalibrate the axes.

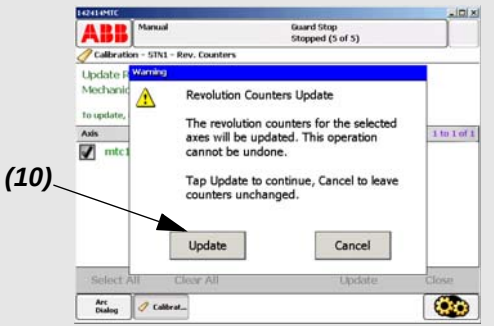
2.1 Updating the revolution counter

This measure is necessary when you have entered the calibration values manually or for some reason need to update one or more of the axes' revolution counters (resolver) against the synchronization position.

Usually the programmed positions are not affected by an update. If this happens the entered values may be incorrect or the axis has been updated before programming at an incorrect position i.e. not by the synchronization markings.

	Action	Info/Illustration
1.	Move the robot's and positioner's axes to their respective zero positions (synchronization marking).	
2.	Tap **ABB**, to open the service window.	
3.	Tap **Calibration.**	
4.	Tap on the mechanical unit to be calibrated. When the unit concerned is not visible in the window, use the scroll bar arrows, in the lower part of the window.	

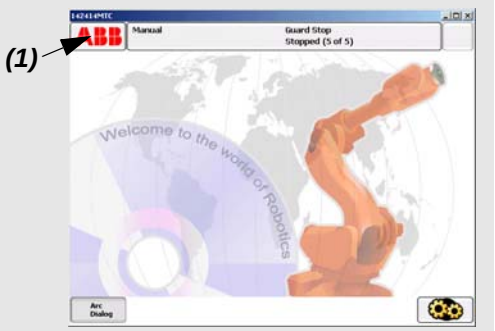
	Action	Info/Illustration
5.	Tap **Revolution Counters**.	
6.	Tap **Update Rev. Counters**.	
7.	The system awaits a response: • Tap **YES** if you want to proceed.	
8.	Select, by tapping, the axes to be updated. • Tap **Select All** to include all the mechanical unit's axes.	
9.	Tap **Update**.	

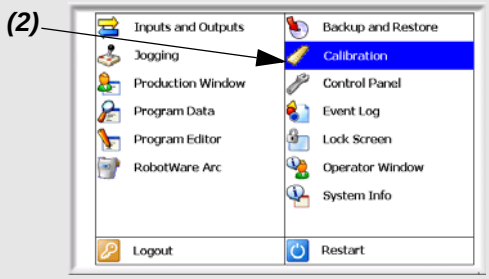
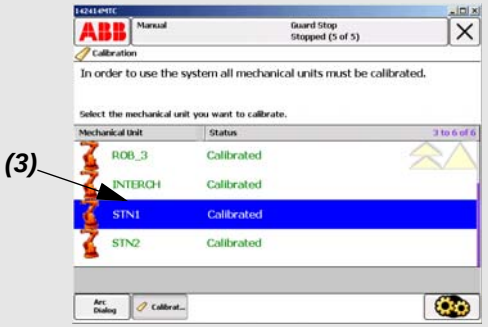
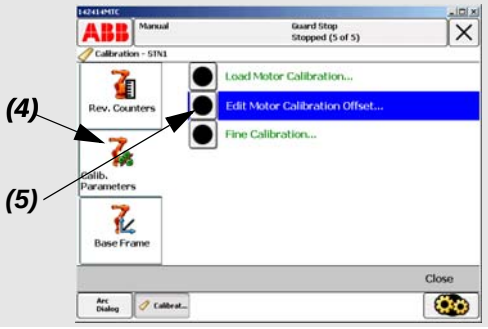
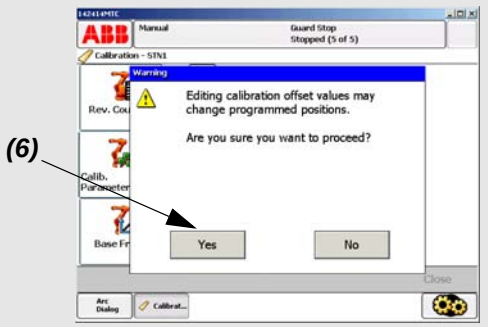
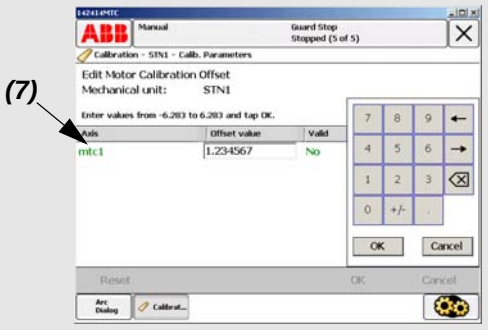
	Action	Info/Illustration
10.	The system awaits a response: • Tap **Update,** to confirm selected axes.	
11.	When the system has updated the axles, go back by tapping **Close** to end this session.	

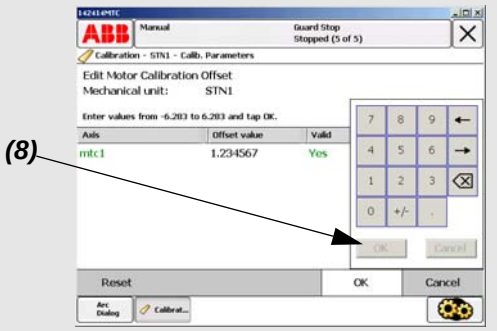
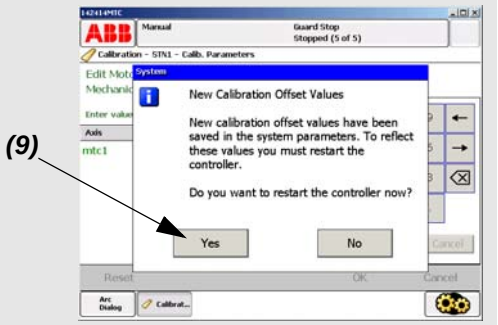
2.2 Manual setting of the calibration values

The measure is only necessary if the system has lost the calibration values (resolver values).

The chapter describes the procedure for all robot and positioner axes where there are calibration values are available.

	Action	Info/Illustration
1.	Tap **ABB**, to open the service window.	

	Action	Info/Illustration
2.	Tap **Calibration.**	
3.	Tap on the mechanical unit to be calibrated. When the unit concerned is not visible in the window, use the scroll bar arrows, in the lower part of the window.	
4.	Tap **Calibration Parameters**.	
5.	Tap **Edit Motor Calibration**.	
6.	The system awaits a response: • Tap **Yes** to proceed.	
7.	Tap on the axis where the value is to be modified. • Enter the new value with the help of the keypad.	

	Action	Info/Illustration
8.	Confirm the value by tapping **OK.**	
9.	The system awaits a response: • Tap **Yes** to restart.	

2.3 Recalibrating the axes

This measure is necessary when the external axes lack calibration values or you wish to recalibrate the axes.

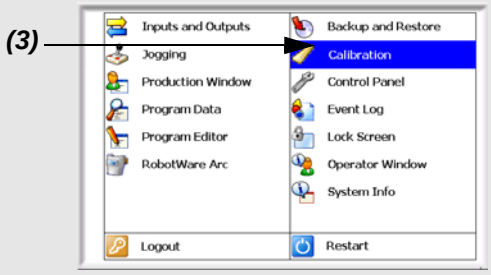
This procedure should not be used if calibration values already exist for the axis in question.

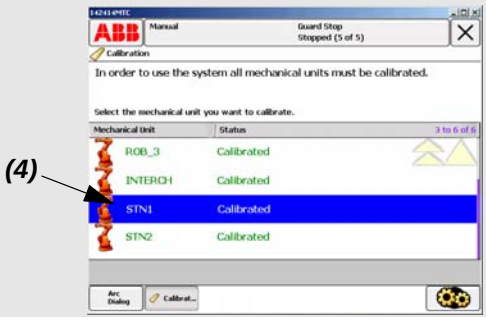
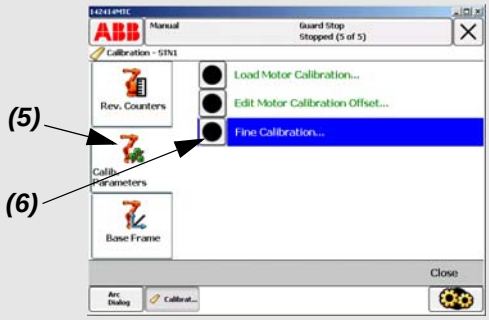
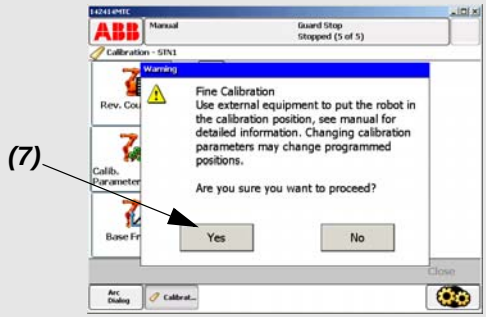
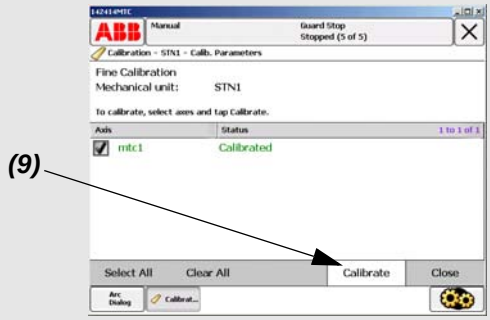
You should be aware that the **programmed positions can change** depending on whether the new calibrated position differs from the previous position.

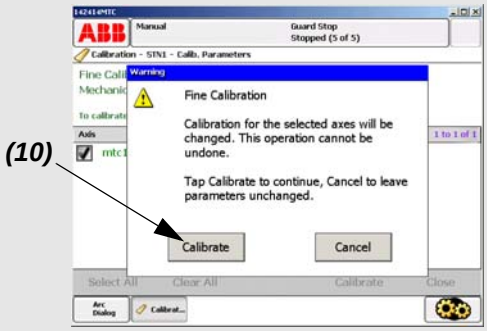
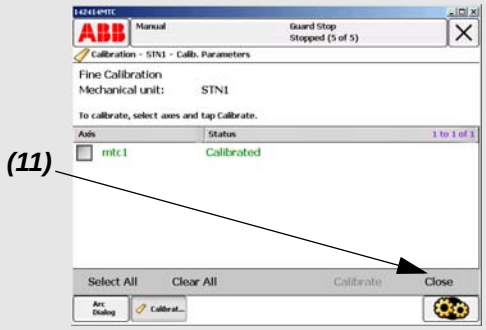
The chapter describes the procedure for the positioner, not for the robot. (Specialist know-how, which is not described here, and equipment are required to calibrate the robot's axes.)

Calibration of the external axes is performed in different ways depending on the type of positioner in question.

2.3.1 Positioners of the types A, L and MTC

	Action	Info/Illustration
1.	Move the positioner's axes (axis) to respective zero positions (synchronization marking). • Be precise when adjusting the position of the axis so that it lies in the centre of marking. The marking is made up of a machined groove or a machined notch on the gearbox respective faceplates.	
2.	Tap **ABB**, to open the service window.	
3.	Tap **Calibration.**	

	Action	Info/Illustration
4.	Tap on the mechanical unit to be calibrated. When the unit concerned is not visible in the window, use the scroll bar arrows, in the lower part of the window.	
5.	Tap **Calibration Parameters**.	
6.	Tap **Fine Calibration**.	
7.	The system awaits a response: • Tap **Yes** to proceed.	
8.	Select one or more axes, to be recalibrated.	
9.	Tap **Calibrate**.	

	Action	Info/Illustration
10.	The system awaits a response: • Tap **Calibrate**, to confirm recalibration.	
11.	Tap **Close**.	

3 Definition of the tool data (tload)

3.1 Definition of the tool data (tload)

These are the movement related data that should be defined first. All movement is dependent on this definition.

When using the *Collision Detection* functionality it is most important to have the right tool load in your tool data.

Recommended data components for the tool:

robhold	true
tframe	**5-point TCP&Z** is normally used with weaving during MIG/MAG welding. Without weaving **4-point TCP** is sufficient. TCP is defined according to *User's Guide BW OS 4.0*
tload	Values for the supplied standard welding guns and guns with a swan neck.

3.1.1 Welding gun with swan neck:

Welding gun type	Swan neck	Weight /kg	X mm	Y mm	Z mm
ESAB PSF 315R	22 grader	3,3	-60	0	57
ESAB PSF 500R	22 grader	3,3	-60	0	57
Dinse PKI 500	22 grader	3,3	-35	0	90
Binzel WH 455	22 grader	3,3	-35	0	55
Dinse PP Alu.	22 grader	4,4	-20	0	120

The five standard welding gun types above are predefined with the right ***tload*** in the module *Tooldata.sys*.

- Always use one of these tools when you are using a standard welding gun.
- Duplicate and change the name of the tool data if you want to make your own tool.
- If you use a non-standard welding gun it is necessary to run the load_identify service routine.

3.2 Setup welding gun without BullsEye®

The position of the robot and its movements are always related to its tool coordinate system, i.e. the TCP and tool orientation. To get the best performance, it is important to define the tool coordinate system as correctly as possible.

For more information, see the User’s guide, Chapter ″7 Defining Tools"

4 Speed data for external axes

Use the following max. speed data for IRBP-axis:

IRBP-positioner	
MTC 250	180 degree/s
MTC 750	150 degree/s
MTC 2000	90 degree/s
MTC 5000	39 degree/s
MIC 1.1	90 degree/s
MIC 1.2	90 degree/s
MIC 2.1	90 degree/s
MIC 2.2	90 degree/s

5 Drivers

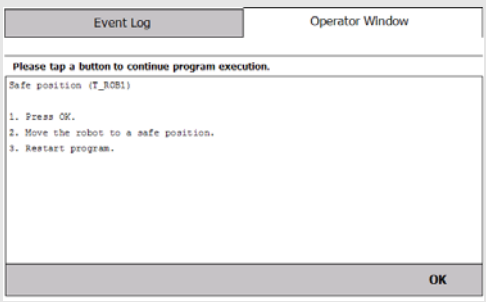
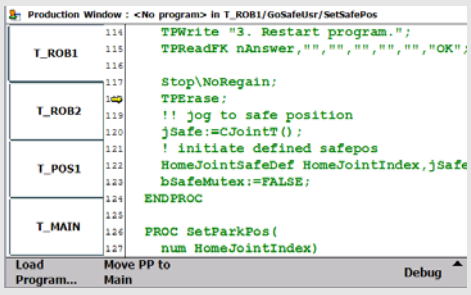
General

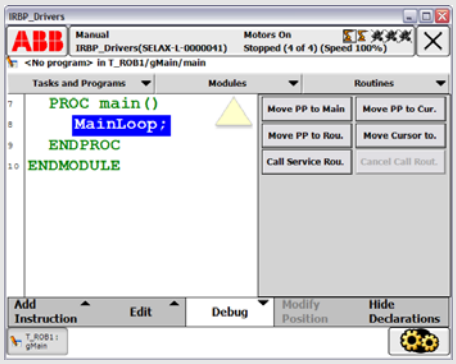
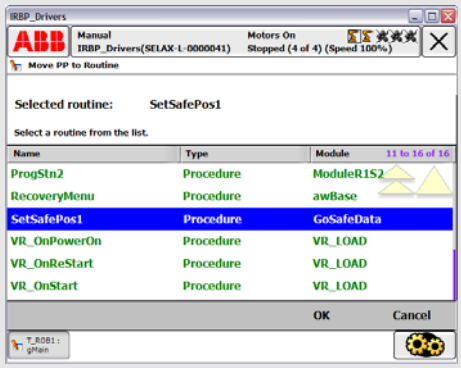
Before start using the station for production you should run the following setups.

5.1 Safe position

This should be a position where the robot is free from the IRBP positioner working area.

The first time that you start the program execution you will be asked to setup the safe position for the robots.

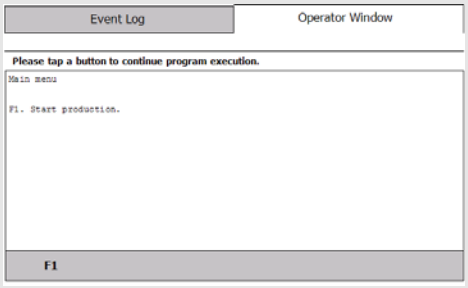
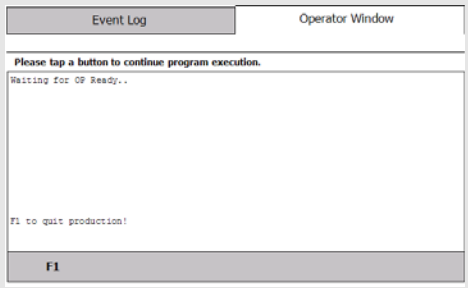
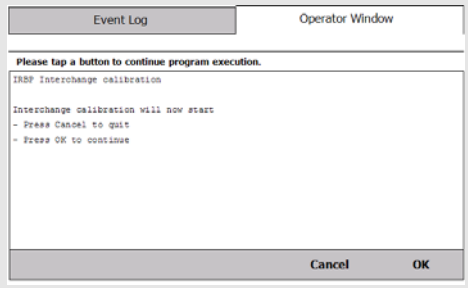
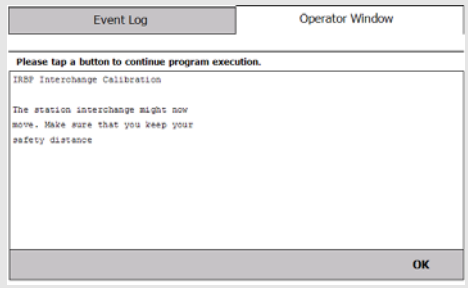
	Action	Info/Illustration
1.	Start	
2.	Tap **OK**. First, the Robot Safe Position is teached. The driver requires this position to safely perform a station interchange.	
3.	Move the robot to a safe position for positioners work area. • Tap **Start**.	
4.	To update the safe position or if you want to do it manually you can move PP to the procedure SetSafePos. Use “Move PP to routine” in “Debug”-menu	

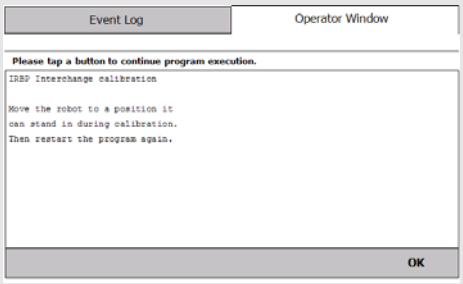
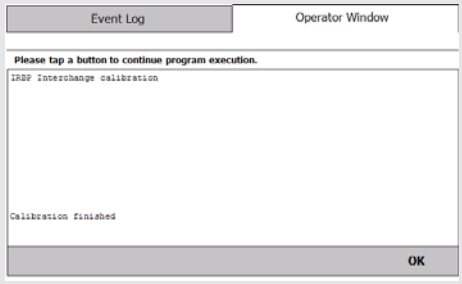
	Action	Info/Illustration
		

5.2 IRBP positioner Interchange calibration

5.2.1 IRBP positioner with mechanical stops

If your IRBP positioner is of type B, C, D, K or R and has mechanical stop.
In order to get the right torque against the stop you must calibrate the positions for side 1 and side 2.
The first time that you start production you will be asked to do an interchange calibration.

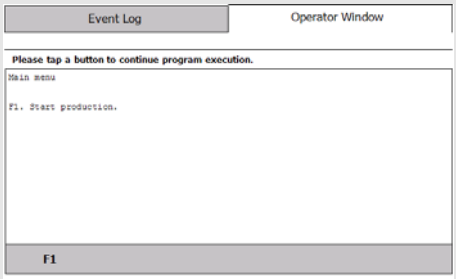
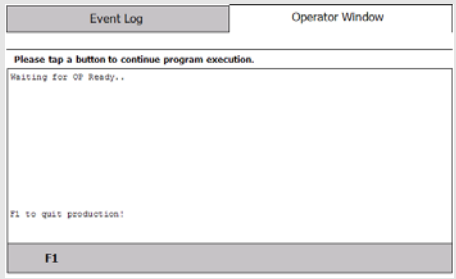
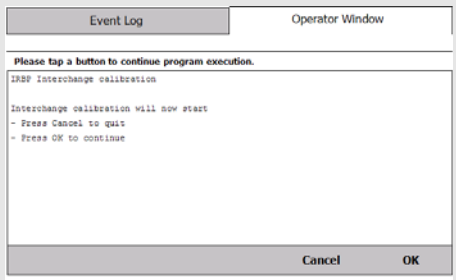
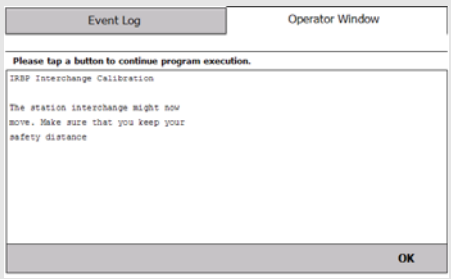
	Action	Info/Illustration
1.	Tap **“F1”** to start production.	
2.	Press “OP-Ready” on your Operator Panel	
3.	Tap **OK** to start the calibration	
4.	Warn user before indexing positioner. The station interchange might now move. Make sure that you keep your safety distance. • Tap **OK** to continue.	

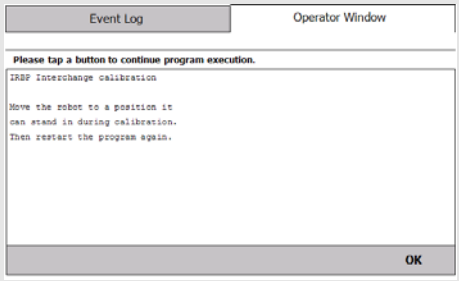
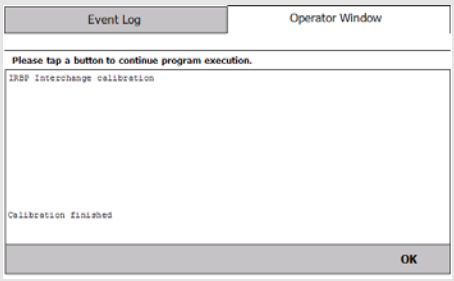
	Action	Info/Illustration
5.	Tap **OK** Move the robot to a safe position for the calibration. • Press **Start**.	
6.	The interchange calibration is finished. • Tap **OK**.	

5.3 IRBP positioner without mechanical stops

IRBP positioner of type C-index.
In order to get the right position you must calibrate the position for side one.

The first time that you start production you will be asked to do an interchange calibration.

	Action	Info/Illustration
1.	Tap **F1** to start production.	
2.	Press **OP-Ready** on your operator panel.	
3.	Tap **OK** to start the calibration.	
4.	Warn user before indexing positioner. The station interchange might now move. Make sure that you keep your safety distance. • Tap **OK** to continue.	

	Action	Info/Illustration
5.	Tap **OK**. Move the robot to a safe position for the calibration. • Press **Start**.	
6.	The interchange calibration is finished. • Tap **OK**.	

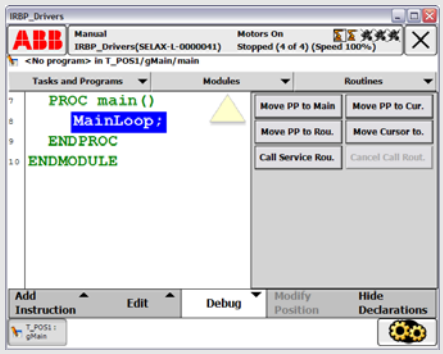
5.4 Working positions

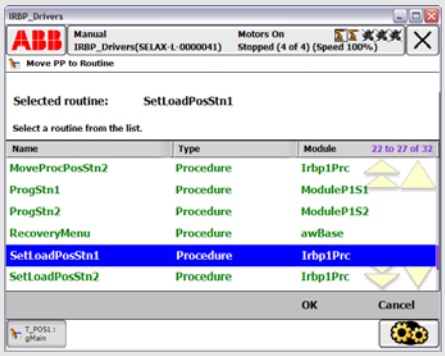
These positions will speed up and simplify your process.
You will be guided through a setup of load position, process position and service position for each one of your mechanical units.

5.4.1 Load position

A load position is the position the side towards the operator will be in after the interchange. Program it in a good position for the operator to load/unload parts.

	Action	Info/Illustration
1.	To update the service position or if you want to do it manually you can move the PP to the procedure SetLoadPosStnX.	

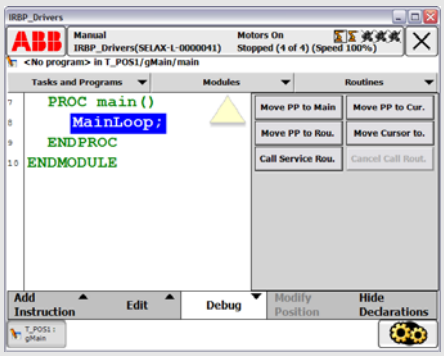


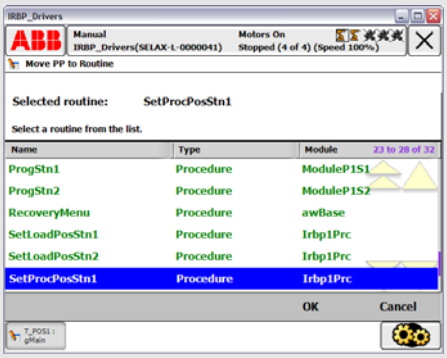


5.4.2 Process position

A process position is the position the side towards the robot will be in after the interchange. Program it to be in a good starting position for the first weld to reduce cycle time.

	Action	Info/Illustration
1.	To update the service position or if you want to do it manually you can move the PP to the procedure SetProcPosStnX.	





Process position

6 Identification of load data for positioners IRBP

Since the data of the different loads that can be mounted on the external positioner can be quite difficult to compute, there is a load identification procedure which computes the necessary load data by moving the positioner. Here we will describe which parameters are identified with the load identificationL.

If you run the load identification for the first time on a specific type of positioner, it is recommended that you first run the procedure in slow test mode to prevent any collisions.

6.1 Load Identification for IRBP L /C

A simplified view of positioner IRBP L is shown in *Figure 2.*
Load identification can be performed in any position for this positioner.

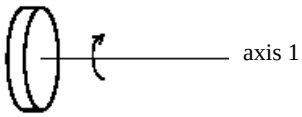


Figure 2. Simplified view of positioner IRBP_L.

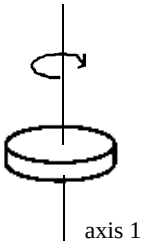


Figure 3. Simplified view of positioner IRBP_C.

6.1.1 Parameters and movements

Parameters

The parameters that are identified are: centre of gravity in a plane perpendicular to the axis, and moments of inertia around the axis, see *Figure 4.*

Note that the mass of the load must be known in advance. The mass data is entered when performing the load identification.

Together with the identified parameters, a measurement accuracy is also given, indicating how successful the identification was.

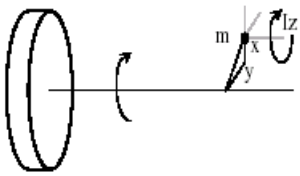


Figure 4. The parameters that can be identified on an IRBP L positioner.

To perform the identification the positioner moves the load and computes the parameters.

Movements

The movements for the axis are performed around two configuration points as described in *Figure 5.* At each configuration, the maximum motion for the axis is approximately 30 degrees up and 30 degrees down. The optimum value for the Configuration angle is 90 degrees.

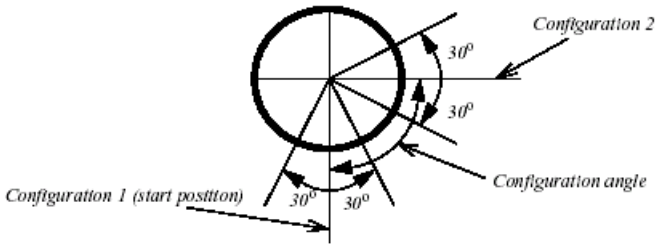


Figure 5. Motion interval for the axis.

6.2 Load Identification for IRBP K

A simplified view of positioner IRBP K is shown in *Figure 6.* Load identification is allowed on axes 2 and 3 for this positioner.
Load identification can only be performed when axis 1 is in one of its end positions. This is checked by the load identification procedure.

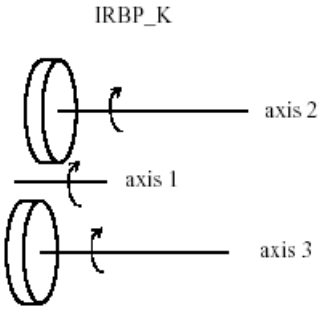


Figure 6. Simplified view of positioner IRBP K.

The identified parameters and movements for each axis are the same as for the IRBP L positioner. *See "Parameters and movements" on page 26.*

6.3 Load Identification for IRBP R

A simplified view of the IRBP R positioner is shown in *Figure 7.* The parameters that are identified are: centre of gravity in a plane perpendicular to the axis, and three moments of inertia at the centre of gravity. Note that both the mass of the load and the distance z to the centre of gravity must be known in advance.

These data are entered when performing the load identification.

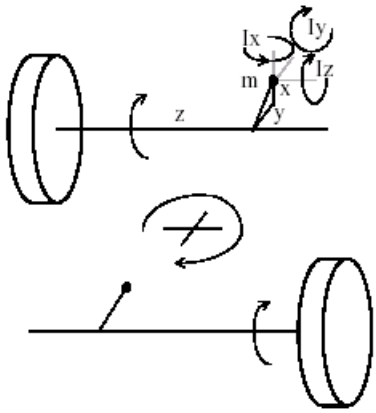


Figure 7. Simplified view of positioner IRBP R.

One part of the identification movements for one axis are the same as for the IRBP L positioner. To find the extra moments of inertia we also move the interchange axis with the load to two different positions.

The movements for the interchange axis are the movements described in *Figure 7.* but only at one configuration point. It is important to remember that the identification on one axis will be correct only if there is no load mounted on the other axis.

6.4 Load Identification for IRBP A, B and D

A simplified view of positioner IRBP A/ B/ D is shown in *Figure 8.* When the identification is performed, the positioner must be positioned so that the z-axis is horizontal.

This is checked by the load identification procedure. If axis 1 is too far from this position the load identification procedure will suggest which angle it should be moved to.

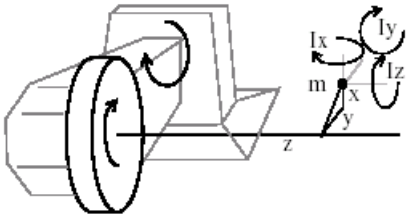


Figure 8. Simplified view of positioner IRBP A.

The parameters that are identified are: centre of gravity and three moments of inertia at the centre of gravity, see *Figure 8.*

The mass of the load must be known in advance and it is entered when performing the load indentification.

The motion for each axis is, in principal, the same as for the IRBP L positioner, see *Figure 5.* However, axis 1 only performs its movements around one configuration point.

Load Identification for IRBP A, B and D

7 MechUnitLoad Defines a payload for a mechanical unit

MechUnitLoad is used to define a payload for an external mechanical unit. (The payload for the robot is defined with instruction *GripLoad*)

When using the drivers *MechUnitLoad* is built in.

This instruction should be used for all mechanical units with dynamic model in servo to achieve the best motion performance.

The *MechUnitLoad* instruction should always be executed after execution of the instruction *ActUnit.*

The axis closest to the payload should be selected in the *MechUnitLoad* instruction.

When execution of *ActUnit INTERCH* should one *MechUnitLoad* for both axis 2 and axis 3 be executed.

Example

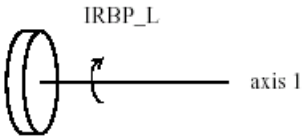


Figure 9. A mechanical unit named IRBP_L of type IRBP L.

```
ActUnit STN1;
MechUnitLoad STN1, 1, load0;
```

Activate mechanical unit STN1 and define the payload *load0* corresponding to no load (at all) mounted on axis *1*.

```
ActUnit STN1;
MechUnitLoad STN1, 1, fixture1;
```

Activate mechanical unit STN1 and define the payload *fixture1* corresponding to fixture *fixture1* mounted on axis *1*.

```
ActUnit STN1;
MechUnitLoad STN1, 1, workpiece1;
```

Activate mechanical unit STN1 and define the payload *workpiece1* corresponding to fixture and work piece named *workpiece1* mounted on axis *1*.

7.1 Arguments

MechUnitLoad MechUnit AxisNo Load

MechUnit *(Mechanical Unit)* Data type: *mecunit*
The name of the mechanical unit.

AxisNo *(Axis Number)* Data type: *num*
The axis number, within the mechanical unit, that holds the load.

Load Data type: *loaddata*
The load data that describes the current payload to be defined.

7.2 Program execution

After execution of *MechUnitLoad*, when the robot and external axes have come to a standstill, the specified load is defined for the specified mechanical unit and axis. This means that the payload is controlled and monitored by the control system.

The default payload at cold start-up, for a certain mechanical unit type, is the pre-defined maximal payload for this mechanical unit type.

When some other payload is used, the actual payload for the mechanical unit and axis should be redefined with this instruction. This should always be done after activation of the mechanical unit.

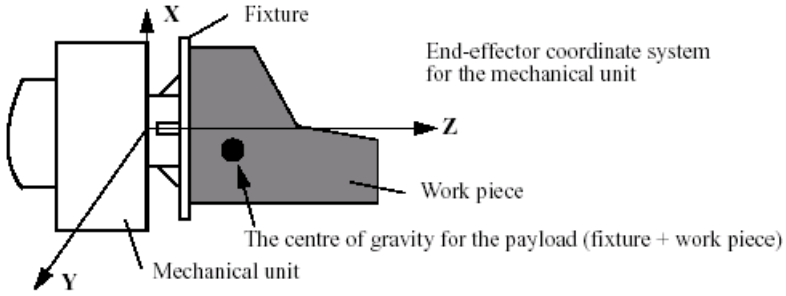


Figure 10. Payload mounted on the end-effector of a mechanical unit.

Example

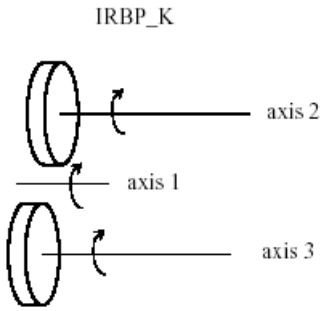


Figure 11. A mechanical unit named IRBP_K of type IRBP K with three axes.

MoveL homeside1, v1000, fine, gun1;

....

ActUnit INTERCH;

The whole mechanical unit *INTERCH_K* is activated.

MechUnitLoad INTERCH, 2, workpiece1;

Defines payload *workpiece1* on the mechanical unit *INTERCH* axis *2*.

MechUnitLoad INTERCH, 3, workpiece2;

Defines payload *workpiece2* on the mechanical unit *INTERCH* axis *3*.

MoveL homeside2, v1000, fine, gun1

The axes of the mechanical unit *INTERCH* move to the switch position *homeside2* with mounted payload on both axes *2* and *3*.

7.3 Limitations

The movement instruction previous to this instruction should be terminated with a stop point in order to make a restart in this instruction possible following a power failure.

7.4 Syntax

MechUnitLoad

[MechUnit':='] < variable (**VAR**) of *mecunit*>','

[AxisNo ':='] <expression (**IN**) of *num* ','

[Load':='] < persistent (**PERS**) of *loaddata* >';'

7.5 Related information

	Described in:
Identification of payload for external mechanical units	LoadID&CollDetect • Program *muloadid.prg*
Mechanical units	Data Types- *mecunit*
Definition of load data Data	Types - *loaddata*
Definition of payload for the robot	Instructions - *GripLoad* Data Types - *tooldata*