

robotlink[®]

igus.eu

bionically inspired robotic joint ... 10.2015 ...



toolbox

The roboLink® joint construction kit. Lean automation.

Robotic joints and components made from igus® tribo polymers.

The plastic specialist igus® gives developers, labs, and automation integrators access to a joint construction kit that can be used to construct customised robot systems. The joints are found in a wide range of applications, such as on humanoid robots, lightweight construction, on handling mechanisms, and in automation tasks. A classic roboLink® articulated arm is extremely light since the draw wire technology allows the drives (motors) to be positioned in a separate drive unit instead of being located on the moving arm. Accordingly, it is principally conceivable that our articulated arms could also cooperate with humans.

There are now 7 different joint types that can be combined and linked together in a variety of ways, up to a maximum of 6 degrees of freedom (DOF). Such a 6 axis arm only weighs about 2 kg and can move a useful load of up to 1 kg – depending on geometric configuration.

A roboLink® articulated arm can be driven with optional igus® stepper motors, or if required, can also be driven with other motors and control solutions. Pneumatic drives can also be used.

The "roboLink® D" direct drive joints are a new product range. In this case, the stepper motors are no longer driven by draw wires, but are instead positioned directly on the axis. The familiar igus® slewing rings PRT-01-20 (and -30 and -50) are the basis for this new development.

Enjoy reading and getting ideas.



Yours
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igus® – plastics for longer life®



www.igus.eu

Also visit our igus® website www.igus.eu, explore other products, technical details, novelties, helpful online tools, and benefit from our online product range – any hour of the day.



Our offers are exclusively directed to dealers / resellers. The quoted unit prices in Euros are net prices without VAT. All previous price lists become invalid with the publication of this price list.



Delivery free within Germany for orders over EUR 150.00



Payment 2% discount within 14 days net within 30 days

roboLink® joints and systems



Rotating joint ► From page 8
Pivoting joint ► Page 10
Base joint ► Page 11
2-axis joint ► From page 12
Infinite possibilities ► From page 16

roboLink® components



Angle sensors ► Page 15
2-jaw gripper ► From page 18
3-jaw gripper ► From page 18
Drive units ► From page 20
Complete 6 DOF unit ► From page 24

roboLink® accessories



Camera adapter ► Page 26
Drive wheel ► Page 27
Clamping tool ► Page 27
Wire end bottom and wires ► Page 28
Bowden cable ► Page 28
Connection tubes ► Page 29
Flange shaft support ► Page 29

roboLink® D



NEW! Robot joints with one or two PRT slewing ring bearing ► Page 31
NEW! Robot joint with direct drive ► Page 34

roboLink® software



NEW! Modular robotics ► Page 30
 roboLink® software "open source" ► From page 36

robotlink® application examples

robotlink® articulated arm with gesture based control. [The Institute for Product Development and Machinery Design at the Leibnitz University, Hannover]



Manual workstation support system with human-machine interface for the production of the Manufacturing Technology Lab (LaFT) at Helmut-Schmidt University in Hamburg



Special design with 4 DOF, 3 joints in series [Fraunhofer IFF Magdeburg]



Submerged camera guidance, articulated arm with 4 DOF [igus®]



The Technical University at Wroclaw, Poland equipped its autonomous robot FLASH with 2 robotlink® articulated arms, each with 4 DOF.



"HOBBIT" service robotics project at TU Vienna. robotlink® articulated joints on autonomous systems. [Project partner Hella Automation, Austria]

Components kit to make movable robotic systems

A couple of years ago, we established our objective to develop a toolbox of mechanical components for the assembly of movable robotic systems. The first component in this toolbox was a plastic link with tendon drive. This element has the following special properties: lightweight, compact and unlimited.

LIGHTWEIGHT: joints made from polymers

- Lubrication free
- Cost effective
- Long service life
- Standard joint weighs only 345 g

COMPACT: 2 degrees of freedom in one element

- Pivoting AND rotating
- Freely configurable "arm length" through modular design

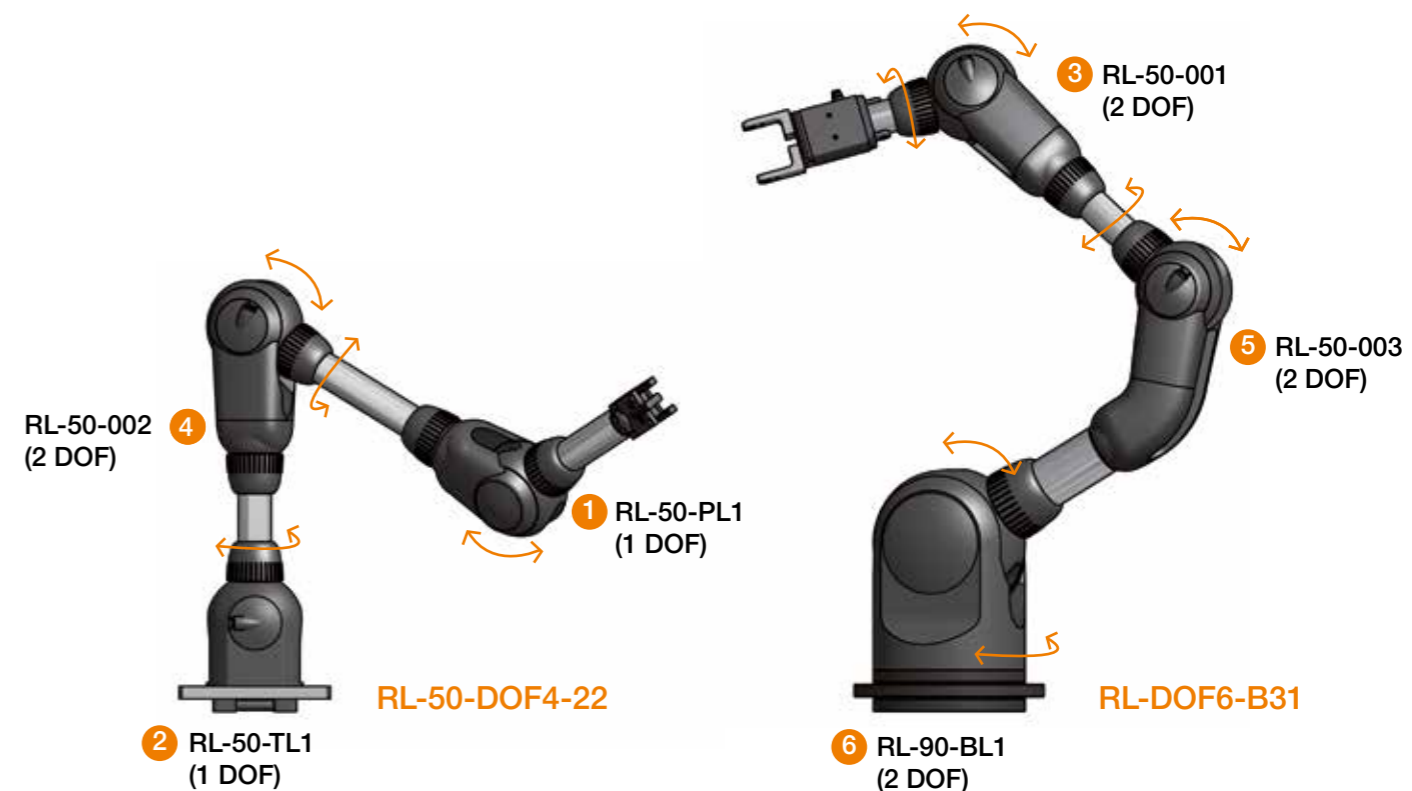
UNLIMITED: freely selectable drive systems

- Connect AND start
- Compact drive unit for a 3 to 6-axis articulated arm
- Drive via sinews (and/or ropes) and stepper motors by igus®
- Alternative drive/control systems easily possible



Available with angle sensors

| Part no. | Number of ropes | | Pivoting angle | | Angle of rotation | | Weight [g] | Max. load | |
|----------------------------|-----------------|-----------------------|--------------------------|---------------------------|--------------------------|---------------------------|------------|---------------|---------------|
| | On-board drive | Optional feed-through | Standard (with stop dog) | Option (without stop dog) | Standard (with stop dog) | Option (without stop dog) | | Pivoting [Nm] | Rotating [Nm] |
| 1 Pivoting joint RL-50-PL1 | 2 | 4 | 180° (±90°) | 210° (±105°) | – | – | 235 | 12 | – |
| 2 Rotating joint RL-50-TL1 | 2 | 8 | – | – | 340° (±170°) | 540° (±270°) | 245 | – | 5 |
| 3 2-axis joint RL-50-001 | 4 | 4 | 180° (±90°) | 210° (±105°) | 340° (±170°) | 540° (±270°) | 345 | 12 | 5 |
| 4 2-axis joint RL-50-002 | 4 | 4 | 180° (+130°/-50°) | 240° (+135°/-105°) | 340° (±170°) | 540° (±270°) | 345 | 12 | 5 |
| 5 2-axis joint RL-50-003 | 4 | 4 | 180° (+180°/0°) | 235° (+180°/-55°) | 340° (±170°) | 540° (±270°) | 400 | 12 | 5 |
| 6 Base joint RL-90-BL1 | 4 | 8 | 180° (±90°) | 190° (±95°) | 180° (±90°) | – | 1,250 | 20 | 10 |



* Option without stop dog:

Mechanical stop dogs perform 2 primary functions: Protecting components and wires against overloads in limit positions, and facilitating wire feed-through from other joints through the respective joint.

All joints can also be operated without stop dogs, provided...

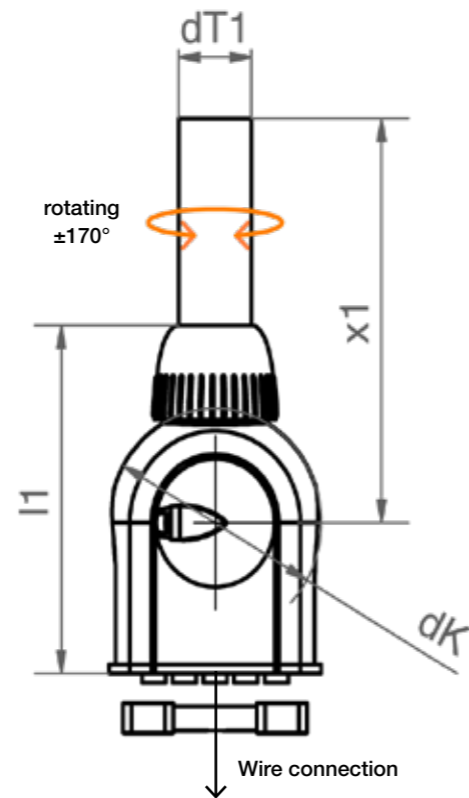
- 1) The limit positions are monitored with software
- 2) The joint has no rope feed through (e.g. at the end of a multi-axes articulated arm)

robolink® joint | Rotating joint type TL1, 1 DOF

1 DOF (degree of freedom), only possible as 1st joint in a system, available with angle sensors

robolink® rotating joint TL1

- **Weight:** 245 g
- **Max. load:** Rotating 5 Nm
- **Angle of rotation:** 340° (± 170°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

| Part no. | Description | x1* | l1 | dK | dT1 | Prices [€] | | |
|-------------|--------------------|-----|-----|----|-----|------------|-------------|-------------|
| | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-TL1 | Rotating joint | 134 | 125 | 76 | 26 | 350.00 | 294.00 | 262.00 |
| RL-50-TL1-E | With angle sensors | 134 | 125 | 76 | 26 | 492.00 | 413.00 | 369.00 |

* Standard tube length = 100 mm; other lengths available

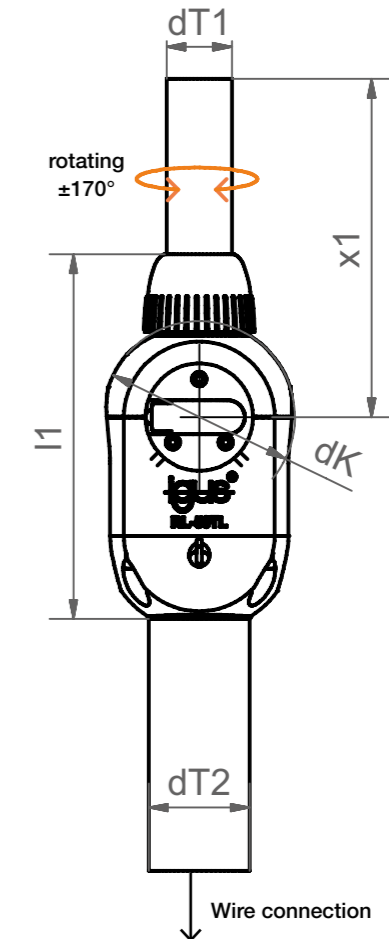


robolink® joint | Rotating joint type TL2, 1 DOF

1 DOF (degree of freedom) for installation as an additional rotating axis after a base joint ("shoulder", 3rd axis), optionally with angle sensors

robolink® rotating joint TL2

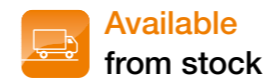
- **Weight:** 245 g
- **Max. load:** Rotating 5 Nm
- **Angle of rotation:** 340° (± 170°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

| Part no. | Description | x1* | l1 | dK | dT1 | Prices [€] | | |
|-------------|--------------------|-----|-----|----|-----|------------|-------------|-------------|
| | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-TL2 | Rotating joint | 134 | 125 | 76 | 26 | 350.00 | 294.00 | 262.00 |
| RL-50-TL2-E | With angle sensors | 134 | 125 | 76 | 26 | 492.00 | 413.00 | 369.00 |

* Standard tube length = 100 mm; other lengths available



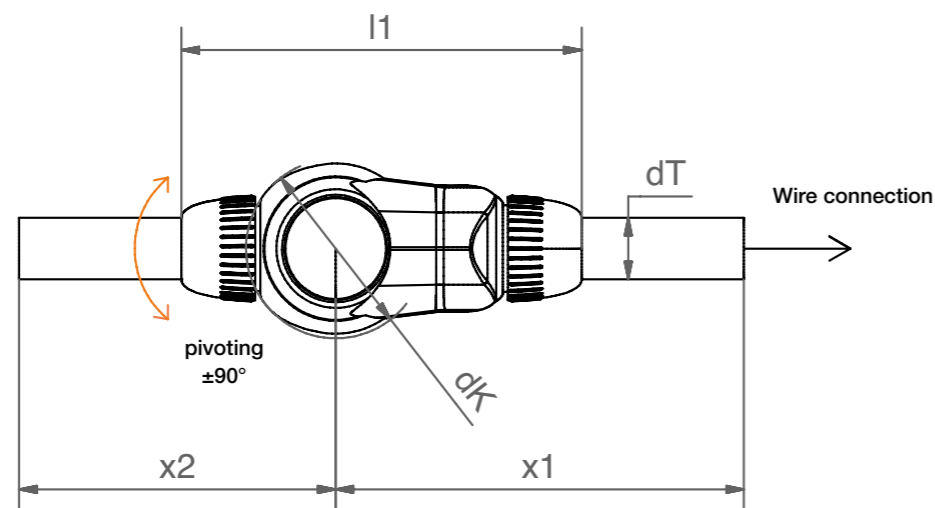
roboLink® joint | Pivoting joint, 1 DOF

1 DOF (degree of freedom), available with angle sensors



roboLink® pivoting joint

- **Weight:** 235 g
- **Max. load:** Pivoting 12 Nm
- **Angle of rotation:** 180° (± 90°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

| Part no. | Description | x1* | x2* | l1 | dK | dT | Prices [€] | | |
|-------------|--------------------------|-----|-----|-----|----|----|------------|-------------|-------------|
| | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-PL1 | Pivoting joint ± 90° | 202 | 134 | 170 | 76 | 26 | 350.00 | 294.00 | 262.00 |
| RL-50-PL1-E | With angle sensors ± 90° | 202 | 134 | 170 | 76 | 26 | 492.00 | 413.00 | 369.00 |

* Standard tube length = 100 mm; other lengths available

Available from stock

roboLink® joint | Base joint, 2 DOF

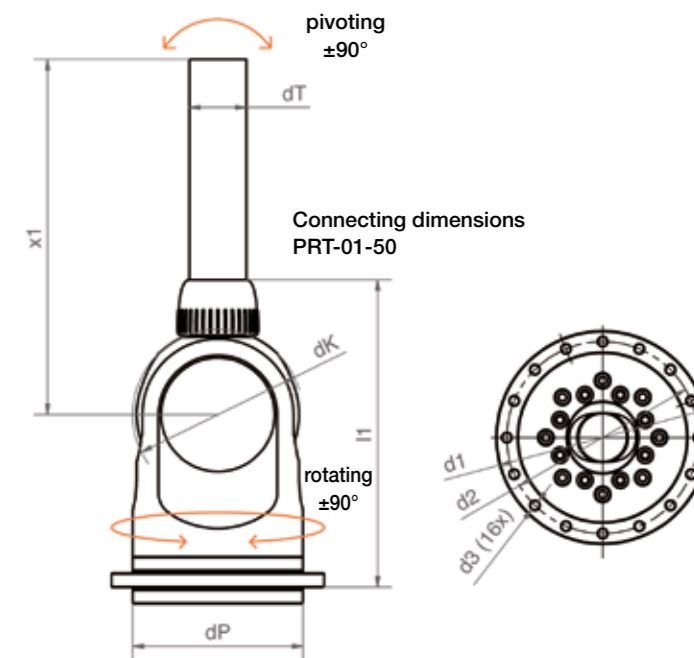
2 DOF (degree of freedom), only possible as 1st joint in a system, available with angle sensors



roboLink® base joint

Bearing ring rotation on the basis of PRT-01-50 iglidur® J gliding elements rotate on aluminium HC

- **Weight:** 1,250 g
- **Max. load:** Pivoting 20 Nm, rotating 10 Nm
- **Pivoting angle:** 180° (± 90°)
- **Angle of rotation:** 180° (± 90°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

| Part no. | Description | x1* | l1 | dK | dT | dP | d1 | d2 | d3 | Prices [€] | | |
|-------------|--------------------------|-----|-----|-----|----|-----|-----|-----|-----|------------|-------------|-------------|
| | | | | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-90-BL1 | Base joint ± 90° | 150 | 217 | 120 | 40 | 120 | 150 | 135 | 6.6 | 998.00 | 838.00 | 749.00 |
| RL-90-BL1-E | With angle sensors ± 90° | 150 | 217 | 120 | 40 | 120 | 150 | 135 | 6.6 | 1,374.00 | 1,154.00 | 1,031.00 |

* Standard tube length = 100 mm; other lengths available

Available from stock

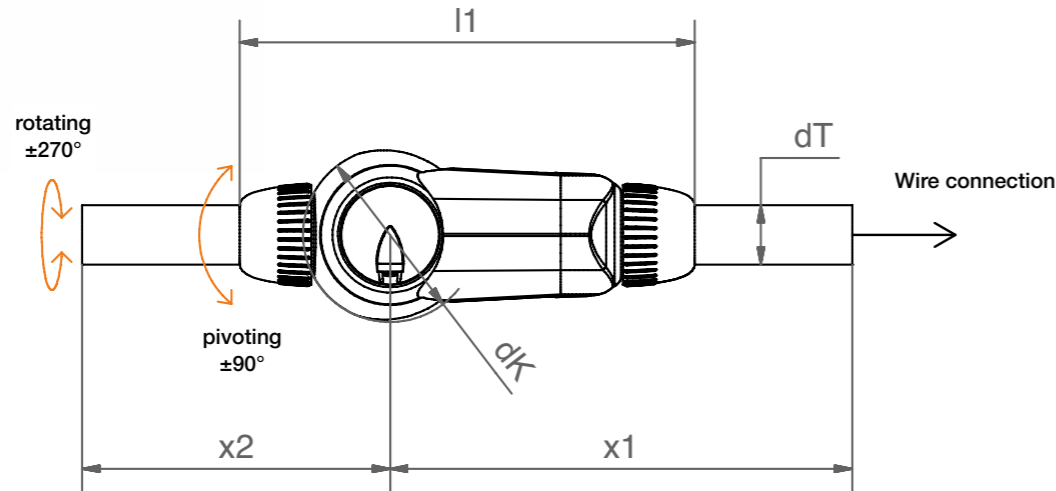
roboLink® joint | 2-axis joint type 001, 2 DOF

2 DOF (degree of freedom), available with angle sensors



roboLink® 2-axis joint type 001

- **Weight:** 345 g
- **Max. load:** Pivoting 12 Nm, rotating 5 Nm
- **Pivoting angle:** 180° (± 90°)
- **Angle of rotation:** 340° (± 170°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

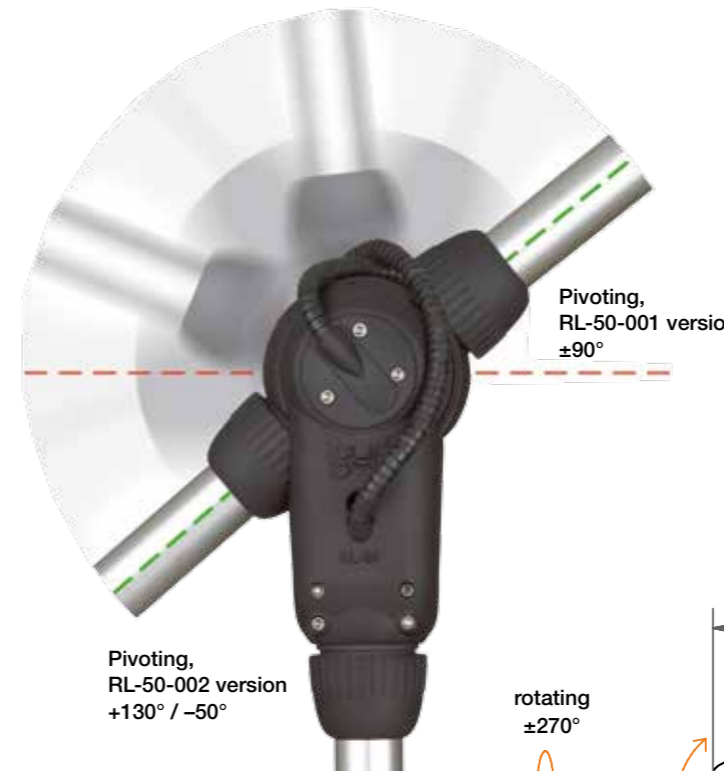
| Part no. | Description | x1* | x2* | l1 | dK | dT | Prices [€] | | |
|-------------|--------------------------|-----|-----|-----|----|----|------------|-------------|-------------|
| | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-001 | Pivoting joint ± 90° | 202 | 134 | 200 | 76 | 26 | 495.00 | 416.00 | 371.00 |
| RL-50-001-E | With angle sensors ± 90° | 202 | 134 | 200 | 76 | 26 | 871.00 | 732.00 | 653.00 |

* Standard tube length = 100 mm; other lengths available

Available from stock

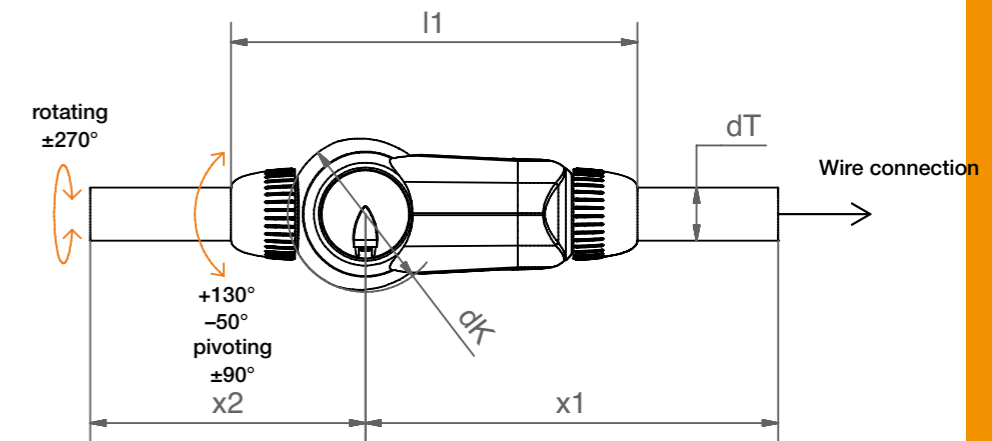
roboLink® joint | 2-axis joint type 002, 2 DOF

2 DOF (degree of freedom), available with angle sensors



roboLink® 2-axis joint type 002

- **Weight:** 345 g
- **Max. load:** Pivoting 12 Nm, rotating 5 Nm
- **Pivoting angle:** 180° (+130°/-50°)
- **Angle of rotation:** 340° (± 170°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

| Part no. | Description | x1* | x2* | l1 | dK | dT | Prices [€] | | |
|-------------|--|-----|-----|-----|----|----|------------|-------------|-------------|
| | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-002 | Rotating and pivoting joint +130° / -50° | 202 | 134 | 200 | 76 | 26 | 495.00 | 416.00 | 371.00 |
| RL-50-002-E | With angle sensors ± 130° / -50° | 202 | 134 | 200 | 76 | 26 | 871.00 | 732.00 | 653.00 |

* Standard tube length = 100 mm; other lengths available

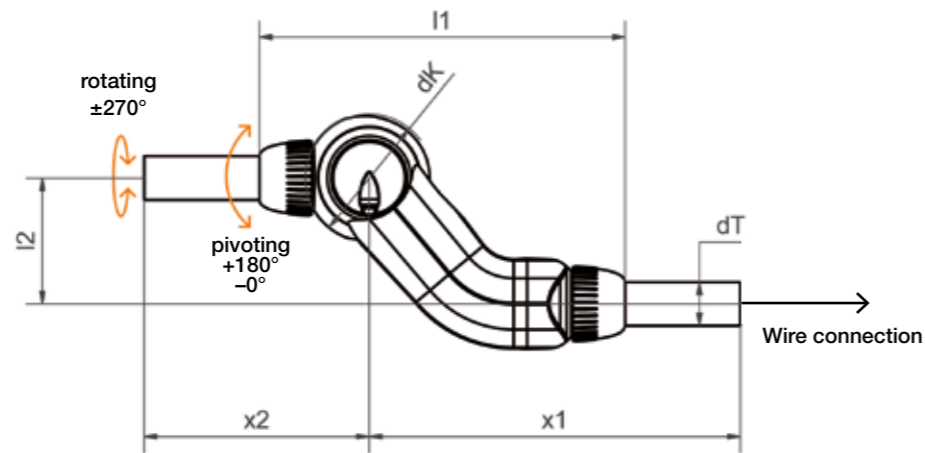
Available from stock

roboLink® joint | 2-axis joint type 003, 2 DOF

2 DOF (degree of freedom), available with angle sensors

roboLink® 2-axis joint type 003

- **Weight:** 400 g
- **Max. load:** Pivoting 12 Nm, rotating 5 Nm
- **Pivoting angle:** 180° (+180°/0°)
- **Angle of rotation:** 340° (± 170°)
- **Material:** Fine grade polyamide PA 2200, stainless steel screws, Dyneema wires, aluminium HC bearings (alternatively iglidur® J)



Dimensions [mm]

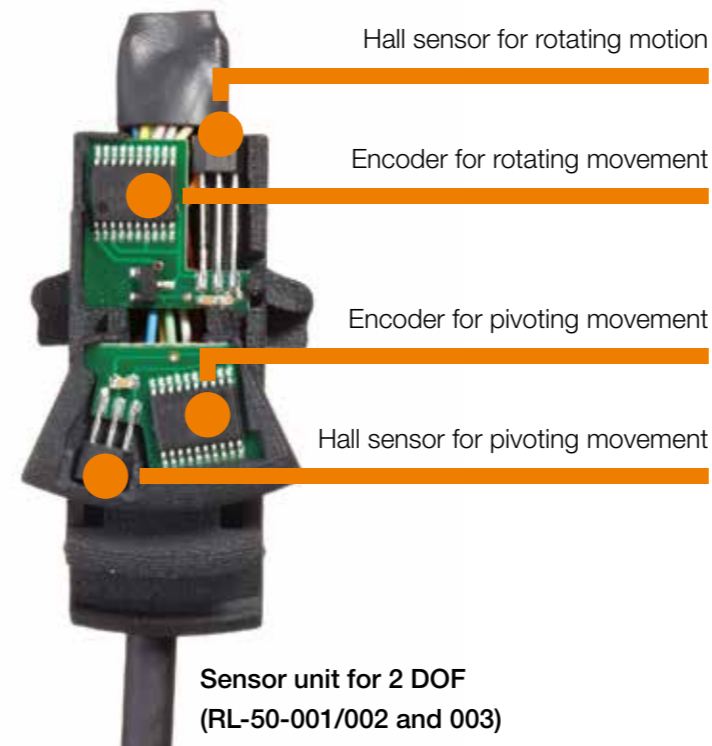
| Part no. | Description | x1* | x2* | l1 | l2 | dK | dT | Prices [€] | | |
|-------------|--|-----|-----|-----|----|----|----|------------|-------------|-------------|
| | | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-003 | Rotating and pivoting joint +180° / 0° | 221 | 134 | 218 | 75 | 76 | 26 | 585.00 | 492.00 | 439.00 |
| RL-50-003-E | With angle sensors +180° / 0° | 221 | 134 | 218 | 75 | 76 | 26 | 961.00 | 807.00 | 749.00 |

* Standard tube length = 100 mm; other lengths available

Available from stock

roboLink® components | Sensors

roboLink® angle sensor (optional)



Sensor unit for 2 DOF (RL-50-001/002 and 003)

Standard sensors

- Magnetic incremental angle sensors
- The sensors have a resolution of 0.07° per axis
- All sensor units are ready to be installed for the respective joints
- Each with 3 m sensor cable (6 leads for each DOF)
- Option: available angle sensors for underwater applications (ES)



Magnetic rings, rotating and pivoting axes

Sensor wiring configuration

| Description | Pivoting motion | Rotation |
|-------------------|-----------------|-----------|
| + 5V | Red | Red/blue |
| GND | Black | Brown |
| Hall sensor | White | Grey |
| Encoder Index | Green | Grey/pink |
| Encoder Channel A | Blue | Violet |
| Encoder Channel B | Yellow | Pink |

Sensor wire

| Manufacturer | Cable | Number of cores | Core cross section | Cable diameter |
|--------------|----------------------|-----------------|----------------------|----------------|
| igus® | FIXFLEX FF900.11.282 | 2 x 6 | 0.09 mm ² | 3.9 mm |

Available from stock

7 joint variants...unlimited possibilities...

2 DOF:

from 495,-*



RL-T1P1-(E)

3 DOF:

from 845,-*



RL-P1P1P1-(E)



RL-T101-(E)



RL-B1P1-(E)

4 DOF:

from 1,134,-*



RL-0101-(E)



RL-B103-(E)



RL-T1P1P1-(E)

5 DOF:

from 1,484,-*



RL-T101P1P1-(E)



RL-B101P1-(E)

6 DOF:

from 2,132,-*



RL-B10101-(E)



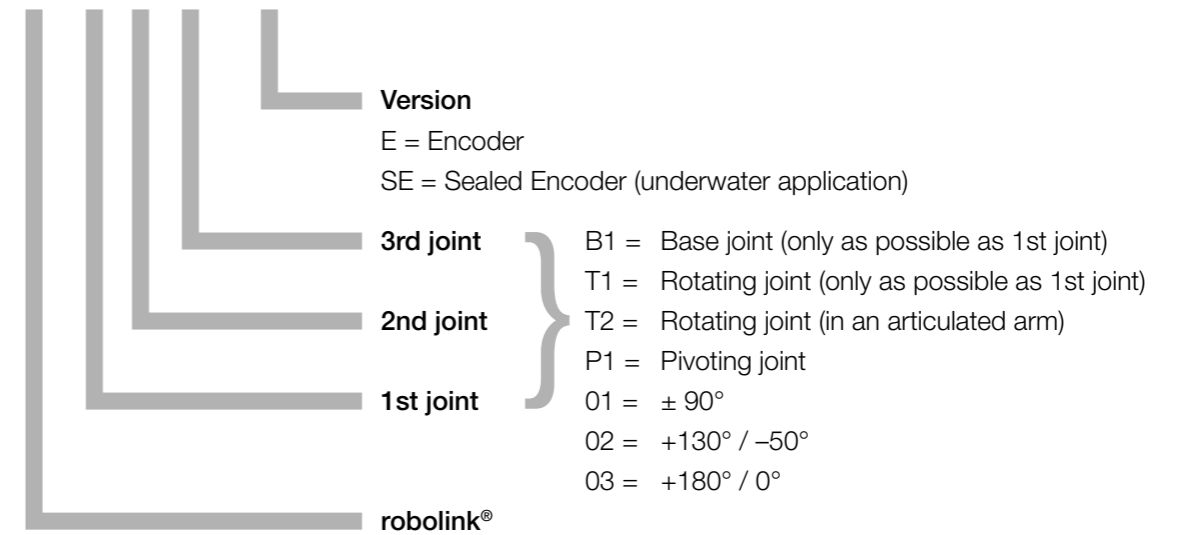
RL-B10301-(E)

* System price in EUR for 1 unit purchases, incl. aluminium tubes and wires (no sensors)
DOF: Degree of freedom

...several possible combinations...

Ordering key complete system:

RL-T10103 - E



i All systems are shipped standard with aluminium tubes of length 100 mm.
The quoted prices and x-dimensions apply to these configurations. Custom lengths or tube materials are possible in mm increments.

Delivery time
5 days

Prices
Page 40



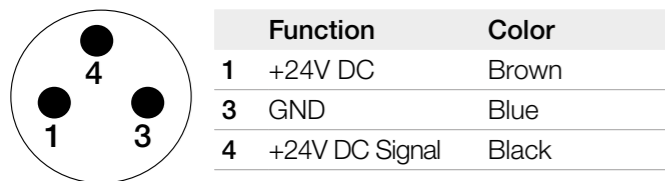
Properties:

- Simple Plug & Play – compatible with all robolink® systems and universally adaptable
- Self-locking drive – continues to grip when powered off
- Replaceable jaws for different applications
- Universal jaws for quick attachment change (RL-50-GRI-02-02-E)
- Light, compact and lubrication free
- Integrated DC motor with planetary gears

Technical data [mm]

| | 2-jaw gripper RL-50-GRI-02-... | 3-jaw gripper RL-50-GRI-03-... |
|------------------------|-----------------------------------|-----------------------------------|
| Nominal voltage | 24V DC | 24V DC |
| Control signal | 24V DC | 24V DC |
| Current draw | 0.2 A | 0.2 A |
| Control signal | < 10 mA | < 10 mA |
| DC motor output | 3.6 W | 3.6 W |
| Tensioning force | 50 N | 50 N |
| Stroke | 2 x 20° | 3 x 20° |
| Max. cycles per minute | 50 | 50 |
| Closing / opening time | 0.5 s | 0.5 s |
| Fitting | M8x1 – 3pol | M8x1 – 3pol |
| Protection class | IP42 | IP42 |
| Weight | 180 g | 200 g |
| Material | PA2200 | PA2200 |

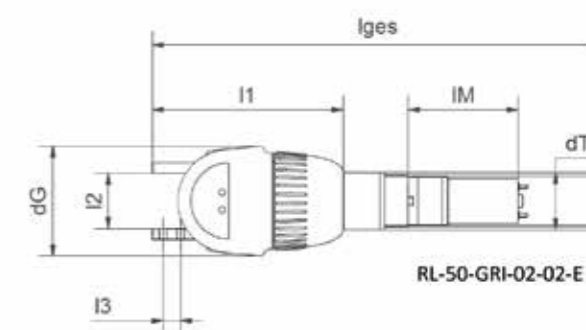
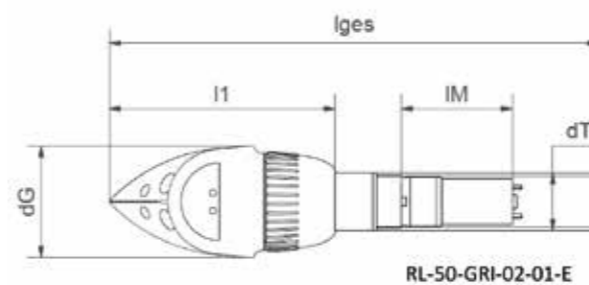
Electrical connection



Other grippers are adaptable



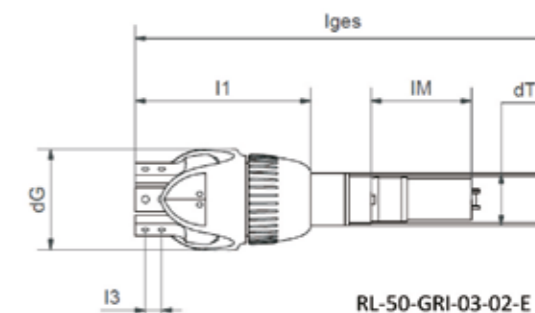
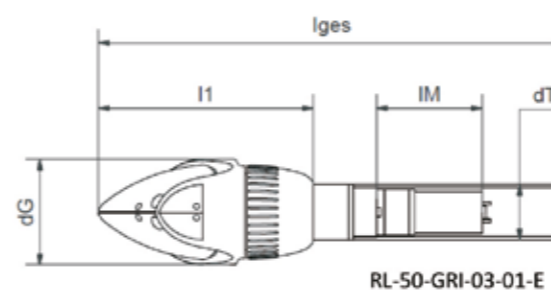
Standard adapters (made from PA 2200) are currently available for the following products: FESTO: DHPS-10-A-NC; HGWM-08-Ex-G7; HGWM-12-EX-G7; adaptive gripper. SCHUNK: SGB-32; SGW-40, Gimatic MPPM 1606



Dimensions [mm]

| Part no. | l1 | l2 | l3 | dG | dT | IM | ltotal | Prices [€] | | | |
|-------------------|-----|----|-----------|----|----|----|--------|--------------|----------------|----------------|---------------|
| | | | | | | | | 1–9 Piece | 10–24 Piece | 25–49 Piece | > 50 Piece |
| RL-50-GRI-02-01-E | 102 | – | – | 50 | 26 | 50 | 220 | 374.00 | 314.16 | 280.50 | on request |
| RL-50-GRI-02-02-E | 87 | 25 | 8 (Ø 3.4) | 50 | 26 | 50 | 205 | 374.00 | 314.16 | 280.50 | on request |

3-jaw gripper



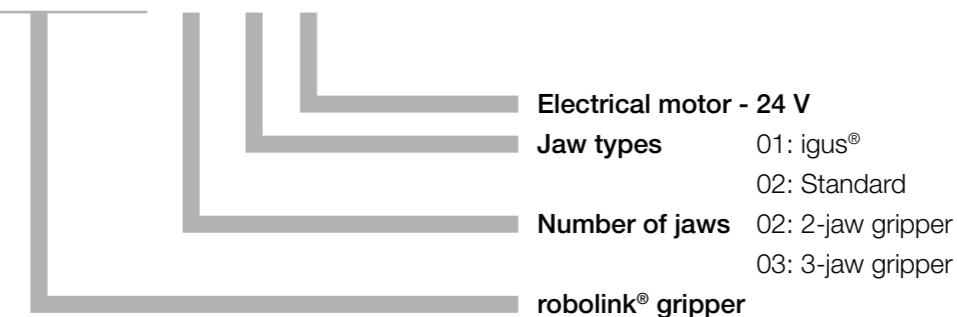
Dimensions [mm]

| Part no. | l1 | l3 | dG | dT | IM | ltotal | Prices [€] | | | |
|-------------------|-----|-----------|----|----|----|--------|--------------|----------------|----------------|---------------|
| | | | | | | | 1–9 Piece | 10–24 Piece | 25–49 Piece | > 50 Piece |
| RL-50-GRI-03-01-E | 102 | – | 50 | 26 | 50 | 220 | 374.00 | 314.16 | 280.50 | on request |
| RL-50-GRI-03-02-E | 87 | 8 (Ø 3.4) | 50 | 26 | 50 | 205 | 374.00 | 314.16 | 280.50 | on request |



Ordering key complete system:

RL-50-GRI-02-01-E



Delivery time
2 days

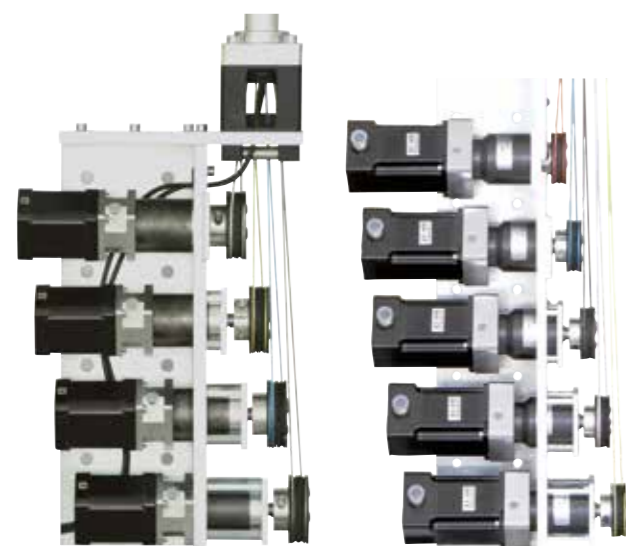
Drive module



Consists of stepper motor, planetary gearbox 1:35 for NEMA17 1:16 for NEMA23 and adjustable drive wheel, completely assembled

| Technical data | | Prices [€] |
|----------------|-------------------|------------|
| Part no. | Description | per piece |
| RL-AEM1-17L | NEMA17, strand | 415.40 |
| RL-AEM1-17 | NEMA17, connector | 477.70 |
| RL-AEM1-23L | NEMA17, strand | 467.00 |
| RL-AEM1-23 | NEMA17, connector | 515.20 |

robolink® drive units for all articulated arms



Pict. 1

Pict. 2

- Freely configurable arm length through modular design
- Stepper motor driven
- Alternative drive/control systems easily possible

Dimensions [mm]

| Description | 3 DOF | | 4 DOF | | 5 DOF | |
|-------------------|------------|---------------|------------|---------------|------------|---------------|
| | Part no. | Prices [€] | Part no. | Prices [€] | Part no. | Prices [€] |
| NEMA17, strand | RL-DU1317L | from 1,647.24 | RL-DU1417L | from 2,119.43 | RL-DU1517L | from 2,634.10 |
| NEMA17, connector | RL-DU1317 | from 1,834.14 | RL-DU1417 | from 2,368.63 | RL-DU1517 | from 2,945.60 |
| NEMA23, strand | RL-DU1323L | from 1,863.39 | RL-DU1423L | from 2,393.60 | RL-DU1523L | from 2,970.10 |
| NEMA23, connector | RL-DU1323 | from 2,007.99 | RL-DU1423 | from 2,586.40 | RL-DU1523 | from 3,211.10 |

More information about igus® stepper motors
▶ From page 20

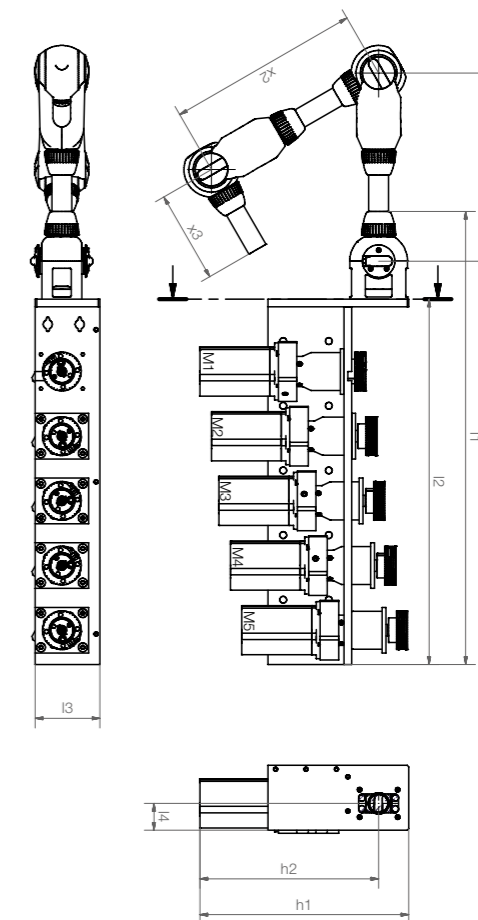
Delivery time Drive module: from stock
Drive unit: 5 days

Example: 5 DOF arm with NEMA 23 drive unit



robolink® drive unit with 5 DOF articulated arm

- Freely configurable arm length through modular design
- Stepper motor driven
- Alternative drive/control systems easily possible



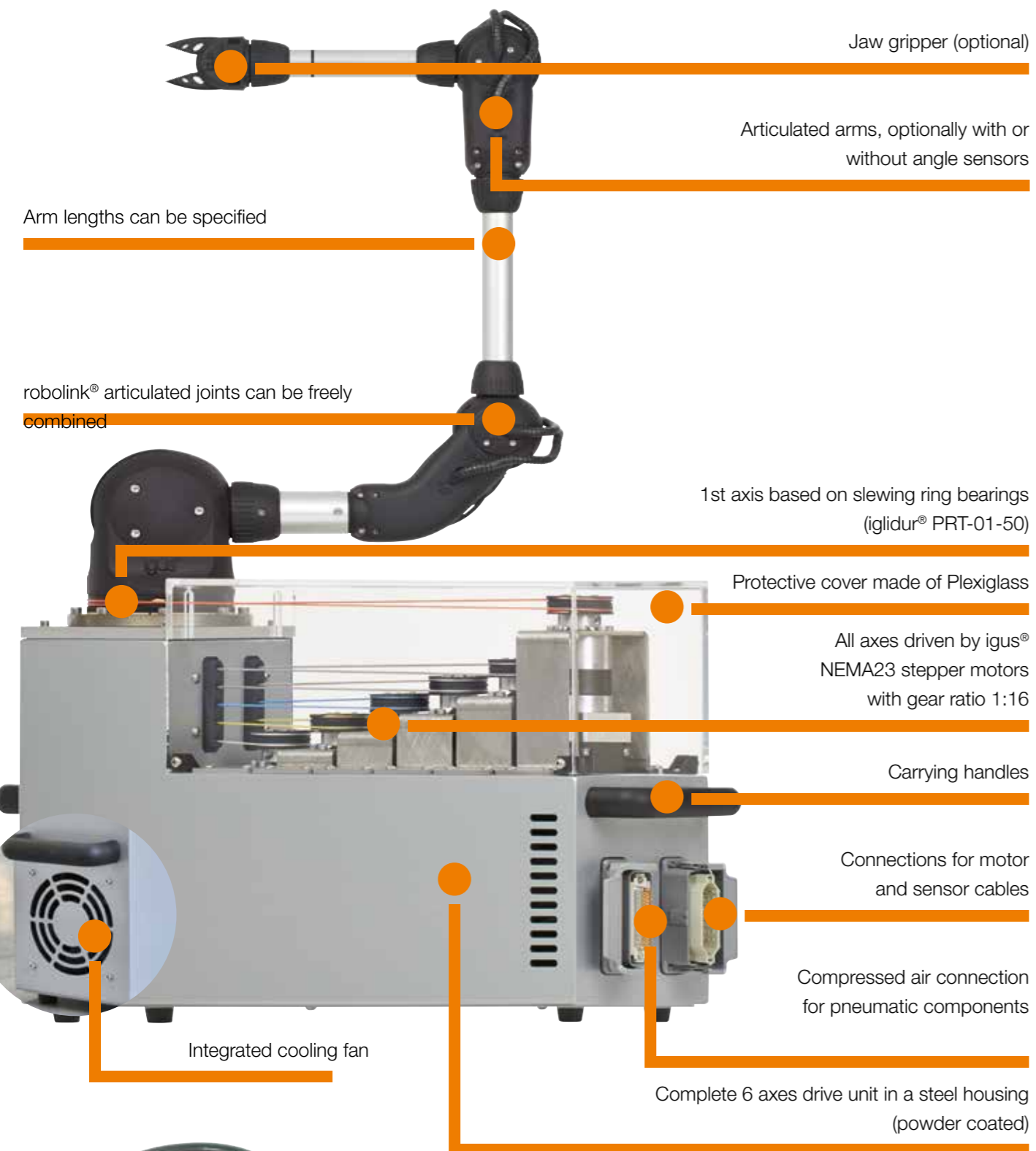
Dimensions [mm]

| Part no. | for motor | dT | h1 | h2 | I1 | I2 | I3 | I4 | Prices [€] |
|--------------------|-----------|----|-----|-------|-----|-----|----|------|---------------|
| | | | | | | | | | 1 Piece |
| RL-T10201-DU1517 | NEMA 17 | 26 | 240 | 197.5 | 530 | 410 | 75 | 32.5 | from 4,118.10 |
| RL-T10201-E-DU1517 | NEMA 17 | 26 | 240 | 197.5 | 530 | 410 | 75 | 32.5 | from 5,012.10 |
| RL-T10201-DU1523 | NEMA 23 | 26 | 275 | 235 | 600 | 480 | 85 | 35 | from 4,454.10 |
| RL-T10201-E-DU1523 | NEMA 23 | 26 | 275 | 235 | 600 | 480 | 85 | 35 | from 5,348.10 |

More information about igus® stepper motors
▶ From page 20

Delivery time 5-10 days

6 DOF drive unit



Cables:
Motor and sensor cables available from stock

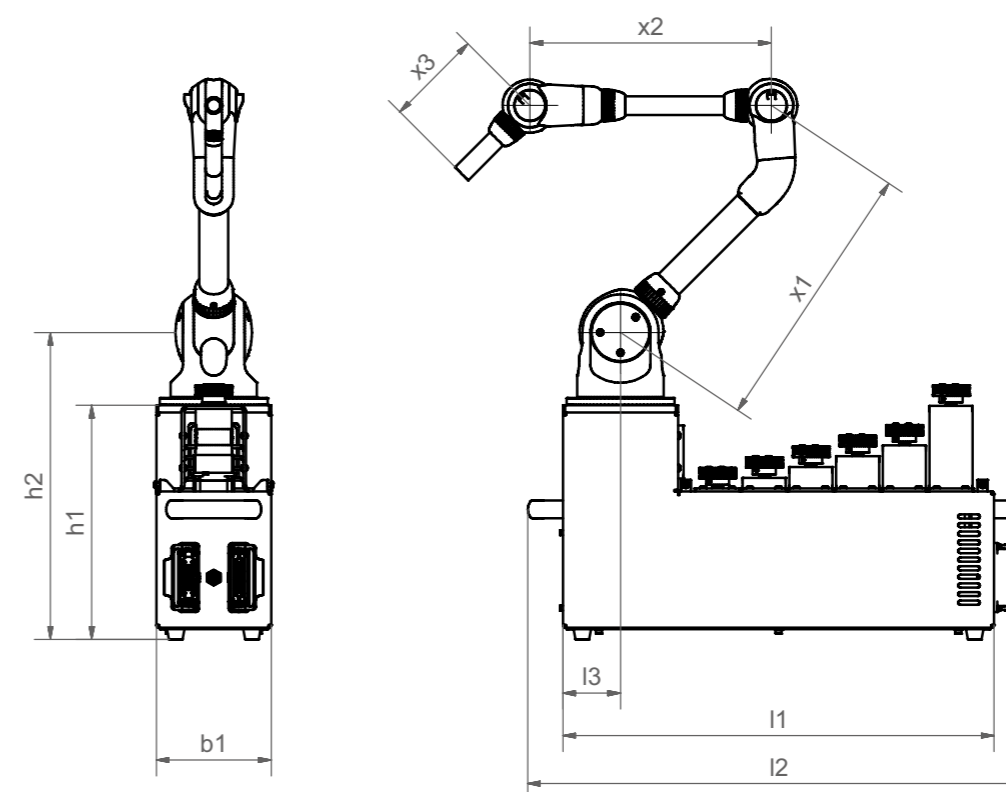
Connector:
2 versions available: Socket/plug and socket/open

i More information about igus® stepper motors
▶ From page 20

Cables

| | Motor cable Socket/connector | Motor cable Socket/open | Sensor cable Socket/connector | Sensor cable Socket/open |
|---|---------------------------------|---------------------------------------|----------------------------------|---------------------------------------|
| Part no. | RL-CB13-CAB-MOT-01 | RL-CB13-CAB-MOT-02 | RL-CB13-CAB-SENS-01 | RL-CB13-CAB-SENS-02 |
| Length | 3 m | 3 m | 3 m | 3 m |
| Cable type | igus® CF130.05.25.UL | igus® CF130.05.25.UL | igus® CF2.01.48 | igus® CF2.01.48 |
| Number of cables / cross section | 25 x 0.5 mm ² | 25 x 0.5 mm ² | 48 x 0.15 mm ² | 48 x 0.15 mm ² |
| Connector housing | Harting Han 16 A | Harting Han 16 A | Harting Han 16 A | Harting Han 16 A |
| Socket | Harting Han 25 D | Harting Han 25 D | D-Sub 50 pol | D-Sub 50 pol |
| Connector | Harting Han 25 D | "open" side for individual connection | D-Sub 50 pol | "open" side for individual connection |
| Price in € / piece | 130.31 | 101.50 | 202.37 | 170.91 |

6 DOF drive unit



Dimensions [mm]

| Part no. | Description | b1 | h1 | h2 | l1 | l2 | l3 | Standard arm lengths | | | 1 Piece |
|---------------------|--------------------------|-----|-----|-----|-----|-----|----|----------------------|-----|-----|---------------|
| | | | | | | | | x1* | x2* | x3* | |
| RL-B10201-DU3623L | Without angular encoders | 160 | 326 | 427 | 600 | 698 | 80 | 280 | 236 | 134 | from 5,846.40 |
| RL-B10201-E-DU3623L | With angular encoders | 160 | 326 | 427 | 600 | 698 | 80 | 280 | 236 | 134 | from 6,992.40 |

Prices [€]

* Standard tube length = 100 mm; other lengths available



Delivery time

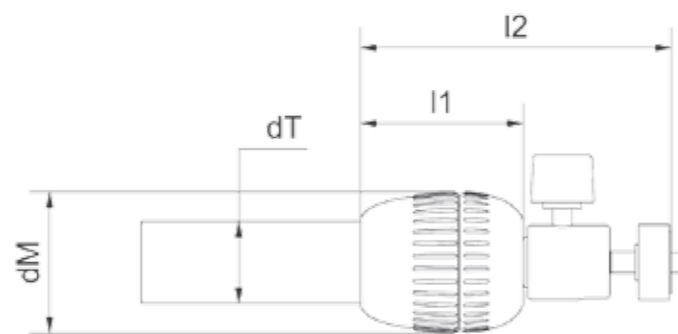
Cables: from stock
Complete drive unit: 5 - 10 days



Universal adapter for cameras on robolink® arms

With standard ball and socket joint to connect with camera thread 1/4" UNC, with cable feedthrough for camera cable or power supply. Cables can be fed through the articulated arm.

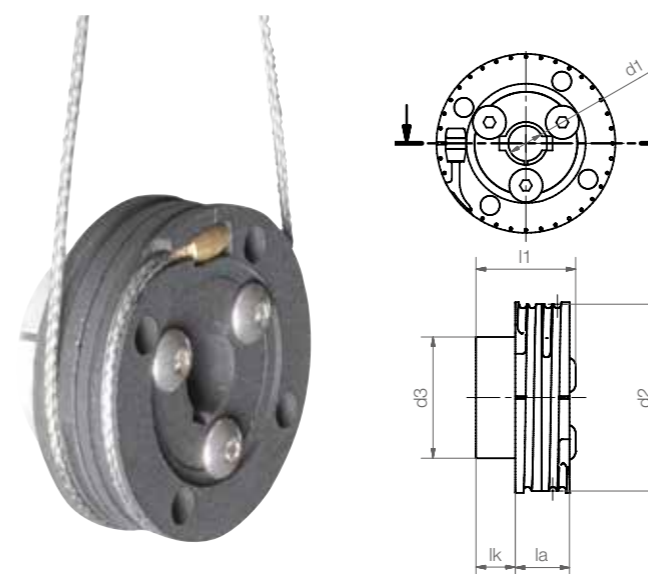
- Weight with ball head: 100 g
- Weight without ball head: 50 g
- Material: Fine grade polyamide PA2200, ball head: aluminium



Dimensions [mm]

| Part no. | Description | l1 | l2 | dT | dM | Prices [€] | | |
|-------------|-------------------|------|------|----|----|------------|-------------|-------------|
| | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| RL-50-CAD01 | With ball head | 51.5 | 98.5 | 26 | 45 | 123.60 | 103.82 | 92.70 |
| RL-50-CAD02 | Without ball head | 51.5 | 98.5 | 26 | 45 | 69.20 | 58.13 | 51.90 |

Available from stock



Tensible robolink® drive wheel

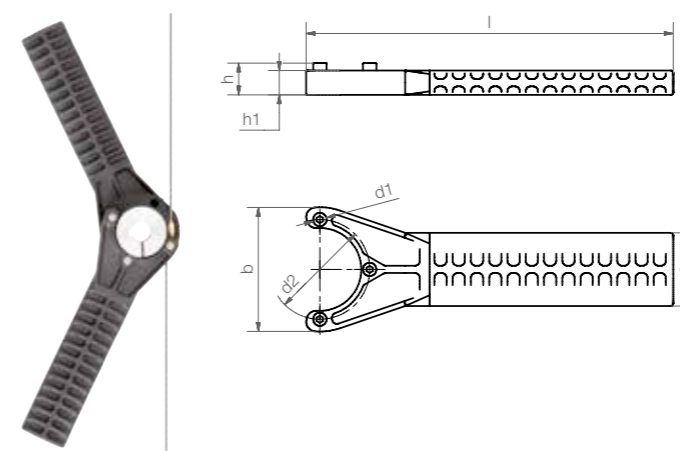
- Split design
- Easy-tensioning of the drive wires
- Releasing and clamping with hexagon socket
- Can be used with optional igus® clamping tool

Dimensions [mm]

| Part no. | d1 | d2 | d3 | l1 | lA | lK | Prices [€] | | | |
|----------------------|----|----|----|------|------|----|------------|-------------|-------------|------------|
| | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece | > 50 Piece |
| RL-ZA011-0250-05 | 5 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |
| RL-ZA011-0250-06 | 6 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |
| RL-ZA011-0250-08 | 8 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |
| RL-ZA011-0250-08PFN* | 8 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | on request |
| RL-ZA011-0250-10 | 10 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |
| RL-ZA011-0250-10PFN* | 10 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |
| RL-ZA011-0250-12 | 12 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |
| RL-ZA011-0250-12PFN* | 12 | 50 | 32 | 26.7 | 14.5 | 11 | 68.85 | 57.38 | 45.90 | |

* with feather key groove DIN 6885

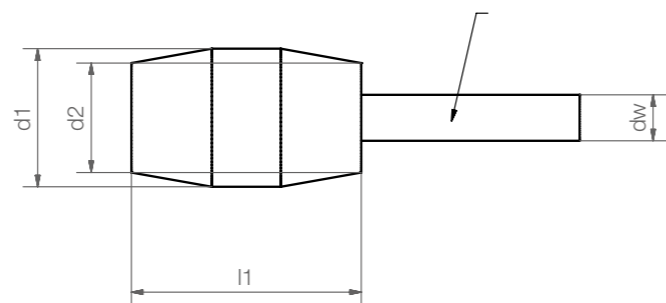
Clamping tool



- Convenient rope tensioning
- For split drive wheel RL-ZA011-0250
- Material: PA2200 / VA

Dimensions [mm]

| Part no. | l | h | h1 | a | b | d1 | d2 | Prices [€] | | | |
|---------------------|-------|----|----|----|----|-----|----|------------|-------------|-------------|------------|
| | | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece | > 50 Piece |
| RL-ZA011-0250-CLMPT | 150.6 | 13 | 10 | 30 | 51 | 5.5 | 41 | 58.80 | 48.75 | 39.20 | on request |



robolink® wire end bottom

- Material: brass

1) Wire end

| Part no. | d1 [mm] | d2 [mm] | dw [mm] | l1 [mm] | Prices [€] | | | |
|--------------|------------|------------|------------|------------|--------------|----------------|----------------|---------------|
| | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece | > 50 Piece |
| RL-SD02-SN01 | 6 | 4.8 | 2.0 | 10 | 2.95 | 2.50 | 2.00 | on request |

2) Dyneema wire

| Part no. | Color | Prices [€] | |
|-------------|-------------|-------------------|--|
| | | Unit price €/m | |
| RL-SD02-01* | Carbon-grey | 0.80 | |

* -xxx = length in mm, max. 10,000 mm (other lengths and colours on request)

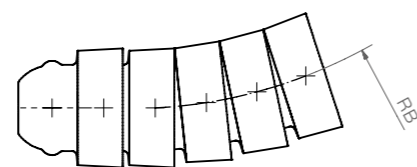
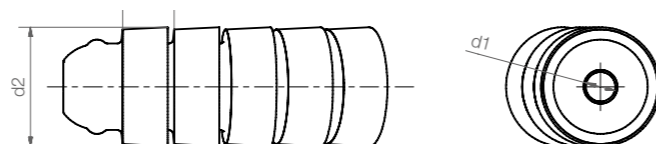
Drive systems for robolink®



robolink® bowden cable

Tear-resistant drive rope (3,800 N) with Dyneema rope

- Outer draw segments (RN54)
- High flexibility
- High axial load capacity
- Bend radius: 33 mm
- Weather resistant



Dimensions [mm]

| Part no. | d1 +0.2 | d2 | l1 | RB | 1 |
|---------------|------------|----|-----|----|-------|
| | | | | | €/m |
| RL-SD02-BZ01* | 2.0 | 8 | 3.5 | 33 | 62.50 |

* -xxx = length in mm, without wire

Available from stock



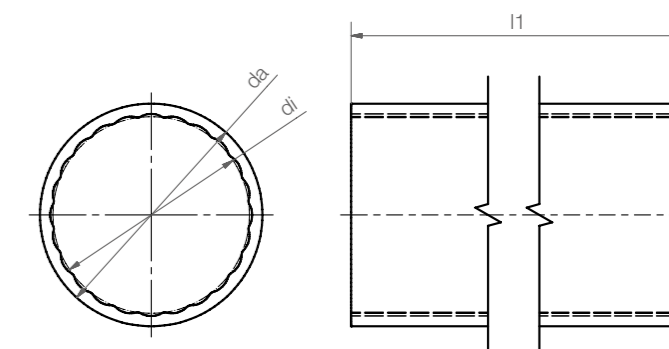
robolink® connecting tubes d26

- Length as required
- Inner contour (anti-twist device)
- Feedthrough of ropes and pneumatic hoses, cables
- Corrosion resistant
- Lightweight
- Stable

Dimensions [mm]

| Part no. | Weight [g/m] | Prices [€] | |
|----------------|-----------------|------------|--|
| | | 1 €/m | |
| RL-TAL-26-xxx* | 270 | 42.00 | |
| RL-TGF-26-xxx* | 200 | 228.00 | |
| RL-TCF-26-xxx* | 170 | 378.00 | |

* -xxx = length (l1) in mm, max. 1,000 mm (other lengths on request)

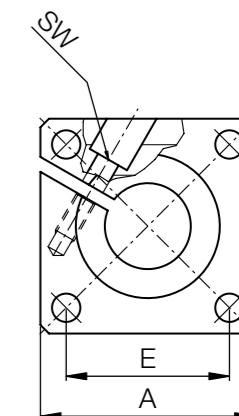
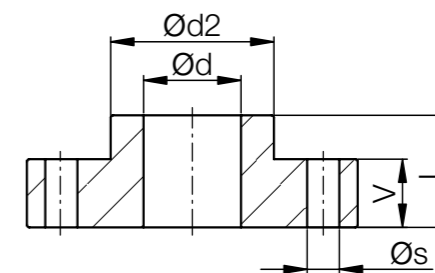


Mounting technology for robolink®



robolink® flange shaft support

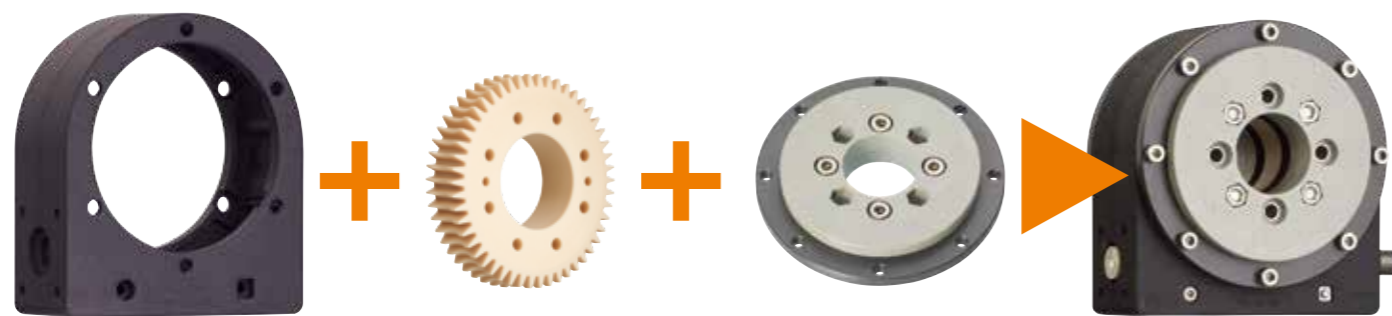
- Material: Aluminium
- Connection to drive housing



Dimensions [mm]

| Part no. | Ø d | A | L | Ø d2 | E | Ø s | V | SW | Weight [g] | Prices [€] | | | |
|------------|-----|----|----|------|-----------|-----|----|----|---------------|--------------|----------------|----------------|---------------|
| | | | | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece | > 50 Piece |
| RL-TWAF-26 | 26 | 60 | 25 | 42.0 | 42 ± 0.15 | 6.6 | 16 | 5 | 150 | 30.71 | 28.50 | 27.14 | on request |

Available from stock



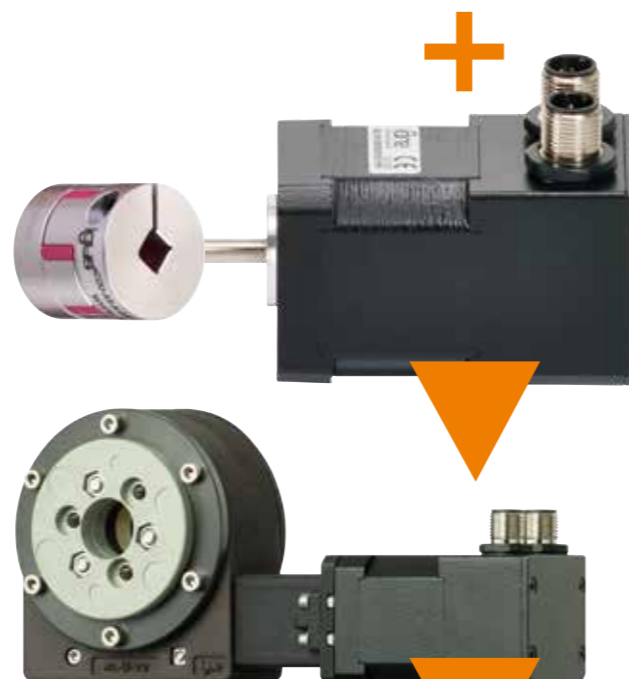
Components kit for robolink® D – 2 options in 3 installation sizes

igus® offers mechanical components for automation solutions, e.g. for articulated robotic arms. The main components are hereby "joints", consisting of iglidur® PRT slewing ring bearings, a worm gear and a plastic housing. In addition, these joints can be optionally equipped with motors, as well as limit switches for zero point definition.

- Light, compact and lubrication free
- Construction kit: Plastic housing + worm wheel made from iglidur® J + worm shaft + PRT slewing ring bearings + axial roller bearings + radial bearings + VA screws
- Adaptable to various motors
 - ▶ From page 34

Potential application areas:

Articulated arms with different kinematics; mechanical design for robotic tasks, driven rotary tables, positioning units



Delivery time

Single parts 1-2 days

Individual combinations 3-8 days



robolink® D robot joint with two PRT slewing ring bearings

Slewing ring bearing (igidur® PRT) with a plastic housing. The drive component is a worm gear. The centre borehole remains free for feeding cables etc through. The articulated joints can be ordered with or without motor.

- Self-locking drive
- Light, compact and lubrication free
- Construction kit: Plastic housing + worm wheel made from iglidur® J + worm shaft + PRT slewing ring bearings + axial roller bearings + radial bearings + VA screws
- Adaptable to various motors,
 - standard option: stepper motor NEMA17 / 23 / 23XL
- INI kit for zero position optionally adaptable

Technical data

| | Size 20 RL-D-20-101-38-01000 | Size 30 RL-D-30-101-50-01000 | Size 50 RL-D-50-101-48-01000 |
|------------------------|---------------------------------|---------------------------------|---------------------------------|
| Weight [g] | 410 | 730 | 1,900 |
| Reduction gearing | 38:1 | 50:1 | 48:1 |
| Axis distance [mm] | 31 | 40 | 63 |
| Efficiency | > 0.25 | > 0.25 | > 0.25 |
| Breakaway torque [cNm] | < 5 | < 7 | < 10 |



robolink® D robot joint with one PRT slewing ring bearing and cover plate

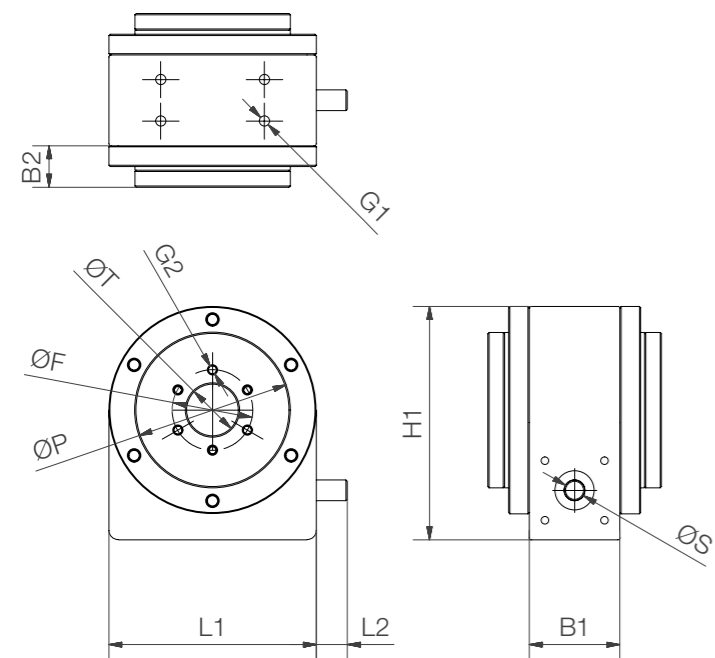
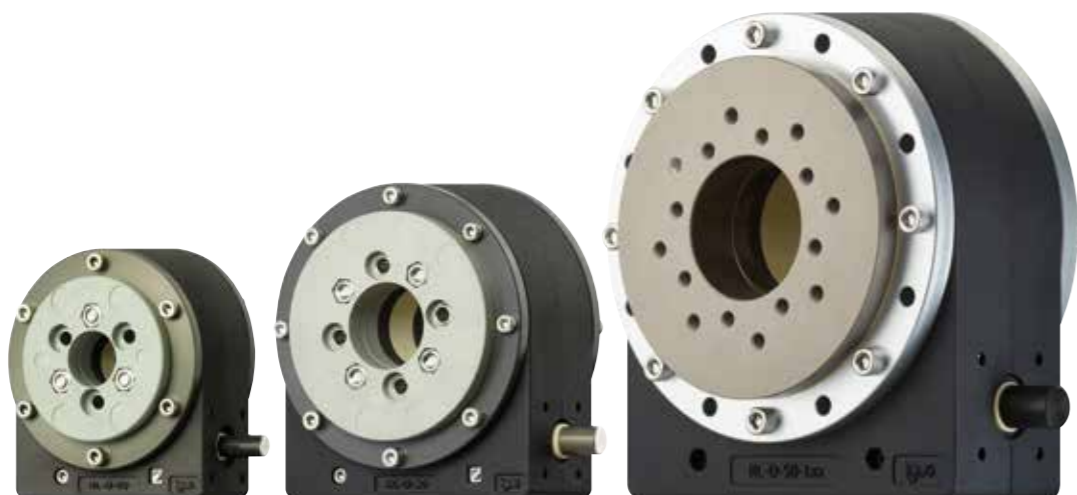
Slewing ring bearing (igidur® PRT) in a plastic housing. The drive component is a worm gear. The centre borehole remains free for feeding cables etc through. The articulated joints can be ordered with or without motor.

- Self-locking drive
- Light, compact and lubrication free
- Construction kit: Plastic housing + worm wheel made from iglidur® J + worm shaft + PRT slewing ring bearings + axial roller bearings + radial bearings + VA screws
- Adaptable to various motors,
 - standard option: stepper motor NEMA17 / 23 / 23XL
- Application e.g. horizontal on base plate

Technical data

| | Size 20 RL-D-20-102-38-01004 | Size 30 RL-D-30-102-50-01004 | Size 50 RL-D-50-102-48-01004 |
|------------------------|---------------------------------|---------------------------------|---------------------------------|
| Weight [g] | 320 | 570 | 1,550 |
| Reduction gearing | 38:1 | 50:1 | 48:1 |
| Axis distance [mm] | 31 | 40 | 63 |
| Efficiency | > 0.25 | > 0.25 | > 0.25 |
| Breakaway torque [cNm] | < 5 | < 7 | < 10 |

Symmetrical - with two PRT slewing ring bearings



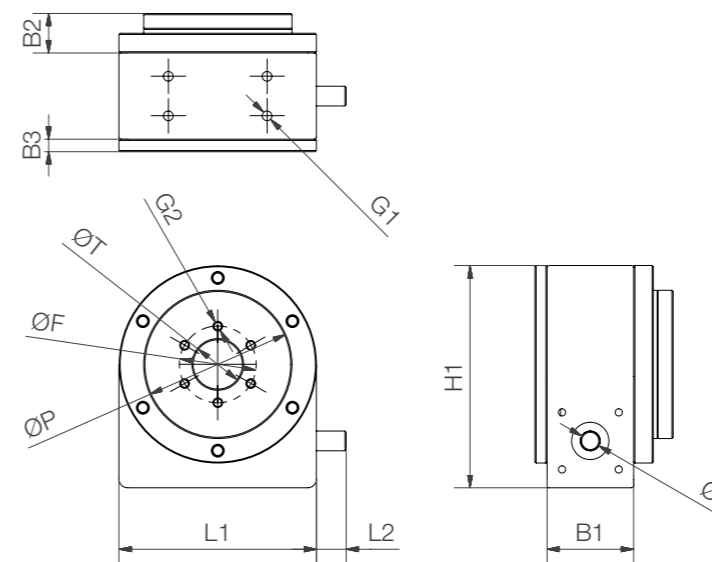
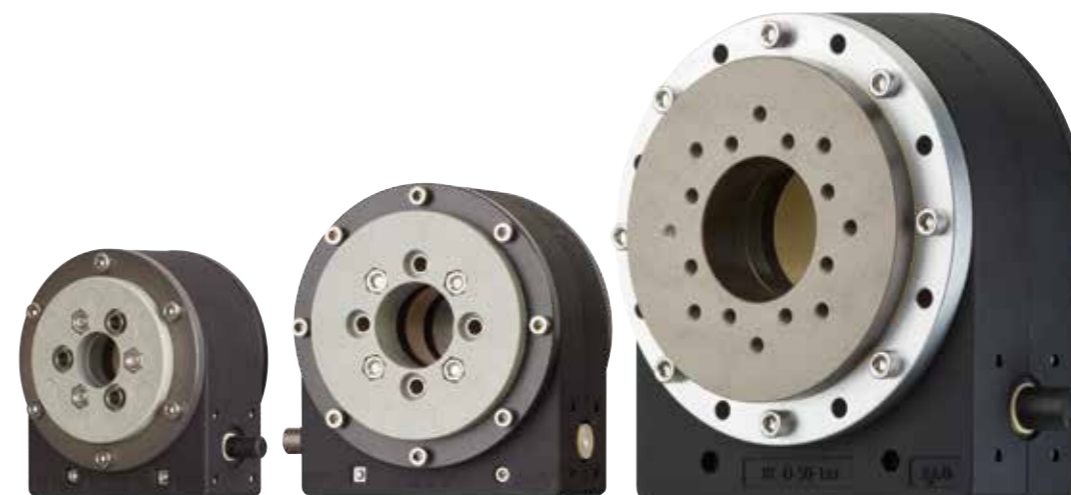
3 versions

- Standard: Aluminium PRT (PRT-02-xx-AL), aluminium worm shaft (AL hard anodised). Application e.g. in our low cost robot arms as front joints (RL-D 20 and RL-D 30).
- Low cost: Low cost PRT (PRT-02-xx-LC), worm shaft made from plastic RN33. Application e.g. for manual adjustments
- High end: PRT design 01 (PRT-01-xx), aluminium worm shaft (AL hard-anodised), high rigidity. Application e.g. as the first pivoting axis in robolink® articulated arms.

Dimensions [mm]

| Part no. | ØT | ØS | ØP | ØF | L1 | L2 | B1 | B2 | H1 | G1 | G2 | Prices [€] | | | |
|----------------------|----|----|-----|------|-----|----|----|------|-----|----|--------|--------------|----------------|----------------|--|
| | | | | | | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece | |
| Standard | | | | | | | | | | | | | | | |
| RL-D-20-101-38-01000 | 20 | 8 | 60 | 31 | 80 | 12 | 35 | 10.5 | 90 | M4 | 3 x M5 | 276.00 | 231.84 | 207.00 | |
| RL-D-30-101-50-01000 | 30 | 10 | 80 | 42.5 | 100 | 12 | 45 | 12.5 | 110 | M4 | 4 x M5 | 309.00 | 259.56 | 231.75 | |
| RL-D-50-101-48-01000 | 50 | 15 | 120 | 60 | 150 | 13 | 60 | 13 | 170 | M6 | 4 x M6 | 448.00 | 376.32 | 336.00 | |
| Low cost | | | | | | | | | | | | | | | |
| RL-D-20-101-38-03011 | 20 | 8 | 60 | 31 | 80 | 12 | 35 | 10.5 | 90 | M4 | 3 x M5 | 189.00 | 158.76 | 141.75 | |
| RL-D-30-101-50-03011 | 30 | 10 | 80 | 42.5 | 100 | 12 | 45 | 12.5 | 110 | M4 | 4 x M5 | 152.00 | 127.68 | 114.00 | |
| RL-D-50-101-48-03011 | 50 | 15 | 120 | 60 | 150 | 13 | 60 | 13 | 170 | M6 | 4 x M6 | 373.00 | 313.32 | 279.75 | |
| High end | | | | | | | | | | | | | | | |
| RL-D-20-101-38-01033 | 20 | 8 | 60 | 31 | 80 | 12 | 35 | 16 | 90 | M4 | 6 x M4 | 387.00 | 325.08 | 290.25 | |
| RL-D-30-101-50-01033 | 30 | 10 | 80 | 42.5 | 100 | 12 | 45 | 19.5 | 110 | M4 | 8 x M4 | 305.00 | 256.20 | 228.75 | |
| RL-D-50-101-48-01033 | 50 | 15 | 120 | 65 | 150 | 13 | 60 | 21.5 | 170 | M6 | 8 x M6 | 554.00 | 465.36 | 415.50 | |

Asymmetrical - with one PRT slewing ring bearing and cover plate



3 versions

- Standard: 1 aluminium PRT (PRT-02-xx-AL), aluminium worm shaft (AL hard anodised). Application e.g. in our low cost robot arms as front joints (RL-D 20 and RL-D 30).
- Low cost: 1 low-cost PRT (PRT-02-xx-LC), worm shaft made from plastic RN33. Application e.g. for manual adjustments
- High end: 1 PRT design 01 (PRT-01-xx), aluminium worm shaft (AL hard-anodised), high rigidity. Application e.g. as the first rotating axis in robolink® articulated arms.

Dimensions [mm]

| Part no. | ØT | ØS | ØP | ØF | L1 | L2 | B1 | B2 | B3 | H1 | G1 | G2 | Prices [€] | | |
|----------------------|----|----|-----|------|-----|----|----|------|----|-----|----|--------|--------------|----------------|----------------|
| | | | | | | | | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| Standard | | | | | | | | | | | | | | | |
| RL-D-20-102-38-01004 | 20 | 8 | 60 | 31 | 80 | 12 | 35 | 10.5 | 5 | 90 | M4 | 3 x M5 | 243.00 | 204.12 | 182.25 |
| RL-D-30-102-50-01004 | 30 | 10 | 80 | 42.5 | 100 | 12 | 45 | 12.5 | 6 | 110 | M4 | 4 x M5 | 259.00 | 217.56 | 194.25 |
| RL-D-50-102-48-01004 | 50 | 15 | 120 | 60 | 150 | 13 | 60 | 13 | 6 | 170 | M6 | 4 x M6 | 401.00 | 336.84 | 300.75 |
| Low cost | | | | | | | | | | | | | | | |
| RL-D-20-102-38-03014 | 20 | 8 | 60 | 31 | 80 | 12 | 35 | 10.5 | 5 | 90 | M4 | 3 x M5 | 152.00 | 127.68 | 114.00 |
| RL-D-30-102-50-03014 | 30 | 10 | 80 | 42.5 | 100 | 12 | 45 | 12.5 | 6 | 110 | M4 | 4 x M5 | 185.00 | 155.40 | 138.75 |
| RL-D-50-102-48-03014 | 50 | 15 | 120 | 60 | 150 | 13 | 60 | 13 | 6 | 170 | M6 | 4 x M6 | 324.00 | 272.16 | 243.00 |
| High end | | | | | | | | | | | | | | | |
| RL-D-20-102-38-01035 | 20 | 8 | 60 | 31 | 80 | 12 | 35 | 16 | 5 | 90 | M4 | 6 x M4 | 305.00 | 256.20 | 228.75 |
| RL-D-30-102-50-01035 | 30 | 10 | 80 | 42.5 | 100 | 12 | 45 | 19.5 | 6 | 110 | M4 | 8 x M4 | 332.00 | 278.88 | 249.00 |
| RL-D-50-102-48-01035 | 50 | 15 | 120 | 65 | 150 | 13 | 60 | 21.5 | 6 | 170 | M6 | 8 x M6 | 461.00 | 387.24 | 345.75 |



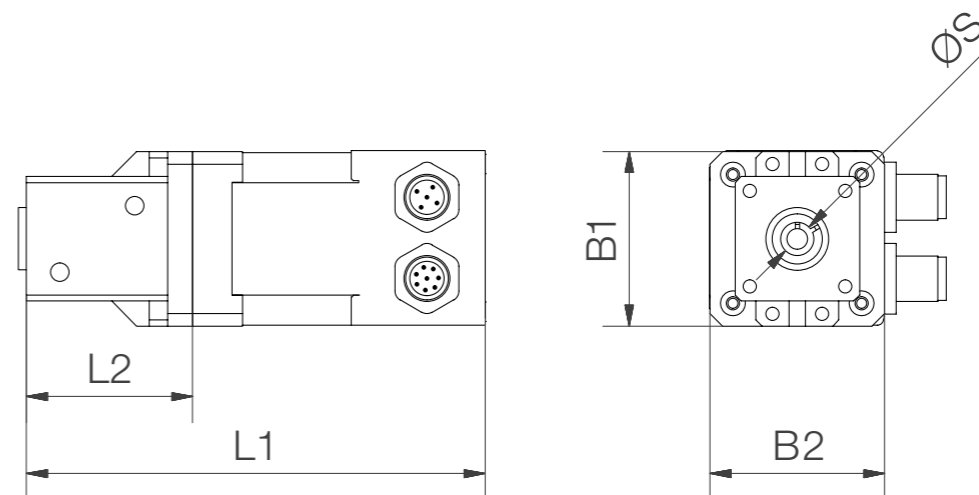
The articulated joints can be ordered with or without motor. We currently offer igus® stepper motors as standard. Other motors are will be available in the future. The robolink® D articulated joints are available in 3 sizes.

- Adaptable to various motors, standard option: stepper motor NEMA17 / 23 / 23XL
- INI kit for zero position optionally adaptable

Technical data

| Joint | Size 20 | | Size 30 | | Size 50 | |
|--|----------------------|----------|----------------------|----------|----------------------|---------|
| | RL-D-20-101-38-xxxxx | | RL-D-30-101-50-xxxxx | | RL-D-50-101-48-xxxxx | |
| Motor | + NEMA17 | + NEMA17 | + NEMA23 | + NEMA23 | + NEMA23XL | |
| Motor type | Stepper motor | | | | | |
| Weight (with standard joint) | [g] | 890 | 1.1140 | 1,860 | 2,540 | 2,970 |
| Max. radial torque strength (short term) | [Nm] | 5 | 6 | 12 | 21 | 38 |
| Max. radial torque strength (long term) | [Nm] | 4 | 5 | 8 | 18 | 33 |
| Max. speed (at max. load) | [rpm] | 5 | 4 | 4 | 4 | 4 |
| Max. axial dynamic load (horiz.installation) | [N] | > 500 | > 700 | > 700 | > 1,200 | > 1,200 |

Delivery time
2-3 days



| INI-Kit | |
|---------------------------|---|
| Fitting | M8x1 |
| Switching output | PNP |
| Switching function | NO (Closer) |
| Operating voltage | 10...30 V DC |
| Rated operational current | 100 mA |
| Part no. | RL-D-20-ИК-001 RL-D-30-ИК-001 RL-D-50-ИК-001 |

| Motor kit | |
|-----------------------|---|
| Motor type | igus® stepper motor NEMA17, NEMA23, NEMA23XL |
| Flange dimension [mm] | 42, 56, 60 |
| Part no. | See dimensions table for standard version (-02) with NEMA motor. Other versions with stranded wire motors (-00) or with stepper motor and encoder (-01) also available. |

Dimensions [mm]

| Part no. | ØS | L1 | L2 | B1 | B2 | Prices [€] | | |
|-----------------------|----|-------|----|------|------|------------|-------------|-------------|
| | | | | | | 1-9 Piece | 10-24 Piece | 25-49 Piece |
| NEMA17 | | | | | | | | |
| RL-D-20-MK-C-N17-02 | 8 | 110.4 | 40 | 42 | 42 | 241.55 | 180.83 | 166.48 |
| RL-D-30-MK-C-N17-02 | 10 | 110.4 | 40 | 42 | 42 | 241.55 | 180.83 | 166.48 |
| NEMA23 | | | | | | | | |
| RL-D-30-MK-C-N23-02 | 10 | 140 | 42 | 56.4 | 56.4 | 304.78 | 234.27 | 217.31 |
| RL-D-50-MK-C-N23-02 | 15 | 146 | 48 | 60 | 60 | 304.78 | 234.27 | 217.31 |
| NEMA23XL | | | | | | | | |
| RL-D-50-MK-C-N23XL-02 | 15 | 158.5 | 48 | 60 | 60 | 374.78 | 294.27 | 274.31 |

For other versions please add the suffix -00 for stranded wire motor and -01 for stepper motor with encoder.

Delivery time
2-3 days

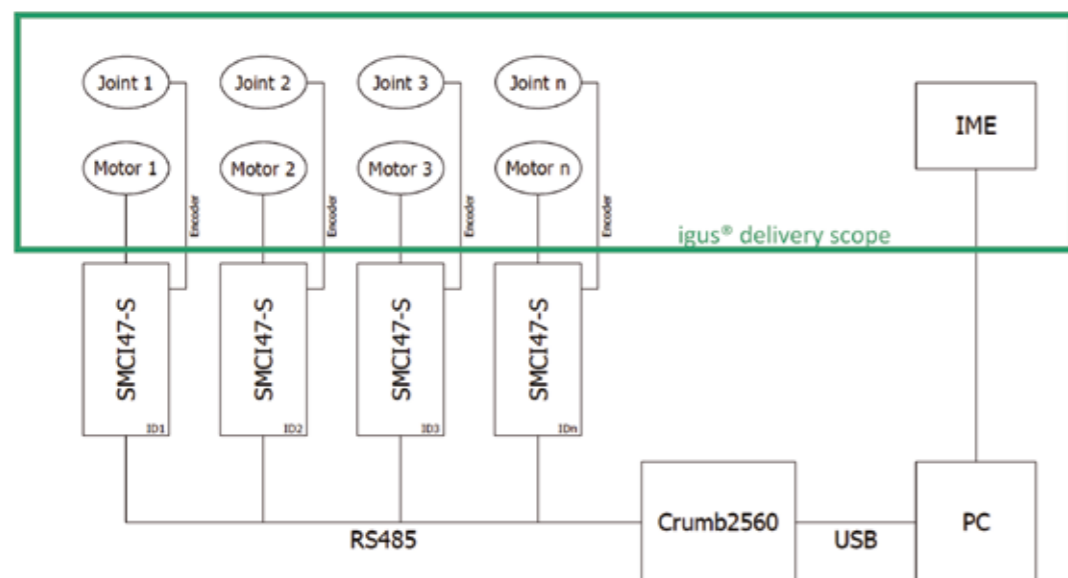
Prices
on request



Open source software for the roboLink® joint construction kit

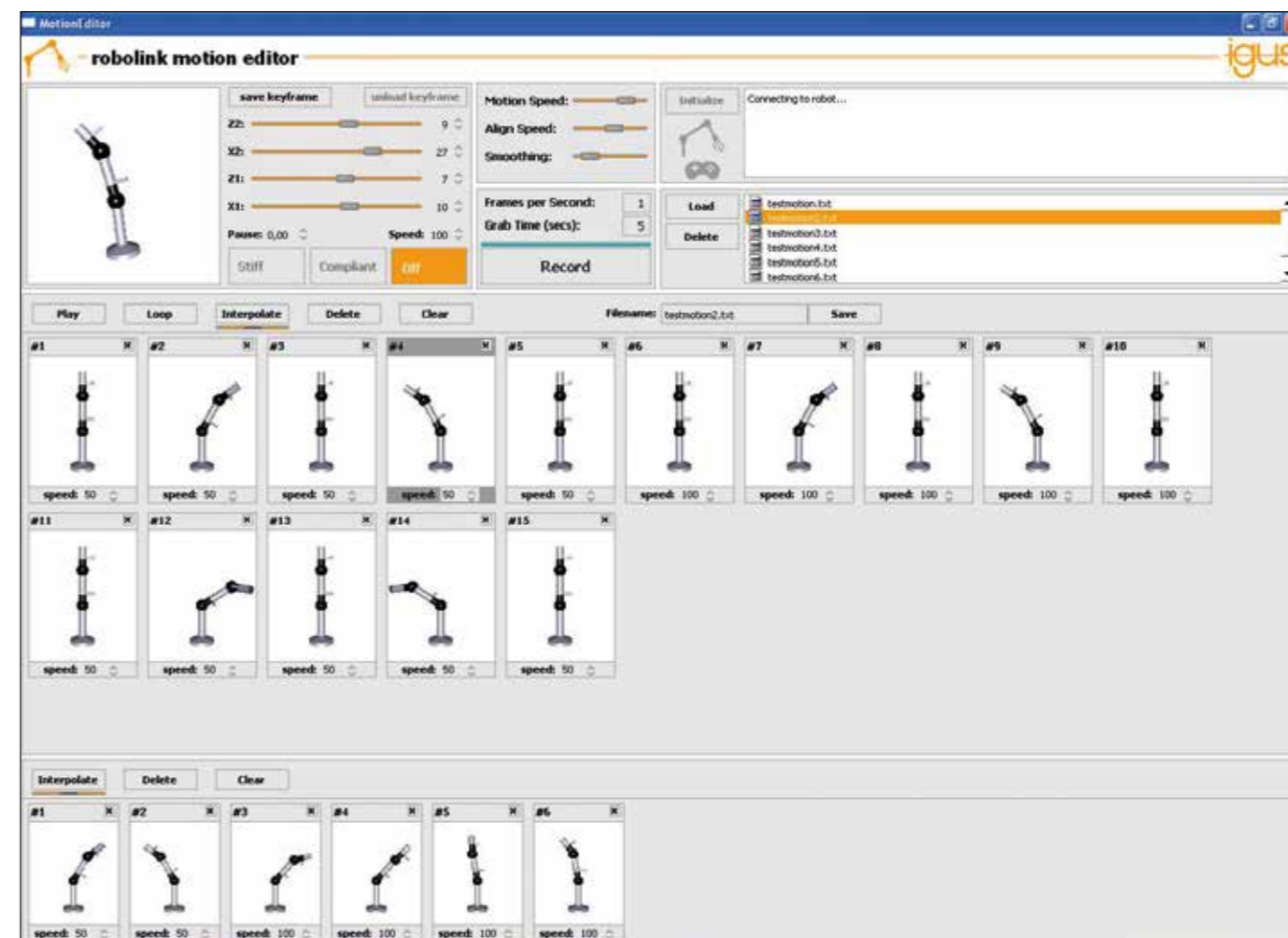
You can use our roboLink® construction kit to implement your ideas and concepts, cost effective, freely and individually, whether it has 1, 2, 3, 4, 5 or 6 axes.

- Free of charge
- Intuitive programming
- For all versions of articulated arms, 1-6 DOF
- Simple control software



Hardware configuration:

Stepper motor control - NANOTEC SMC147-S2, memory-chip Crumb2560 ATmega USB module.



roboLink® software for programming articulated arms: IME (igus® motion editor)

A large number of options exist to control roboLink® articulated arms. For controlling of igus® stepper motors usually using stepper motor cards. Additionally a higher level control is required to coordinate the axes. igus® has developed a simple, intuitive control software, which allows the programming of articulated arms (1-6 DOF).

Simple control software: free of charge, open source:

► www.igus.eu/roboLink/software



More information about software also online in roboLink® blog


► www.igus.eu/roboLink/blog

System examples without angle sensor Prices [€]

| DOF | Part no. | Components | 1–9 Piece | 10–24 Piece | 25–49 Piece | > 50 Piece |
|-----|-------------|-----------------------|--------------|----------------|----------------|---------------|
| 2 | RL-T1P1 | TL1 - PL1 | 679.00 | 571.00 | 510.00 | |
| 3 | RL-P1P1P1 | PL1 - PL1 - PL1 | 1,275.00 | 1,071.00 | 957.00 | |
| 3 | RL-T101 | TL1 -001 | 845.00 | 710.00 | 634.00 | |
| 3 | RL-B1P1 | BL1 - PL1 | 1,327.00 | 1,115.00 | 995.00 | |
| 4 | RL-0101 | 001 - 001 | 1,134.00 | 953.00 | 851.00 | |
| 4 | RL-B103 | BL1 - 003 | 1,583.00 | 1,330.00 | 1,187.00 | on request |
| 4 | RL-T1P1P1P1 | TL1 - PL1 - PL1 - PL1 | 1,625.00 | 1,365.00 | 1,219.00 | |
| 5 | RL-T101P1P1 | TL1 - 001 - PL1 - PL1 | 1,791.00 | 1,505.00 | 1,344.00 | |
| 5 | RL-B101P1 | BL1 - 001 - PL1 | 1,956.00 | 1,643.00 | 1,467.00 | |
| 6 | RL-B10101 | BL1 - 001 - 001 | 2,122.00 | 1,782.00 | 1,592.00 | |
| 6 | RL-B10301 | BL1 - 003 - 001 | 2,212.00 | 1,858.00 | 1,659.00 | |

System examples with angle sensor Prices [€]

| DOF | Part no. | Components | 1–9 Piece | 10–24 Piece | 25–49 Piece | > 50 Piece |
|-----|----------------|-----------------------|--------------|----------------|----------------|---------------|
| 2 | RL-T1P1-E | TL1 - PL1 | 963.00 | 809.00 | 723.00 | |
| 3 | RL-P1P1P1-E | PL1 - PL1 - PL1 | 1,701.00 | 1,429.00 | 1,276.00 | |
| 3 | RL-T101-E | TL1 - 001 | 1,363.00 | 1,145.00 | 1,023.00 | |
| 3 | RL-B1P1-E | BL1 - PL1 | 1,845.00 | 1,550.00 | 1,384.00 | |
| 4 | RL-0101 | 001 - 001 | 1,886.00 | 1,585.00 | 1,415.00 | |
| 4 | RL-B103-E | BL1 - 003 | 2,305.00 | 1,936.00 | 1,729.00 | on request |
| 4 | RRL-T1P1P1P1-E | TL1 - PL1 - PL1 - PL1 | 2,193.00 | 1,843.00 | 1,645.00 | |
| 5 | RL-T101P1P1-E | TL1 - 001 - PL1 - PL1 | 2,593.00 | 2,179.00 | 1,945.00 | |
| 5 | RL-B101P1-E | BL1 - 001 - PL1 | 2,851.00 | 2,395.00 | 2,138.00 | |
| 6 | RL-B10101-E | BL1 - 001 - 001 | 3,250.00 | 2,730.00 | 2,438.00 | |
| 6 | RL-B10301-E | BL1 - 003 - 001 | 3,340.00 | 2,806.00 | 2,505.00 | |

 Other robolink® systems prices on request. Please call us.

General Conditions of Sale and Delivery of

igus® GmbH (hereinafter called igus) as of March 2003

I. Scope

The following conditions apply only to dealers, if the contract concerns the operation of their commercial enterprise, legal persons under public law and public special funds.

II. Application

Orders only become binding with the acceptance of the order by igus. Alterations and additions must be made in writing. All offers are without engagement in so far as they are not described as firm offers. In the case of continuous business relations, these conditions also apply to future transactions which do not refer explicitly to them in so far as the conditions have been received by the customer for an earlier order accepted by igus. If the customer has differing conditions of purchase these obligate igus only if they have been explicitly accepted by igus. Should individual conditions be or become ineffective, the other conditions remain unaffected by this.

III. Prices

The prices are ex works exclusive of freight, customs duty, ancillary import charges and packaging plus the respectively prevailing value added tax, in so far as nothing else has been agreed upon. igus is not bound to previous prices in the case of new orders (= follow-up orders).

IV. Obligation to deliver and obligation to take delivery

Terms of delivery begin after the following have been received: all documents necessary for carrying out the order, the advance payment and the on-time supply of materials, in so far as these were agreed upon. If, through no fault of igus, it becomes impossible to ship the goods, the delivery deadline is regarded as having been met when notification is given that the goods are ready to be shipped. If an agreed delivery deadline is not met due to the fault of igus, the customer is, in so far as igus has not acted in a grossly negligent or wilful manner, entitled after expiry of an adequate period of grace and under exclusion of further claims to demand compensation for delayed performance or to cancel the contract if the customer has indicated the rejection of the performance in writing when fixing the period of grace. The compensation for delayed performance is limited to a maximum of 5% of that part of the delivery which has not been carried out according to the contract. In the case of blanket orders without an agreement regarding the term, size of the manufacturing lot and appointed times to take delivery, igus can, at the latest three months after the order has been accepted, demand that these are fixed in a binding manner. If the customer does not meet this demand within three weeks, igus is entitled to fix a two-week period of grace and to cancel the contract after this period has expired or to refuse to deliver and to claim damages. If the customer does not fulfil his obligation to take delivery, igus is, without affecting other rights, not bound to the provisions concerning the self-help sale but can sell the delivery item by private contract after having notified the customer. For igus to take back a delivery item out of good will, the item must be returned in good order and condition, in its original packaging and must be delivered with freight prepaid after a date has been appointed. igus is entitled to charge a reasonable amount for the costs it incurs through taking back the item. Acts of God entitle igus to postpone delivery by the length of the hindrance and a reasonable start-up period or, due to the part of the contract not yet fulfilled, to cancel the contract in part or completely. Strikes, lockouts or unforeseeable circumstances, e.g. plant interruptions, which make it impossible for igus, despite reasonable efforts, to deliver on time, are equivalent to acts of God; igus must furnish proof in such cases. This also applies when the above-named hindrances occur during a delayed performance or occur to a subcontractor. The customer can call upon igus to declare within two weeks whether it wishes to cancel the contract or deliver within a reasonable period of grace. If igus does not provide this declaration, the customer can cancel the part of the contract which has not been fulfilled. igus will notify the customer without delay if an act of God occurs. It must keep the disturbances caused to the customer to a minimum.

V. Packaging, shipment, passage of risk

In so far as nothing else has been agreed upon, igus selects packaging, type of shipment and shipping route according to its own best judgment. The risk passes to the customer when the delivery item leaves the igus factory, even with a freight prepaid delivery. If there is delay in shipping the item and the customer is responsible for this delay, the risk passes to the customer when he is notified that the item is ready for shipping. At the written request of the customer, the goods can be insured at the customer's cost against damage during storage, damage through breakage, damage during transport and damage due to fire.

VI. Reservation of ownership

The deliveries remain the property of igus until all claims which igus has on the customer have been satisfied, including when the purchase price for specifically designated claims has been paid; in the case of a current account, the reservation of ownership of the deliveries (conditional goods) acts as cover for igus's invoice balance. If igus sets up a liability under a bill of exchange in connection with the payment of the purchase price, the reservation of ownership does not terminate until the bill of exchange has been paid by the customer as drawee. Working or processing of the goods by the customer is carried out under exclusion of the acquisition of ownership under § 950 German Civil Code (Bürgerliches Gesetzbuch, BGB); igus becomes, in accordance with the relationship of the net invoice value of its goods to the net invoice value of the worked or processed goods, coowner of the item which has come into being in this way and which serves as conditional goods to safeguard igus's claims. If the item is processed, combined or mixed with other goods which do not belong to igus, the provisions of §§ 947, 948 German Civil Code apply with the result that igus's share of the co-ownership of the new item is now regarded as conditional goods according to these provisions. The customer is only permitted to resell the conditional goods in normal business on the condition that he also agrees upon a reservation of ownership with his customers in accordance with the above provisions. The customer is not entitled to dispose of the conditional goods in any other way, particularly through pledging or the transferral of ownership as security. If the goods have been resold the customer herewith assigns to igus all debt claims and other claims on his customers which result from the resale and all ancillary rights until such time as all igus's claims have been satisfied. On igus's demand, the customer is obliged to give igus all information and documents which are necessary to assert igus's rights over the customer's customers. If the conditional goods are resold after processing, in accordance with the above provisions, together with other goods which do not belong to igus, the purchase money claim, in accordance with the above provision, is assigned to igus only to the extent of the invoice value of igus's conditional goods. If the value of the securities existing for igus exceed igus's total claims by more than 10%, igus is, on the customer's demand, obliged to release securities at igus's option to this extent. Attachments and seizures of the conditional goods by a third party must be reported to igus without delay. Action costs resulting from this are carried by the customer in every case in so far as they are not to be carried by a third party. If igus, in accordance with the above provisions, makes use of its reservation of ownership by taking back the conditional goods, igus is entitled to sell the goods by private contract. The conditional goods are taken back at the price of the proceeds gained, at the most, however, at the price of the agreed delivery prices. Further claims to damages, particularly lost profits, remain unaffected.

VII. Warranty and liability for defects

The reference samples are binding for the quality and specification of the products; at the request of the customer, these reference samples can be presented by igus for testing. The warranty of certain qualities of the delivery item and for the performances of moulds must be made in writing in the order acceptance. The reference to standard technical specifications serves to describe the performance. If igus has advised the customer outside the contractual performance, it is liable for the operability and suitability of the delivery item only with explicit written assurance of this. The state of technology at the time the order is accepted is decisive. Complaints must be made in writing without delay, at the latest two weeks after receipt of the delivery. In the case of hidden defects, complaints must be made immediately after such defects have been ascertained. In both cases all claims due to defects lapse, in so far as nothing else has been agreed upon, twelve months after passage of risk. Insofar as the law, under §§ 438 paragraph 1 no. 2 German Civil Code, 479 paragraph 1 German Civil Code, 634 paragraph 1 no. 2 German Civil Code, makes longer periods of limitation mandatory, these longer periods apply. In the case of justified complaints – whereby the reference samples released in writing by the customer are binding for the quality and specification – igus is obliged to supplement its performance. If igus does not fulfil these obligations within a reasonable period, or if a repeated attempt to rectify the defects fails, the customer is entitled to demand reduction of purchase price or to rescind the contract. Further claims, in particular claims for reimbursement of expenses or damages due to harm caused by a defect or consequential harm caused by a defect, only exist with regard to the regulations under VIII. At igus's request replaced parts must be sent back to igus postage not prepaid. The customer's own reworking or improper use of the goods result in the loss of all claims for defects. The customer is entitled to rework the goods and demand compensation for reasonable costs only to prevent unreasonably high damage or when there is a delay by igus in rectifying the defects, and then only after igus has been notified. Wear and tear through use in conformity with the contract do not result in warranty claims. Claims under a right of recourse, in accordance with §§ 478, 479 German Civil Code, only exist insofar as the consumer was justified in availing himself of these claims and only to the extent laid down in the law. Such claims do not, however, exist in the case of liberal settlements agreed upon with igus. A prerequisite for the existence of claims under a right of recourse is that the person entitled to recourse observes his own obligations, in particular the requirement to give notice of defects.

VIII. General limitations of liability

In all cases in which igus is obliged, by way of derogation from the above provisions, to pay damages on account of contractual or legal subject-matters, igus is only liable in so far as it, its managerial employees or assistants can be charged with having acted wilfully or with gross negligence or with having injured life, body or health. The liability without fault under the Law pertaining to Product Liability and liability for the performance of a guarantee of quality remain unaffected. Liability for culpable violation of essential contractual duties also remains unaffected; however, liability in this respect is limited to the foreseeable, typical damages except for the cases named on p. 1. The above regulations do not result in the burden of proof being changed to the disadvantage of the customer.

IX. Terms of payment

All payments are to be made exclusively to igus. In so far as nothing else has been agreed upon, the purchase price for deliveries or other performances must be paid with a 2% cash discount within 14 days or without discount within 30 days of the invoice date. A prerequisite for the granting of a cash discount is that all undisputed invoices payable on an earlier date have been settled. No cash discount is granted for payments with bills of exchange. If the agreed payment date is exceeded, interest will be charged at eight percentage points above the respective base interest rate in so far as igus does not prove that it must pay a higher interest rate. The right to refuse checks or bills of exchange is reserved. Checks and eligible bills are only accepted on account of performance, all costs connected with these are carried by the customer. The customer can only offset debt or assert a right of retention when his claims have been found to be undisputed or legally effective. If terms of payment are not observed or circumstances arise which justify serious doubts about the credit worthiness of the customer, all igus's claims on the customer become immediately payable. igus is furthermore entitled to demand advance payments for outstanding deliveries and, after a suitable period of grace, to cancel the contract or demand damages for failure of performance, and also to prohibit the customer from reselling the goods and, at the customer's cost, to take back goods which have not yet been paid for.

X. Sampling

The costs for one-time sampling do not contain the costs for test and machining equipment or changes caused to be made by the customer. Costs for further sampling which are igus's responsibility, are carried by igus. In so far as nothing else has been agreed upon, igus is and remains owner of the moulds manufactured for the customer by igus itself or by a third party commissioned by igus. Moulds are only used for the customer's orders if the customer fulfils his obligations to pay and to take delivery. igus is obliged to replace these moulds at no cost only if this is necessary to fulfil an output quantity which the customer has been assured.

XI. Supply of materials

If materials are delivered by the customer they must be delivered on time in good order and condition at the customer's cost and risk and with a reasonable quantity bonus of at least 5%. If these prerequisites are not met the delivery time is extended by a reasonable amount. Except in the case of acts of God, the customer carries the additional costs which arise, including those incurred through manufacturing interruptions.

XII. Industrial property rights

If igus has to deliver based on drawings, models, samples or using parts supplied by the customer, the customer is responsible for ensuring that the industrial property rights of third parties are not contravened by this. The customer must indemnify igus against claims of third parties and compensate damages which have occurred. If igus is prohibited from manufacturing or delivering by a third party with reference to a protective right belonging to this third party, igus is entitled, without examining the legal status, to stop the work. Drawings and samples given to igus which have not led to an order, will be sent back on request; otherwise igus is entitled to destroy them three months after the offer has been submitted. igus is entitled to copyrights and, if applicable, industrial property rights regarding models, moulds, equipment, designs and drawings drawn up by igus or by a third party under commission to igus.

XIII. Place of fulfilment and place of jurisdiction

igus's registered office is the place of fulfilment. The place of jurisdiction may be, at igus's option, igus's registered office or the customer's registered office; this also applies to legal proceedings regarding legal documents, bills of exchange and checks. Only German law is applicable. UN Sales Law is excluded.

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Orders can be placed until 8:00 pm local time. Ordering and deliveries weekdays from 7.00 am to 8.00 pm, Saturday from 8.00 am to 12.00 pm. No minimum order quantities, no surcharges..

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