

Powerball Lightweight Arm LWA 4 P

Assembly and operating manual



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SCHUNK products are inspiring.

Our detailed assembly and operation manual will support you.

Do you have further questions? You may contact us at any time – even after purchase.

Kindest Regards

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1 About this manual

1.1 Purpose/validity

This manual forms part of the light-weight arm and describes safe and proper use during all phases of operation.

This manual is only valid for the light-weight arm as specified on the front page.

The following knowledge is necessary:

- Advanced knowledge of mechanical engineering
- Advanced knowledge of electrical engineering
- Knowledge of robot control systems

1.2 Symbols in this manual

To give you quick access to information, the following symbols will be used in this guide:

1.2.1 Signal words

DANGER	Dangers for persons. Non-compliance will inevitably cause irreversible injury or death.
WARNING	Dangers for persons. Non-compliance may cause irreversible injury or death.
CAUTION	Dangers for persons. Non-observance may cause minor injuries.
ATTENTION	Information about avoiding material damage

1.2.2 Symbols



Warning about a danger point



Warning about hot surfaces



Warning about dangerous electrical voltage



Warning about hand injuries



General mandatory sign to prevent material damage

1.3 Terms used in this manual

Term	Meaning
Light-weight arm	<p>Powerball light-weight arm LWA 4 P (hereinafter referred to as "light-weight arm" or "LWA")</p> <p>The light-weight arm is a modular system. It is made up of individual rotary modules, connecting elements and a pedestal. The drive controllers are integrated into the light-weight arm.</p>
Operators (users)	Responsible (user) for operating the light-weight arm.
System integrator (automated system integrator)	Person responsible for safely integrating the light-weight arm into an automated system. Responsible for starting up the automated system.
Operating area	The light-weight arm's operating area is made up of the operating areas of the individual axes that make up the light-weight arm. The connecting elements partially restrict the range limits of the individual axes.
Danger zone	<p>Area in which risks to the life or health of people or damage to property can be expected. The danger zone shall be secured by a protective barrier.</p> <p>When specifying the protective equipment, it is important to take into account the stopping distances of the moving light-weight arm.</p>
Protection zone	Protected area outside the danger zone (the area within which the operator is permitted).
Setup work	All work on the light-weight arm or the automated system that enables switching to automatic operation.
Additional axis	<p>Not part of the light-weight arm but activated by the robot control system.</p> <p>For example: SCHUNK gripper PG+070 with FWS.</p>

1.4 EC declaration of conformity and declaration of incorporation

This light-weight arm is an incomplete machine, as defined in the EC Machine Directive. The light-weight arm may only be operated under the following preconditions:

- The light-weight arm has been integrated into a machine or automated system by a system integrator.
- All the necessary safety functions and protective equipment have been added to the light-weight arm as specified for a complete machine as defined in the EC Machine Directive.
- The automated system corresponds to the EC Machine Directive. This has been established by means of a conformity assessment procedure.

Declaration of conformity The system integrator is obliged to create a declaration of conformity for the entire system, in accordance with the Machine Directive. The declaration of conformity forms the basis for the automated system's CE marking. The light-weight arm may only be operated in accordance with local laws, specifications and standards.

Declaration of incorporation As an incomplete machine, the light-weight arm is delivered by SCHUNK with a declaration of incorporation in accordance with Annex II B of Machine Directive 2006/42/EC. This declaration of incorporation includes a list of basic requirements observed in accordance with Annex I and the light-weight arm's assembly and operating manual (the present documentation).

The declaration of incorporation states that starting up the incomplete machine remains impermissible until the incomplete machine is installed in a machine or assembled with other parts to form a machine and these correspond to the specifications of the EC Machine Directive and there is an EC declaration of conformity as defined in Annex II A.

The declaration of installation and its annexes are retained by the system integrator as part of the complete machine's technical documentation ([👉 14, Page 50](#)).

1.5 Applicable documents

- SCHUNK Mobile Gripping Systems catalogs
- Assembly and operating manual for flat change system FWS *
(consisting of a flat change adapter FWA and a flat change head FWK)
- General terms of business *
- Assembly and operating manual for robot control system (supplied by customer)
- Operating software for robot control system (supplied by customer)

Alternatively, the data listed above with * can be downloaded on the following pages.

* www.schunk.com

2 Basic safety notes

The light-weight arm described in the assembly and operating manual is a component intended for industrial use.

The light-weight arm represents the state of the art and the recognized safety rules at the time of delivery. However, it can present risks if, for example:

- The light-weight arm is not used in accordance with its intended purpose.
- The light-weight arm is not installed or maintained properly.
- The EC Machine Directive, the VDE directives, the safety and accident-prevention regulations and environmental protection regulations valid at the usage site, or the safety and installation notes are not observed.

The light-weight arm may only be used when in a technically perfect condition and as intended, with an awareness of safety and possible dangers.

It must always be used in compliance with the present assembly and operating manual, including the declaration of incorporation. Malfunctions that could affect safety must be rectified without delay.

2.1 Appropriate use

The light-weight arm is intended for installation in a machine. The requirements of the applicable guidelines must be observed and complied with.

The light-weight arm may be used only in the context of its defined application parameters.

Any other use or use exceeding that specified is an infringement of appropriate use. The manufacturer bears no liability for damage resulting from such use.

Examples of inappropriate applications:

- Transporting people and animals
- Use as a climbing aid
- Use outside the permissible operating limits
- Use in a potentially explosive environment

- Use without additional protective equipment
- Use outdoors
- Leaning on the light-weight arm

NOTE

Modifications, additions, and conversions which could impair safety may not be made to the light-weight arm without permission from SCHUNK.

Unauthorized changes result in the exclusion from product liability.

2.2 Ambient conditions and operating conditions

- Use the light-weight arm only within its defined application parameters, technical data and catalog
- Make sure the environment is clean and the ambient temperature corresponds to the specifications. Comply with maintenance and lubrication intervals.
- Make sure that the environment is free from splash water and vapors as well as from abrasion or processing dust.

2.2.1 Protective equipment

- Provide protective equipment in line with EC Machine Directive.

2.3 Personnel qualification

The assembly, initial start-up, maintenance, and repair of the light-weight arm may only be performed by trained specialist personnel.

Personnel The following persons or groups of persons are defined for the light-weight arm:

- Operator
- System integrator
- User

Operator The operator is obliged to observe and implement the occupational safety regulations. These include:

- The operator must comply with his or her monitoring duties.
- The operator must carry out briefings at specified intervals.

Every person called upon by the operator to work on the light-weight arm must have read and understood the complete assembly and operating manual, especially chapter 2 "Basic safety notes". This applies particularly to personnel only used occasionally, such as maintenance personnel.

System integrator Person responsible for safely integrating the light-weight arm into a machine or automated system. The system integrator is responsible for starting up the system and has the following tasks:

- Carrying out a risk assessment
- Creating an operating manual for the system
- Issuing the declaration of conformity
- Attaching the CE marking
- Adopting the necessary safety functions and protective equipment
- Setting up the light-weight arm
- Connecting the light-weight arm

User The user shall meet the following prerequisites:

- The user must be trained in the work to be carried out.
- Work on the light-weight arm may only be carried out by qualified personnel.

Qualified personnel refers to persons who, thanks to their specialist training, knowledge and experience and their knowledge of the applicable standards, can assess the work to be carried out and identify possible dangers.

2.4 Operating area, protection and danger zones

- Operating areas must be restricted to the minimum necessary
- The operating area shall be secured by means of protective equipment.
- The protective equipment (e.g. protective doors) must be located in the protection zone. In the event of a stop, the light-weight arm and additional axes brake and come to a standstill in the danger zone.

Protective barriers shall be used to prevent risks to persons, animals or objects.

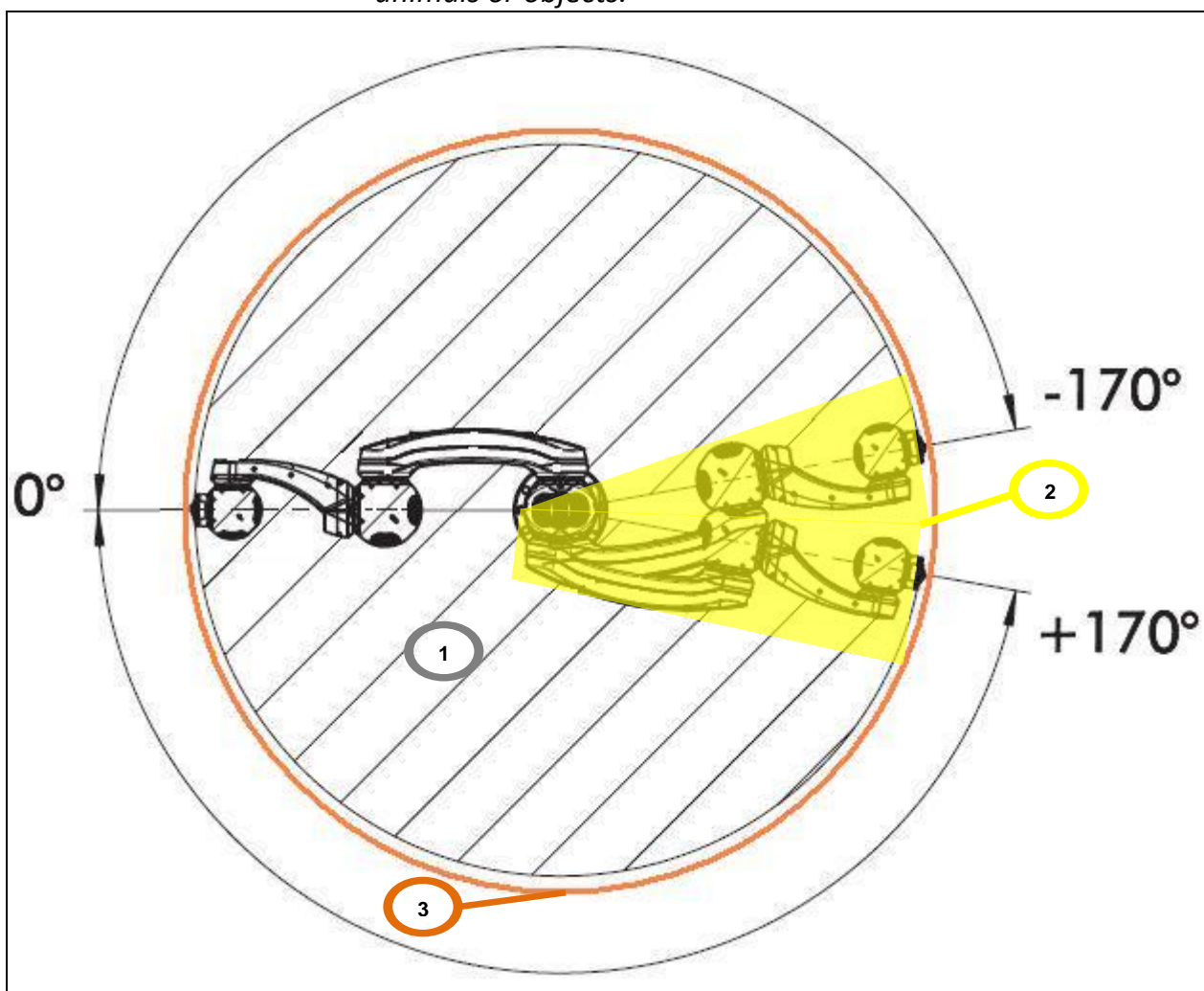


Fig.1 Horizontal operating area, zones marked for axis A1 with axis A2 in 90 degrees position
(robot arm shown in zero, maximum and minimum position)

1	Operating area
2	Stopping distance
3	Protection zone

2.5 Additional protective fittings

Software limit switches The axis ranges of all light-weight arm axes can be limited by means of adjustable software end positions.

These software end positions serve only to protect the machine and should be set in such a way that the light-weight arm can not travel as far as the mechanical limit stops.

The software limit switches are adjusted when setting up the light-weight arm in the machine.

Further information

Operating software for robot control system (option supplied by customer)

Labeling on the light-weight arm All signs, instructions, symbols and markings are safety-relevant components of the light-weight arm. They are attached by the manufacturer and by the system integrator. They must not be changed or removed.

Labeling on the light-weight arm includes:

- Rating plates
- Warnings
- Safety symbols
- Identification plates
- Line markings
- Name plates
- Reference marks

NOTE







Further information can be found in the technical documentation for the system to be created by the safety integrator

External protective equipment Access to the light-weight arm's danger zone shall be prevented by means of protective equipment. The protective equipment must comply with the requirements of standard EN 953 (Safety of machinery. Guards. General requirements for design of fixed and movable guards.) or of standard EN 13849-1 (Safety of machinery, Safety-related parts of control systems).

2.6 Safety-conscious working

- Avoid any manner of working that may interfere with the function and operational safety of the light-weight arm.
- Observe the safety, working and accident prevention regulations valid at the site of use.

General safety measures

	<div data-bbox="512 685 721 734">  DANGER </div> <p>Remaining in the light-weight arm's operating area can lead to serious physical injury or death!</p>
	<div data-bbox="512 947 721 996">  DANGER </div> <p>The light-weight arm can cause harm to persons and property unless functioning safety and protective equipment is used.</p> <ul style="list-style-type: none"> • The light-weight arm must not be operated if safety functions and protective equipment are deactivated or disassembled.
	<div data-bbox="512 1258 730 1308">  CAUTION </div> <p>The light-weight arm joints become very hot during operation!</p> <ul style="list-style-type: none"> • Avoid touching them. • Employ suitable protective measures, e.g. wearing protective gloves

External manual control The operator must ensure that only authorized persons operate the light-weight arm with an external manual control.

If multiple manual controls are used in one system, make sure that each manual control is allocated to one light-weight arm only. These must not become mixed up.



DANGER

Effective and ineffective EMERGENCY STOP equipment can be dangerous!

Non-observance can lead to death, serious physical injury or major damage to property.

- Uncoupled or unconnected manual controls should immediately be removed from the sight and reach of personnel working on the light-weight arm in order to avoid mix-ups.

Malfunctions In the event of malfunctions on the light-weight arm, the following steps are necessary:

- Switch off robot control system and secure it against unauthorized restarting.
- Label the malfunction with a suitable warning sign.
- Record information about malfunctions.
- Rectify the malfunction and carry out a functional check.

Alterations Alterations to the light-weight arm require testing to ensure that the specified safety standards are guaranteed. New or altered programs must always be tested in accordance with the robot control system specifications.

This applies for all the components of the light-weight arm and includes alterations to the software and the configuration settings.





DANGER

Risk of injury when the machine/system moves unexpectedly in the danger zone!

- The light-weight arm may only be used when in a technically perfect condition and as intended, and in compliance with the safety specifications.

**Unforeseeable
sources of danger**



	<div style="background-color: #f4a460; padding: 5px;"> WARNING</div> <p>Risk of injury when the machine/system moves unexpectedly due to faulty handling!</p>
---	--

Assembly errors (e.g. overloading the light-weight arm) or mechanical faults (e.g. brake fault) can cause the light-weight arm and its load to drop.

If work is being carried out on the de-energized light-weight arm, secure the light-weight arm and load, so that they can not move unintentionally.

2.6.1 Additional safety and protective measures when working in the danger zone

- Whenever possible, carry out work **outside** the danger zone.
- The EMERGENCY STOP equipment must remain active.
- Switch off light-weight arm and secure it against unauthorized restarting.
 - If the work has to be carried on with the robot control system switched on, this must only take place in manual operating mode and at a low speed.
- Label work with a sign on the system.
 - This sign must also be present during temporary work breaks.

	<div style="background-color: #ff0000; color: white; padding: 5px;"> DANGER</div> <p>Risk of injury when the machine/system moves unexpectedly in the danger zone!</p> <ul style="list-style-type: none"> • If safety functions or protective equipment are deactivated due to maintenance or repair work, the protective function must be restored immediately after the work.
---	---

If maintenance and repair work in the danger zone is unavoidable, take the following measures:

- Work in manual mode must be carried out at a manually reduced speed.
- The operator must ensure before starting the maintenance and repair work that the necessary devices for release control in accordance with EN 60204-1:2006 (enabling device as per EN 60204-1:1997) are functioning.
- All persons must carry a device for release control (enabling device) on their person.
- The operator must be able to view the danger zone and avert a risk, in case of emergency.
- If possible, avoid having more than one person in the danger zone.
- If more than one person has to be in the danger zone, employ special, extra protective measures:
 - No person's view to the light-weight arm may be obstructed.
 - The persons must be able to maintain continuous eye contact.

2.7 Safety functions

The system integrator is responsible for installing the safety functions ([👉 2.3, Page 11](#)).

The following safety functions or circuits shall be implemented in the machine in accordance with the requirements of EN 13849-1:

- Operating mode selection
- Operator protection
- Local EMERGENCY STOP device
- External EMERGENCY STOP device
- Device for release control (enabling device)

Additional measures according to requirements of EN ISO 10218-2 (Robots for industrial environments, Safety requirements) shall be implemented in the machine by the system integrator.

3 Warranty

The warranty is valid for 12 months from the delivery date to the production facility under the following conditions:

- Intended use in 1-shift operation
- Observation of the maintenance and lubrication intervals
- Observation of the ambient conditions and operating conditions

Parts touching the workpiece and wearing parts are not part of the warranty.

4 Scope of delivery

The scope of delivery includes:

- One Light-weight arm LWA 4 P with one fitted manual tool change head FWK 115 and one pedestal
- Software for testing and diagnostics of the individual axes, see chapter 13 for details of CANopenTools (COT) and web link
- One USB connection cable (USB A to USB mini)
- One Plug insert of type Harting Han 3A-BU-S (09 20 004 2711) for connection on customer side
- 1 sleeve housing type Harting Han 3A-gg-M20 (19 20 003 0420)
- One cable fitting M20 (for cable diameter 5 to 9 mm)
- Two cables for CAN Bus, one for RS232 with connectors M12, 5 pole and D-Sub, 9 pole (to connect to a robot control device)
- Transport container (Part ID 9957491, see chapter 9 for details)

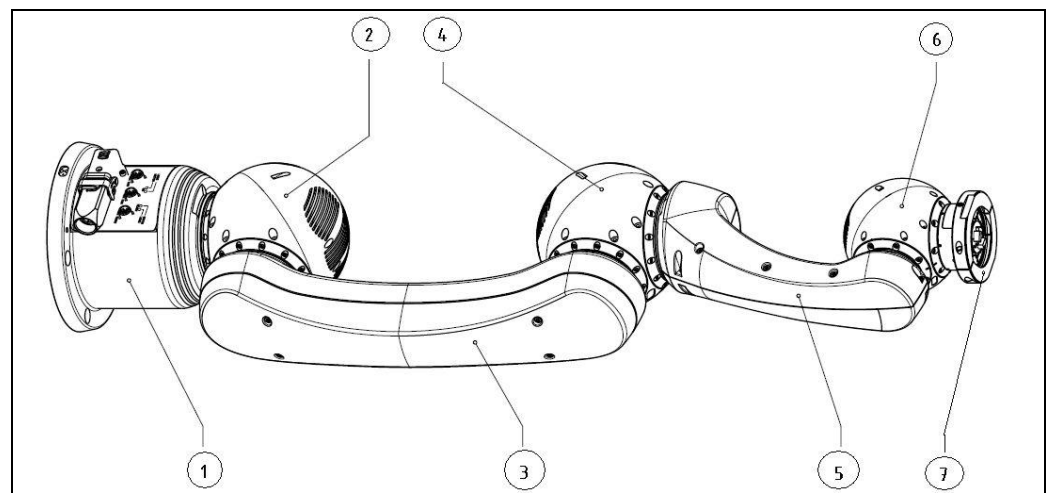


Fig.2 Principal constituents of LWA 4 P

Item	Description	Axis
1	Pedestal (robot base)	
2	Rotary module ERB145	A1 / A2
3	Connecting element	
4	Rotary module ERB145	A3 / A4
5	Connecting element	
6	Rotary module ERB115	A5 / A6
7	Flat change head FWK115	

Tab.1: Main assembly data for light-weight arm LWA 4 P



Fig. 3 Standard accessories Kit for LWA 4 P

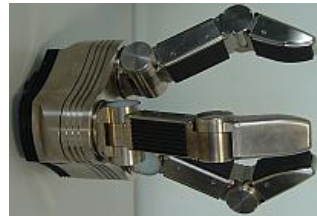
5 Accessories (optional)

In addition to the light-weight arm, the following additional accessories are available, within the standard product range:

- Electrical parallel grippers PG+70 (ID 31000796, WSG-050 with FWA 115 (ID 31000905) or EGP-040 - FWA 115 (ID 31001005)



- Three-finger hand SDH2 (part ID 0306452)



- Force/torque sensors
FTM 115 (part ID 30064043)
or FTM 075 (part ID 31001023)



- Manual tool change adapter
FWA 115 (part ID 31000871)



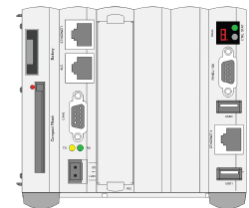
Adapter
FWA 115

- CAN Bus Adapters for USB PCM 13 (part ID 0307913) or PCM 15 (part ID 0307915), other Interface types available on request
- CAN Bus Termination adapter plug PAE 200 (part ID 31001036)
- Robot base plate for LWA 4 (part ID 31000866)

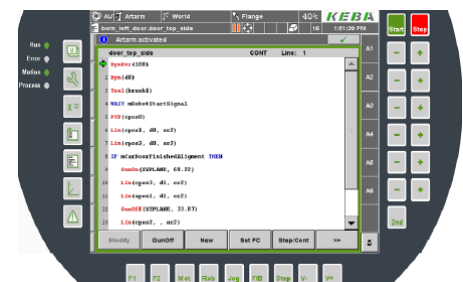


For a robot control device, we recommend using products from KEBA AG located in Linz / Austria. Training and support for application programming is available on request, but directly from manufacturer only. KEBA products may be purchased directly from the manufacturer or from SCHUNK.

- Robot control system central unit assembly (part ID 31000863)



- Manual operation unit with touch function assembly (part ID 31000864)



- CF card for KEBA robot control system (part ID 31000865)



- Robot control system with power supply 24 V DC and touch screen panel in a suitcase on rolls (part ID 31000862)



Fig. 4 Example of an optional accessory for LWA 4 P, KEBA Control and Teach Panel

6 Technical data

Weight [kg]	12.70					
Weight with pedestal [kg]	15.30					
Recommended workpiece weight [kg]	6 (including gripper, see chapter 6.1 for load capacity range)					
ambient temperature min. [°C]	5					
ambient temperature max. [°C]	55					
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
Max. angular acceleration [°/s ²]	150	150	150	150	150	150
Max. angular velocity [°/s]	72	72	72	72	72	72
IP rating	40					
Noise emission [dB(A)]	≤ 70					
Nominal voltage, rated voltage [VDC]	24					
Motor voltage range [VDC]	21.3 to 28.7					
Logic voltage range [VDC]	21.3 to 28.7					
Average current input [A]	3					
Max. current input [A]	12					
Communication interface	One CAN Bus for all axes, protocol: CANopen (CiA DS402:IEC61800-7-201					
Service Interface	USB-mini type B					

6.1 Dimensions

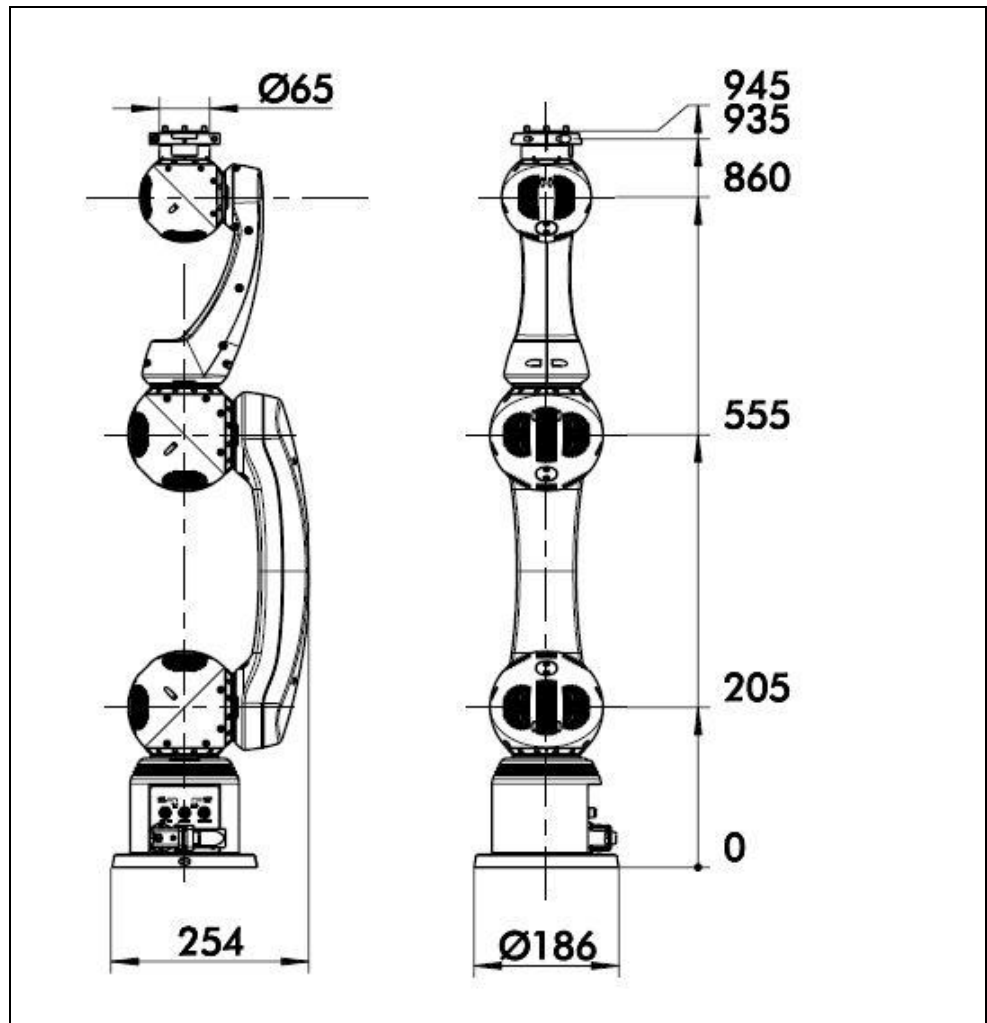


Fig. 5 Dimensions of light-weight arm LWA 4 P

Flat tool change system FWS

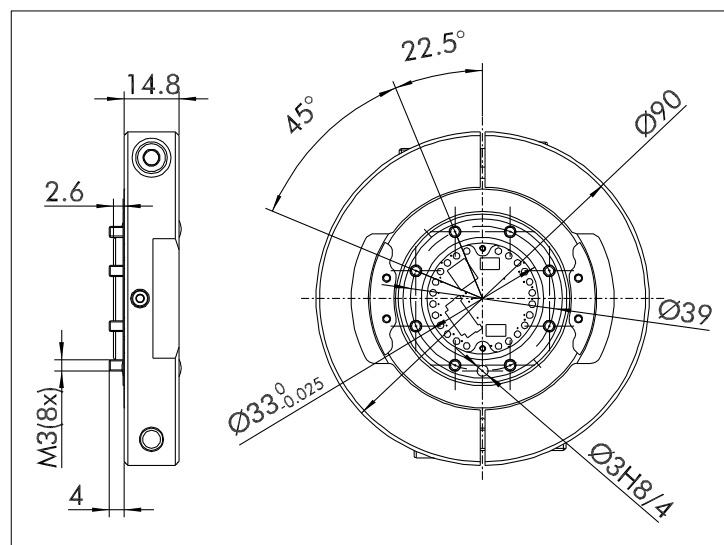


Fig. 6 Dimensions of Flat tool change system head FWK (connection robot side)

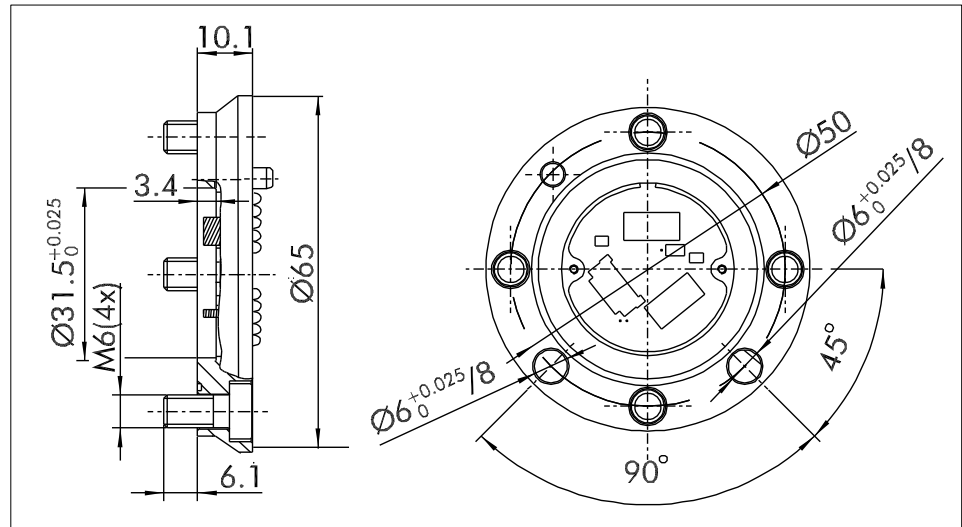


Fig. 7 Dimensions of Flat tool change system adapter FWA (connection tool side)

Axis data

Axis	Rotary module	Angle of rotation [°]	Angle of rotation limited by software [°]
A1	ERB145	+/- 170	+/- 170
A2	ERB145	+/- 170	+/- 170
A3	ERB145	+/- 170	+/- 156.5
A4	ERB145	+/- 170	+/- 170
A5	ERB115	+/- 170	+/- 170
A6	ERB115	+/- 170	+/- 170

Tab. 2 Axis data for light-weight arm LWA 4 P

Software limit switches The permissible angles of rotation for all axes in the light-weight arm are restricted by adjustable software end positions. These software end positions serve only to protect the machine and should be set in such a way that the light-weight arm can not be commanded to travel as far as the mechanical limit stops. The software limit switches are pre adjusted during assembly of the robot arm and might be changed when setting up a light-weight arm.

NOTE

Further information can be found in the operating manual for the robot control system.

Axis	Rotary module	Peak torque [Nm]
A1	ERB145	64
A2	ERB145	64
A3	ERB145	64
A4	ERB145	64
A5	ERB115	19
A6	ERB115	19

Tab. 3 Peak torque values of the light-weight arm axes

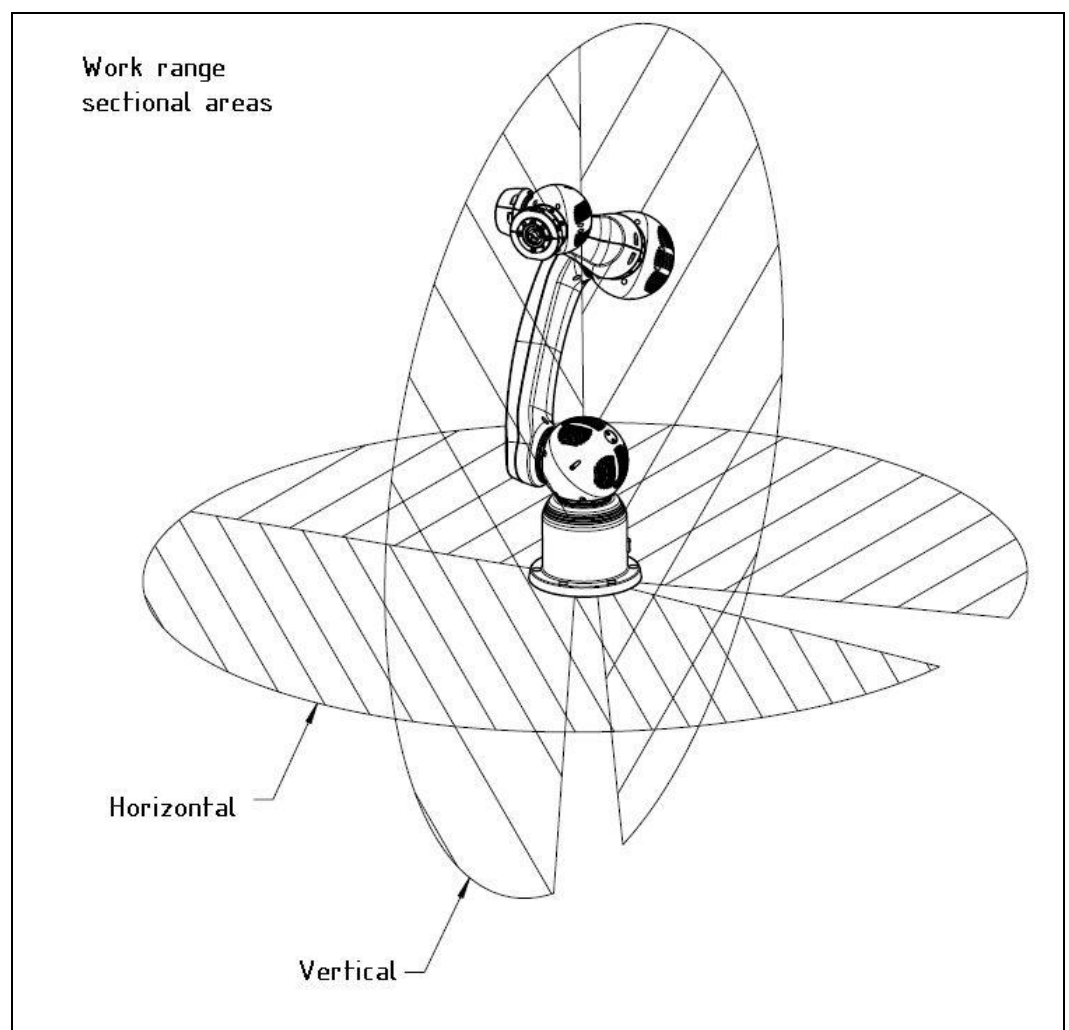


Fig. 8 Cross section areas of operating range, considering axes A1 (horizontal) and A2 (vertical) only

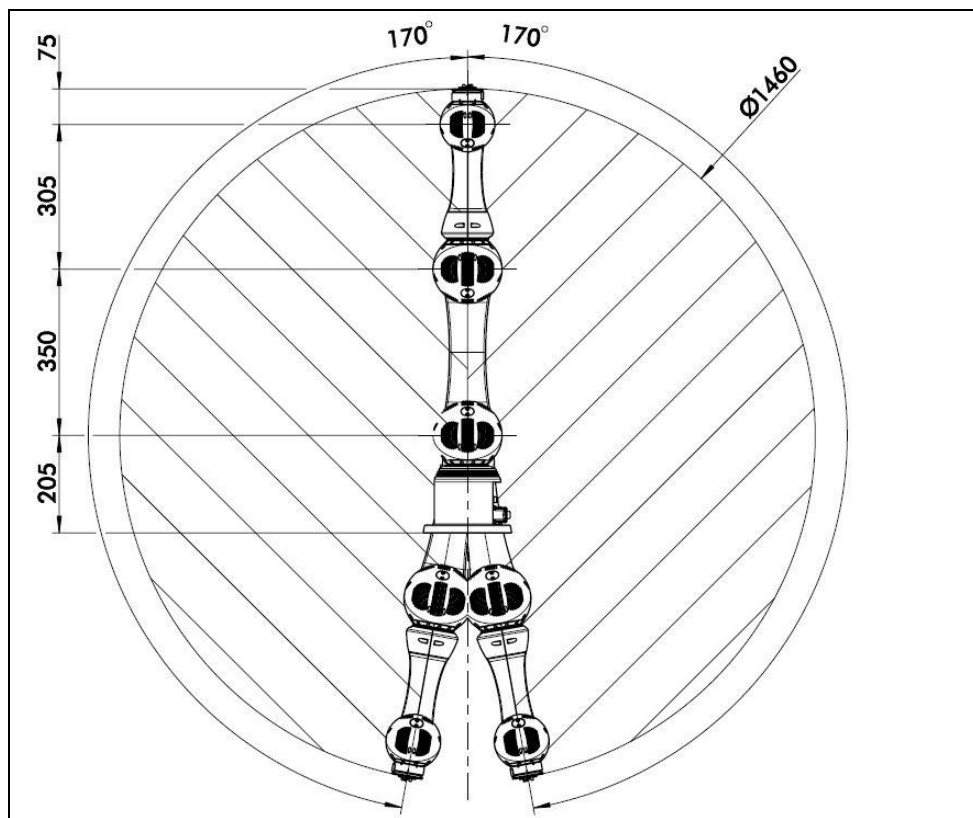


Fig. 9 Vertical operating range,
robot arm shown in centered, maximum and minimum position for axis A2 only

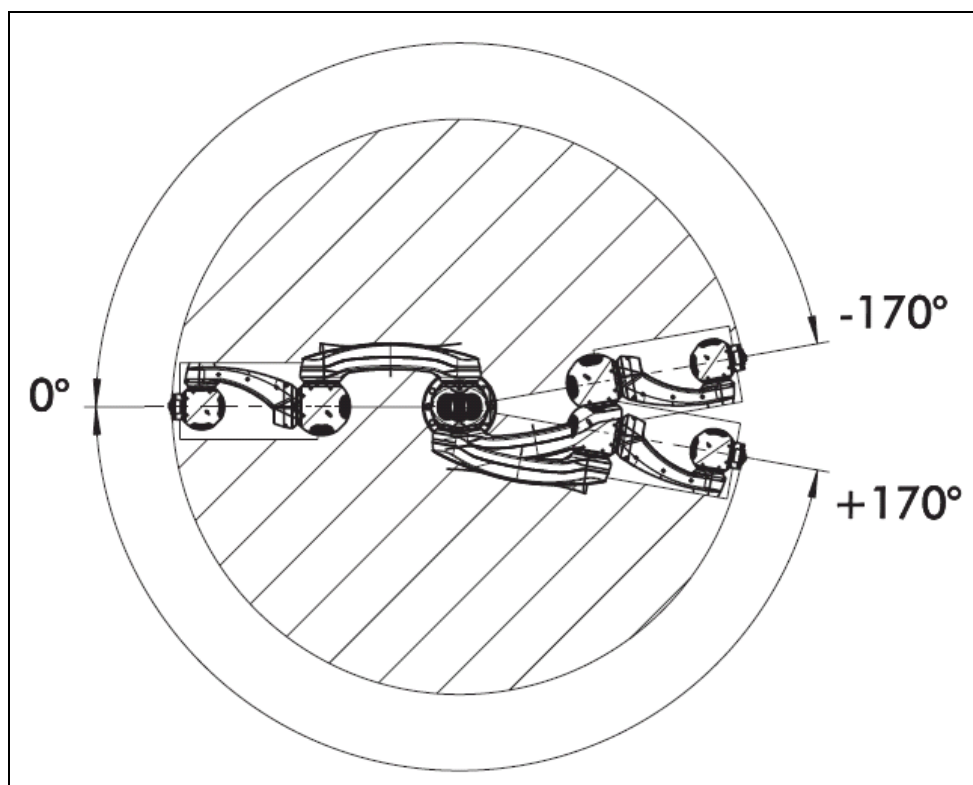


Fig. 10 Horizontal operating range,
robot arm shown in 3 example positions for axis A1 only, with A2 in 90 degrees position

Maximum permissible load capacities

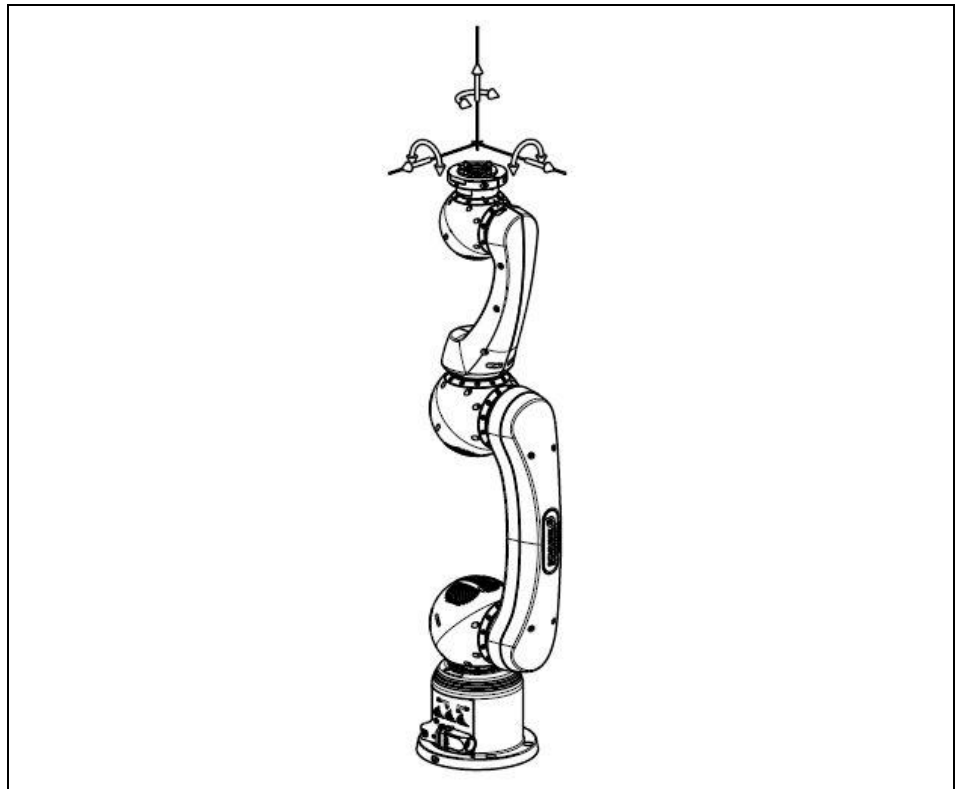


Fig. 11 Effective directions of load capacity

Exceeding the maximum bearing load capacity significantly reduces the light-weight arm's life span.

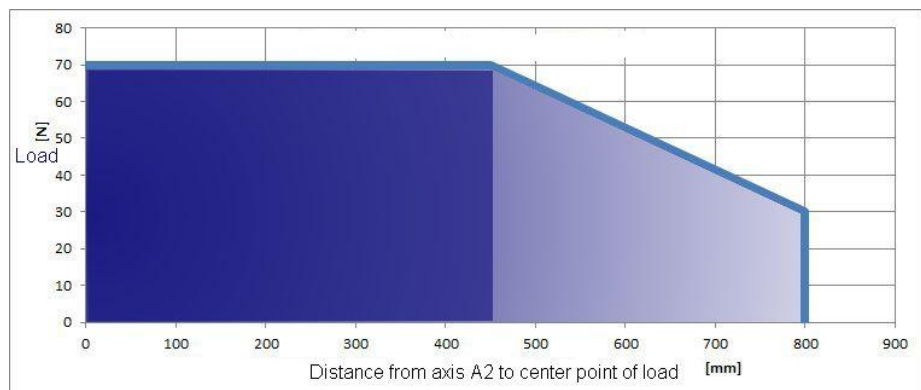


Fig. 12 Maximum permissible load capacity related to effective working range

This load curve shows maximum bearing load capacity. The load capacity and moment of inertia must be checked before start-up.

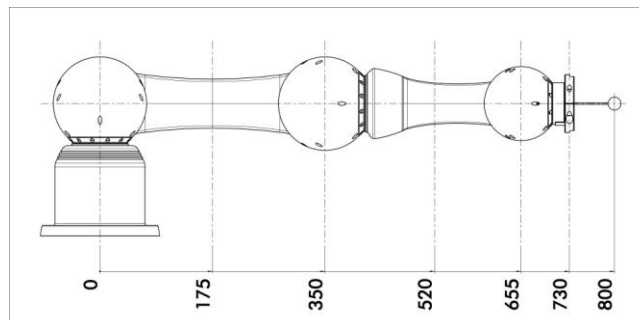


Fig. 13 Distance between second axis and center points of load (for pay load and arm structure)

**Load capacity
areas**

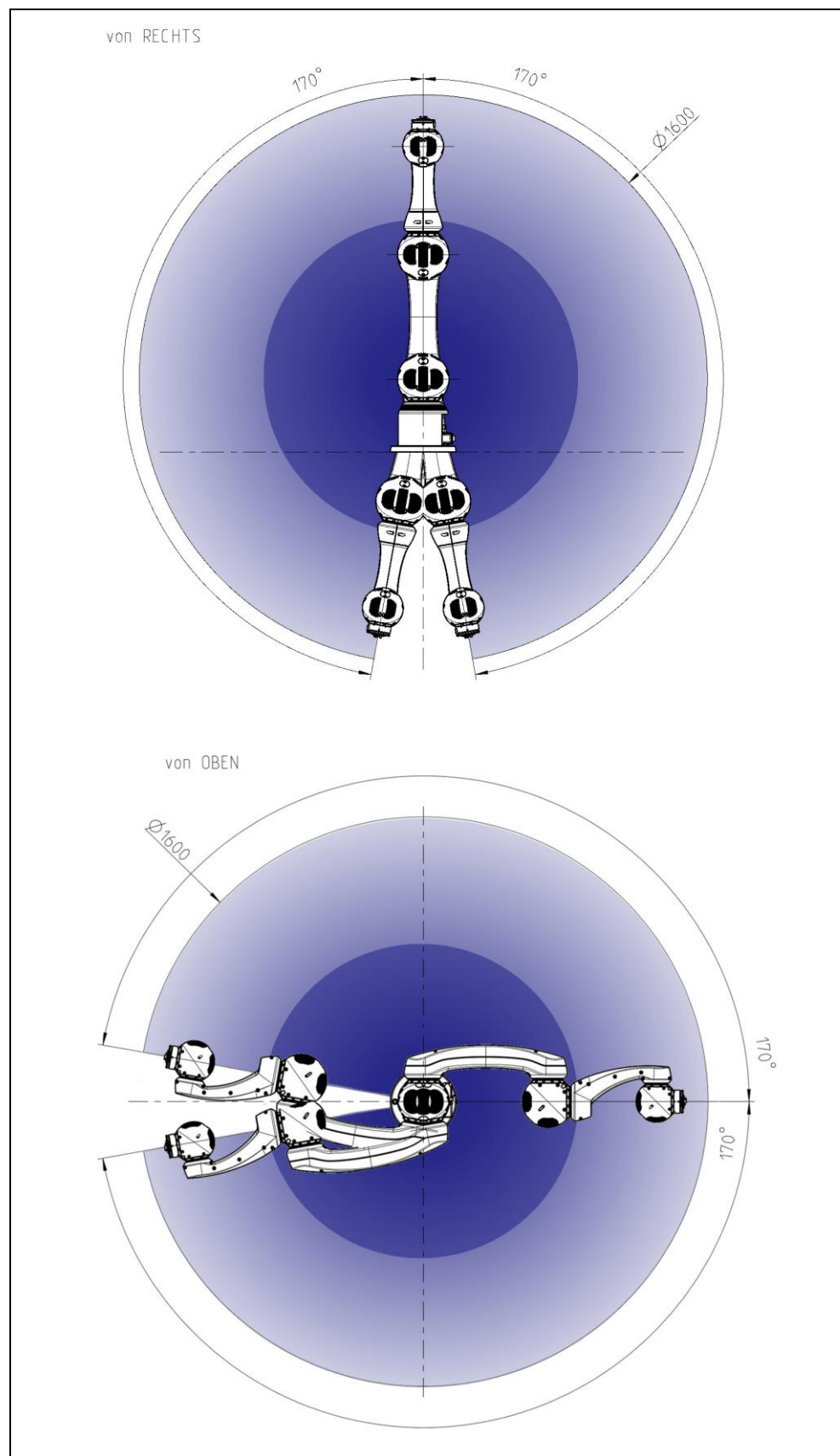


Fig. 14 and 15 Effective vertical and horizontal working areas, marked for allowed load capacity

Foundation loads



The forces and moments specified below contain the maximum load capacity and weight of the light-weight arm.

Type of load	Force/moment/mass
Max. vertical force [N]	400
Max. torque [Nm]	200

Tab. 4 Minimum required loading capacity values for foundation

7 Assembly

7.1 Mechanical connection

	 WARNING
	<p>Risk of injury when the machine/system moves unexpectedly Switch off energy supply and secure against being switched on again.</p>

Check the evenness of bolting surface

The following value relates to the entire bolting surface.

Permissible unevenness [mm]: < 0.2
--

Tab. 5 : Requirements for the evenness of the bolting surface

Mounting The light-weight arm can be fitted to the foundation, the wall or the ceiling.

NOTE

When installing, connecting and starting up the light-weight arm, always comply with the local specifications and laws. The light-weight arm may only be put into operation if the applicable specifications have been met.

Mounting flange

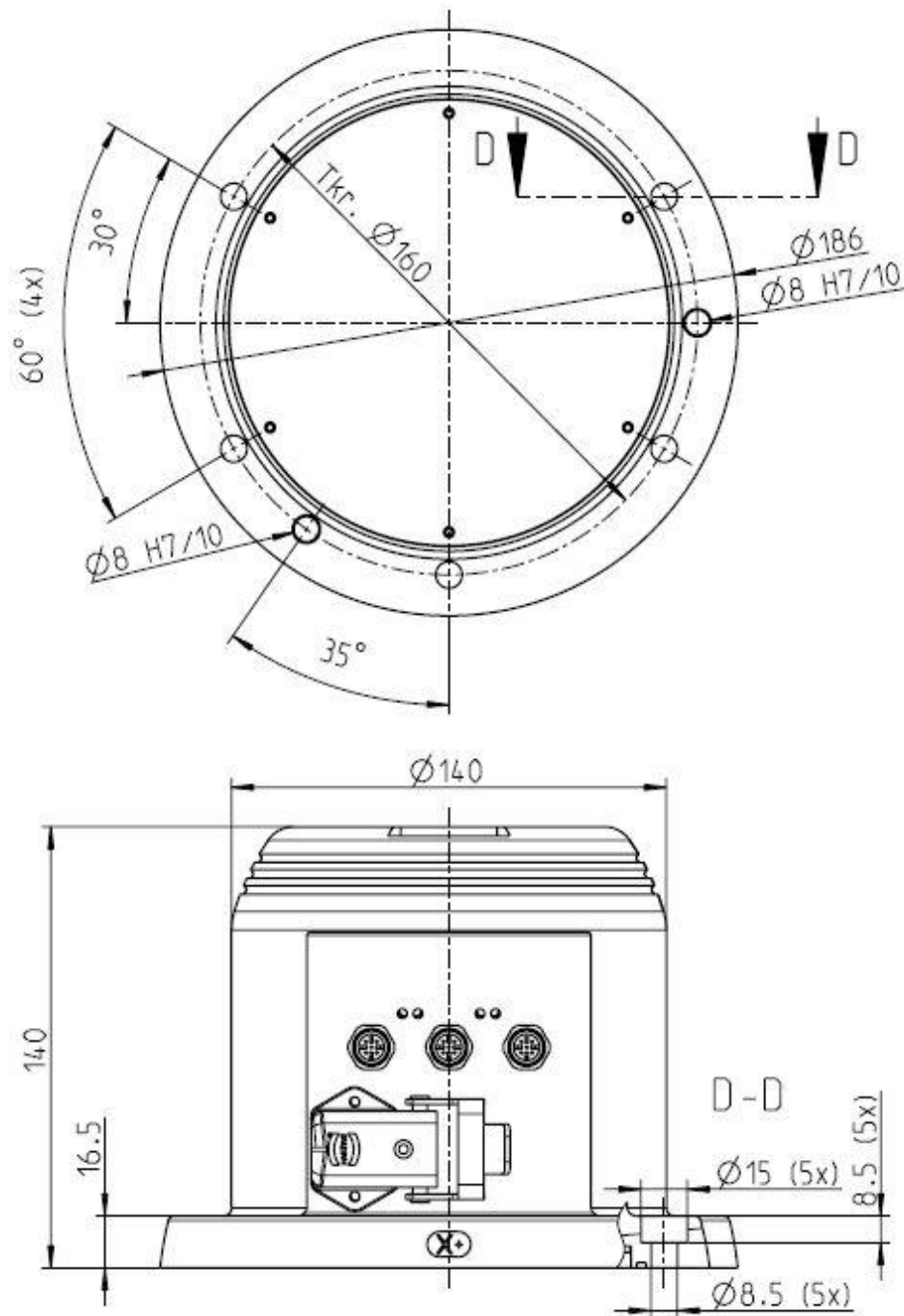




Fig. 16 Robot base of LWA 4 P

7.2 Electrical connection

	 WARNING
	Risk of injury when the machine/system moves unexpectedly Switch off energy supply and secure against being switched on again.

NOTE

Observe the maximum electrical energy values ([6, Page 23](#))

Electrical connection on the robot base The plug connectors on the light-weight arm's robot base contain all the necessary connections for activation via the bus connection and power supply of the light-weight arm. All the wiring for the light-weight arm axes is contained inside the light-weight arm and designed to be low-wear.

Position of connectors

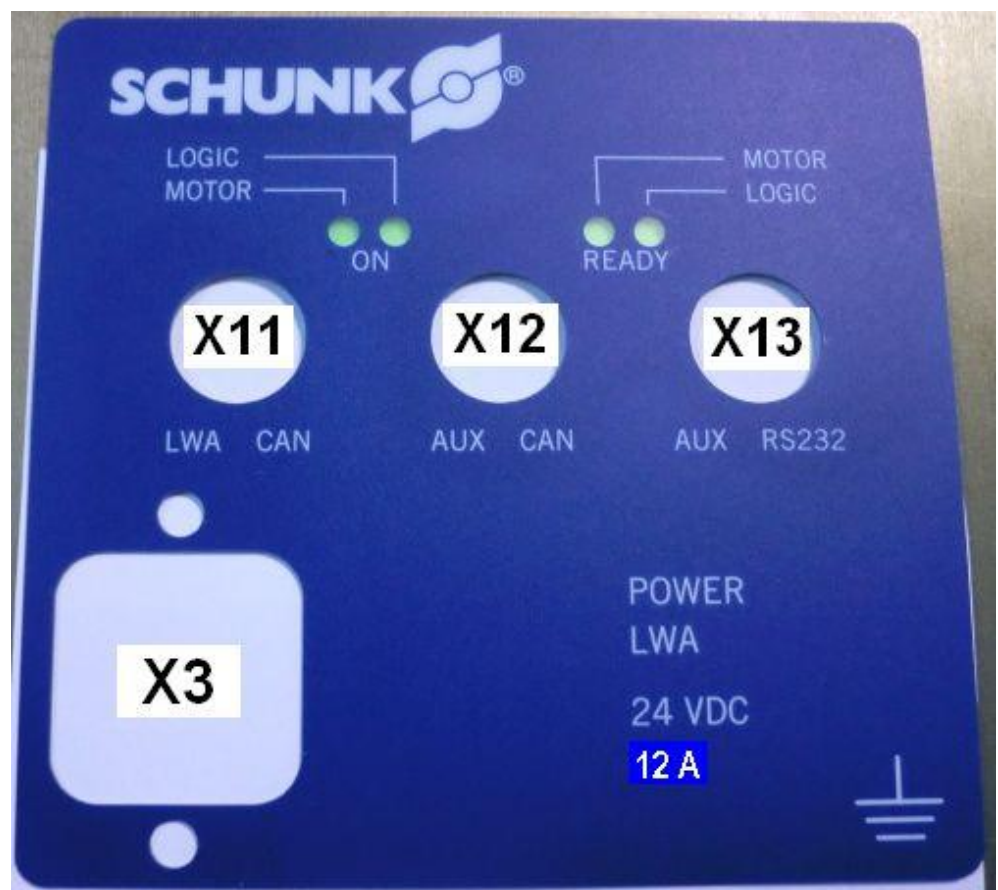


Fig. 17 Position of connector sockets at LWA 4 P pedestal (robot base) in labeled panel

Dimensions and pin allocation

Socket	Purpose of Interface
X3	Supply Voltage (Motor and Logic, 24 V DC)
X11	CAN Bus communication for LWA 4 axis Modules
X12	CAN Bus communication for optional Accessories
X13	RS232 communication for optional Accessories

Tab. 6 Connector sockets at LWA 4 robot base

Socket X3

One 5 pin insert Han 3A-M (Harting Nr. 09 20 004 2611) is mounted at pedestal of LWA 4 P in a 90 degree angular socket housing.

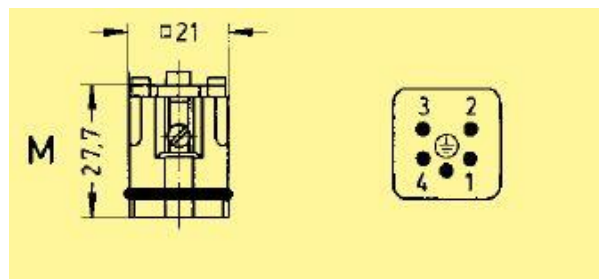


Fig. 18 Dimensions of Han 3A-M socket insert (X3)



One 5 pole insert Han 3A-F (Harting Nr. 09 20 004 2711) is attached to each LWA 4 P with a sleeve housing in an accessories kit.

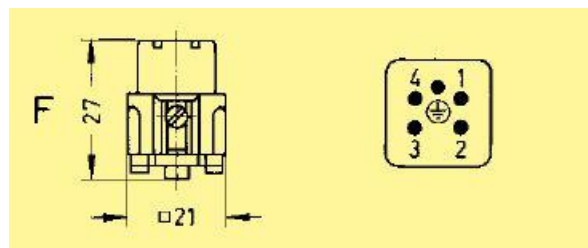


Fig. 19 Dimensions of Han 3A-F plug insert



Pin	Allocation	Recommended wire gauge [mm²]
X3 - 1	Logic 24 V DC	1.5
X3 - 2	Motor 24 V DC	1.5
X3 - 3	Logic/Motor 0 V	1.5
X3 - 4	--	
X3 - PE	Earth	1.5

Tab. 7 Pin allocation of connector insert (X3)

Two CAN Bus cables (ID 5522658) and one cable for serial communication RS232 (ID 5522659) are attached to each LWA 4 P with a sleeve housing in an accessories kit.

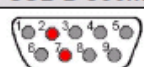


Fig. 20 Sockets M12, 5 pole for communication interfaces at connector panel (X11, X12, X13)

Sockets X11 and X12 (CAN Bus Interfaces)

Pin	Allocation	Pin	Allocation
X11-1	---	X12-1	Earth
X11-2	---	X12-2	---
X11-3	GND	X12-3	GND
X11-4	CAN High (_H_ERB)	X12-4	CAN High SDH / FTM (Res 3)
X11-5	CAN Low (_L_ERB)	X12-5	CAN Low SDH / FTM (Res 4)

Tab. 8 and 9 Pin allocation of M12 connectors for CAN Bus (X11, X12)

SUB D socket solder side	Pin	Terminal
	2	Bus_L
	7	Bus_H

(GND = Pin 3)

Tab. 10 Standard pin allocation for CAN Bus

Termination of CAN Bus with 120 Ohm at master side is necessary. At last in line axis of LWA 4, a second resistor must be switched ON (see pages 36 and 38 for further details).

Socket X13 (RS232 Interface)

Pin	Allocation
X13-1	Tx SDH (Res 1) (or customer specific)
X13-2	Rx SDH (Res 2) (or customer specific)
X13-3	GND
X13-4	---
X13-5	Earth

Tab. 11 Pin allocation of M12 connector for RS232 (X13)

Pin at Sub-D	Assignment
3	Tx_SDH
2	Rx_SDH
5	RS232_GND

Tab. 12 Standard pin allocation for RS232

**Flat change system
– pin allocation**

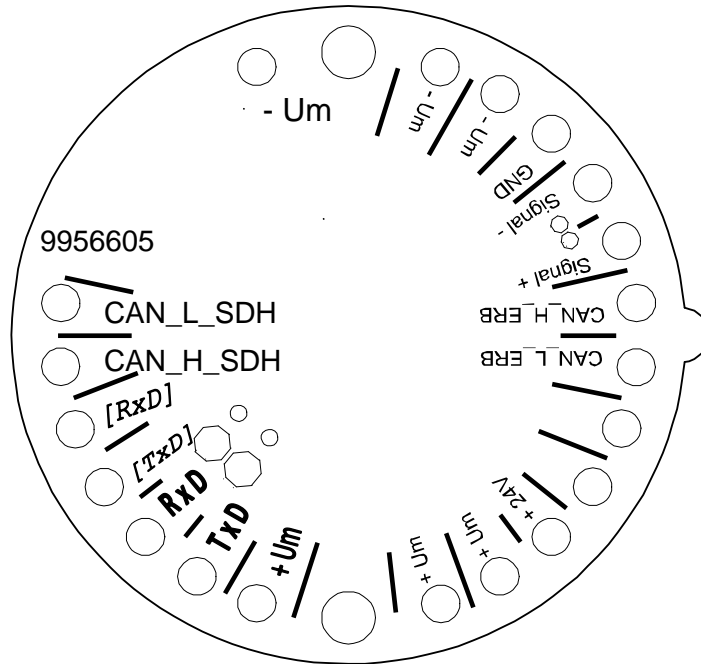


Fig. 21 Circuit board at the flat tool change adapter (Upper side)

	Pin at 8 pole connector	Wire color	Pin at FWS board	Description	Remark	Wire gauge, recom- mended	Wire color, old version
			+Um	+24V motor	- soldering pad	1.5 mm ²	
			-Um	0V motor	- soldering pad	1.5 mm ²	
Cable 1	7	GN	CAN_H_ERB	CAN high	- for arm communication	0.14 mm ²	GN
	8	WH	CAN_L_ERB	CAN low		0.14 mm ²	YE
	5	YE	GND	0V logic		0.14 mm ²	WH
	6	BN	+24V	+24V logic		0.14 mm ²	BN
Cable 2	3	GN	* CAN_H_SDH	CAN high (reserved)	- for optional SDH2, 3F Hand or Force - Torque - Sensor- Module or PG+70 Gripper	0.14 mm ²	GN
	4	WH	* CAN_L_SDH	CAN low (reserved)		0.14 mm ²	YE
	1	YE	* TxD	Serial Transmit (reserved)	- for optional SDH2, finger control and configuration, RS232 communi cation	0.14 mm ²	WH
	2	BN	* RxD	Serial Receive (reserved)		0.14 mm ²	BN

Tab. 13 Pin allocation for the flat tool change adapter board

*** NOTE**

These channels are available, **if no** FTM or SDH was connected.

Service interface on the ERB module

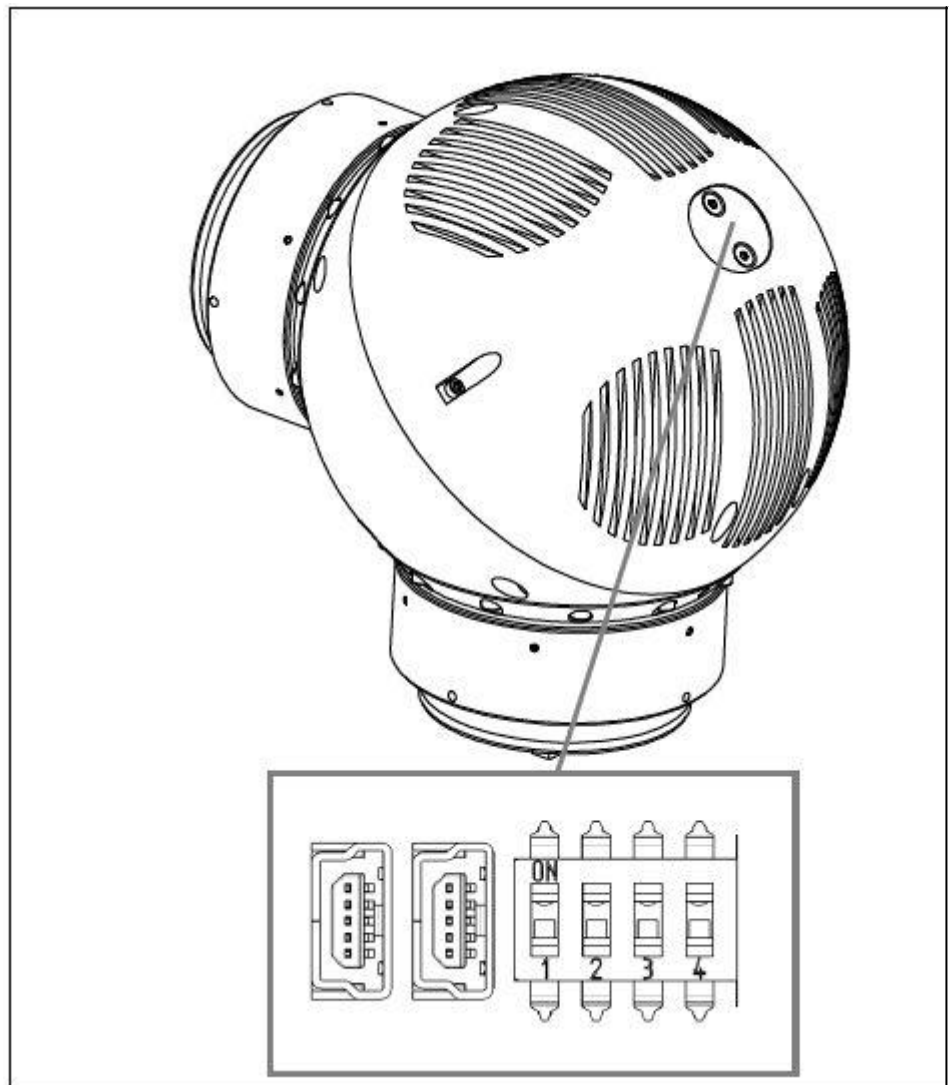


Fig. 22 Service Interfaces on the ERB two axes rotary modules



Location	Description
Left Side	USB mini B Socket for Drive 1
Center	USB mini B Socket for Drive 2
Right Side	Quadruple DIP switch

Tab. 14 Constituents of Service Interface

NOTE

On delivery, the SW1, SW2, SW3 and SW4 switches are in the OFF position (for spare modules only). These tiny switches are actuated best, by using a small screwdriver. Before doing this, disconnect the supply voltage to the light-weight arm.

In LWA 4 P the CAN Bus is terminated with SW1 set ON at last axis in line only (axis A6 in ERB 115).

	 DANGER
	<p>Risk of injury when the machine/system moves unexpectedly due to incorrect programming or interruption to communication.</p> <p>Ensure that the light-weight arm and the rotary modules of the light-weight arm can not move while the service interface is being used.</p> <p>Ensure that the motor power supply for the light-weight arm is securely disconnected when the USB connection is being used.</p> <p>Only specialised personnel or specially trained staff should carry out settings and enter parameters.</p>

Rotary module Rotary modules of type ERB have a service interface located below a screwed cover at housing (see picture 22 at [page 36](#)).

USB Service Interface The USB interface is purely intended for the following service functions:

- Parameterization of the rotary modules
- Fault diagnosis
- Importing firmware updates

The USB interface is not suitable to function as a control interface.

The USB connection is a connector in the USB mini B format. It can be used with commercially available mini USB cables.

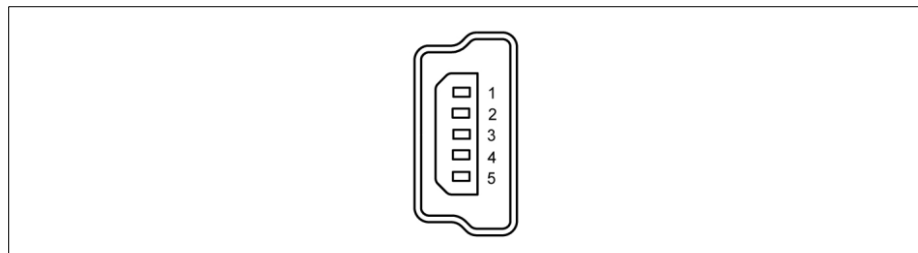


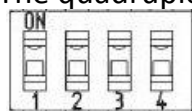
Fig. 23 Pin allocation for USB-mini type B interface

Pin	Name	Color (Standard)	Description
1	VCC	red	+ 5V
2	D-	white	Data -
3	D+	green	Data +
4	ID	None	Type B mini: not connected
5	GND	black	Ground

Tab. 15 Pin allocation of USB-mini type B

DIP switch

The quadruple DIP switch in service area has following functions:



Switch	ON	OFF
SW1	CAN Bus Termination resistor switched ON	CAN Bus Termination resistor switched OFF
SW2	BOOT Drive 1 active	BOOT Drive 1 inactive
SW3	BOOT Drive 2 active	BOOT Drive 2 inactive
SW4	DEFAULT active	DEFAULT inactive

Tab. 17 DIP switch functions

CAN termination resistor ON/OFF

The termination resistor should be switched ON for the last axis at the CAN Bus only (e.g. axis A6 on the LWA 4 P).

According to the standard, the CAN bus must be terminated at both ends, with 120 Ohms each. Check, that the DIP switch position is correct at the light-weight arm side.

In case a gripper (for example PG+70) was mounted, the termination resistor at this gripper must be switched ON and the resistor integrated in LWA 4 (in ERB Module) must be switched to OFF.

Switch DEFAULT values ON/OFF

The DEFAULT function resets the drive controller's bus address and communication interface to a preset value. Once the switch is activated, the drive receives a different bus address and can then only be addressed via the USB interface. The switch must only be activated when the light-weight arm is de-energized.

	Default values	(before 2013)	
Communication Interface	RS232 (at USB)		
Communication data rate	(9600 B)		
Module address axis 1, ERB 145	3	13	15
Module address axis 2, ERB 145	4	14	16
Module address axis 1, ERB 115	7	17	
Module address axis 2, ERB 115	8	18	

Tab. 16 Factory settings

BOOT function for firmware update ON/OFF

The BOOT function deactivates the drive controller and prepares it for a firmware update. The switch must only be activated when the light-weight arm is de-energized. The procedure for a firmware update is described in a separate set of instructions.

8 Start-up and reconnection



8.1 Initial commissioning

Before commissioning machines and automated systems, make sure that they are fully functioning and that they can be operated safely.

Observe the applicable national or regional industrial safety regulations during this check. In addition, test that all the safety circuits function securely.

NOTE

The passwords for the robot control system have to be changed before start-up and may only be revealed to authorized personnel.

	 WARNING
	<p>The additional installation of components not included in the SCHUNK light-weight arm scope of delivery must not impair the safety functions.</p> <p>The operator is responsible for ensuring that additional installations do not impair safety functions.</p> <p>Improper installation can result in harm to persons or property.</p>

8.1.1 Functional testing

Before start-up and reconnection, carry out the following tests:

General testing

- The light-weight arm is correctly positioned and securely fastened.
- There are no foreign objects or faulty or loose parts on the light-weight arm.
- All the protective equipment is correctly installed and fully functioning.
- The power supply to the light-weight arm is suited to local conditions.
- Protective conductors and equipotential bonding are installed correctly.

- The connecting lines to the light-weight arm are connected correctly and the plug connector is locked.

Testing the safety-related circuits

The safety-related circuits have to be checked by means of a functional test. In particular, this involves the local and external EMERGENCY STOP mechanisms, the release control devices (enabling devices) and the operator protection (for automatic operating modes).

8.1.2 Network safety and protection against malware

The operator of the light-weight arm and its robot control system is responsible for protecting the machine against malicious software.

8.1.3 Manual mode

Setup work on the light-weight arm is carried out in manual operation. This includes:

- Inching operation (slow motion in small steps)
- Teaching
- Programming
- Program testing

New or changed programs should always be tested first in manual operation at a low speed.



WARNING

The light-weight arm, its additional axes (e.g. grippers) and tools must not come into contact with the barriers or project beyond the barrier fence.

Otherwise this could result in harm to people or property.



- During setup work, the light-weight arm must not be damaged by tools or other objects when traveling in manual operation.
- Wherever possible, the setup work should be carried out in the secure area outside the protective equipment.
- If setup work in the danger zone is unavoidable, switch to manual operation at a low speed.

- The operator must be able to view the danger zone and avert a risk, in case of emergency.
- If possible, avoid having more than one person in the protection zone.
- If more than one person has to be in the protection zone, employ special, extra protective measures:
 - No person's view to the light-weight arm may be obstructed.
 - The persons must be able to maintain continuous eye contact.
- Before starting the setup work, the operator must ensure that the necessary devices for release control (as per EN 60204-1:2006) are fully functioning. All persons in the vicinity of the setup work must have a device for release control (enabling device).

8.1.4 Automatic mode

The following safety measures are mandatory for automatic operation:

- There are no persons inside the system.
- All the safety and protection equipment is present and complete.
- The working methods specified by the system integrator are complied with.

	 DANGER
	The danger zone may only be entered if an EMERGENCY STOP was triggered.

For operation at high velocity and acceleration with nominal load, an operational temperature of about 40 degrees Celsius at least must be reached. Therefore a warm up movement is recommended after each initial power on.

9 Transportation

9.1 Transportation



NOTICE

The light-weight arm may only be transported in the transport position and in the designated transport container.

Transport position

Before transporting the light-weight arm, place it in the corresponding transport position. The light-weight arm is in the transport position when the axes are in the following positions:

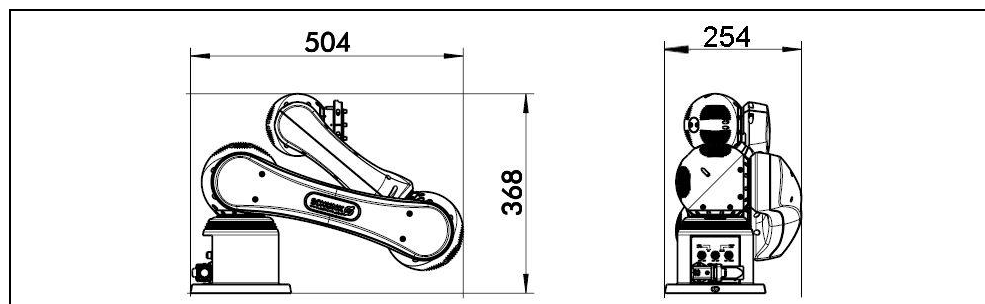


Fig. 24 Transport position for light-weight arm LWA 4 P

	Axis A1	Axis A2	Axis A3	Axis A4	Axis A5	Axis A6
Standard CAN Bus	3	4	5	6	7	8
Position [degree] with KEBA Control	0	105	-155	0	140	0
Position [degree] with LWA-Tool (PC)	0	-105	-155	0	140	0

Tab. 18 Transport positions for all axes

Transport dimensions

When transporting the light-weight arm, ensure that it is stable. Transport the light-weight arm preferred in the designated transport container with the following external dimensions:



Length 800 mm, Width 600 mm, Height 410 mm



NOTE

One transport container (aluminum box with lockable lid, our Part ID 9957491, inside dimensions 750 x 550 x 380 mm³) is included in each delivery.

10 Maintenance and care

	 DANGER
	<p>After maintenance and repair work, it is essential to check the required safety level.</p> <p>Observe the national and regional industrial safety regulations during this check.</p>



10.1 Maintenance

The system integrator's maintenance and care instructions shall be complied with in order to ensure lasting operation free from malfunctions.

Notes on maintenance and care

For the ERB rotary modules any special maintenance is not necessary. Housing and surface materials are sensitive against scratching and knocking and should be handled with care.

10.2 Cleaning the light-weight arm

	 DANGER
	<p>The danger zone may only be entered if an EMERGENCY STOP was triggered.</p> <p>Before reconnection, warn all the persons involved.</p>

The system integrator provides cleaning instructions for the light-weight arm, taking into account the cleaning specifications from the manufacturers of the subcomponents. Examples of general specifications include:

- Only use solvent-free, water-soluble cleaning agents.
- The cleaning agents must not be flammable.
- Do not use steam, refrigerant agents or high-pressure cleaners for cleaning.
- The cleaning agents must not enter into electrical or mechanical parts of the system.

Procedure

- 1 Put the light-weight arm out of operation and secure it against being switched on again.
- 2 If necessary, turn off adjacent parts of the system and secure them.
- 3 Put up signs to inform those in the vicinity of the cleaning work.
- 4 Cleaning the light-weight arm:
 - ⇒ Clean the ERB rotary module at regular intervals with a clean, dry, lint-free cloth and check it for damage or wear.
 - ⇒ Remove all contamination from the cavities and edges of the ERB housing.
- 5 Disassemble cladding where necessary in order to clean.
- 6 Clean the light-weight arm.
- 7 When finished, completely remove cleaning agents, containers and equipment from the light-weight arm's danger zone.
- 8 Properly dispose of cleaning agents.
- 9 If applicable, fully reassemble any removed protective and safety equipment and check that it functions correctly.
- 10 Replace damaged or illegible signs and notices.
- 11 Reassemble cladding.
- 12 Only reconnect fully functioning light-weight arms and automated systems.

10.3 Light-weight arm repair

The light-weight arm may only be repaired by SCHUNK as otherwise the mechanics and electronics could be damaged.

Before returning the light-weight arm to manufacturer for repair, a description of suspected malfunction must be send to:

robotics@schunk.com

In reply you will receive a service address for delivery (do not send the box to head quarter address) or advice for self analysis. If asked to return the light-weight arm, use the original transportation container with sufficient cushioning or equivalent material only.

11 Decommissioning, storage and disposal

Send components of the light-weight arm for recycling or properly dispose of them according to the local regulations.

12 Applied standards and specifications

Name	Definition
2006/42/EC:2006	Machine Directive: Directive 2006/42/EC of the European Parliament and Council of May 17, 2006 concerning machinery and to amend Directive 95/16/EC (amendment)
2004/108/EC:2005	EMC Directive: Directive 2004/108/EC of the European Parliament and Council of December 15, 2004, harmonizing the legal requirements of the member states concerning electromagnetic compatibility and repealing 89/336/EEC
EN ISO 13850	Safety of machinery: Emergency stop – Principles for design
EN ISO 12100-1	Safety of machinery: Basic concepts, general principles for design; Part 1: Basic concepts
EN ISO 12100-2	Safety of machinery: Basic concepts, general principles for design; Part 2: Technical principles and specifications
EN ISO 10218-2:2011	Robots for industrial environments – Safety requirements – Part 1:
EN 13849-1:2008	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design (ISO 13849-1:2006); German version EN ISO 13849-1:2008
EN 614-1:2009	Safety of machinery - Ergonomic design principles – Part 1: Terminology and general principles; German version EN 614-1:2006+A1:2009
EN 61000-6-2:2006	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards – Immunity for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005


...

Name	Definition
EN 61000-6-4:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards – Immunity for industrial environments (IEC 61000-6-4:2006 + A1:2010); German version EN 61000-6-4:2005 + A1:2011
EN 60204-1:2007	Safety of machinery: Electrical equipment of machines, Part 1: General requirements

Tab. 19 Notation of applied Standards

13 Software for LWA 4 axis module control

13.1 Description of available computer programmes

	Disclaimer
	SCHUNK GmbH & Co. KG and SCHUNK Mobile Gripping Systems GmbH do not accept liability for damage caused by usage of the programmes. This applies in particular to damage to persons, property or assets, which is directly or indirectly linked to usage of the programmes as consequential damage.
	Our user service might be contacted in case of problems during installation or handling by phone +49-7133-103-2892.
	The data was checked for viruses with state-of-the-art technology before the programs were manufactured. We reserve the right to continuously improve the software and to make corrections.

CANopen Test Software

A few software tools are available for download, but must be used with CAN Bus adapters by manufacturer esd (for example our part ID 0307913) on a 32-bit win operating system only.

<https://dl.dropboxusercontent.com/u/4896179/SCHUNK/dist/CANopenToolsExt-1.0.2.5.zip>

The programme COT_ResetToSMP for example allows to switch the communication protocol from CANopen to CAN (SMP, SCHUNK Motion Protocol) for one axis or several axes at the same time. Another programme from this collection (LWA_Tool) provides functions for testing an LWA 4 in interpolated positioning mode, but axis by axis and point to point motion only.

With COT_ReferenceTool the pre adjusted zero position of each axis in LWA 4 can be set, if lost in a rare case. This tool also allows simple motion of each axis with arrow keys and mouse buttons.

Test- and Configuration Software

For SMP (SCHUNK Motion Protocol) only, a test and configuration programme MTS (Motion Tool SCHUNK) is provided in Service-, Download area of our webpage with following link:

http://www.schunk.com/schunk_files/attachments/MTS_v_1_56_20130904.zip

Included in this archive a documentation about SMP CAN Bus protocol and all functions of the MTS programme can be found.

Alternatively the USB service Interface at each axis can be used for configuration changes, but after Default Reset via DIP switch only and without any possibility of motion testing.

Firmware- and electronic data sheet files

An archive with firmware files, with electronic data sheets in XML based xdd format for CANopen and with small pictures in bmp format for CANopen configuration programmes can be downloaded through following link:

https://dl.dropboxusercontent.com/u/4896179/SCHUNK/dist/CANopen_2013-07-05_0.63.zip

CANopen Standards

All details of CANopen protocol are described in Industrial Standards and are therefore not retold here. Copies of the Standards are available direct from responsible Institutions (for example <http://www.can-cia.org> or <http://www.iec.ch/>).

[1] Common CANopen protocol description,
CiA Draft Standard DS301 version 4.2 „CANopen application layer and communication profile“

[2] Device profile for motion control
Device profile for Drives: IEC 61800-7-201 „Adjustable speed electrical power drive systems – Part 7-201: Generic interface and use of profiles for power drive systems – Profile type 1 specification (previous: CiA DS402 „Device Profile for Drives and Motion Control“)

[3] For configuration of module-ids and baud rate
CiA 305 Draft Standard proposal DSP V2.2 CANopen layer setting services (LSS) and protocols

Example Programme and Support address

On request to our Service email address (robotics@schunk.com) we will provide additional information, like a simple CANopen example programme and short description of our CANopen implementation for LWA 4 and ERB Drive Modules.

13.2 Error codes

Our mechatronics Modules with CANopen protocol utilize the Emergency-Object, like specified in Standard, for reporting error states (see chapter 7.2.7 Emergency object (EMCY) in [1]) and the device profile specific error codes (see section 7.1 in [2]). ([👉 13.1, Pages 46/47](#)) The Emergency-Object contains, amongst others, an Emergency error code describing the error cause. The subset shown in table below only, is used from all codes specified in Standards.

Error code (hex)	Designation according to [1] and [2]	Additional explanations
General error codes according to [1]		
0x0000	Error reset or no error	
0x1000	Generic error	
0x6100	Internal software - generic	
0x8100	Communication – generic	
0x8110	CAN overrun (objects lost)	The module could not process incoming CAN data as quickly as required, therefore communication objects have been lost.
0x8210	PDO not processed due to length error	
0x8250	RPDO timeout	
Device specific error codes according to [2]		
0x2110	Short circuit/earth leakage (input)	
0x2310	Continuous over current	A motor current that is too high has been applied for too long.
0x2350	Load level fault (I _{2t} , thermal state)	The module monitors the motor load level using a simplified motor temperature model that uses the motor current (I) and the time (t). If currents above the nominal current have been applied for too long this I _{2t} error is signaled to protect the motor from overheating.
0x3211	Over-voltage no. 1	The logic voltage is too high
0x3212	Over voltage no. 2	The motor voltage is too high
0x3221	Under-voltage no. 1	The logic voltage is too low
0x3222	Under-voltage no. 2	The motor voltage is too low
0x4210	Excess temperature device	
0x4220	Too low temperature device	
0x4310	Excess temperature drive	
0x4410	Excess temperature supply	
0x5520	ROM/EPROM	

Error code (hex)	Designation according to [1] and [2]	Additional explanations
0x5530	EEPROM	
0x6320	Parameter error	<p>This error is reported for the following internal error conditions:</p> <ul style="list-style-type: none"> - INFO_POSITION_NOT_REACHABLE, commanded position is beyond software limits - INFO_WRONG_PARAMETER, parameter is wrong - ERROR_WRONG_RAMP_TYPE, parameter type is wrong - ERROR_INITIALIZE, error during initialization, check EEPROM parameters.
0x7122	Motor error or commutation malfunction	<p>Commutation error, sinus vector could not be found. Possible causes are:</p> <ul style="list-style-type: none"> - Position measurement system defective - Movement of axis is mechanically blocked - Current sensor defective or not calibrated - Motor phase defective
0x7303	Resolver 1 fault	
0x7305	Incremental sensor 1 fault	Module could not be referenced due to an error with the incremental position sensor
0x7320	Position	Fault in position measurement system
0x8400	Velocity speed controller	The measured velocity has been too high. For safety reasons the module was stopped and the error is reported.
0x8611	Following error	Actual position of the module could not follow the commanded target position.
0x8612	Reference limit	Actual position of the module is out of the specified limits. After acknowledging the error only movements towards the allowed movement range are allowed.
0x8900	Process data monitoring	Fault in internal process surveillance
MANUFACTURER SPECIFIC CODES (see manual "SCHUNK Motion Protocol SMP" for details)		
0xFF00	Combined manufacturer errors message	Reports one of several internal faults and should never occur during operation with permissible work conditions.
0xFF01	ERROR_HARDWARE_VERSION	
0xFF02	ERROR_MATH	
0xFF03	INFO_NO_RIGHTS	A parameter write access has been refused due to insufficient rights. See also manufacturer specific parameter 0x2008/0.
0xFF04	INFO_UNKNOWN_COMMAND	
0xFF05	INFO_FAILED	

Tab. 20 Notation of Error codes for LWA 4 axis Modules with CANopen Interface

14 Translation of the original EC declaration of incorporation

In terms of the EC Machinery Directive 2006/42/EG, Annex II, Part B

manufacturer/	SCHUNK GmbH & Co. KG.
distributor	Mobile Gripping Systems Bahnhofstr. 106 – 134 D-74348 Lauffen/Neckar

We hereby declare that the following product:

Product designation:	Lightweight arm LWA 4 P
ID number	0306960

meets the applicable basic requirements of the **Directive Machinery (2006/42/EC)**.

The incomplete machine may not be put into operation until conformity of the machine into which the incomplete machine is to be installed with the provisions of the Machinery Directive (2006/42/EC) is confirmed.

Applied harmonized standards, especially:

EN ISO 12100-1	Safety of machines – Basic concepts, general principles for design – Part 1: Basic terminology, methodology
EN ISO 12100-2	Safety of machines – Basic concepts, general principles for design – Part 2: Technical principles

The manufacturer agrees to forward on demand the special technical documents for the incomplete machine to state offices.

The special technical documents according to Annex VII, Part B, belonging to the incomplete machine have been created.

Person responsible for documentation: Mr. Uwe Heinz, Address: see address of the manufacturer



Lauffen/Neckar, August 2012

ppa. Andreas Schuster; Director for Development