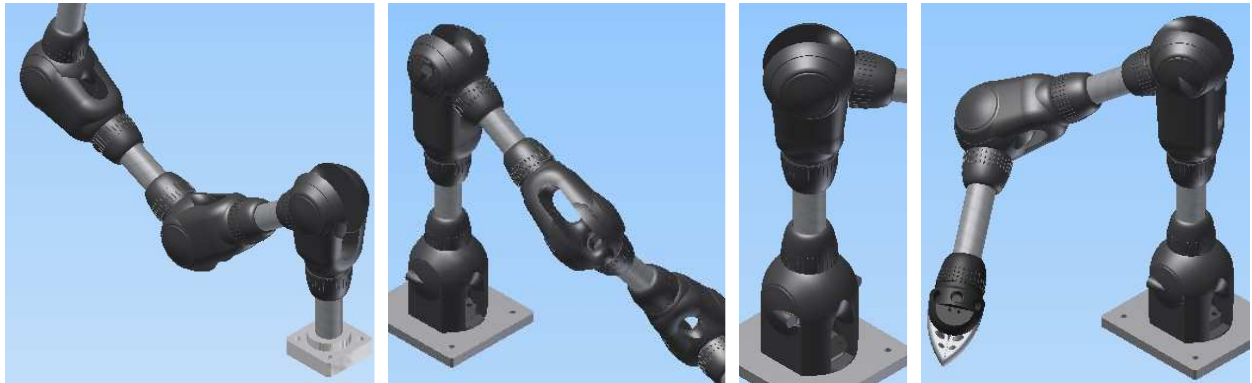


robolink® Joint kit



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Basics

igus[®] GmbH develops plastic robotics joints, and produces and harnesses these under the product group robolink[®] Joint kit. At present, 10 different joint types exist, which can be combined with each other (status 2015-01).

This provides options to configure and design customized articulated arms for a variety of customer applications.

Articulated arms can be equipped with angle sensors for positioning purposes. The angle position of the joint is determined and electronically output (incremental magnetic sensor system).

A variety of products, such as suction cups, blowers, grippers, camera, light source, etc., can be used as actuators (at the end of the articulated arm). Generally, the wires for these actuators can be fed inside the articulated arm.

Articulated arms are moved with draw wires. One pair of wires each is designed to create motion for one degree of freedom. The wire pair must be driven in an antagonistic fashion. This provides for a wide selection of drive technologies. A host of drive technologies are available, such as: pneumatic drives, electro-motors, but also manual drives.

igus[®] GmbH offers step motors in various configurations as one possible drive technology.

The step motors are configured into a drive module by means of a planetary gear and a drive wheel. The drive wheel is a standardized option to attach and move draw wires.

A drive unit has the same number drive modules as the articulated arm has degrees of freedom (DOF). igus[®] GmbH offers assembled drive units for a variety of articulated arms on the basis of step motors with planetary gears in an aluminum housing.

A control (in this case: step motor control) is needed to move a robolink[®] articulated arm. igus[®] GmbH does not offer or supply these controls and other electrical and electronic components.

Joint types

The following joint types are on offer and can be combined into articulated arms:

Swivel joint	RL-50-PL1	+/-90° swivel range
Rotating joints	RL-50-TL1	+/-90° rotating range
	RL-50-TL2	+/-90° rotating range
Symmetric 2 axes joint	RL-50-001	+/-90° swivel range +/-170° rotating range
Asymmetric 2 axes joint	RL-50-002	+130°/-50° swivel range +/-170° rotating range
Version without rotation	RL-50-PL2	+130°/-50° swivel range
Fully swing in 2 axes joint	RL-50-003	+180°/0° swivel range +/-170° rotating range
Version without rotation	RL-50-PL3	+180°/0° swivel range
Big base joint (for 6 DOF arms)	RL-90-BL1	+/-90° swivel range +/-90° rotating range
Small base joint (as “shoulder”)	RL-50-BL2	+/-90° swivel range +/-90° rotating range

The swivel ranges are limited by mechanical stop dogs. These can be removed, thus expanding the swivel range. This is only possible if the wire feed-through is not designed to be inside the joint (=> Section - Wire feed-through) This option can only be used after a technical review. Each joint can be optionally equipped with angle sensors.





Articulated arms

The 10 joint types can be used to configure customized articulated arms. Please consider the following characteristics:

- Rotating joint RL-50-TL1 and base joints RL-90-BL1 and RL-50-BL2 can only be used as first joints in a multi axes joint arm.
- Rotating joint RL-50-TL2 can only be used in annexation to base joint RL-90-BL1 ("shoulder" kinematics: rotation – pivot – rotation).
- A 6 DOF configuration needs a big base joint RL-90-BL1 as first joint.
- The small base joint RL-50-BL2 is designed for easy humanoid applications with low additional loads (max. 5 DOF: shoulder and elbow).
- Further joint variants or higher angle range on request.

Standard aluminum tubes (dia = 26 mm) are used as connecting elements between the joints. The tubes have an inside contour to prevent rotation on the joint interface. The big base joint RL-90-BL1 is connected by a plain aluminum tube (da = 40 mm), the distortion

lock is given by 4 pcs. M4 screws in this case. Fiberglass (FGC) or carbon-fiber (CFC) tubes can be selected as alternatives. The tube length is user selectable between $l(\min)$ and $l(\max) = 1,000\text{mm}$. The minimum length $l(\min)$ differs depending on the location in the system and is defined in Fig. 12 and Fig. 13. The standard length is 100 in each case.

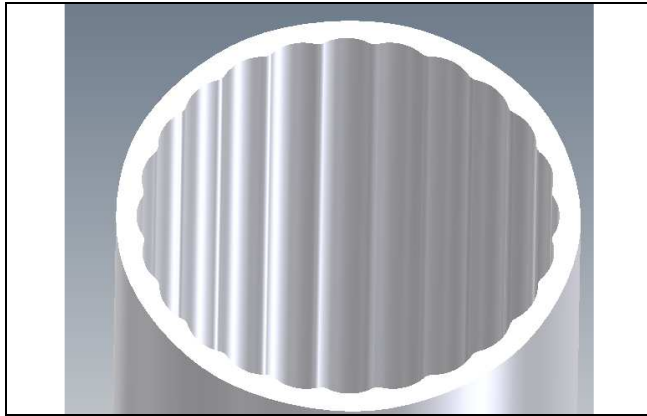


Fig. 9: Interior contour of a connecting tube

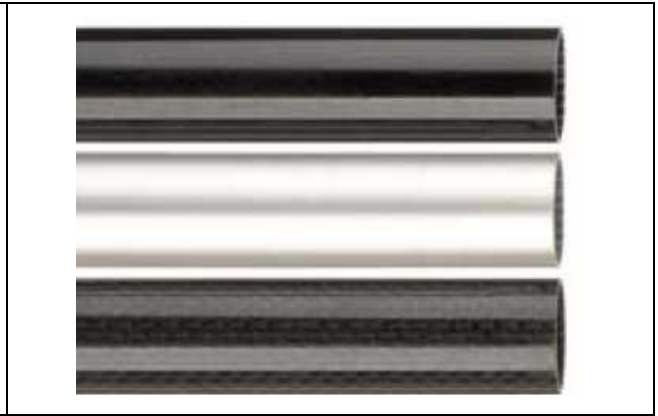


Fig. 10: Material versions - connecting tube: FGC, aluminum, CFC

The specifications for the tube lengths, visible tube lengths and rotating point distances are shown in Figures 7 and 8, along with information for minimum lengths:

X distance of the rotating points to each other, and from the end of the arms,

Y visible tube length,

L true tube length,

1...4 the first figure is always at the beginning of the articulated arm, increasing to a max. of 4

2 axes joints and swivel joints are designed so that a maximum of 4 wires for each joint located above can be fed through the joint (\Rightarrow Section - Draw wires). In addition, each joint can also feed 3 more cables or hoses with a maximum diameter of 4mm.

The rotating joint can only be the first joint of a series connection, but it can feed up to 8 additional wires, and directly distribute these to the drives in wire pairs.

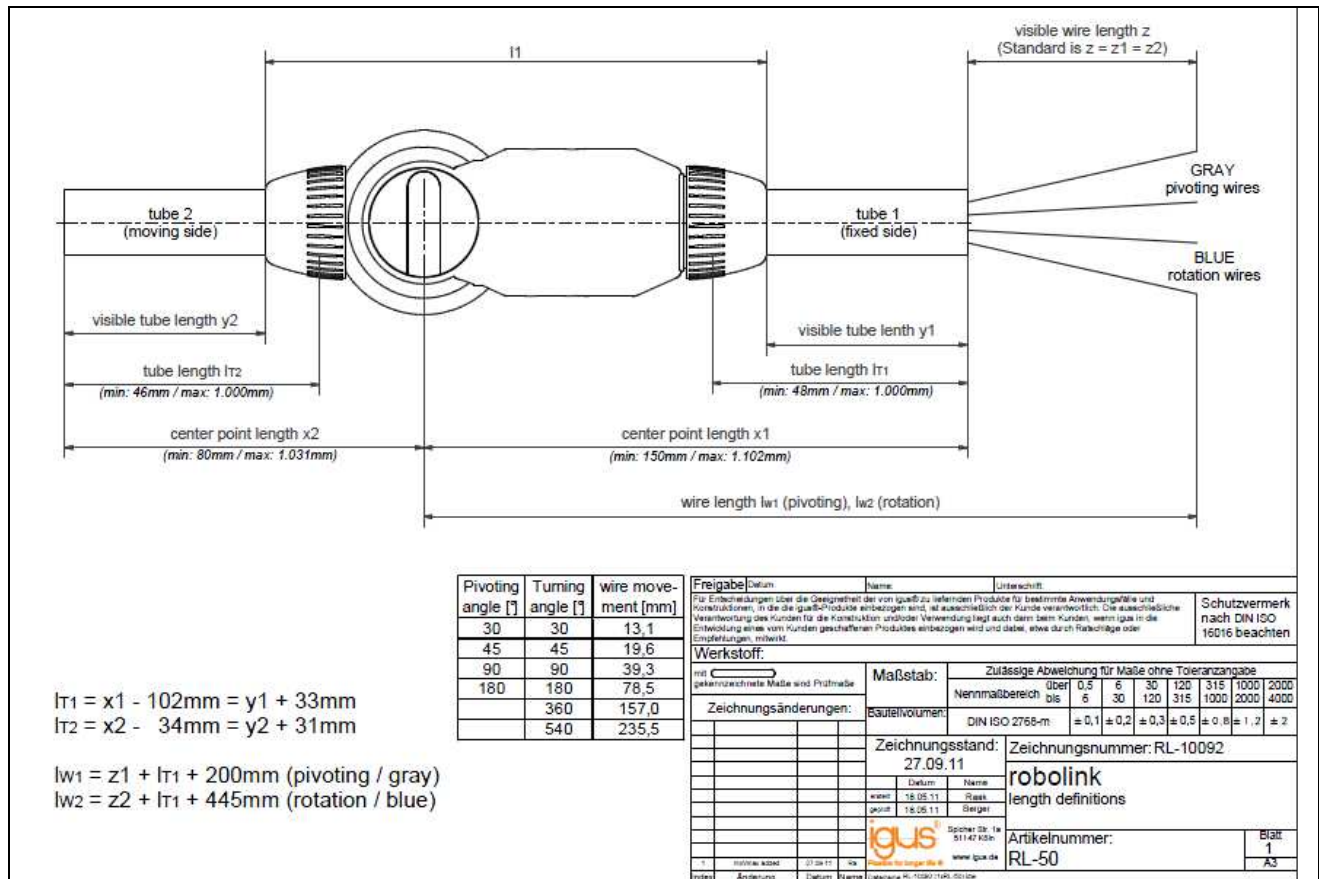


Fig. 11: Tube length information for 1 joint

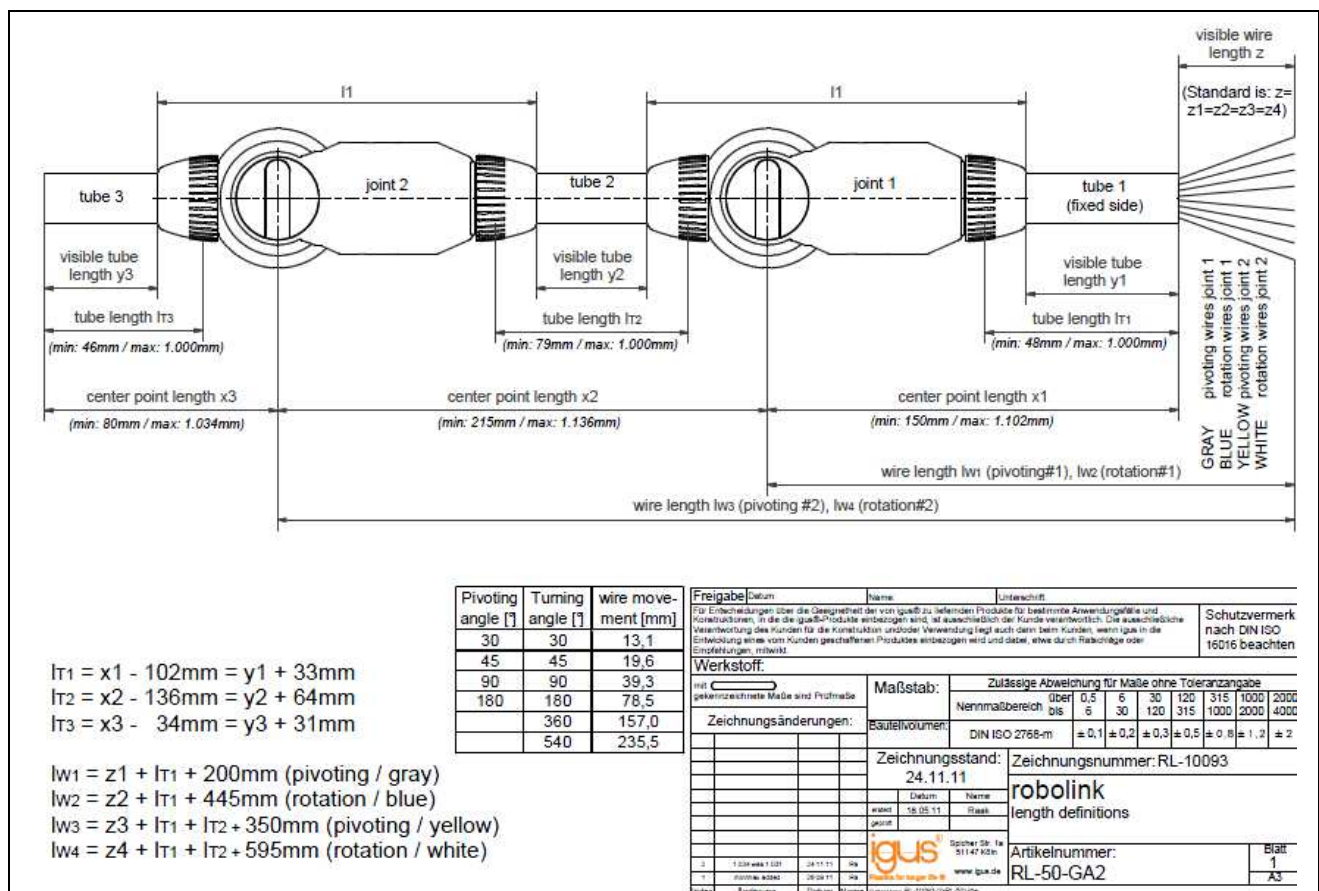


Fig. 12: Tube length information for combinations of 2 joints

This results in certain configuration options of the joints to each other. Articulated arm versions can be configured with 1 to 6 degrees of freedom (DOF). The following figures show some possibilities as an example.

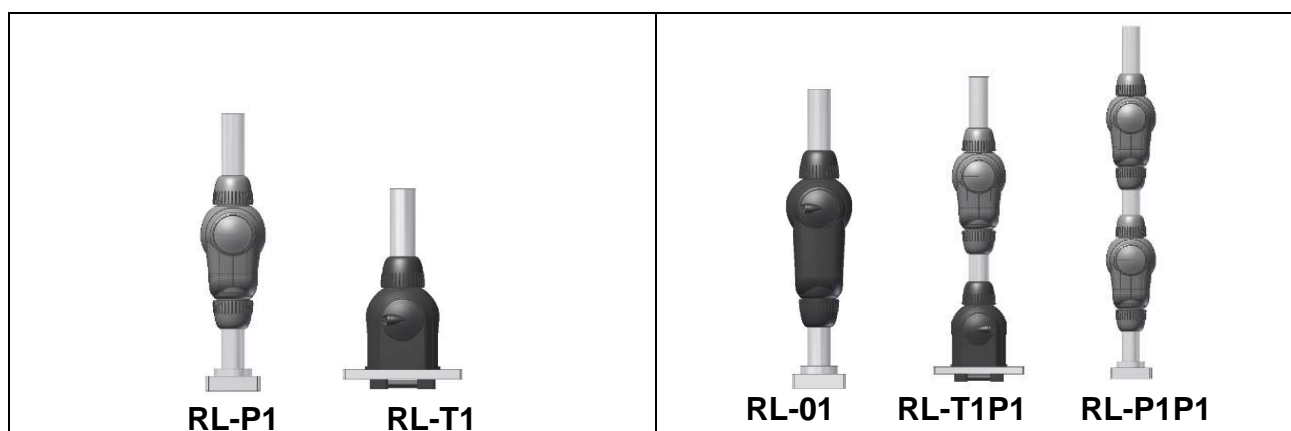


Fig. 13: Articulated arms with 1 DOF

Fig. 14: Articulated arms with 2 DOF

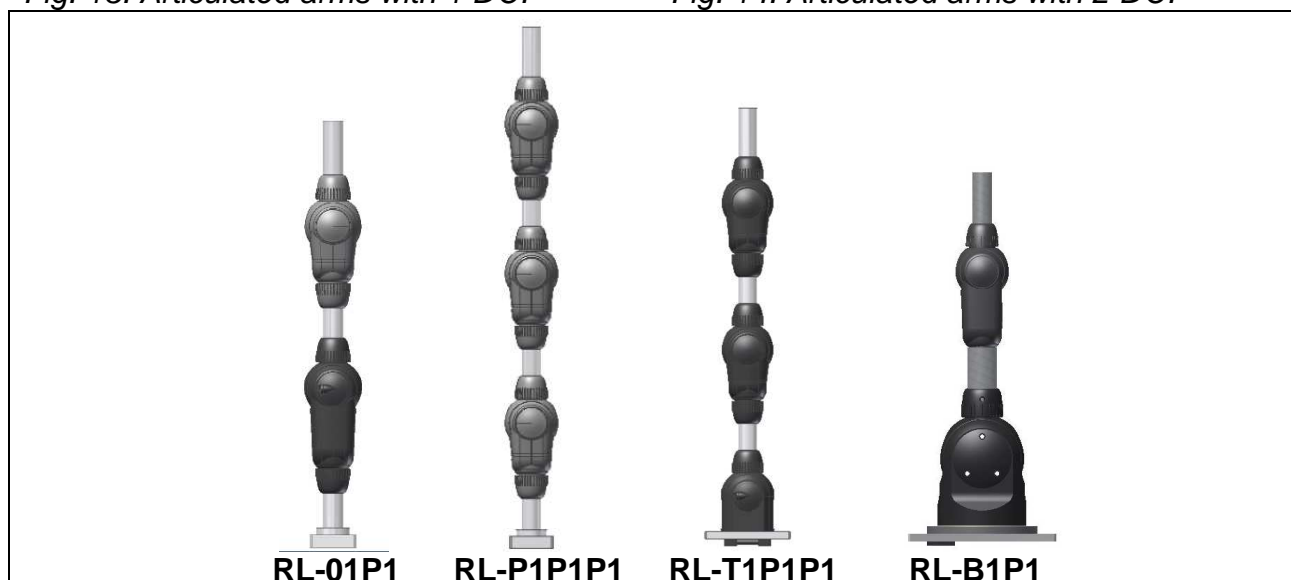


Fig. 15: Articulated arms with 3 DOF

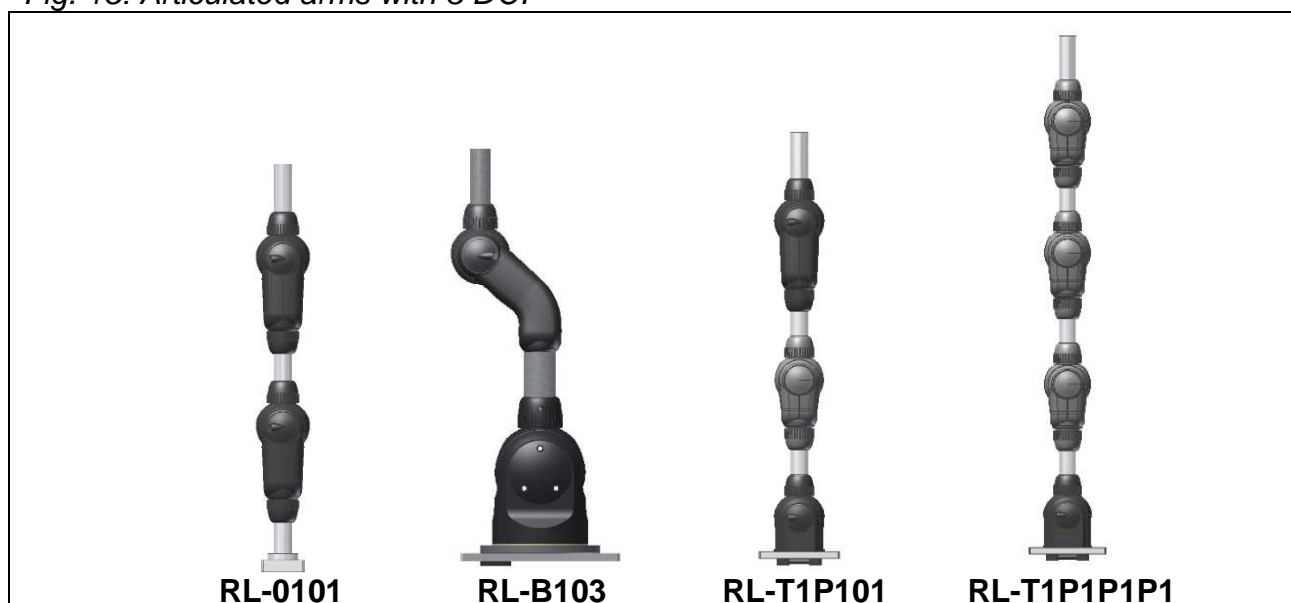


Fig. 16: Articulated arms with 4 DOF

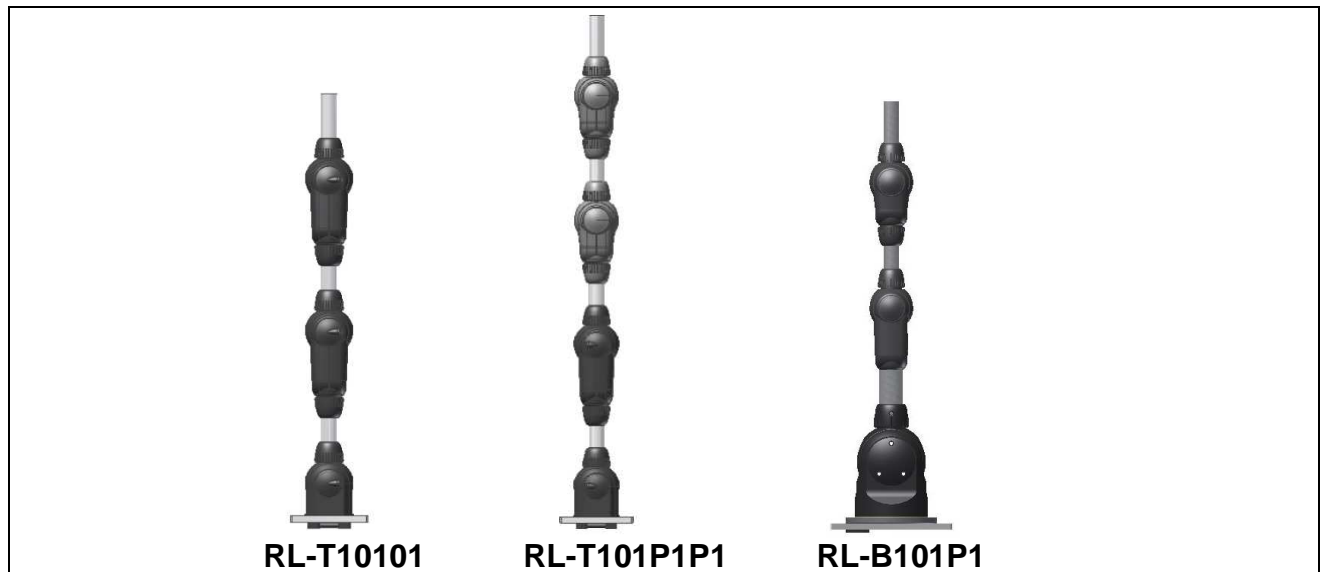


Fig. 17: Articulated arms with 5 DOF

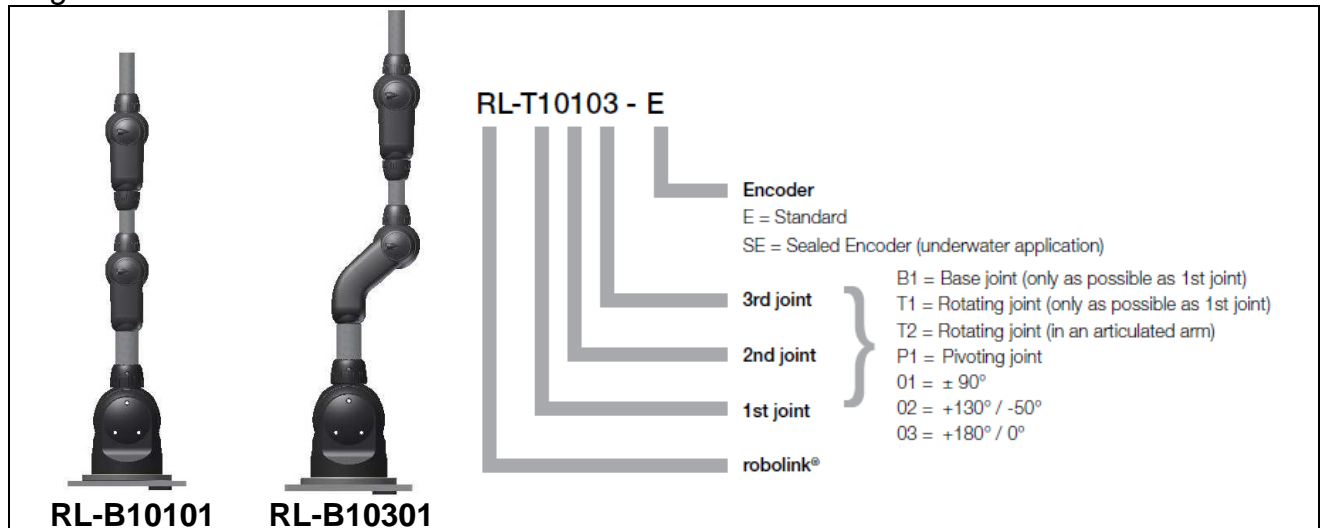


Fig. 18: Articulated arms with 6 DOF, ordering key

The following technical data corresponds to the system examples shown (at 100 mm tube length each):

DOF	Fig.	Version	LT [mm] (Stand.)	x1*) [mm]	x2*) [mm]	x3*) [mm]	x4*) [mm]	x tot. [mm] (*)	weight [gr] (*)	max. stat. load [N] (*)	max. dyn. load [N] (***)
1	13	RL-T1(-E)	100	173	134	-	-	307	290	89	62
	13	RL-P1(-E)	100	134	-	-	-	134	270	89	62
2	14	RL-01(-E)	100	202	134	-	-	336	400	89	62
	14	RL-T1P1(-E)	100	207	134	-	-	341	535	89	62
	14	RL-P1P1(-E)	100	173	207	134	-	514	555	33	15
3	15	RL-01P1(-E)	100	202	207	134	-	543	665	33	15
	15	RL-P1P1P1(-E)	100	173	207	207	134	721	815	18	5
	15	RL-T1P1P1(-E)	100	207	207	134	-	548	800	33	15
	15	RL-B1P1(-E)	100	252	134	-	-	386	1.585	49	21
4	16	RL-0101(-E)	100	202	236	134	-	572	775	30	12
	16	RL-B103(-E)	100	282	134	-	-	416	1.750	44	18
	16	RL-T1P101(-E)	100	207	236	134	-	577	910	30	12
	16	RL-T1P1P1P1(-E)	100	207	207	207	134	755	1.060	18	5

DOF	Fig.	Version	LT [mm] (Stand.)	x1*) [mm]	x2*) [mm]	x3*) [mm]	x4*) [mm]	x tot. [mm] *)	weight [gr] *)	max. stat. load [N] *)	max. dyn. load [N] *)**)
5	17	RL-T10101(-E)	100	236	236	134	-	606	1.020	30	12
	17	RL-T101P1P1(-E)	100	236	207	207	134	784	1.170	18	5
	17	RL-B101P1(-E)	100	252	207	134	-	593	1.960	30	9
6	18	RL-B10101(-E)	100	252	236	134	-	622	2.060	29	8
	18	RL-B10301(-E)	100	282	236	134	-	652	2.115	28	7,5

*) only applies to geometric configurations with standard tube length = 100mm

**) at 30 RPMs and 0.1 sec. ramp time

Table 1: Specification for articulated arms with 1-6 DOF

All articulated arms can be optionally equipped with angle sensors (=> Section - Angle sensors). The shown end-plates (for rotating joints) or end-flanges (for 2 axes and swivel joints) are not part of the delivery scope, but can be ordered as accessories.

When the articulated arm is equipped with a rotating joint, RL-50-TL1, in the first position, the assembled wires already exit the arm in pairs.

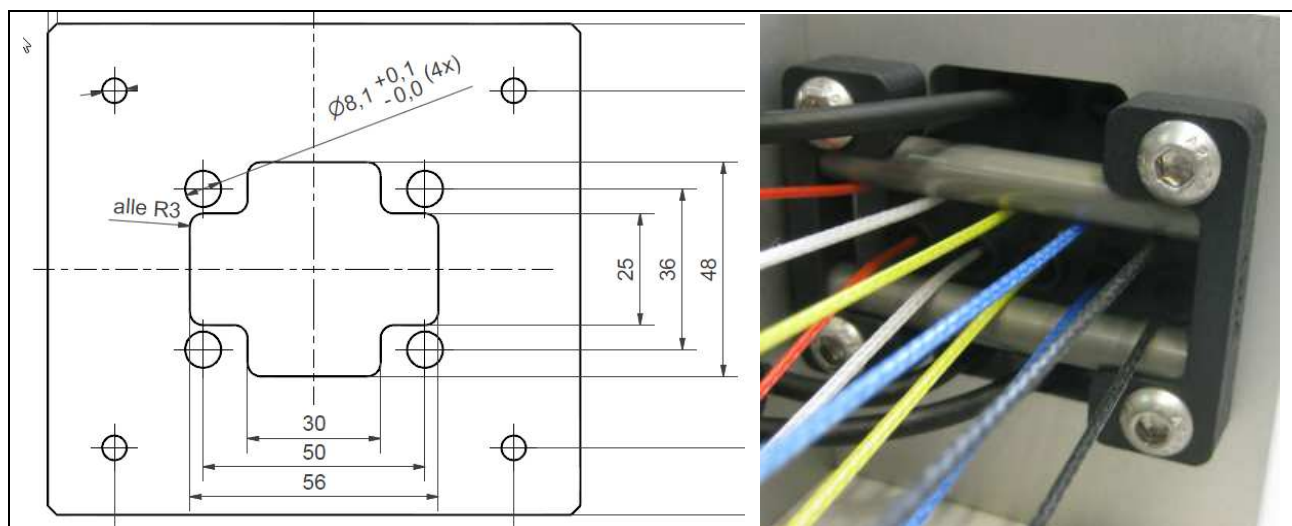


Fig. 19: Dimensioned drawing for an optional mounting plate for the rotating joint, rotating joint view from below

When the articulated arm is equipped with a 2 axes or a swivel joint in the first position, the use of a wire splitting unit (RL-WSU8-001) is generally recommended starting at 3 DOF for a controlled distribution of the drive wires.

The 3D STEP data for all articulated arms is available for download at:

www.igus.de/robolink/support&service.

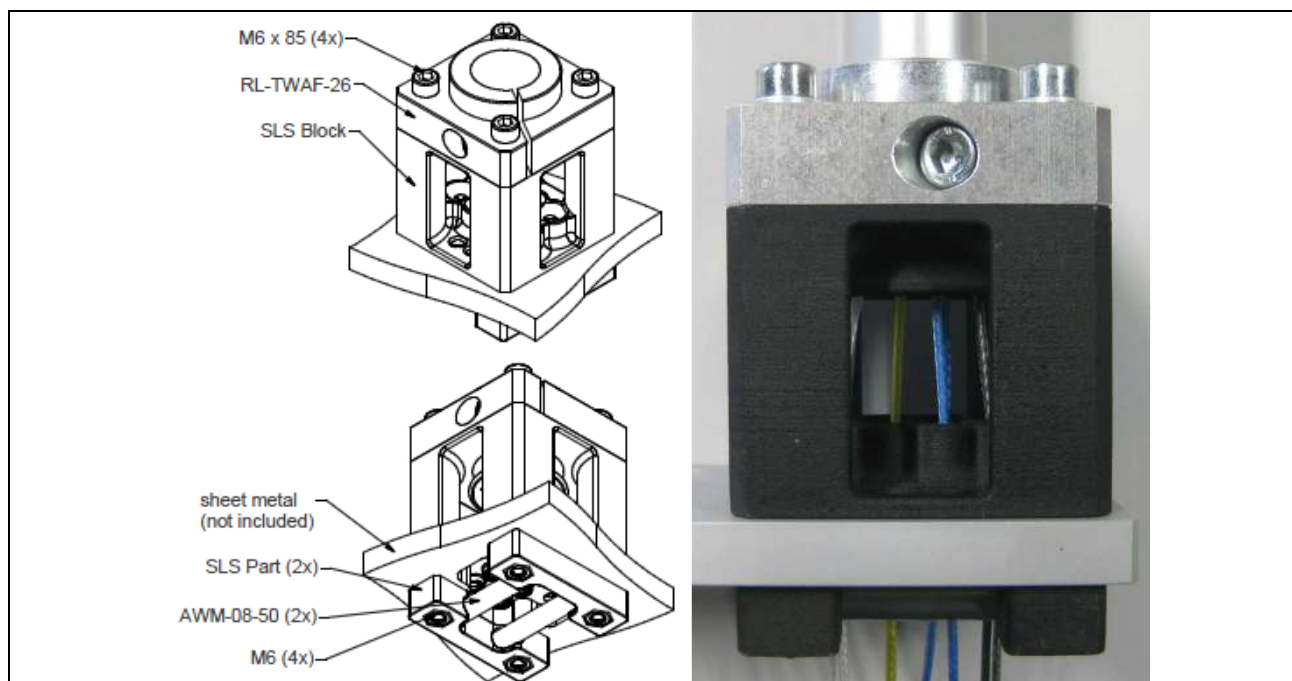


Fig. 20: RL-WSU8-001 to connect an articulated arm with a 2 axes or swivel joint in the first joint

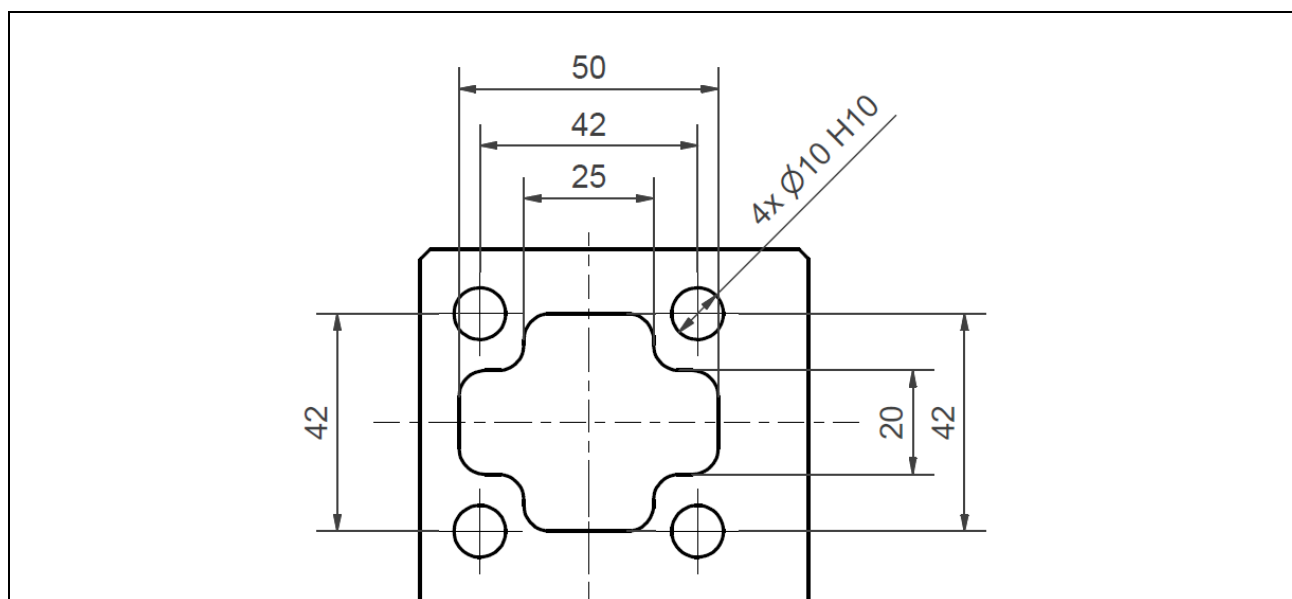


Fig. 21: Dimensioned drawing for an optional mounting plate for the mounting component RL-WSU8-001

Angle sensors

robolink® sensors are magnetic incremental angle sensors. Each axis (DOF) has (optional) one magnetic ring and one associated sensor chip. The magnetic rings are specified as follows:

Swivel motion RL-50-xxx	31 pole pairs	1 additional south pole
Rotating motion RL-50-xxx	29 pole pairs	1 additional south pole
Swivel and rotating motion RL-90-xxx	29 pole pairs	1 additional south pole

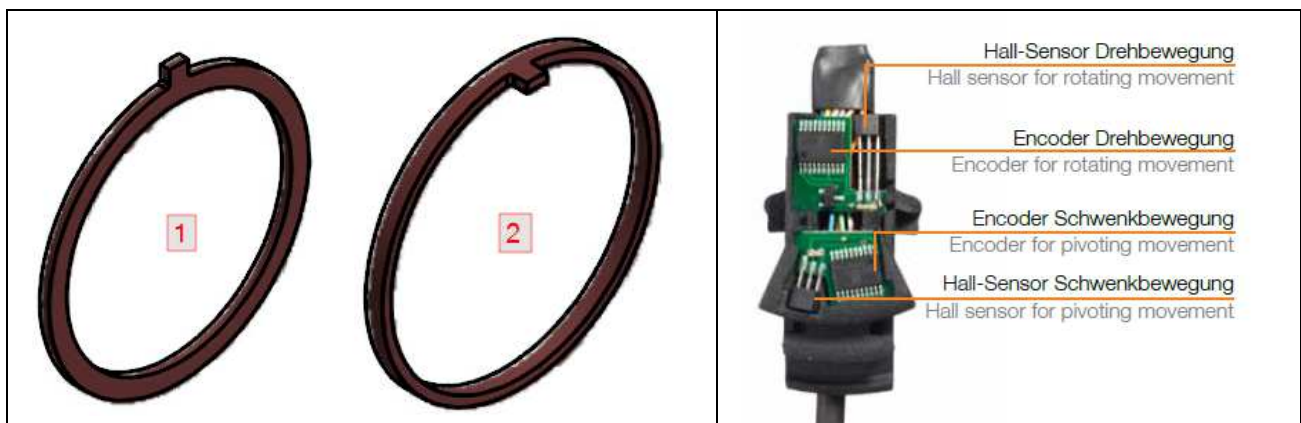


Fig. 22: Magnetic rings - swiveling (1) and rotating (2) for RL-50-xxx

Fig. 23: Sensor unit for 2 axes joint RL-50-001 /-002 /-003

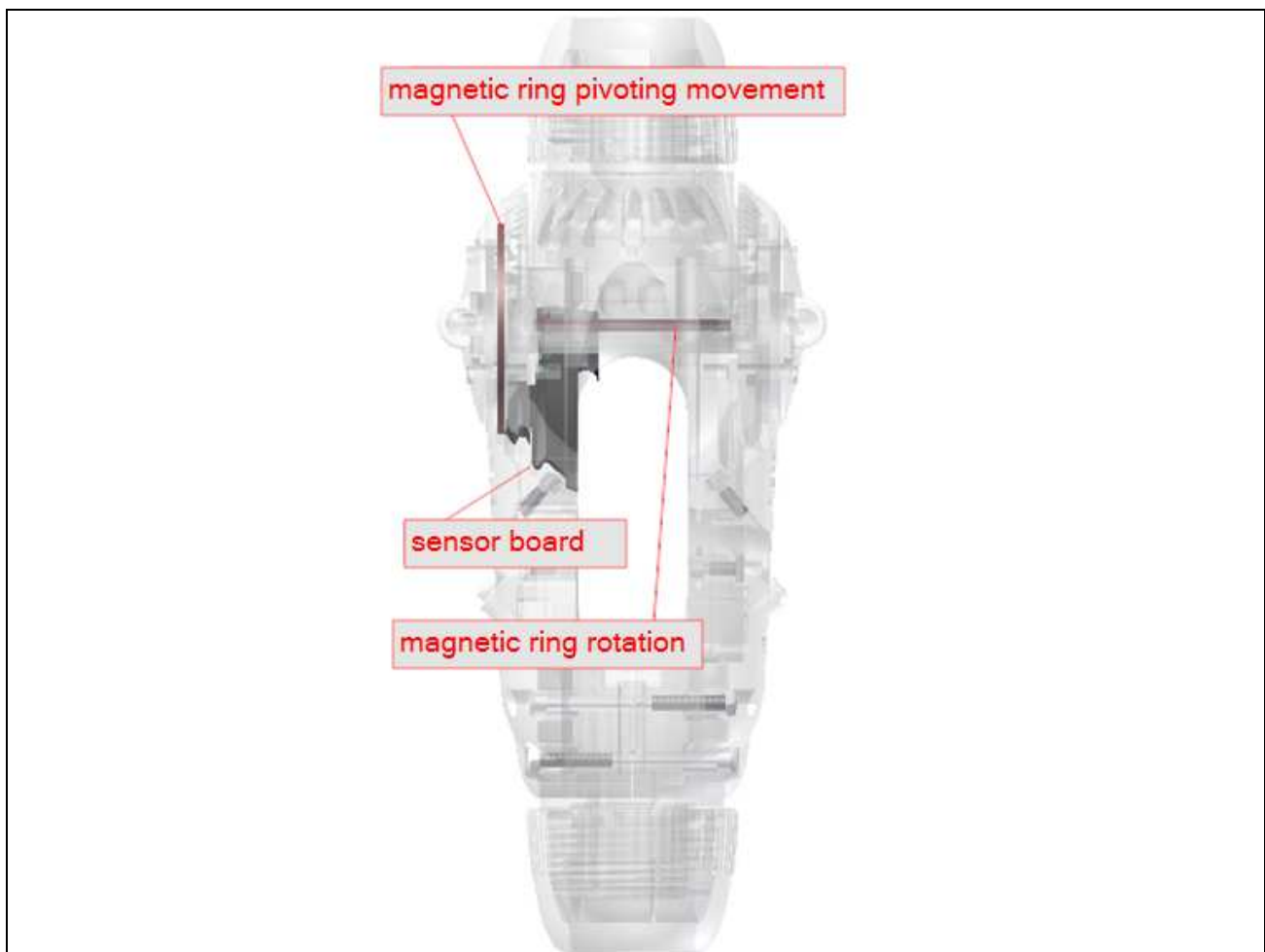


Fig. 24: Installation situation of the sensor in the joint RL-50-001 /-002 /-003

The encoder from Austriamicrosystems (=> Spec sheet download at www.igus.de/robolink/support&service) determines $4 \times 40 = 160$ A/B signals per pole pair.

This permits the following resolutions per axis:

Swivel motion RL-50-xxx	4,960 signals, resolution 0.073°
Rotating motion RL-50-xxx	4,640 signals, resolution 0.078°
Swivel and rotating motion RL-90	9,920 signals, resolution 0.036°

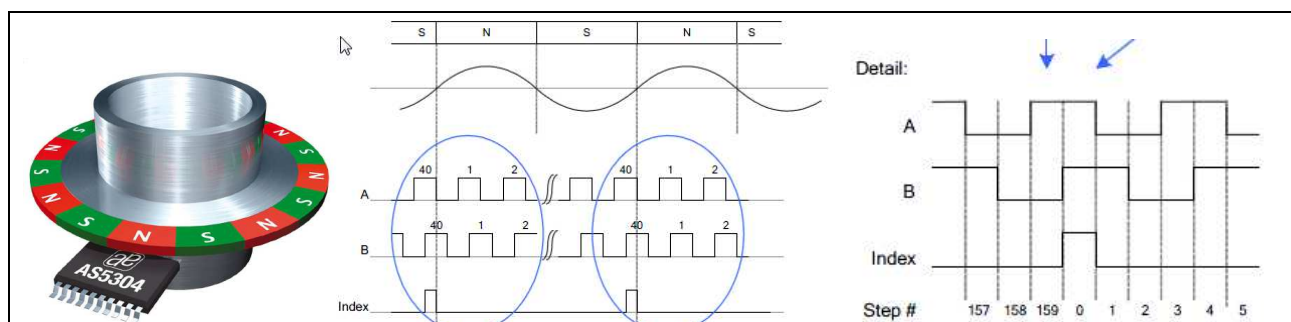


Fig. 25: A/B and index signals from the encoder

The resolution of the individual axis approximately corresponds to the following positioning errors at the corresponding tube lengths:

Distance from center point (x) [mm]	Positioning accuracy [mm]
200	0,24
400	0,49
500	0,61

Table 2: Positioning accuracy with angle sensors

Since the positioning errors for multiple axis are compounded, system designs have a positioning inaccuracy, or repeatability accuracy of approx. 1-2mm for multi-axes systems (depending on the number of axes and tube lengths).

The Hall Sensor Honeywell SS443A is used to reference the system (home position). It has an Open-Collector-Output. This is designed for the connection to a TTL/CMOS-circuit – the $10k\Omega$ pull-up-resistance exists on the board already.

If the output has to be adapted to a 24V-circuit (e.g. PLC), it is realizable e.g. with the following circuit diagram with an optical coupler device. The components have to be adjusted to the respective loads. For this case, a possible electrical configuration is shown in Fig. 26.

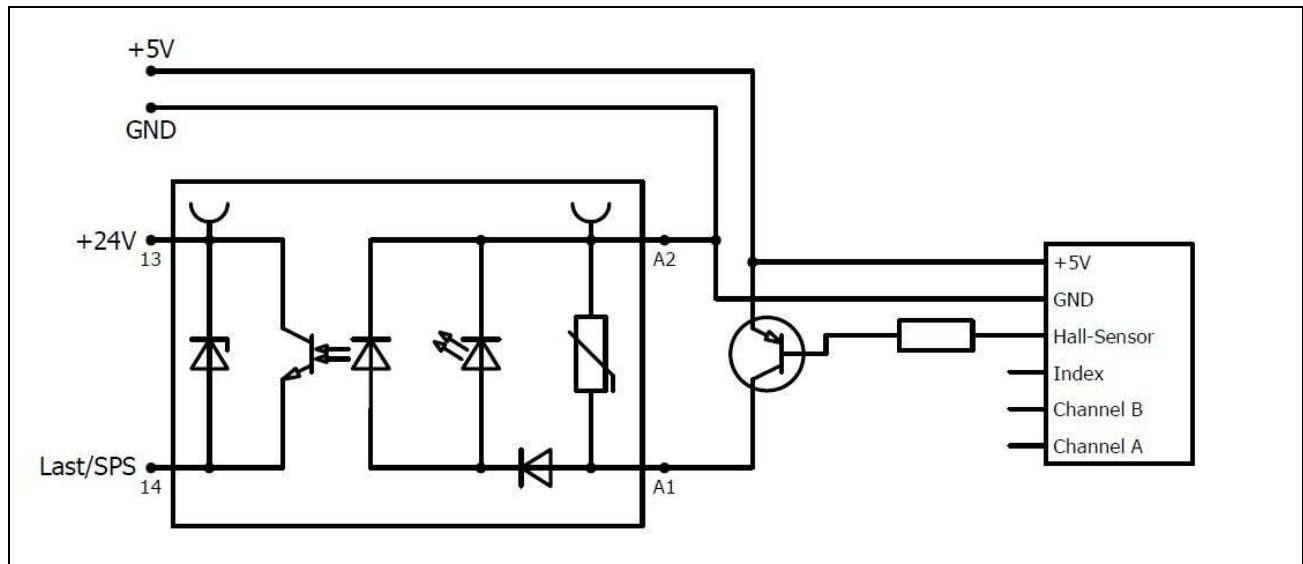


Fig. 26: Wiring the Hall sensors

Electrical circuit diagrams for the sensors are at www.igus.de/robolink/support&service. Each joint axis must be reinitialized (homed) after a power failure.

Each axis (DOF) has 6 conductors. The corresponding strands are assigned as follows:

State
2012-08

producer	igus	
line name	FIXFLEX FF900.11.282	
number of conductors	12	
conductor cross section	0,09	
line diameter [mm]	3,9	
usage	from 04.2012	
pivoting movement		
+5V	red	
GND	black	
Hall-Sensor	white	
Encoder Index	green	
Encoder Channel A	blue	
Encoder Channel B	yellow	
turning movement		
+5V	red/blue	
GND	brown	
Hall-Sensor	grey	
Encoder Index	grey/rose	
Encoder Channel A	violet	
Encoder Channel B	rose	

Fig. 27: Cable definition - igus® sensor cables

Actuators

It is possible to connect various actuators to the last connecting tube of the articulated arm. We generally recommend a plastic adapter element for this. igus® GmbH already provides standard adapter elements for pneumatic grippers from FESTO® and SCHUNK®, for electrical grippers from GIMATIC®, and also for suction systems. Cameras or lighting sources (e.g. LED) can also be adapted.



Fig. 28: standardized adaptable pneumatic grippers

Our own draw wire gripper from igus® GmbH can also be mounted on the tube. 2 versions are possible:

- 1) Wire force opens, spring force closes,
- 2) wire force closes, spring force opens.

The spring force can be configured between 20 and 100 N.

(technical documentation of the gripper under design, status 08-2012)

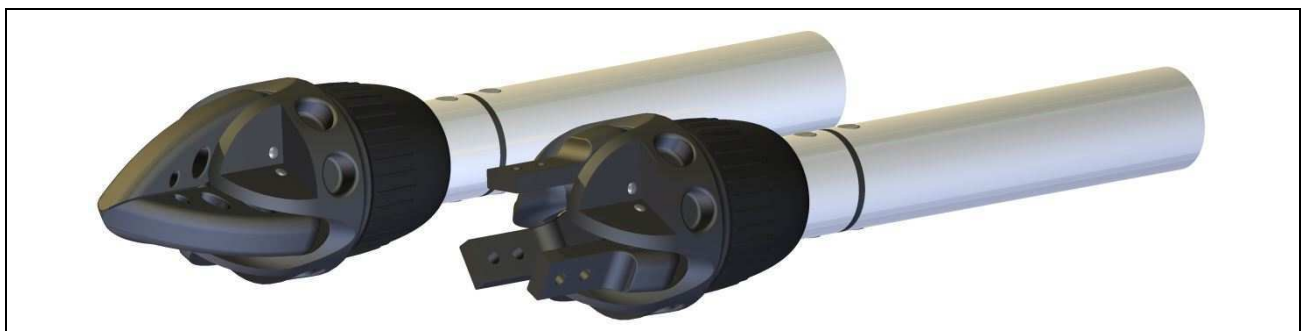


Fig. 29: igus® electrical gripper RL-50-GRI-03-xx with standard (left) and universal jaws (right)

Draw wires

The construction kit components are generally driven by draw wires. Standard wires are made from Dyneema®, 12-strand braiding, d=2mm, approx. 1.8 g/m, breaking strength > 3.500 N, operating elongation approx. 1%. A special coating ensures the best possible service life and low friction.

The wires are installed and held in the joints and the drive (see Fig. 30) by means of wire end nipples (wire end plate assembly instructions at the end of this chapter).

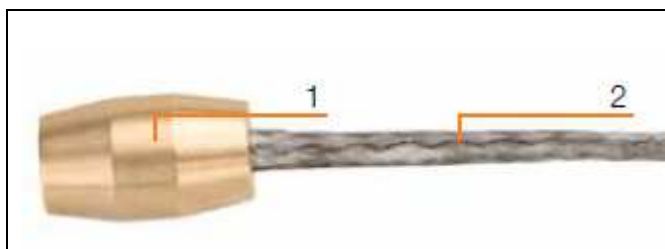


Fig. 30: Wire (2) with nipple (1)



Fig.31 : assembled drive wire in a tensionable drive wheel

The wire tension in an assembled roboLink® system should be 5-10 N at idle. The joint has (generally undesirable) play when the wire tension is inadequate. When the wire tension is too high, the wire friction in the system and the service life of the wires are negatively impacted. The tensionable drive wheels from igus® (see Fig. 25) are ideally suited for adjusting the pretension in the draw wires. These come in two parts and can be easily adjusted to the correct pretension by hand or with an igus® tensioning tool (instructions at the end of this chapter). Readjusting the antagonistic draw wires is generally only needed during initial operation (2-3 times) or after extended down-time.

The wire guidance for rotating motions is accomplished with Bowden cable segments from igus® GmbH. For this application, the Bowden cables fulfill the following requirements:

- high compressive strength up to max. 1,500 N wire tension force;
- continuous motion possible, because the segments are made from RN54 material;
- low bending radii, optionally as small as 30mm.



Fig. 32: igus® Bowden cable

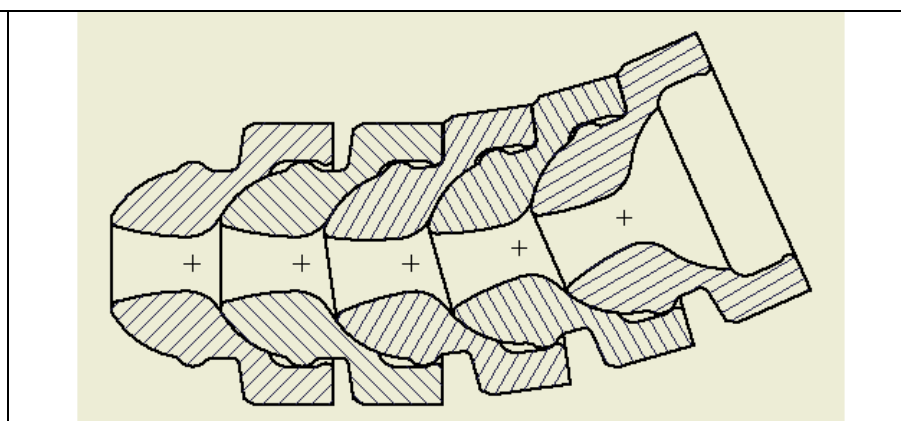


Fig. 33: Bowden cable segments / schematic

All draw wire components are available for reorder from igus® GmbH as replacement parts or as individual components. The article numbers are:

Wire:	RL-SD02-01-xxxx	xxxx = desired wire length in mm
Nipple:	RL-SD02-SN01	2 parts, brass
Bowden cable:	RL-SD02-BZ01-xxxx	xxxx = Bowden cable length in mm
Tensionable drive wheel	RL-ZA011-0250-xx	xx = shaft diameter of the drive

The following instructions for feeding robolink® wires must be observed:

- wires must never travel across sharp edges,
- surfaces that are in contact with moving wires should as flat as possible,
- maintain a bending radius of 30mm for wire deflections,
- always slightly pretension wires in robolink® systems (approx. 10N),
- inadequately tensioned wires result in undesirable play in the joint,
- excessively tensioned wires cause increased friction and wear,
- igus® GmbH recommends using tensionable drive wheels, RL-ZA011-0250-xx,
- igus® GmbH recommends using the igus® Bowden cable RL-SD02—BZ01 to feed wires on sections that are not straight,
- whenever possible, feed wires in a straight line and in a free-floating manner (minimize the use of Bowden cables),
- using deflection pulleys is only recommended for systems with low loads.

When multiple joints are arranged in series, the draw wires of the upper joint are fed through the lower joint. In this case, the motion of the upper joint must be independent from the motion of the lower joint. The 4 draw wires of the second joint are therefore fed through the first joint in a Bowden cable.

In the current configuration, a maximum of 4 wires can be fed through the lower joint. This is the reason for the limitation of the number of joints that can be arranged in series.

The following figures show how the wires are fed through a lower joint. This feed-through is pre-assembled by igus® and is not assembled by the customer.



Fig. 34: Two wire pairs are fed through the lower joint

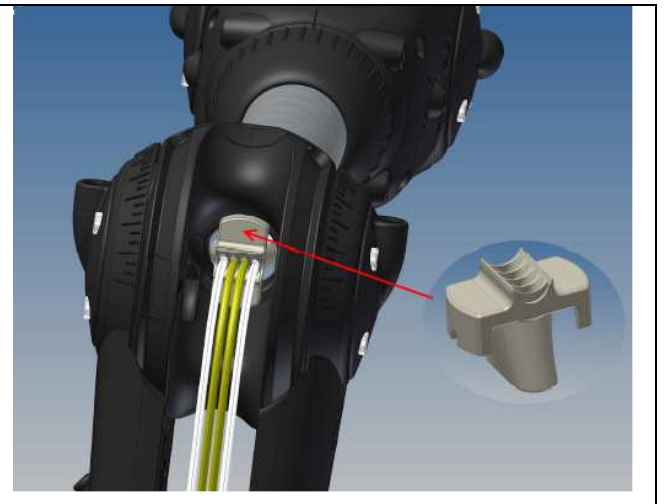


Fig. 35: Upper connecting element for guiding the wire

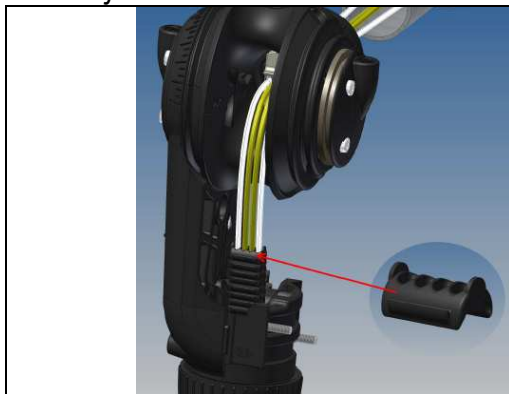


Fig. 36: Bowden cable segments for parallel feed-through

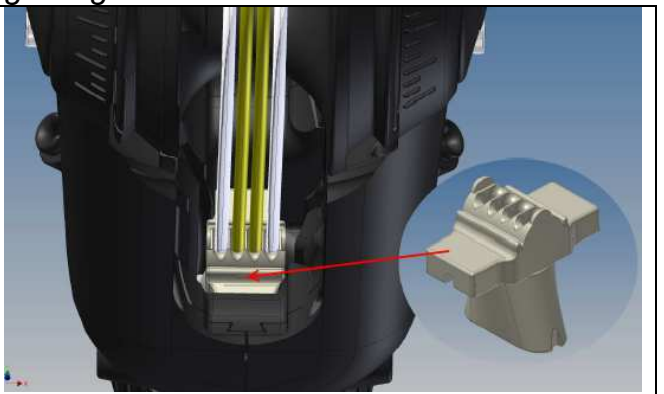
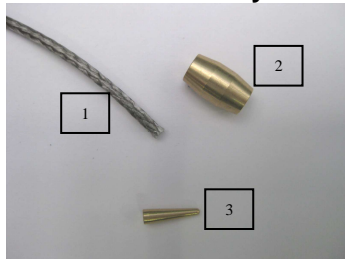


Fig. 37: Lower connecting element

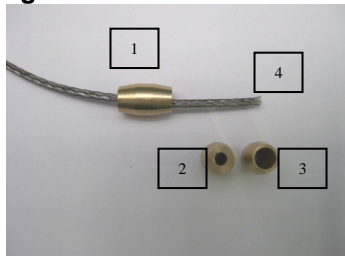
Mounting instruction cable end bottom

1) Overview of the necessary accessories



(1) wire, (2) terminal block, (3) wedge

2) Threading the terminal block onto the wire



- threading the terminal block onto the wire (1)
- smaller diameter (2) of the terminal block first on the wire, (larger diameter (3) shows for cable-end (4))

3) Insert the wedge into the rope



- Manually insertion of the wedge in the cable end (with the tip first)
- Insert wedge as centrally as possible in the rope
- Insert wedge fully into the rope



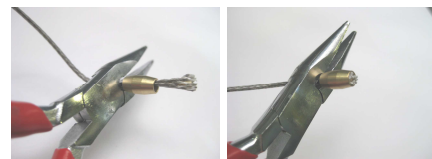
4) Wetting with Loctite Nr. 4204 (alt. 401)



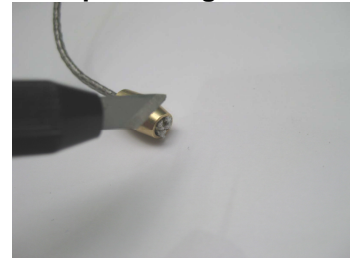
- Wire end (with the insert wedge) must necessarily be wetted with Loctite No. 4204 or 401 ("superglue")

5) Mounting the terminal block on the wedge

- with a suitable device (pliers with suitable opening), the terminal block has to be leaded on the wedge,
- cable shall not be damaged,
- bring cable end bottom in the following end position:



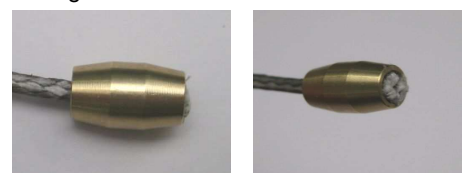
6) Remove protruding wire



- If necessary / desired remove the overlap with a scalpel

7) Control / end position

The tree should look after these steps as the following:



! drying time min. 90 minutes before use !

- strength/retention **with** Loctite 4204 > **1.900N**
- strength/retention **with** Loctite 401 > **1.400N**
- strength/retention **without** Loctite > **190 N**

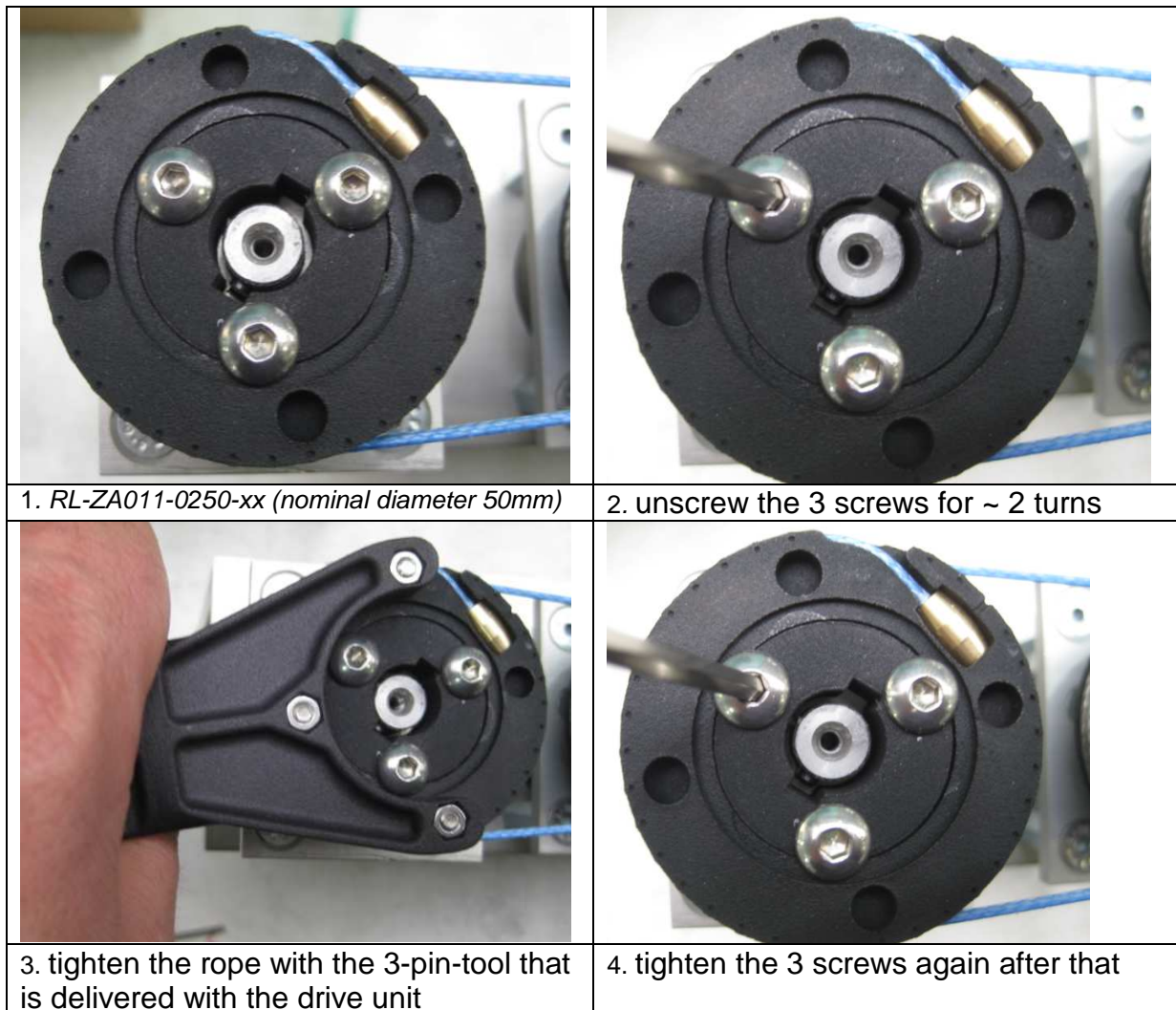
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Drive pulleys with integrated wire tightening

The igus® drive unit is equipped with new pulleys RL-ZA011-0250-xx (since July 2011). They enable the user to tighten the wires for the robolink arm easily.

The tension of the wires can be adjusted individually:

- ⇒ If the tension is too low: the joint will have play (will bounce).
- ⇒ If the tension is too high: friction in the system will rise, all components will be wearing faster



All drive pulleys can be adapted to different motor shafts (res. gear shafts) by using different adapter pieces. The following standard dimensions can be chosen from stock:

- | | |
|-----------------------|---|
| • RL-ZA011-0250-05 | for shaft diameter 5 mm |
| • RL-ZA011-0250-06 | for shaft diameter 6 mm |
| • RL-ZA011-0250-08 | for shaft diameter 8 mm |
| • RL-ZA011-0250-08PFN | for shaft diameter 8 mm (with feather key groove DIN 6885) |
| • RL-ZA011-0250-10 | for shaft diameter 10 mm |
| • RL-ZA011-0250-10PFN | for shaft diameter 10 mm (with feather key groove DIN 6885) |
| • RL-ZA011-0250-12 | for shaft diameter 12 mm |
| • RL-ZA011-0250-12PFN | for shaft diameter 12 mm (with feather key groove DIN 6885) |

Step motors

Step motors from igus® are one possible drive option for wires. These are bipolar 2-phase hybrid motors. The following options are available: NEMA17 and NEMA23 step motors with M12 plug connectors or as strand conductors (cost effective alternative). Technical documentation can be found in the technical spec sheet (download at www.igus.de/robolink/support&service).

Motor		NEMA 17	NEMA 23
Maximalspannung	Maximum voltage	60 VDC	60 VDC
Nennspannung	Nominal voltage	24-48 VDC	24-48 VDC
Nennstrom	Nominal current	1,8 A	4,2 A
Haltemoment	Holding torque	0,5 Nm	2 Nm
Flanschmaß	Distance over hubs	42 mm	56 mm

Tab. 3: Basic technical specs for step motors



Fig. 38: Connector versions:
MOT-AN-S-060-005-042-M-A-AAAA (NEMA17)
MOT-AN-S-060-020-056-M-A-AAAA (NEMA23)



Fig. 39: Strand conductor versions:
MOT-AN-S-060-005-042-L-A-AAAA (NEMA17)
MOT-AN-S-060-020-056-L-A-AAAA (NEMA23)

Flanschmaß flange dimension 42 (NEMA17), 56 (NEMA23),			
Motor bipolar M12 5-polig M12 5-pole		Litzen stranded wire	Motor Leitung cable M12 5-polig M12 5-pole
PIN	Signal	Farbe Color	Farbe Color
1	A/	braun brown	braun brown
2	A	weiß white	weiß white
3	B	blau blue	blau blue
4	B/	schwarz black	schwarz black
5	PE	–	grün/gelb green/yellow
Gehäuse housing	Schirmung shielding	–	–

Fig. 40: Connector assignments for motors

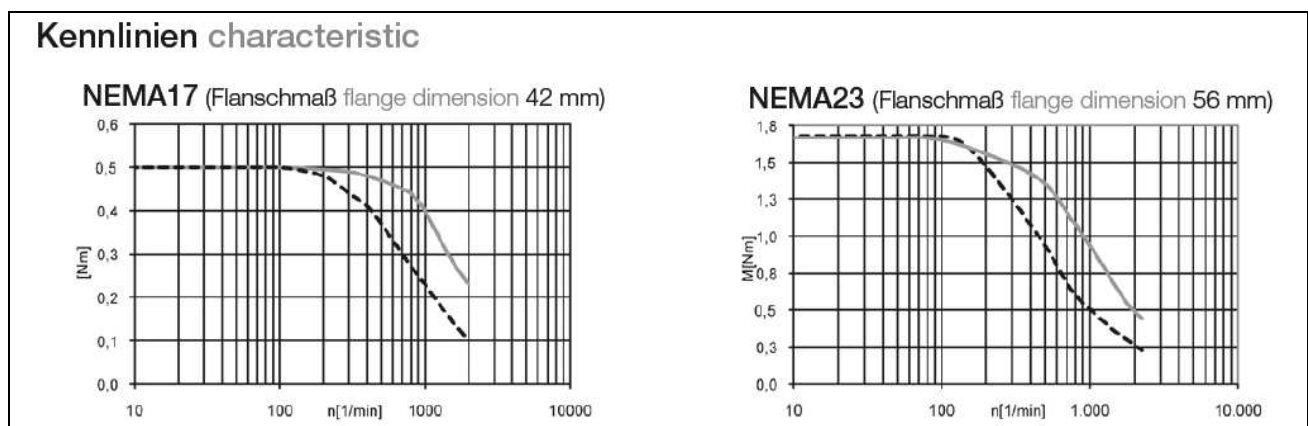


Fig. 41: Characteristic progression for motors

Abmessungen dimensions [mm]

The image contains two technical drawings of stepper motors. The left drawing is a side view of a NEMA17 motor, showing dimensions L1 (total length), L2 (body length), L3 (flange thickness), L4 (mounting flange thickness), D1 (shaft diameter), and D2 (total height). The right drawing is a top view of a NEMA23 motor, showing dimensions B1 (total width), B2 (body width), B3 (flange width), and D3 (mounting flange thickness). Both drawings show the motor's internal structure, including the stator and rotor.

Bestellnummer	B1	B2	B3	D1	D2	D3	L1	L2	L3	L4
Part number		±0,2		-0,013	±0,025		±1,0	±1,0		
NEMA17										
MOT-AN-S-060-005-042-L-A-AAAA	42,3	31,00	–	5,0	22,0	M3	24,0	49	2,0	–
MOT-AN-S-060-005-042-M-A-AAAA	42,3	31,00	13	5,0	22,0	M3	24,0	70	2,0	–
NEMA23										
MOT-AN-S-060-020-056-L-A-AAAA	56,4	47,14	–	6,35	38,1	5,0	20,6	76	1,6	5
MOT-AN-S-060-020-056-M-A-AAAA	56,4	47,14	13	6,35	38,1	5,0	20,6	98	1,6	5

Fig. 42: Motor dimensions



Flanschmaß flange dimension
42 (NEMA17), 56 (NEMA23),

Bestellnummer Partnumber	Mantel Jacket	Typ type	Leitungslänge cable length [m]	Stecker connector
Motorleitung power cable				
MAT9043737	TPE	CF9-CF.INI	3,0	gerade straight
MAT9043738	TPE	CF9-CF.INI	5,0	gerade straight
MAT9043740	TPE	CF9-CF.INI	10,0	gerade straight
MAT9043742	TPE	CF9-CF.INI	3,0	gewinkelt angulate
MAT9043743	TPE	CF9-CF.INI	5,0	gewinkelt angulate
MAT9043745	TPE	CF9-CF.INI	10,0	gewinkelt angulate

Fig. 43: Connecting cables for motors with connectors from igus® (optional)

Drive modules

igus® equips step motors with a planetary gear and a tensionable drive wheel (RL-ZA011-0250-xxPFN) in order to increase the motor torque. The following gears are used in the standard configuration:

- NEMA17 motors: Reduction gearing 1:35
- NEMA23 motors: Reduction gearing 1:16

Other reduction gearing is available upon request. The technical specs for the gears can be found in the dimension or specification sheet in the attachments. The function of the tensionable drive wheel is described in (=> Section - Accessories) Depending on the motor versions, the following drive modules can be selected:

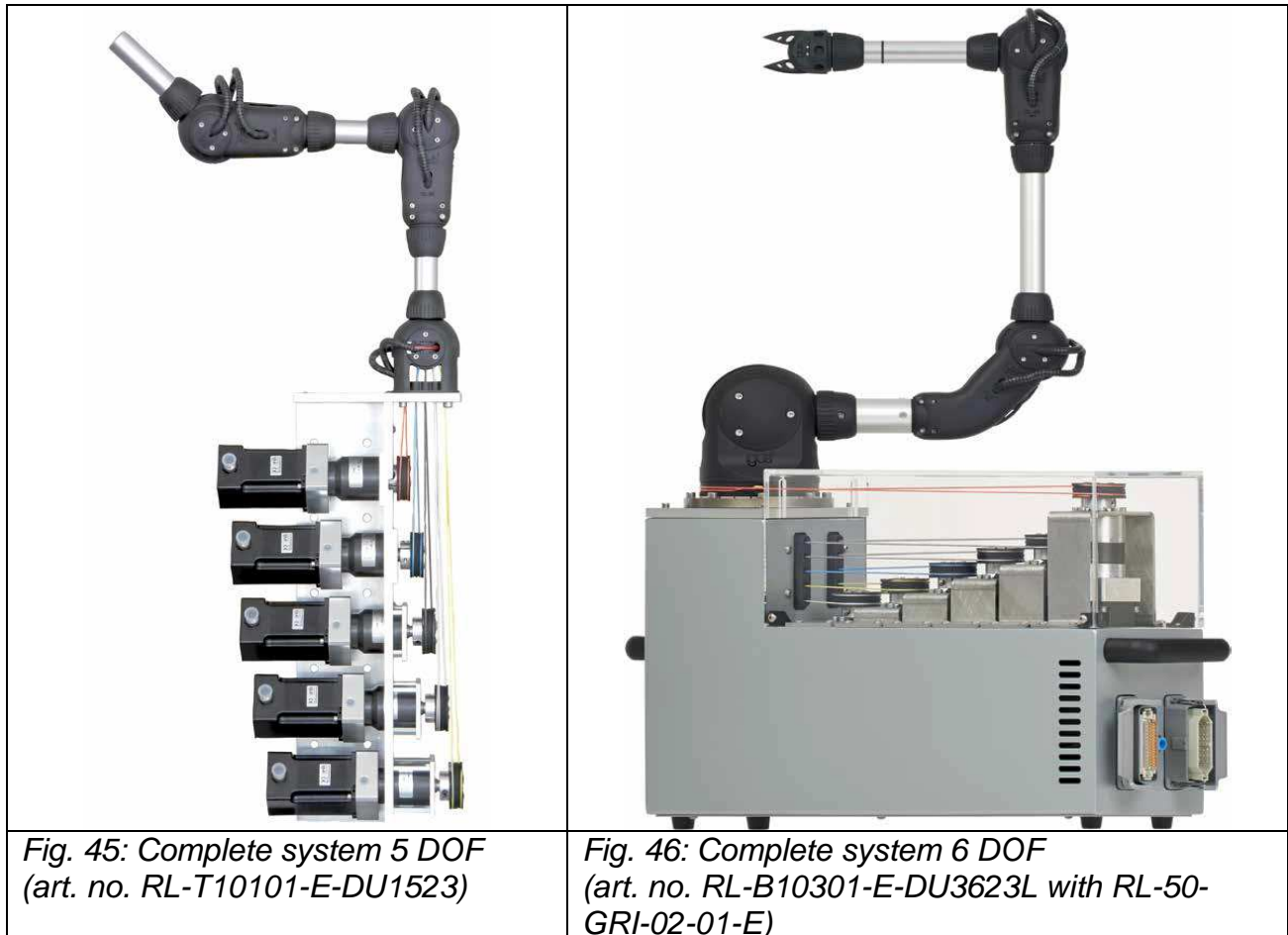
- | | | | |
|------------|--------------|--------------------------|--------------|
| • AEM1-17L | NEMA17 motor | Strand conductor version | Gearing 1:35 |
| • AEM1-17 | NEMA17 motor | Connector version | Gearing 1:35 |
| • AEM1-23L | NEMA23 motor | Strand conductor version | Gearing 1:16 |
| • AEM1-23 | NEMA23 motor | Connector version | Gearing 1:16 |



Fig. 44: Drive module consisting of the step motor, planetary gear and tensionable drive wheel

Drive units

Drive modules can be optionally assembled in drive units. In this case, the entire wire feed mechanism is assembled at the factory. A completed module then consists of a customized articulated arm, and a pre-assembled and tested drive unit. igus® offers drive units starting at 3 DOF. Drive units for 1 and 2 DOF are available upon request.



The following options are user selectable for these systems:

- Articulated arm with 3-5 DOF per specification (=> Section - Articulated arms)
- With or without angle sensors in the joints (=> Section - Sensors)
- Tube lengths per specification (standard = 100mm, max. = 1,000 mm),
- NEMA17 or NEMA23 motors, connector or strand conductor version,
- Grippers or suction cups per specification (=> Section - Actuators).

Other options (on request):

- Step motors with encoder and/or brake,
- Other reduction gearing,
- Special designs.

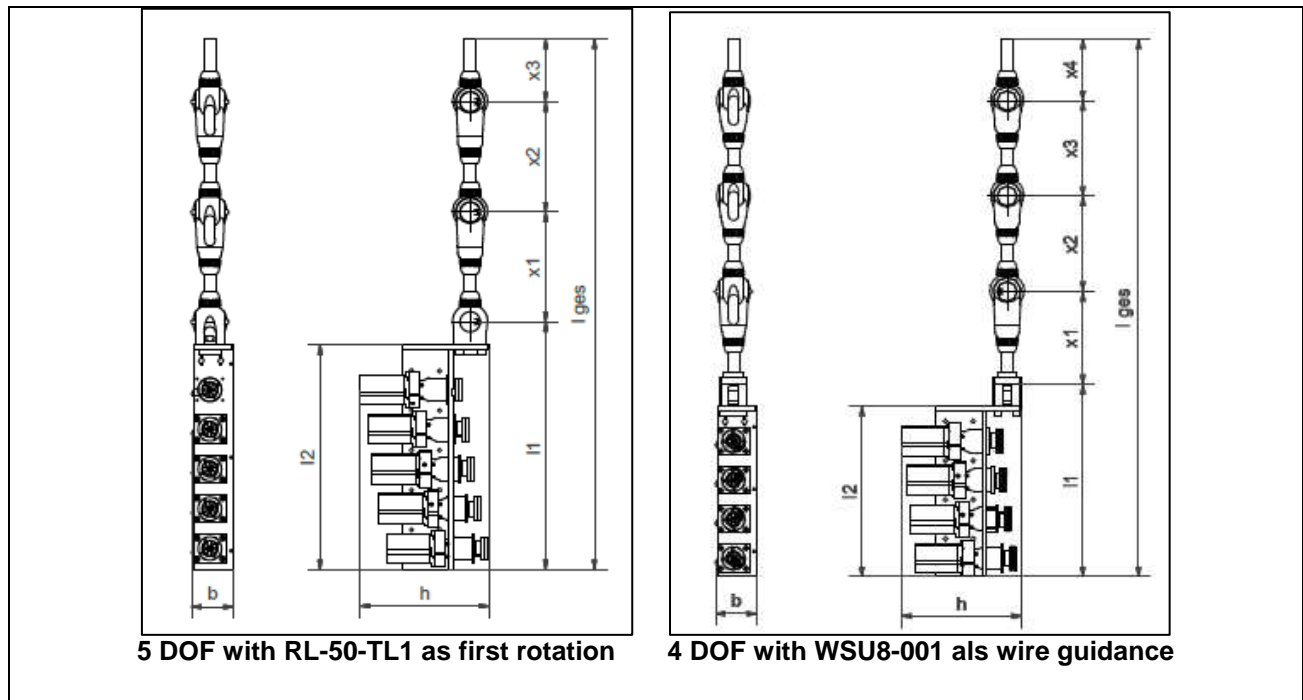


Fig. 47: Complete system drawings with 4 and 5 DOF

Complete units have the following specifications (3-5 DOF):

DOF	NEMA17 versions	l1 [mm]	l2 [mm]	b [mm]	h [mm]	l ges. [mm]*)	Weight [gr]*)
3	RL-01P1-DU1317	258	210	80	240	801	5.415
	RL-P1P1P1-DU1317	258	210	80	240	979	5.565
	RL-T1P1P1-DU1317	260	210	80	240	808	5.150
4	RL-0101-DU1417	358	310	80	240	930	6.875
	RL-T101P1-DU1417	360	310	80	240	937	6.610
	RL-T1P1P1P1-DU1417	360	310	80	240	1.115	6.760
5	RL-T10101-DU1517	460	410	80	240	1.066	8.070
	RL-T101P1P1-DU1517	460	410	80	240	1.244	8.220

*) only applies to geometric configurations with standard tube length = 100mm

Table 4: Complete system specification with NEMA17 motors (3-5 DOF)

DOF	NEMA23 versions	l1 [mm]	l2 [mm]	b [mm]	h [mm]	l ges. [mm]*)	Weight [gr]*)
3	RL-01P1-DU1323	308	260	80	240	851	8.965
	RL-P1P1P1-DU1323	308	260	80	240	1.029	9.115
	RL-T1P1P1-DU1323	310	260	90	275	858	8.700
4	RL-0101-DU1423	358	310	80	240	930	11.475
	RL-T101P1-DU1423	420	370	90	275	997	11.210
	RL-T1P1P1P1-DU1423	420	370	90	275	1.175	11.360
5	RL-T10101-DU1523	530	480	90	275	1.136	13.720
	RL-T101P1P1-DU1523	530	480	90	275	1.314	13.870

*) only applies to geometric configurations with standard tube length = 100mm

Table 5: Complete system specifications with NEMA23 motors (3-5 DOF)

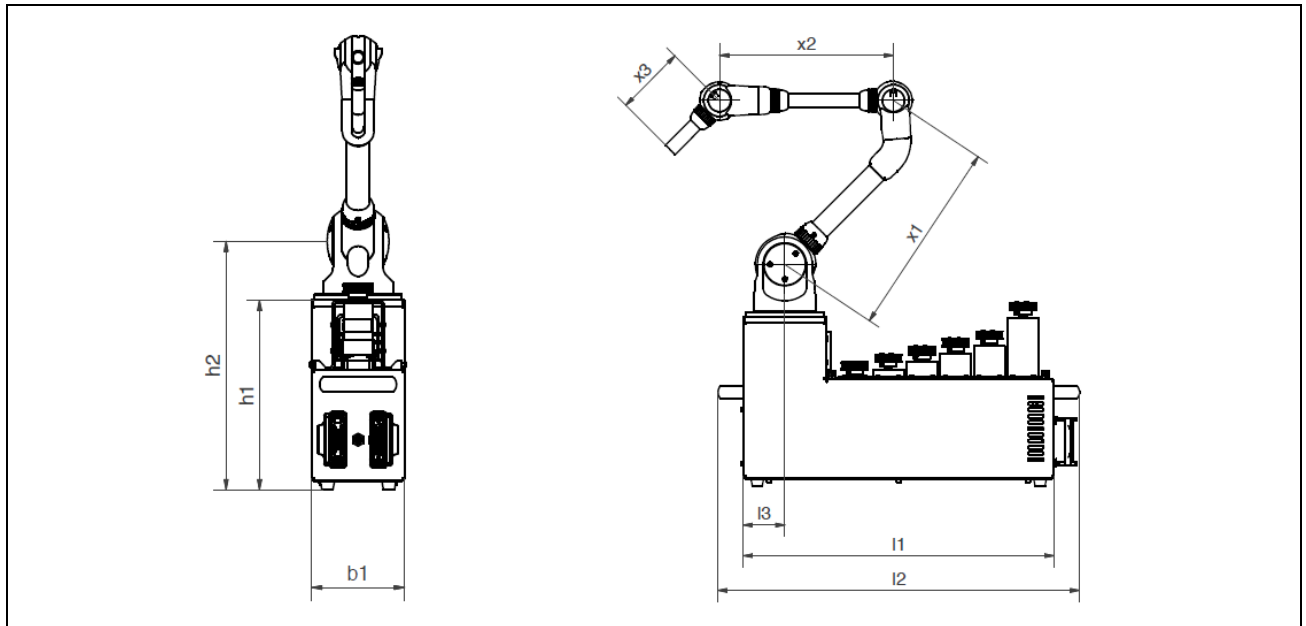


Fig. 48: Complete system drawings with 6 DOF

Complete units have the following specifications (6 DOF):

DOF	NEMA23L versions	l1 [mm]	l2 [mm]	b1 [mm]	h2 [mm]	x ges. [mm]*)	Gewicht [gr]*)
6	RL-B10101-DU3623L	600	698	160	427	622	26.895
	RL-B10301-DU3623L	600	698	160	427	650	26.950

*) only applies to geometric configurations with standard tube length = 100mm

Table 6: Complete 6 DOF system specification with NEMA23L motors

Accessories

igus® GmbH provides a host of additional accessories for the robolink® Joint kit. Our regularly updated catalog provides an overview. The most current version with prices is always available as a download at www.igus.de/robolink/support&service.

Controls

igus® GmbH does not sell motor controls (specifically no step motor controls), and also no other electrical or electronic components. We use the following products in our lab and for trials, with which we have had good experience:

- NANOTEC® step motor controls, SMC147-S
- SIEMENS® SPS controls, S7-1200

In cooperation with WAGO Kontakttechnik GmbH & Co.KG, a Germany-based manufacturer of automation and interconnection products, a solution for controlling the robolink® system is available since autumn 2014. The modular WAGO-I/O-SYSTEM 750 with its industrial design is used as a stand alone unit for the control of the stepper drives. The ready-made libraries and application notes provided by WAGO ensure an easy start-up in CODESYS. Thus a user-specific solution for robolink® applications is only a small step away. Due to the possibility of a seamless integration of the IME software any application is possible with minimum engineering input.

Further Information about control solutions will be published by igus in 2015.

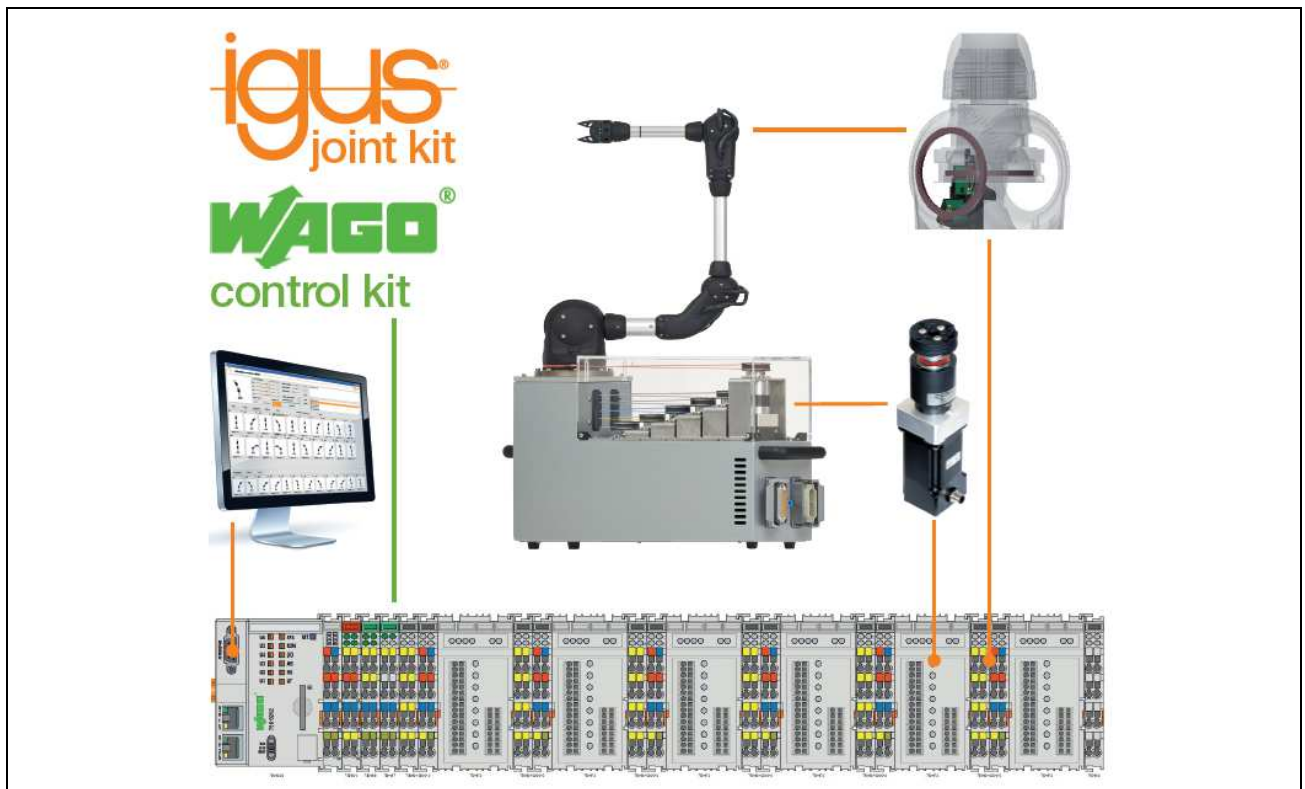


Fig. 49: schematic diagram WAGO® control unit and igus® robolink®

Dimensioned drawings

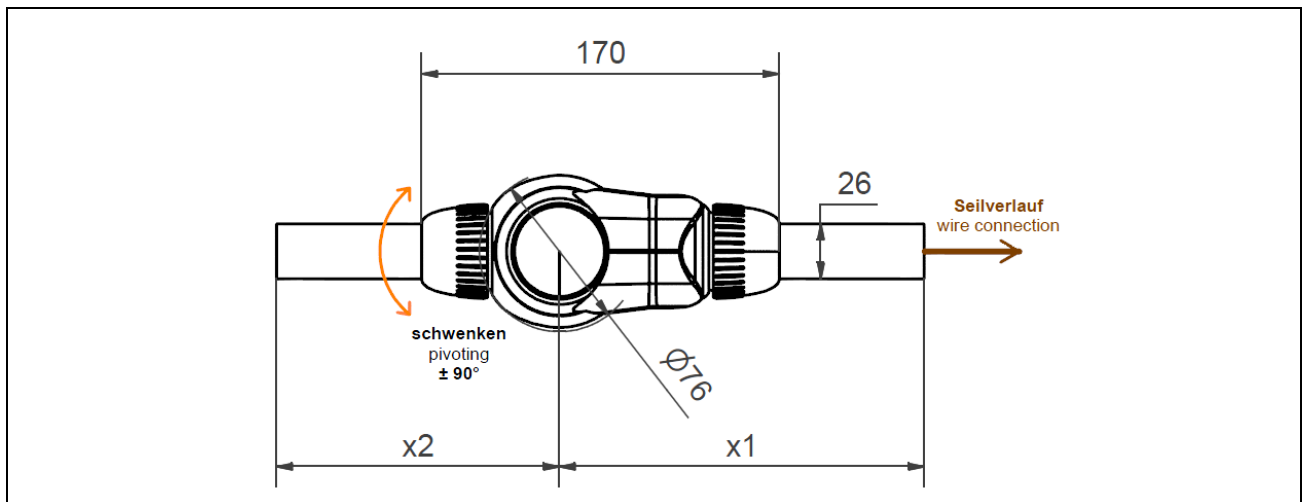


Fig. 50: Dimensioned drawing - Swivel joint RL-50-PL1

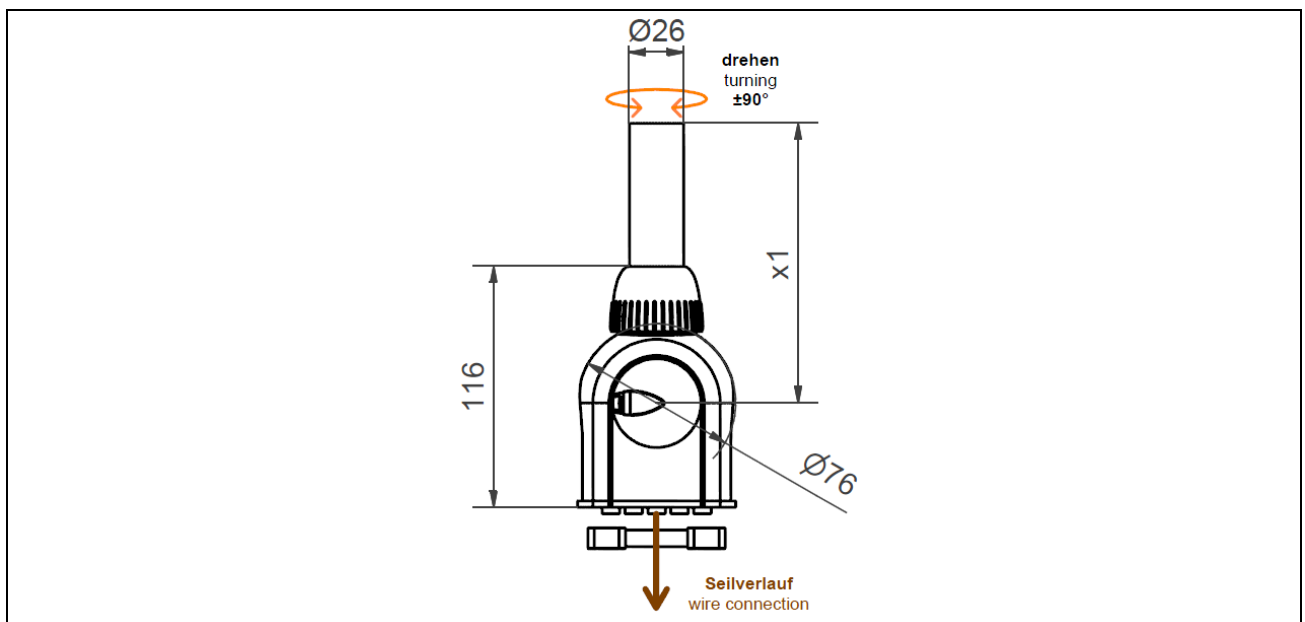


Fig. 51: Dimensioned drawing - Rotating joint RL-50-TL1

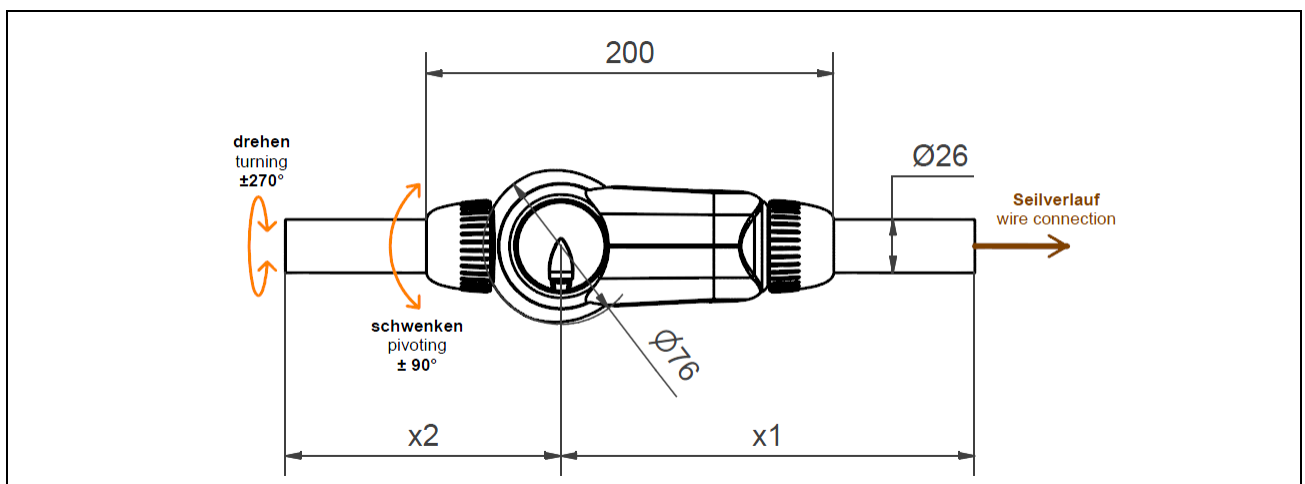


Fig. 52: Dimensioned drawing - 2 axes joint RL-50-001

Exploded drawings / parts lists

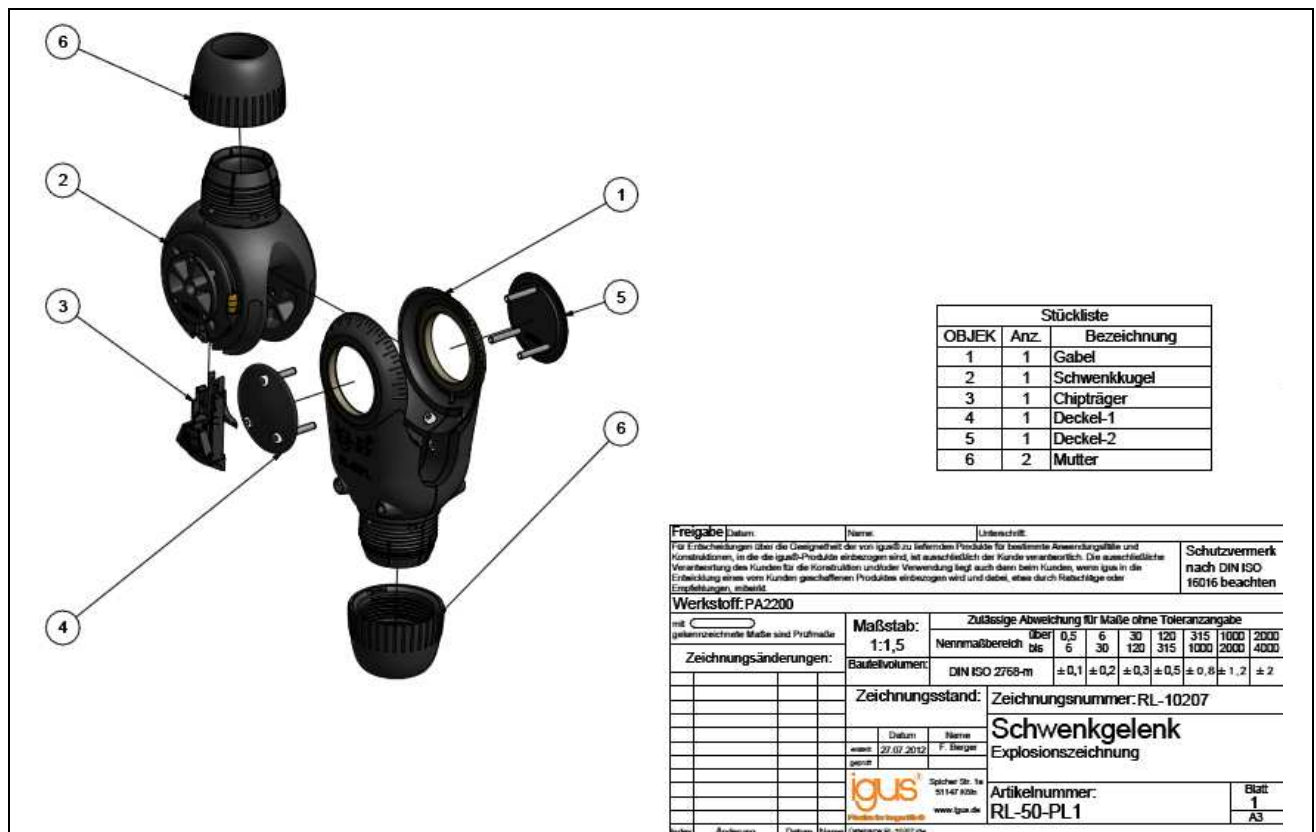


Fig. 53: Exploded drawing / parts list - Swivel joint RL-50-PL1

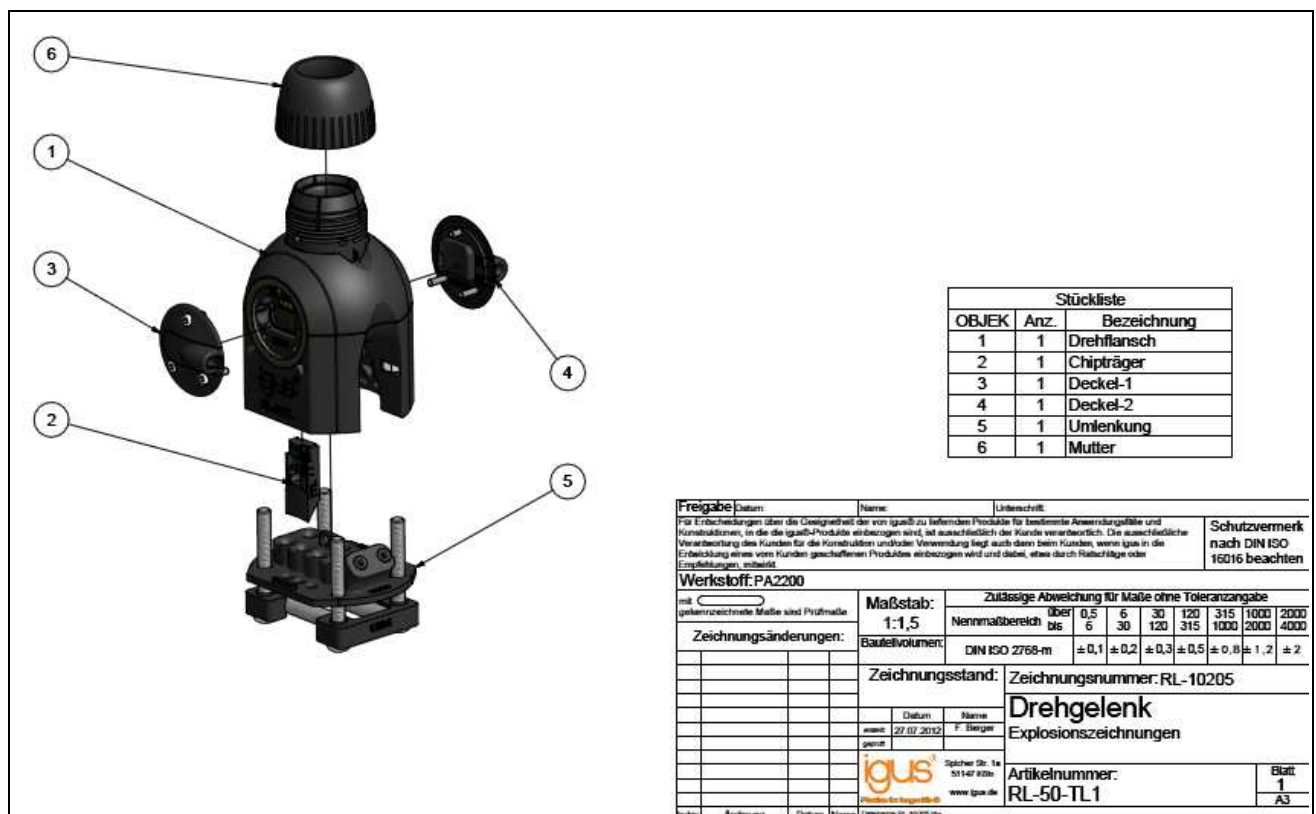


Fig. 54: Exploded drawing / parts list - Rotating joint RL-50-TL1

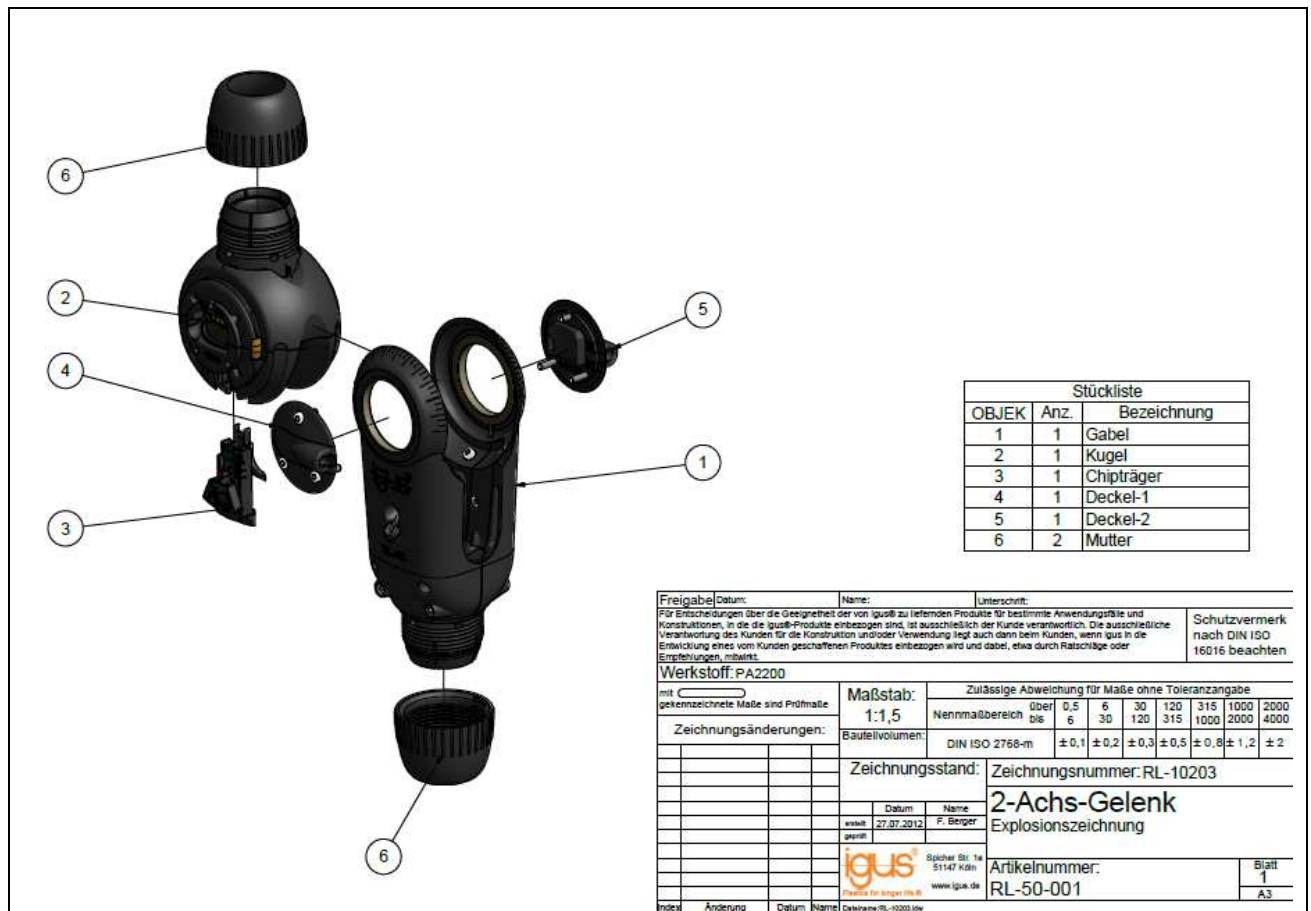


Fig. 55: Exploded drawing / parts list - 2 axes joint RL-50-001 (-002)