DAIMLER

Powertrain Requirement Specifications 2020 Part III Robotics Process: Welding - ABB

Version 2020.0.19

Version	2020.0.19	Number of pages	37
Last revised	21.01.2020		
File	2.1_01_Project_Book_Welding_ABB_v2020.0.19.docx		

Table of Contents

1. General Information

1.1 Document Control

This document is part of the collection of documents for the design of robot welding systems. Please refer to the documents listed below to ensure that you have all the information you need for project processing. Questions about the documents should be addressed at the launch event.

Title	Location	Remark
1 Project Book **Robotics General**	Not yet defined	General requirements for robotics (safe, etc.) – manufacturer-independent
1.1 Project Book **Robotics ABB**	Not yet defined	Supplementary or additional detail on 1 for the manufacturer ABB
1.2 Project Book **Robotics KUKA**	Not yet defined	Supplementary or additional detail on 1 for the manufacturer KUKA
2.0 Project Book Robotics **Welding Cells – General**	Not yet defined	General requirements for robot welding cells – manufacturer independent, based on 1
2.1 Project Book Robotics **Welding Cells – ABB**	Not yet defined	Supplementary or additional detail on 2.0 for the manufacturer ABB
2.2 Project Book Robotics **Welding Cells – KUKA**	Not yet defined	Supplementary or additional detail on 2.0 for the manufacturer KUKA, also including the NANO standard
2.3 Project Book Robotics Welding Cells – **Welding Technology**	Not yet defined	All the technology that must be used for welding cells (beyond that listed at 1.0) must be used in conjunction with 2.0 and 2.1 or 2.2.
Robotics Model Programs	Download portal	Template for base robot program Welding sample programs including error handling

Table 1: Overview of related documents for welding technology

References to these documents are given as follows: ↑*Title of the document*

The version identifier contained in each document is structured as follows:

[H].[U].[Revision]

H=main version = specifications version
U=subversion = update (0= original release of the main version)
Revision = sequentially incremented number which is not reset when a new main version is released
(Every change (even if not published) causes the revision number to be incremented)

This project book defines the specifications for the use of welding robots for all production locations and production centers within the Passenger Car/Powertrain (GFP/P) divisions of Daimler AG.

All information in this project book has been compiled based on the current state of knowledge and the current state of technology. Technical modifications in the software and hardware areas, as part of ongoing developments and/or project-specific requirements, remain reserved.

The information makes no claim to completeness and the technical boundary conditions shall be coordinated with the pertinent specialist unit in the corresponding project phase in individual cases, if necessary.

1.2 Record of Revisions

Version	Last revised:	Chapter / topic	Changed by:
14.0.3	21.3.17	All restructuring/contents. ABB to-do's appear in comments and red text.	MR,SS(ABB)
14.0.4	31.3.17	Closing unit figure, note on positioner	MR
14.0.7	10.4.17	Definition	SS(ABB)
14.0.9	27.04.17	Advance version at copy deadline	MR
14.0.11	31.5.17	Cleaning, clarification	MR, JE
14.0.12	28.6.17	Finalization	MR
14.0.13	20.3.18	Corrections, omission of closing unit, release	MR
14.0.14	01.03.2019	Closing unit revised	MR,SS(ABB)
15.0.15	01.04.2019	Release LH15	MR
15.0.16	03.05.2019	3.5 SafeMove software option	MR, AG
15.0.17	04.11.2019	3.6. Set-up information on programming balls, error handling and field bus	MR, ZS
15.0.18	14.01.2019	Adaptation / preparation LH16	MR
2020.0.19	21.012.2020	Requirement specifications formatting	MR, 21.01.2020

Changes to the last version are marked as shown in this example.

Previous version:
This text is before. This is the original text. This text is after.

New version:
This text is before. This is the modified text. This text is after.

1.2.1 Contacts

The contacts responsible must be identified at project launch.

1.3 Information Coding

NOTE	Information to be observed in the design.

IMPORTANT	Disregard of this information will cause problems in the process

SPECIFICATION	Organizationally mandatory specifications.

2. Other Applicable Provisions

The specifications on programming and commissioning industrial robots for welding can be seen in the robotic specifications from the individual manufacturers. Model programs for arc-welding applications: See Appendix: Robotic Programming Specifications (↑*KUKA Robotic Specifications / ABB Robotic Specifications*).
The specifications for welding technology itself (↑*Project Book on Welding*) must also be observed.

The general specifications of ↑*SPPA Requirement Specifications* (especially Part 3 – Electrical Components) shall be complied with.

3. IR Selection Criteria

The robots are selected as per ↑*Robotics: General Powertrain*.
ABB offers MultiMove systems combining multiple robots and optional external axes in a control system group.
For welding applications, the interlinked welding robots must be implemented in a MultiMove system.

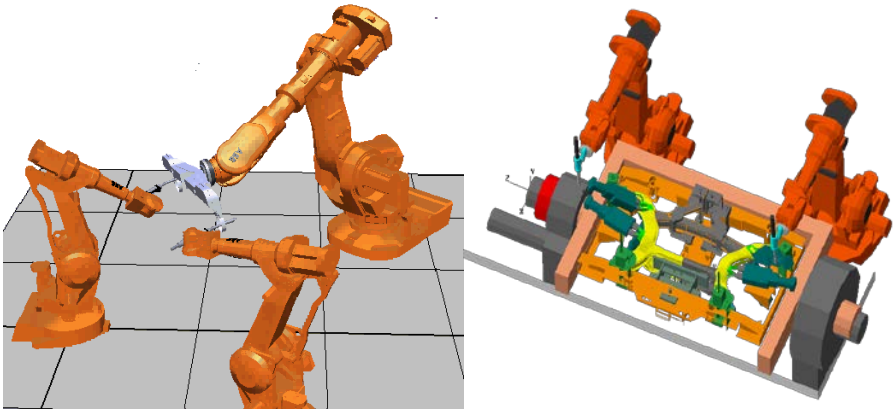


Figure 1: *Example of MultiMove systems (left: flexible positioner, right: twin system with rotator)*

Motions and logical instructions are organized in tasks. Tasks can be completed both temporally and geometrically coordinated. Geometrical coordination occurs via a reference coordinate system (typically workpiece coordinates) that is either static or coupled to a robot or positioner. All units participating in the motion move relative to this reference coordinate system. For each robot, a measurement occurs in a separate workpiece coordinate system.

When designing a MultiMove system, it shall be ensured that the number of motion tasks is limited to a maximum of 6. For each robot a motion task shall be provided. **The positioners must be programmed in separate tasks.** A two-axis turntable (2 axes) can be combined into a single motion task. A rotator shall be programmed
for 3 motion tasks. Alternative concepts shall be coordinated with Daimler.

Typical programming for a twin system (rotator) looks like the following:

Task designation	Remark / function
T_ROB1	Robot 1
T_ROB2	Robot 2
T_POS1	Rotator or two-axis turntable, 1st axis at H-table
T_LOGIC	Management task of the Daimler template (PLC connection and task synchronization)

Specification
For the simulation and analysis of process data, at least one free task must be available.

Detailed information about MultiMove can be found in the manufacturer's documentation. Please note that, at the start of the project, Daimler AG will provide the latest valid sample programs for template installation and welding programming on the *download portal* provided for this purpose.
The programming specifications ↑*Robotics: General Powertrain* must be complied with. You can also find these on the *exchange medium*.
The use of MultiMove in strictly handling areas is mandatory prior to ordering by the client (Planning + Maintenance).

Note:
Deviations from this arrangement are possible if approved by the client.

3.1. Load Selection and Commissioning

For the standard GMAW arc-welding process a load capacity of up to 10 kg shall be provided. For laser hybrid processes a load capacity of 30-60 kg shall be provided.

Process	IRB2600-ID 15/1.85	IRB4600
GMAW arc-welding	X	-
Laser Hybrid	-	X (1" or 2" head)

Specification
The system builder shall follow the initial operation of the robot with the load determination.

4. Hose Packages (GMAW + Laser Hybrid)

The process-specific hose packages (e.g. MIG/MAG welding) appear in the corresponding ↑*Welding Technology Programming* and shall be included. Assembly is carried out **by the provider of the power source** on-site as part of robot commissioning (construction site). A function test for the process shall be performed by the power source manufacturer. **Commissioning shall be ordered by the manufacturer of the installation!**

Note:
The prerequisites for commissioning are the complete routing of the cable to the power source, the Profinet programming and the energy supply to the power source and robot control system.

4.1. Welding Ground for Handling Robot

If a handling robot is used for stationary torches ("free finish welding") or within a KIR cell, that robot shall be fitted with a welding-specific package.

The following substances shall be provided:

- Welding ground 2x35 mm² current feedback
- Profinet 4x0.34 mm² Profinet,
- Profinet power supply 5x1.5 mm² voltage
- Functional ground 1x10 mm² potential equalization
- Air ½"

Important
In tandem processes or with the use of multiple welding robots on a component part, for each power source at least one ground line shall be provided in the hose package. If the **2x35 mm²** does not suffice for the planned process, a separate welding earth must be provided. This special package shall be coordinated with the robot manufacturer.

ABB supplies by default hose packages from Sumcab as a substance package from axis 1 to axis 3. The following lists the packages per robot type:

Robot model	Order number 1 ground	Order number 2 grounds
IRB4600	Hose package 4600 HA+SW	Hose package 4600 HA+2xSW
IRB6700	Hose package 6700 HA+SW	Hose package 6700 HA+2xSW

The specification (connection types, etc.) of the hose package appears in the appendices of the ↑*ABB Robot Specifications*.

4.2. Welding Torch Hose Package

The welding torch hose packages differ according to manufacturer and cooling type. The length of the hose package shall be coordinated with the IRB 2600 ID 15/1.85. Details: see ↑*Welding Technology Programming*.

Important
The package-specific limits for the rotational ranges of axis 6 or the combined rotation of axes 4 and 6 shall be observed in the simulation **and** programming.

Example of a permitted combined rotation (torsion of the torch hose package) through +/-240° (Cloos):

Axis 4	Axis 6	Torsion	Permitted
0°	0°	0°	Yes
250°	0°	+250°	No
-250°	0°	-250°	No
250°	-100°	+150°	Yes
-250°	100°	-150°	Yes

Table 2: Examples of combined torsion of hose assemblies and their classification for permissibility

Example of a typical procedure during a welding seam:

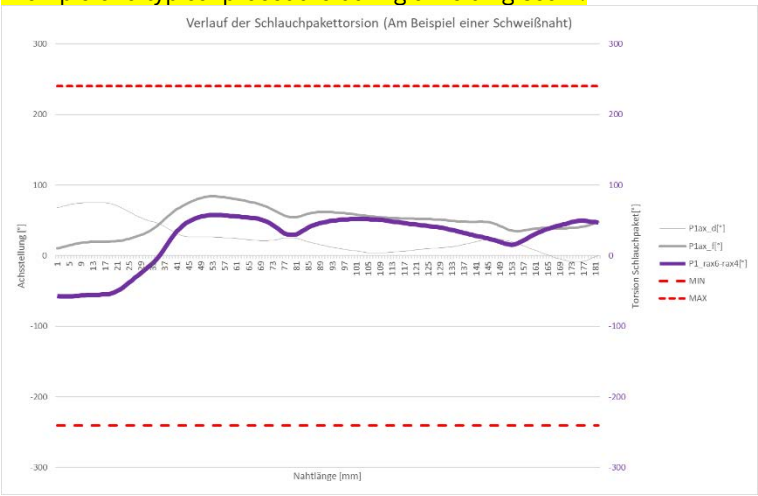


Figure 2: Example of a torsion course (purple) along a seam. You can see that the axis rotations A4 and A6 (grey) partially compensate each other. The actual torsion of the package must be within the manufacturer's limits.

Important
If the wire feed unit (DVS) is mounted on the robot arm, make sure that the attachment of the DVS does not restrict the motion of the robot. Should this not be possible, the robot must be appropriately adjusted regarding the axis boundaries A3, to prevent damage to DVS and the robot kinematics.

5. General Specifications on the Use of Positioning

- The following versions are available:
  - Operating range of the table axes: **-180° / +360° in version with torsion cable**
  - Endlessly rotating version with slip ring (Profinet, voltage, air, welding ground
  - Version with flexible power duct only by agreement with robot manufacturer.
- The positioning accuracy (transmission play + regulation) of **0.05 mm** at a **distance of 500 mm** from the axis of rotation shall be assumed
- All positioners have a default feed line of 10 m. Other lengths shall be requested when ordering.
- Mount lists for jigs/fixtures as per Daimler version. (See *Fehler! Verweisquelle konnte nicht gefunden werden.*)
- It shall be ensured that the table does not vibrate during loading and unloading. If necessary, a mechanical support shall be provided (not available as ABB product).
  This is especially important when H-tables are used.
  Overshooting tables require an additional waiting time before the process can start. This will affect the takt time. **For this reason, overshoot prevention must be designed in.** (Optimized centers of mass and corresponding design of the positioners)
- During commissioning, ABB will check the stress on the positioner regarding acceleration / speed curves as a function of load torques (center of mass outside the axis of rotation) – this concerns only special positioners (like H-tables and closing units). Standard positioners have already been optimized via a dynamic model.
- **Load arrangements of the jigs/fixtures must have a safety margin of approx. 20%,**, to allow any necessary adaptations of the jigs/fixtures on the construction site.

Important
All **standard positioners** shall be parameterized during commissioning regarding the load and inertia moments. For standard positioners the automated ABB routines shall be used! **Programming without load measurement is not permissible!**

For **special positioners** (H-tables, closing units, heavy-duty rotators, etc.) there exists no dynamic model (and therefore no load optimization). For optimizing the speed or vibrational characteristics, individual optimization of the drive parameters by ABB is possible. **This optimization shall be requested by the system builder.**

5.1. IRC5 Equipment for Operating Additional External Axes

Drive modules or the compact control system are fitted with a switch for operating external axes. The control system is fitted with the corresponding driver stages for the additional axes. All robot types can be fitted with up to 3 additional axes in each case.

The axes **must** be individually activated and deactivated via the RAPID program. Examples of actuation are contained in the robot programming specifications (↑*Robotics: General Powertrain*). The latter shall be requested from Daimler at the start of the project.

Connector plugs for the external axes are HAN modular.
The serial measurement board (SMB) to be externally attached is connected to the drive module via Burndy plugs.

Electric wiring diagrams and further information appear in the *Fehler! Verweisquelle konnte nicht gefunden werden.*.

5.2.

6. Robot Base

Welding robots can be placed on bases. The bases shall be procured from the IR manufacturer. Special shapes of bases shall be coordinated with the IR manufacturer.
Bases are available in heights starting at 200 mm and increasing in increments of 10 mm for all robot types. The bases are manufactured as required. For details, see the product handbook of the particular robot or Appendix in the Project Book ↑*Robotics: General Powertrain*.

7. Software Options

For a welding robot (including free finish welding), in addition to the default options the following software options shall be ordered.

Process	Single robots	Multi-robot systems, robot & ext. axis, robot & robot

Standard version	• RobotWare Base
	• German
	• 603-1 Absolute Accuracy
	• 608-1 World Zones
	• 611-1 Path Recovery
	• 613-1 Collision Detection
	• 614-1 FTP SFTP and NFS Client
	• 616-1 PC Interface
	• 633-4 RobotWare Arc6 (the following are options included for Arc6)
	  • Standard IO Welder – must be selected
	  • 637-1 Production Screen (automatic selection)
	  • 652-1 Bullseye (if ABB TCP measurement used)
	  • 653-1 TSC2013 (only with ABB TSC)
	  • 659-1 Production Monitoring (automatic selection)
	  • 624- Continuous Application platform (automatic selection)
	• 623-1 Multitasking
	• 735-7 Keyless Mode Switch, 3 Modes
	• 888-2 PROFINET Controller/Device
	• 996-1 Safety Module
	• 997-1 PROFIsafe F-Device	

Standard GMAW	• 1125-2 SafeMove Pro2	• 604-1 MultiMove Coordinated • 634-1 Multiprocess
IRBP A-1000 ServoClamp	• 635-6 Spot6 (includes: ADU, Spot Servo Equalizing, no supervision track, 625-1 discrete application platform) • 604-1 MultiMove Coordinated	• ServoClamp previously not tested as MutliMove system

	• 634-1 Multiprocess • 1180-1 ToolControl	
Laser Hybrid	• 1125-2 SafeMove Pro2 • Daimler LH package (supplied by Daimler)	• 1125-2 SafeMove Pro • Daimler LH package (supplied by Daimler) • 604-1 MultiMove Coordinated • 634-1 Multiprocess

Multirobot systems are systems with multiple robots or positioners. (Example: 2600ID + IRPBA750)
When commissioning the robot control system: **the 1st welding robot is always robot 1**.
The following lists all options in tabular form

Station type / **Options**	**Standard GMAW – Single IRB**	**Standard GMAW – Multi IRB**	**IRBP A-1000 ServoClamp**	**Laser Hybrid Single IRB**	**Laser Hybrid – Multi IRB**
RobotWare Base	x	x	x	x	x
German	x	x	x	x	x
603-1 Absolute Accuracy	x	x	x	x	x
608-1 World Zones	x	x	x	x	x
611-1 Path Recovery	x	x	x	x	x
613-1 CollisionDetection	x	x	x	x	x
614-1 FTP SFTP&NFS Client	x	x	x	x	x
623-1 Multitasking	x	x	x	x	x
735-7 Keyless 3 Mode Switch	x	x	x	x	x
888-2 PROFINET Controller/Device	x	x	x	x	x
996-1 Safety Module	x	x	x	x	x
997-1 PROFIsafe F-Device	x	x	x	x	x
616-1 PC Interface	x	x	x	x	x
633-4 RobotWare Arc6	x	x	x	x	x
Standard IO Welder	x	x	x	x	x
624-1 CAP	x	x	x	x	x
637-1 Production Screen	x	x	x	x	x
659-1 Production Monitoring	x	x	x	x	x
652-1 Bullseye	x	x	x	x	x
653-1 TSC2013 (only with ABB TSC)	x	x	x	x	x
635-6 Spot6			x		
ADU			x		
Spot Servo Equalizing			x		
No supervision track			x		
625-1 Discrete Appl. Platform			x		
1180-1 ToolControl			x		
6604-1 MultiMove Coordinated		x	x		x
634-1 Multiprocess		x	x		x
1125-2 SafeMove Pro2			x	x	x
Daimler LH package			x	x	x

Table 3: Overview of the software options by use case

7.1. Necessary User

The following two users must be created on the IR control system (contact is Maintenance):

User	Purpose	Necessary authorization
TSS	Interface to robot for laser hybrid TCP measurement and correction, as well as camera control	Reading of variables and system information in all operating modes Writing of variables in automatic mode (if possible also manually)
GPK	Correction of robot points via graphical user interface	Reading of variables and system information in all operating modes Logging of variables in automatic mode

Table 4: Users to be set up on the IRC5

For security reasons, users should have different passwords **for each** robot. The allocation and setup of users is carried out by the maintenance department.

8. Parameterization Specifications

Specification
All welding robots **must** be parameterized according to the settings described below. The correct settings are checked randomly during the shipping acceptance procedure.

8.1. Start-up Routines

When starting the controller, some routines **must** be triggered automatically by events. This must be ensured by the IR programmer accordingly.

This matter is explained specifically as part of the start-up event.

8.2. LUPO Move

To use LUPO, it is necessary to enable the commands used in the controller. This must be ensured by the IR programmer accordingly.

This matter is explained specifically as part of the start-up event.

8.3. Laser Hybrid (and JGM)

Technology packages are necessary for the use of laser hybrid or JGM. These packages install the commands to be used in the controller. This must be ensured by the IR programmer accordingly.

This matter is explained specifically as part of the start-up event.

8.4. Automatic Change of Kinematics Based on the Activated Programming Window

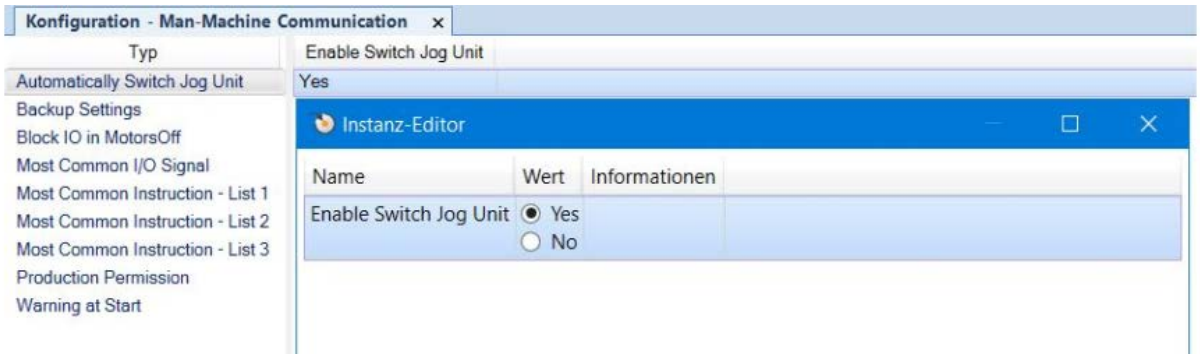


Figure 3: Activating the automatic change

8.5. Automatic Change of the Program Sequence when Changing to Automatic Mode

When automatic mode is activated, the robot automatically resets the program pointers and sets the sequence to continuous mode (not step mode). This must be included accordingly in the settings. If the parameter is changed for commissioning, it must be reset correctly again before it is handed over to the manufacturer.

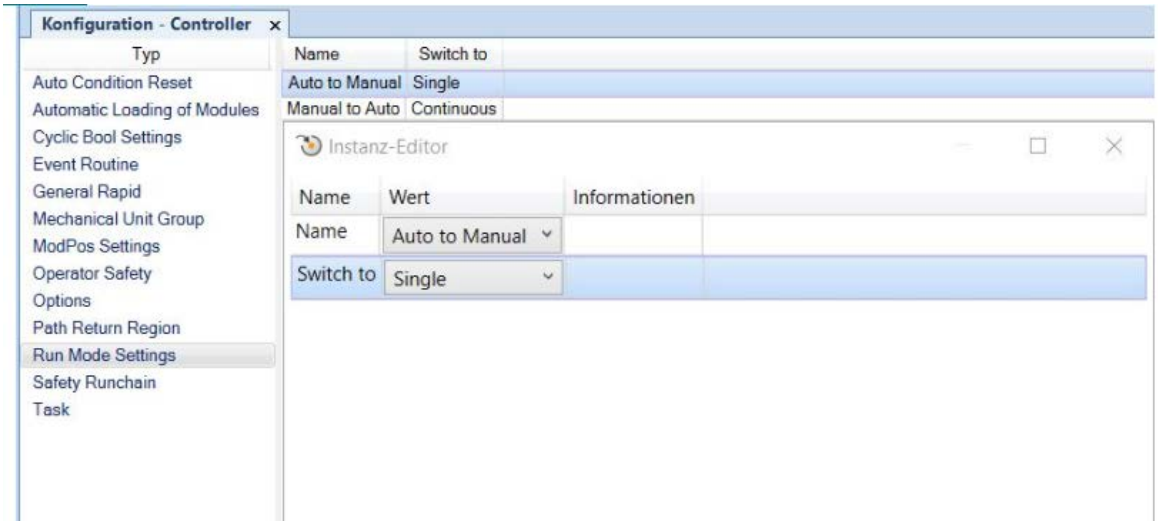


Figure 4: Activating the automatic program sequence change

8.6. Limited Modifications (Limited ModPos)

The ABB controller restricts the correction of programmed points. However, the parameters must be set **before** handover and are checked during shipping acceptance. This is activated after initial programming and as part of handover for production (Limited ModPos = true).

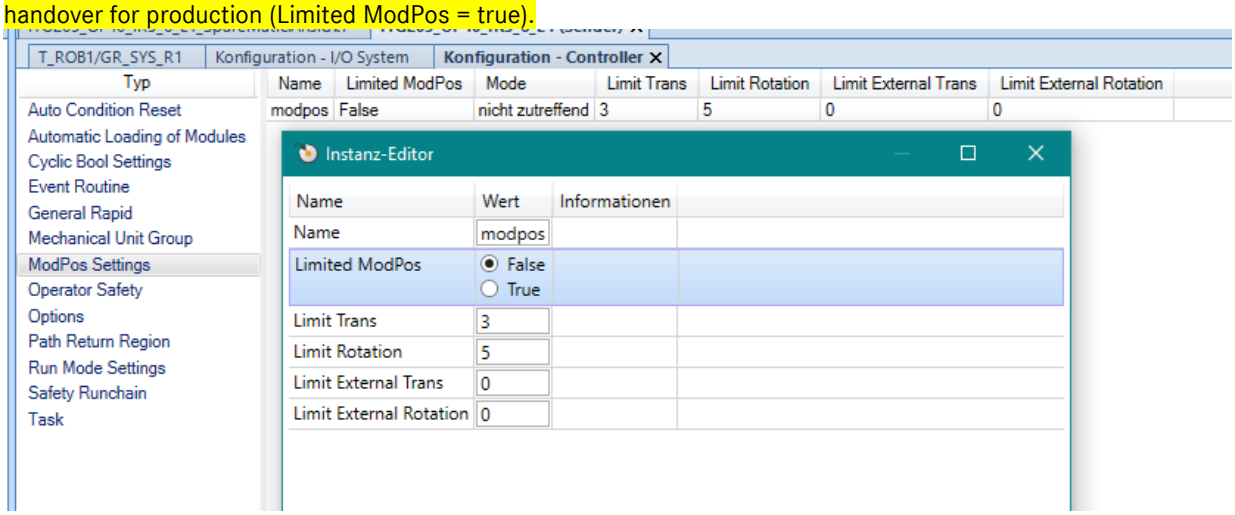


Figure 5: Specifications for setting the correction restriction

8.7. Storage of System Configurations (Profinet, Excel Spreadsheet for Creating Signal Names)

The software must be used to configure the bus project for the ABB controller

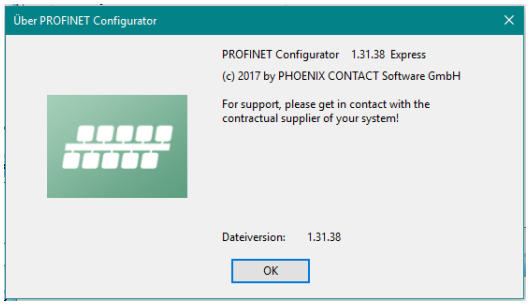


Figure 6: Profinet programming for ABB IRC5 from RW 6

is to be used. If other software packages are used, they must be handed over to the client and the maintenance department, including any necessary licenses, so that they can expand the project programming.

Specification
The Profinet project data belonging to the controller must be stored in full as a ZIP file in the HOME folder of the controller. The current Excel spreadsheets for the interface must also be stored in the home folder.

Please ZIP all the files in the Profinet project folder. The following example shows the files contained in the field bus projects (*.BCP) for an archive with the field bus project engineering
(Example project **m26-63965_2015-08-13**):

```
:/m26-63965_2015-08-13]
:/m26-63965_2015-08-13\_s102Bus]
:/m26-63965_2015-08-13\_s49IBG4]
:/m26-63965_2015-08-13\CntrlBrd_6]
:/m26-63965_2015-08-13\CntrlBrd_6\_s49IBG4]
:/m26-63965_2015-08-13\CntrlBrd_6\_s49PNIO]
/m26-63965_2015-08-13\CntrlBrd_6\_s49PNIO\PNARID.aru
/M26-63965_2015-08-13.bcp
/m26-63965_2015-08-13\_s49IBG4\Version.ini
/IPPNIO.xml
/m26-63965_2015-08-13\CntrlBrd_6\_s49IBG4\Data.INI
/m26-63965_2015-08-13\CntrlBrd_6\_s49PNIO\IPPNIO.xml
/m26-63965_2015-08-13\CntrlBrd_6\_s49PNIO\Pnio.ini
/m26-63965_2015-08-13\Upgrade.log
```

Figure 7: Example of the necessary files of a fieldbus project engineering (without the GSDML files)

Specification
The ZIP file must include all the GSDML files required to enable all I/O units (power source, Leoni, Murr MVK modules, HKS, etc.) to be addressed by a fresh installation of the Profinet parameterization software.
(Operating instructions, CAD data, etc., which are included in the GSDML downloads of some manufacturers, are not permitted to be included in the ZIP).

If not all the GSDML control files are available, the project cannot be extended and will be displayed as shown below:

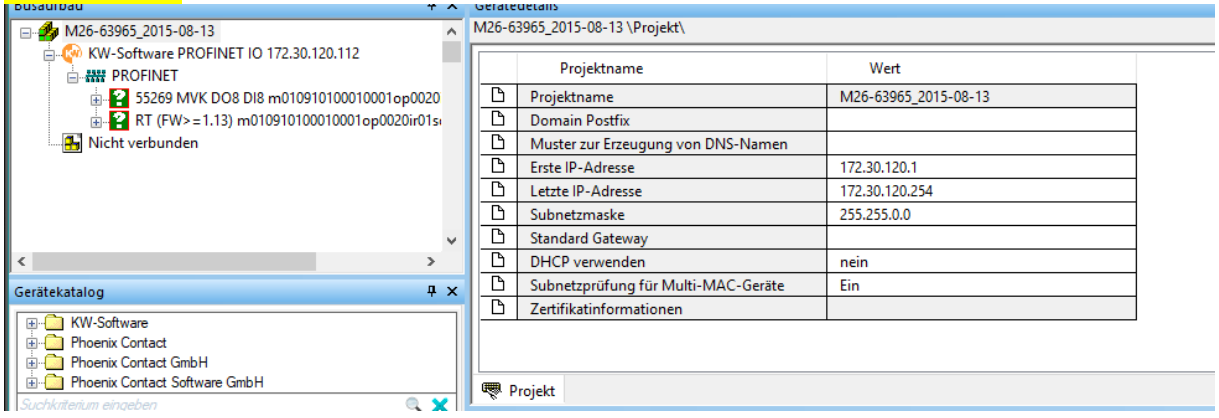


Figure 8: Example showing missing GSDML files ("?" icon) in a project

8.8. Setting the Arc Package for ABB Welding Robots

The standard IO Welder must be booted and activated for the robots concerned. The signals of the power sources are identified with SQ1 and SQ2 in their designations. Below is an example of two welding robots (T_ROB1 and T_ROB2).

Typ	Name	Welder Type	Loaded in robot	Use Arc Equipment Class	Use Arc Equipment Properties
Arc Equipment	ARC1_EQUIP_T_ROB1	StandardIO	T_ROB1	stdIO_T_ROB1	stdIO_T_ROB1
Arc Equipment Analogue Inputs	ARC1_EQUIP_T_ROB2	StandardIO	T_ROB2	stdIO_T_ROB2	stdIO_T_ROB2

Figure 9: Equipment settings (required for each robot)

Typ	Name	Equipment Class File Name	Path
Arc Equipment	stdIO_T_ROB1	awEquipSTD	RELEASE:/options/arc/WeldEquip/Code/
Arc Equipment Analogue Inputs	stdIO_T_ROB2	awEquipSTD	RELEASE:/options/arc/WeldEquip/Code/
Arc Equipment Analogue Outputs			
Arc Equipment Class			

Figure 10: Setting the equipment class (required for each robot)

Typ	Name	ManFeedInput	WeldInhib	WeaveInhib	TrackInhib	SupervInhib	StopProc	ArcEst	ArcEstLabel	ArcEst2	ArcEstLabel2
Arc Equipment	stdIO_T_ROB1		siR1_BlockArc			siR1_BlockParam		diSQ1_LiBo_OK	MINOR		
Arc Equipment Analogue Inputs	stdIO_T_ROB2		siR2_BlockArc			siR2_BlockParam		diSQ2_LiBo_OK	MINOR		
Arc Equipment Analogue Outputs											
Arc Equipment Class											
Arc Equipment Digital Inputs											

Figure 11: Setting the digital inputs (required for each robot)

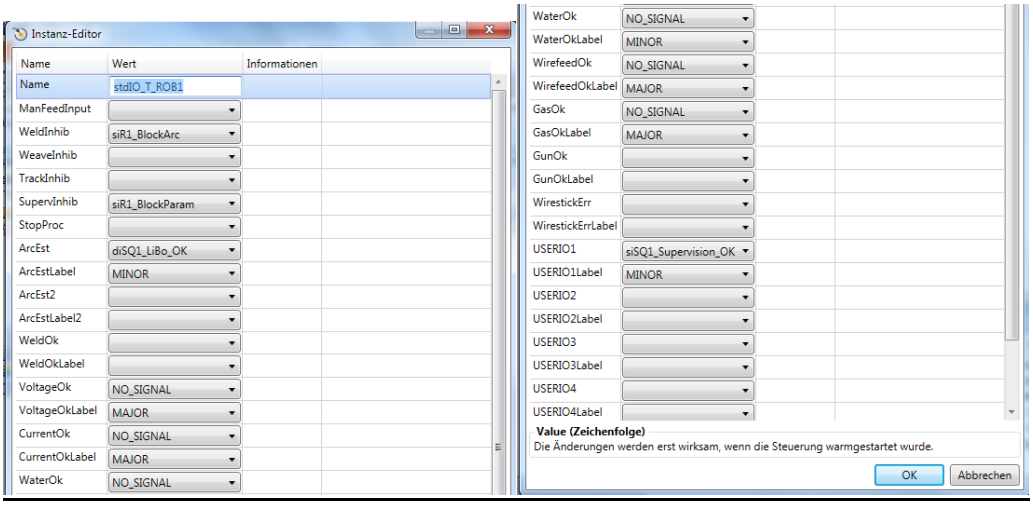


Figure 12: Setting the required parameters with the specified responses (required for each robot)

Typ	Name	AWError	GasOn	WeldOn	FeedOn	FeedOnBwd	SchedStrobe	ProcessStopped
Arc Equipment	stdIO_T_ROB1		doGas_Ein_SQ1	doArcOn_SQ1	soDraht_Vor_SQ1	doDraht_Zurueck_SQ1		
Arc Equipment Analogue Inputs	stdIO_T_ROB2		doGas_Ein_SQ2	doArcOn_SQ2	soDraht_Vor_SQ2	doDraht_Zurueck_SQ2		
Arc Equipment Analogue Outputs								
Arc Equipment Class								
Arc Equipment Digital Inputs								
Arc Equipment Digital Outputs								

Figure 13: Setting the digital outputs (required for each robot)

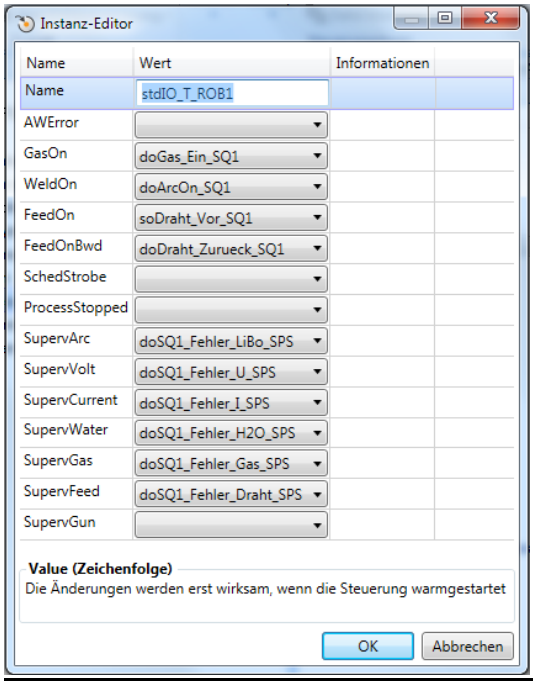


Figure 14: Setting and assigning the I/O signals of a power source using robot 1 as an example (adapt appropriately for other robots)

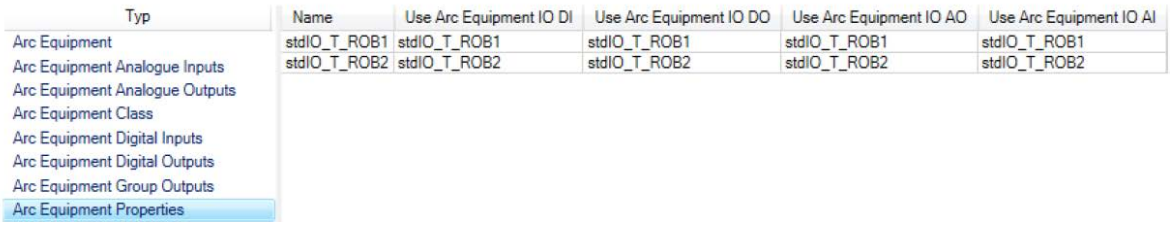


Figure 15: Assignment of ARC equipment characteristics shown here for two robots

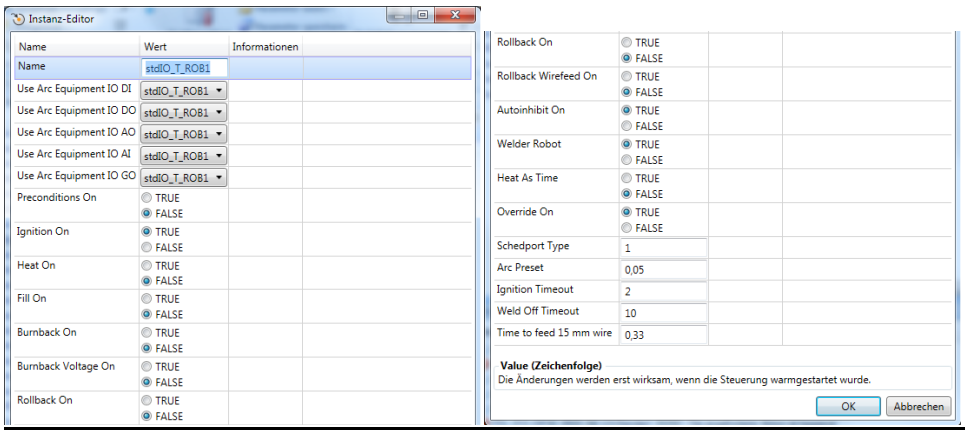


Figure 16: Setting the ARC function for robot 1 (adapt appropriately for other robots)

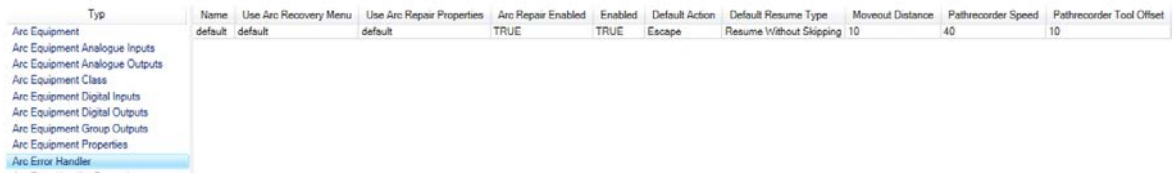


Figure 17: Setting the error handler in accordance with specifications

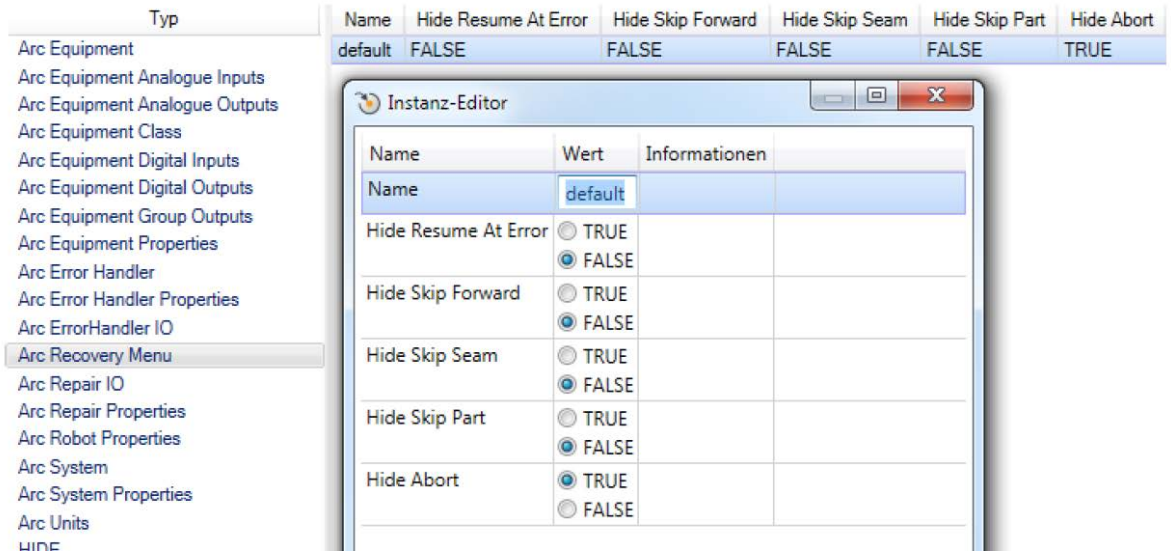


Figure 18: Setting the ARC menu in accordance with specifications

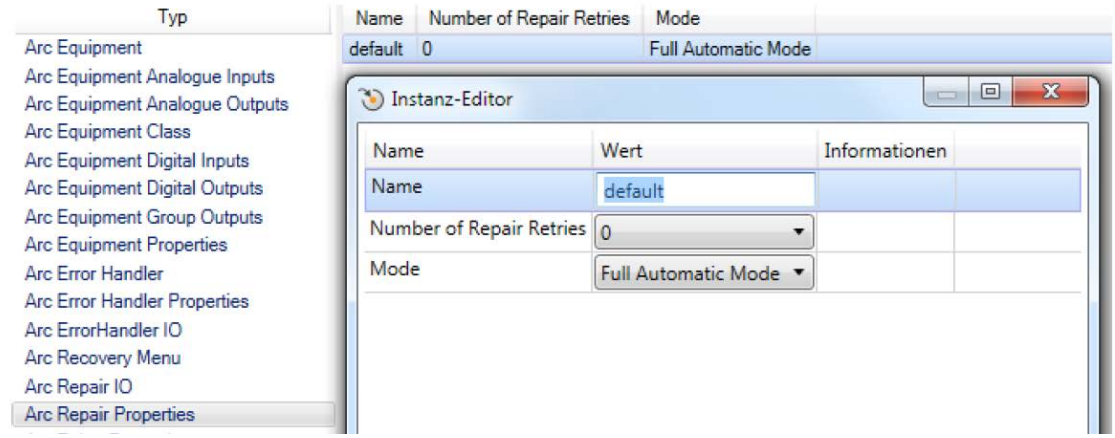


Figure 19: ARC repair characteristics – set to automatic mode!

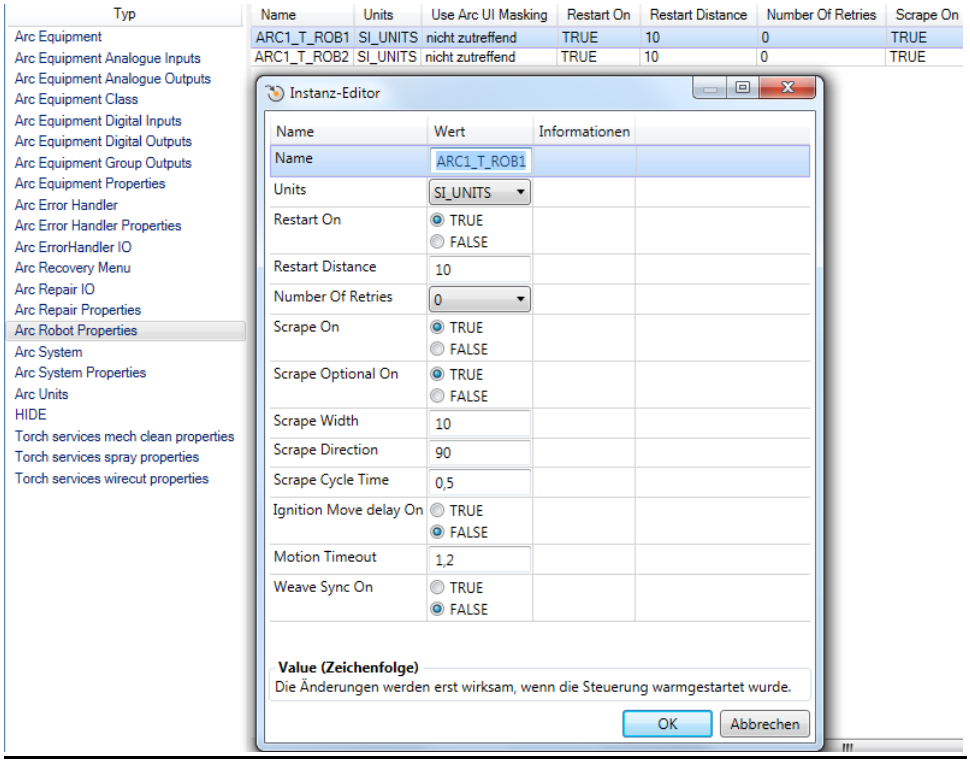


Figure 20: ARC robot characteristics using T_ROB1 as an example (adapt other robots accordingly)

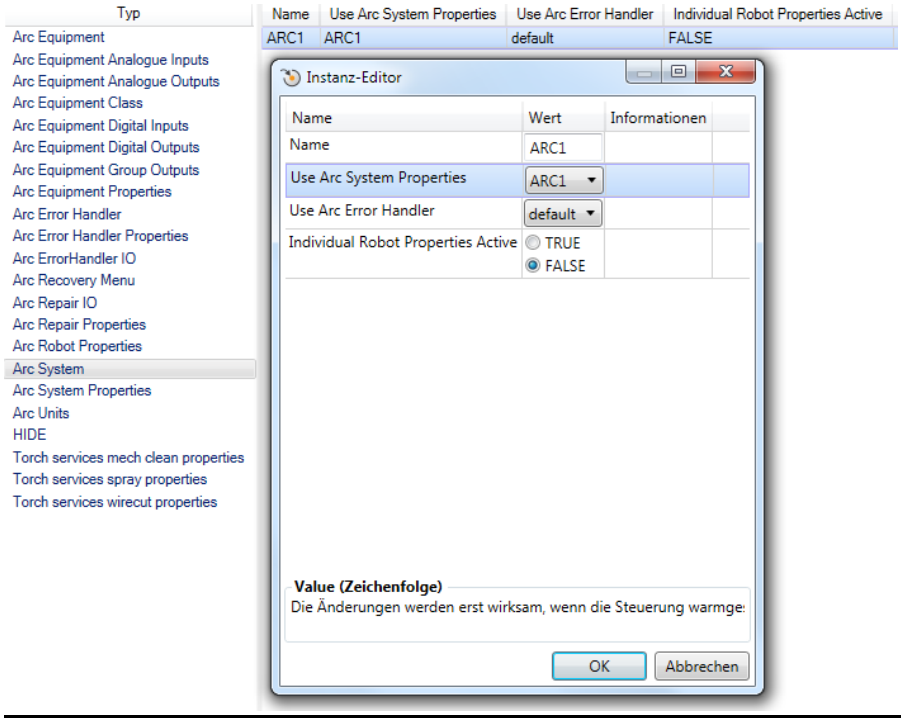


Figure 21: ARC system with necessary specifications.

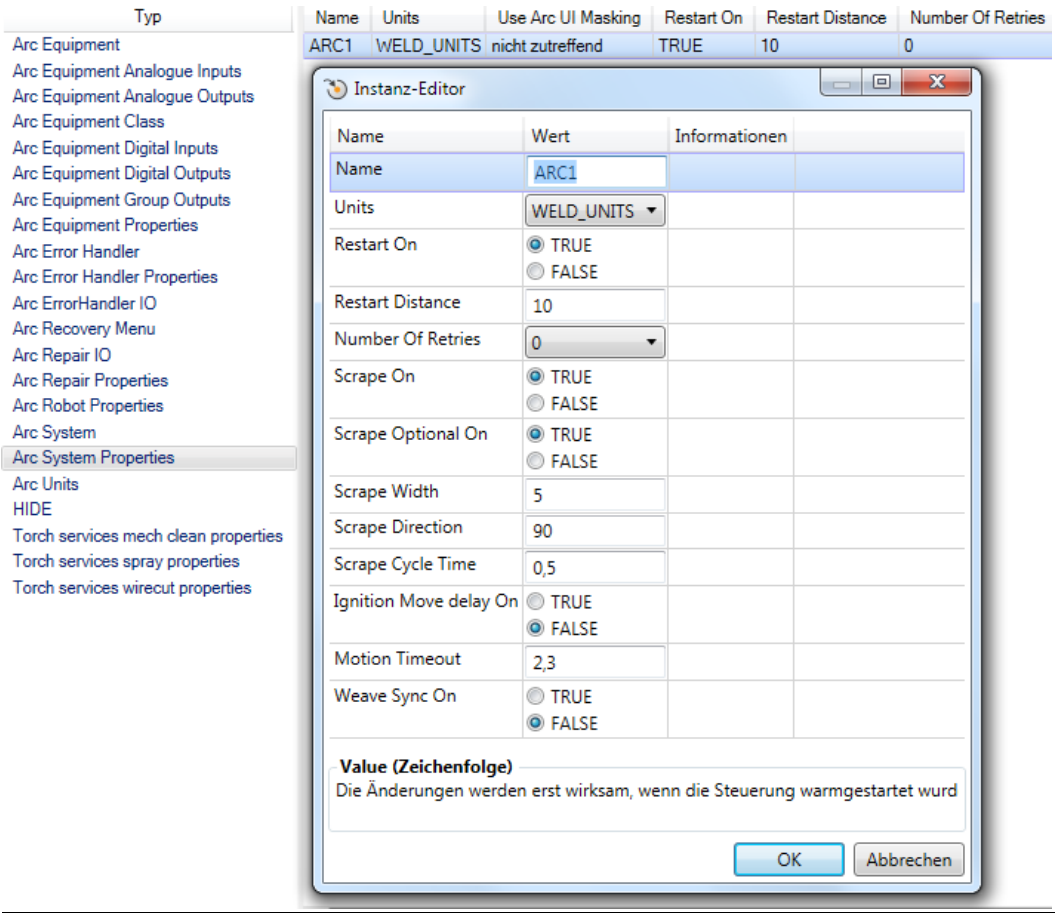


Figure 22: ARC system characteristics with the necessary specifications.

9. System Concepts

The following describes the standard systems. The necessary measurement sequence and the technical specifications to be observed are discussed.

Further information on specifications and the procedure in measuring ABB welding cells is contained in the manufacturer's documentation and the Project Book ↑*Robotics: General Powertrain*.

9.1. Handling IR with Stationary Welding Torch

Important
In tandem processes or with the use of multiple welding torches on a handling robot, for each power source a ground line shall be provided.

The following describes the procedure in commissioning regarding measurements.

1 robot (stationary jig/fixture)

Step	Measurement to be performed
1	Determine robot TCP
2	Determine external TCP for welding torch
3	Determine workpiece coordinates (work object)

Important
For welding at the tops and bottoms of jigs/fixtures, separate work objects shall be used in each case, to improve the accuracy of the system.

9.2. Robots (1-2) and Two-axis Turntable

The following two-axis turntable is available

Load capacity / Type	IRBP A750
Order number	See order list
Load capacity	750 kg
Type	Standard positioner

Other two-axis turntables with smaller load capacities are possible on request and pending approval by Daimler.

To ensure an optimal operating position, the robot shall be placed on a base.

The following substances shall be provided at the plate (for available connection points, see ***Fehler! Verweisquelle konnte nicht gefunden werden.***):

- Profinet + voltage
- Air
- Welding ground

The axes are reversible. The plate is endlessly rotating depending on the wiring.

Important
In tandem processes or with the use of multiple welding robots on a DCP, for each power source a ground line shall be provided in the DCP. **The two-axis turntables from ABB come with only 1 integrated ground line.** Additional ground lines shall be routed externally.

The following describes the procedure in commissioning regarding measurements.

Measurement of the jig/fixture load is possible before and after the calibration of the robots.

1x robot on two-axis turntable

Step	Measurement to be performed
1	Determine robot TCP
2	Calibrate robot with DCP
3	Determine workpiece coordinates (work object)

2x robots on two-axis turntable

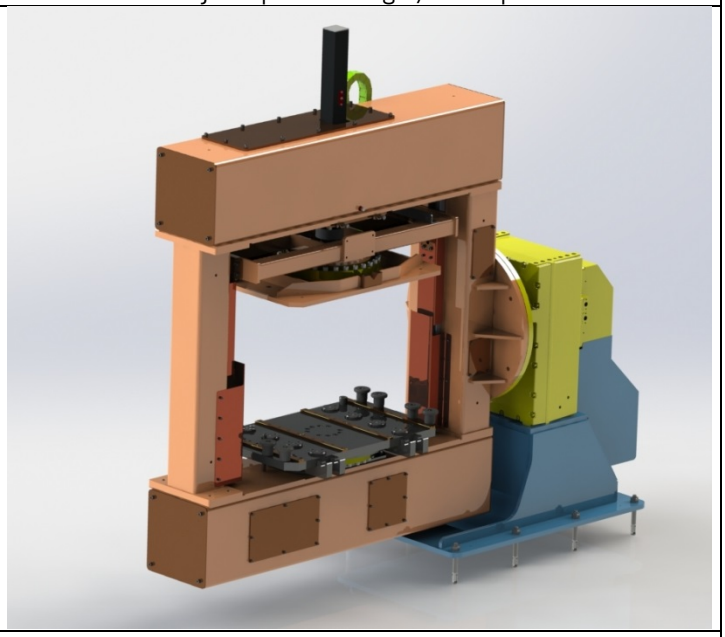
Step	Measurement to be performed
1	Determine robot 1 TCP
2	Determine robot 2 TCP
3	Calibrate robot 1 with DCP
4	Measure robot 2 on robot 1
5	Determine robot 1 workpiece coordinates (work object)
6	Determine robot 2 workpiece coordinates (work object)

Important
For welding at the tops and bottoms of jigs/fixtures, separate work objects shall be used in each case, to improve the accuracy of the system.

The commissioning shall conclude with a check of the synchronized trip from robot 1 and robot 2 onto the plate of the DCP. No programming may occur beforehand.

9.3. Robots (1-2) and Closing Unit

The following closing unit is available. This is a special machine specially manufactured by ABB for this application. The detailed technical specifications shall therefore be requested from ABB at the start of the project or the necessary technical adjustments coordinated with the ABB by the system builder.
If a closing unit is used, the closing force shall be checked cyclically. Details shall be requested from the manufacturer, ABB.

Load capacity / Type	FBU RP-1201-01-001
Order number	Project-specific design / on request
Graphic	
Max. device weight	~1000 kg
Closing force	50 kn
Substance connections to device adjuster	1x Harting modular: Profinet, voltage (24V logic + 24V actuator), welding ground, air)
Positioning accuracy (A1)	The precise data shall be requested from ABB
Positioning accuracy (A2)	
Positioning accuracy (stroke)	
Force control	The unit presses the two assembly plates together with a programmable force. Should the force diminish during the process, the closing unit will adjust accordingly (tracking in closing direction). If the force increases, the self-locking action of the drive for the die will be strong enough to compensate for this force.
Type	Special positioner

The closing unit is put in operation by ABB on site. For optimizing the motion, the device must be installed.

To ensure an optimal operating position, the robot shall be placed on a base.

The following substances are available at the plate:
- Profinet + voltage
- Air
- Welding ground

The axes are reversible.

Important
In tandem processes or with the use of multiple welding robots on a closing unit, for each power source a ground line shall be provided.

The following describes the procedure in commissioning regarding measurements.

1x robot on closing unit

Step	Measurement to be performed
1	Determine robot TCP
2	Calibrate robot on closing unit
3	Determine workpiece coordinates (work object)
4	Perform force calibration
5	Calibrate stroke

2x robots on closing unit

Step	Measurement to be performed
1	Determine robot 1 TCP
2	Determine robot 2 TCP
3	Calibrate robot 1 on closing unit
4	Measure robot 2 on robot 1
5	Determine robot 1 workpiece coordinates (work object)
6	Determine robot 2 workpiece coordinates (work object)
7	Perform force calibration
8	Calibrate stroke

Important
For welding at the tops and bottoms of jigs/fixtures, separate work objects shall be used in each case, to improve the accuracy of the system.

The commissioning shall conclude with a check of the synchronized trip from robot 1 and robot 2 onto the plate of the DCP. No programming may occur beforehand.

9.4. Robots (1-2) and Rotator (1 station)

Load capacity / Type	IRBPL-2000
Order number	See order list

Load capacity	2000 kg
Type	Special positioner

The rotator comprises the drive and the support bushing.
To ensure an optimal operating position, the robot shall be placed on a base.

The following substances are available at the plate:
- Profinet + voltage
- Air
- Welding ground

The axes are reversible or restricted depending on the wiring.

Important
In tandem processes or with the use of multiple welding robots on a rotator, for each power source a ground line shall be provided.

The following describes the procedure in commissioning regarding measurements.

1x robot on rotator

Step	Measurement to be performed
1	Determine robot TCP
2	Calibrate robot on rotator
3	Determine workpiece coordinates (work object) for top and bottom

2x robots on rotator

Step	Measurement to be performed
1	Determine robot 1 TCP
2	Determine robot 2 TCP
3	Calibrate robot 1 on rotator
4	Measure robot 2 on robot 1
5	Determine robot 1 (work object) workpiece coordinates for top and bottom
6	Determine robot 2 (work object) workpiece coordinates for top and bottom

Important
For welding at the tops and bottoms of jigs/fixtures, separate work objects shall be used in each case, to improve the accuracy of the system.

The commissioning shall conclude with a check of the synchronized trip from robot 1 and robot 2 onto the plate of the rotator. No programming may occur beforehand

9.5. Flexible Positioner (KIR)

To ensure an optimal operating position, the welding robot shall be placed on a base.

The following substances are available at the handling robot:
- Profinet + voltage
- Air

- Welding ground

Important
In tandem processes or with the use of multiple welding robots, for each power source a ground line shall be provided.

The following describes the procedure in commissioning regarding measurements.

1x robot on handling IR

Step	Measurement to be performed
1	Determine robot 1 TCP (welding robot)
2	Determine robot 2 TCP
3	Measure robot 1 on robot 2 (robot 1 = master)
4	Determine robot 1 workpiece coordinates (work object) on robot 2
5	Determine robot 2 (work object) workpiece coordinates for top and bottom

2x robots on handling IR

Step	Measurement to be performed
1	Determine robot 1 TCP (welding robot)
2	Determine robot 2 TCP (welding robot)
3	Determine robot 3 TCP
4	Measure robot 1 on robot 3
5	Measure robot 2 on robot 3
4	Determine robot 1 workpiece coordinates (work object) on robot 3
5	Determine robot 2 workpiece coordinates (work object) on robot 3

Commissioning shall conclude with a check of the synchronized trips of all robots on the handling robot.
No programming may occur beforehand

Important
The SafeMove2 interface currently allows a maximum of 2 robots. For a KIR constellation with more than 2 robots, the latter must come with discrete safety I/O interfaces (Pilz PSSU, model designation Powertrain BR205). Clarification with the IR manufacturer and Daimler **must** precede the project start.

9.6. Other System Concepts

The manufacturer shall be asked about any special shapes, which shall be discussed with Daimler **prior to use**.

If IRs are placed on positioners, holding a 150 kg wire drum **per** robot shall be possible.

Detailed information, data sheets, etc., are available through the internet at
https://new.abb.com/products/robotics/en

10. Specifications on Weld Programming

The manufacturer's documentation (such as *Arc and Arc Sensor Application Handbook*) for programming welding scope shall be observed. At the project start the system builder will receive sample programs for designing the welding programs, including error handling. ↑*Robotics: General Powertrain* and on the download portal.

Specifications
For welding with ABB robots the error handler must be set as given in 8.8.
(Additional information can be seen in Appendix 8))

At the start of the project, a sample program for welding with the error handler must be obtained from the download portal (Planning is the contact) by the supplier. Questions can be clarified during the initial launch meeting.

Specifications
The supplier must demonstrate the functionality of error handling, KIR welding and re-programming with one (1) multi-robot cell in Robot Studio while the robot program is running as part of the design release. The installation must be booted with all the necessary software options, I/O interface and template. This cell then serves as a blueprint for further cells. At that point, the cell does not have to contain a correct frame and a real component part – but two robots and one rotator must be demonstrated and each robot must run through at least three weld seams when the external axis is rotated. PLC signals may be simulated or bypassed. Power sources / cleaning units may be simulated (I/O window of the simulation).
Power source-specific data recording is described in ↑*Welding Technology Programming* and **implemented by the system manufacturer (including the necessary robot programming)**. Sample programs for this purpose are available on the download portal.

Specification
The DMC relating to the component part to be welded now (or the partial information clearly required for identification within a plant life cycle - to be clarified in the start discussion) must be communicated to the robot by the PLC, but **before the 1st seam is welded**. If this is not possible for some reason, the robot may use an internal component part counter for this purpose after **explicit approval**.

Important
Generally the following limitation of the *ABB ArcWare* shall be observed:
Only 1 weld track may be contained in 1 procedure (PROC) in order to use error handling (otherwise software errors in error handling will result!).

11. Specifications on Measuring

11.1. TCP / Welding Torch Measurement / Measurement of External Axes

The welding torch service system (TSC, Torch Service Center) consists of a TCP measurement unit and welding torch cleaning system).

The following systems are available for ABB robots:

- **ABB TSC Edition 2018 with** welding torch service unit and *Leoni Advintec TCP 3D* TCP measuring system (see ↑*Robotics: General Powertrain* Appendix 5) constructed as per ↑*Welding Technology Programming*

- **Cloos Sparematic** with torch service unit, Leoni TCP measuring system and automatic change of contact tube and gas nozzle ↑*Welding Project Planning*

Existing systems use an older system:

- ABB TSC Edition 2017 with BullsEye (use to be clarified with client PRIOR to ordering)

Specification
All welding robots **must** be fitted with automatic TCP correction. Sharing the TCP correction (2 robots use 1 TSC) is **not** permitted. The measurement and cleaning sequences in the TSC shall also be possible while a positioner is being rotated (observe robot interference contours).

Use of the Leoni Advintec TCP3D system is recommended for TCP measurements. To attain maximum accuracy, the system is used, instead of manual measurement with measuring tips, also for measuring the work objects in welding jigs/fixtures and for calibrating the welding robots on external axes or a handling robot. The system is in this case 100% compatible with the measuring tips from Aumann described in ↑*Robotics: General Powertrain* Appendix 5.

Specification
In order to ensure that the **Leoni can be used to measure IR-IR, IR-ext. axis** and the **work objects**, it **must be possible to fit the adapters for the Leoni system to the mounting points of the measuring tips on the clamping frame and it must be possible to carry out measurements without dismantling fixture elements**. (Observe the robot interference contours).

Figure 23:Arrangement of the Leoni system for the measurement of tensioning frames and IR-R – the photo shows assembly at the point where a tip was mounted before.

11.2. Specifications on Programming the Measuring Process

The measurement is to be carried out with the routines available from the download portal. The routines have to be adapted selectively (tool names + teach positions and set up Leoni). In the course of the start-up meeting, one of the robot programmers from the manufacturer of the installation will be instructed in its use. The test routines must be stored for each measurement. Examples are available on the download portal.

12. Directories

12.1. Source Code Directory

Es konnten keine Einträge für ein Abbildungsverzeichnis gefunden werden.

12.2. List of Figures

12.3. List of Tables

12.4. List of Appendices

APPENDIX 1 – Programming Specifications and I/O for Power Sources

Some sample programs and info files – for detailed and complete programs, refer to download portal.

APPENDIX 2 – EPS SafeMove Information for Rotator

Circuit diagram and information from ABB for the safe shutdown of rotators.

APPENDIX 3 – Information on MultiMove

Manufacturer's information on MultiMove. Take note of the documentation.

APPENDIX 4 – Mechanical Interface for the Rotator and Positioner

Documentation of the interface

13. Checklist & Summary

Below is a list of the main topics dealt with in the previous document:

	Description ➔ Text criterion	Responsible	Inspection by				
			Supplier	Planning	TFT	Maintenance	IR manufacturer
1	Not more than eight tasks defined (one free task) →Monitoring	Plant manufacturer	X/P			A	
2	Robots have been installed with template and sample program →Check options and program	Plant manufacturer	X/P			A	
3	Positioners in a separate task →Check task list	Plant manufacturer	X/P			A	
4	Names of the tasks match the specifications →Check the task list	Plant manufacturer	X/P			A	
5	MultiMove only for welding (exceptions are agreed with Project)	Plant manufacturer	X/P	A			
6	Welding load specification complied with (GMAW 10 kg, LH 60 kg)	Plant manufacturer	X	P		A	
7	Commissioning of hose package by SQ manufacturer completed →Commissioning log	Plant manufacturer	P		A		X
8	Welding earth correctly dimensioned + laid →Check compartments and fixtures	Plant manufacturer	X/P		A		
9	Torsion limits for torch hose package adhered to during all movements (reserve 0°) →Analyze the course of movement	Plant manufacturer	X		P/A		
10	Robot soft limits adapted to DVS assembly position →IR moves all axes + test collision	Plant manufacturer	X/P		A		

11	Degree of freedom of rotator -180/+360° or DKP complied with, cable installation according to specifications	Plant manufacturer	P			A	X
12	Fixture does not oscillate during feed and loading/unloading →opt. monitoring	Plant manufacturer	X/P	A			
13	Mounting strips for fixture according to specifications →opt. monitoring	Plant manufacturer	X	P/A			
14	Robot base according to specifications – special shapes agreed with the manufacturer and approved.	Plant manufacturer	X			P/A	
15	Load on the positioners (20% reserve), commissioning by IR manufacturer →Commissioning log, load planning	Plant manufacturer	P			A	X
16	IRC5 with safe interface and positioner control in line with specifications	Plant manufacturer	P			A	X
17	SafeMove with Cartesian monitoring only for absolutely essential areas →Safe project programming	Plant manufacturer	X	P		A	
18	Software options (→7.) booted correctly (Standard I/O welder, PathRecovery, abs. accuracy) → Check backup	IR manufacturer	P			A	X
18	Parameterization ModPos (programming ball) →Test	Plant manufacturer					
19	LUPO programming implemented, tech package installed →Check backup	Plant manufacturer	X		P/A		
20	For LH: Technology package installed and correctly applied →Check backup	Plant manufacturer	X		P/A		
21	Is the Profinet project included in the backup? →Check backup	Plant manufacturer	X			P/A	
22	Parameterization ARC package (standard I/O welder including error handler)	Plant manufacturer	X		P/A		
23	All installation concepts are in accordance with specifications	Plant manufacturer	X	P/A			
24	Measurement sequence according to specifications →Commissioning log	Plant manufacturer	X			P/A	
25	Work objects available on top and bottom →Welding program	Plant manufacturer	X		P/A		
26	Earth lines have not been joined together	Plant manufacturer	X/P		A		
27	Use of more than two robots in SafeMove version must be agreed with the client and IR manufacturer (safety engineering)	Plant manufacturer	X			A	P
28	Robot studio cell with fully functional robot program and error handler →Pack and Go + presentation	Plant manufacturer	X		P/A		
29	DMC (or part info) transmitted from PLC to robot before welding →Test	Plant manufacturer	X	P/A			
30	Each weld track in a separate procedure →Backup	Plant manufacturer	X/P		A		
31	User TSS and GPK have been created → Check log-in	Maintenance	P		A	X	

32	TCP measurement using Leoni or Sparematic →Presentation	Plant manufacturer	X/P		A		
33	A Leoni sensor can be attached to the fixture for ext. axis and robot measurement	Plant manufacturer	X/P		A		
34	Measurement with Leoni ext. axis and robot is possible without dismantling the jig (Option: Automatic execution is programmed)						
35	Measurement programs for work objects, tensioning frame/rotator and robot are used →Presentation	Plant manufacturer	X/P		A		
36	Standard behavior when switching to automatic mode (Reset program pointer, continuous processing)	Plant manufacturer	X		A/P		
37	Automatic change of kinematics to selected programming window	Plant manufacturer	X		A/P		
36							

14. Abbreviations

Abbreviation	Explanation
IRB	Industrial Robot
KIR	Cooperating Industrial Robot (Kooperierende Industrie Roboter)
TCP	Tool Center Point
TSC	Torch Service Center (welding torch cleaning device, wire cutter, TCP measurement)
PLC	Programmable Logic Controller
I/O	Inputs & outputs of a control program (the interface)
SQ	Power source
LS	Laser
LH	Laser hybrid – combined GMAW and laser process
GMAW	Gas metal arc welding