SCHAEFFLER

We pioneer motion

System components for lightweight robotics

Bearing supports, gearboxes for articulated arms, and drive motors

Innovations that “tune” your robots

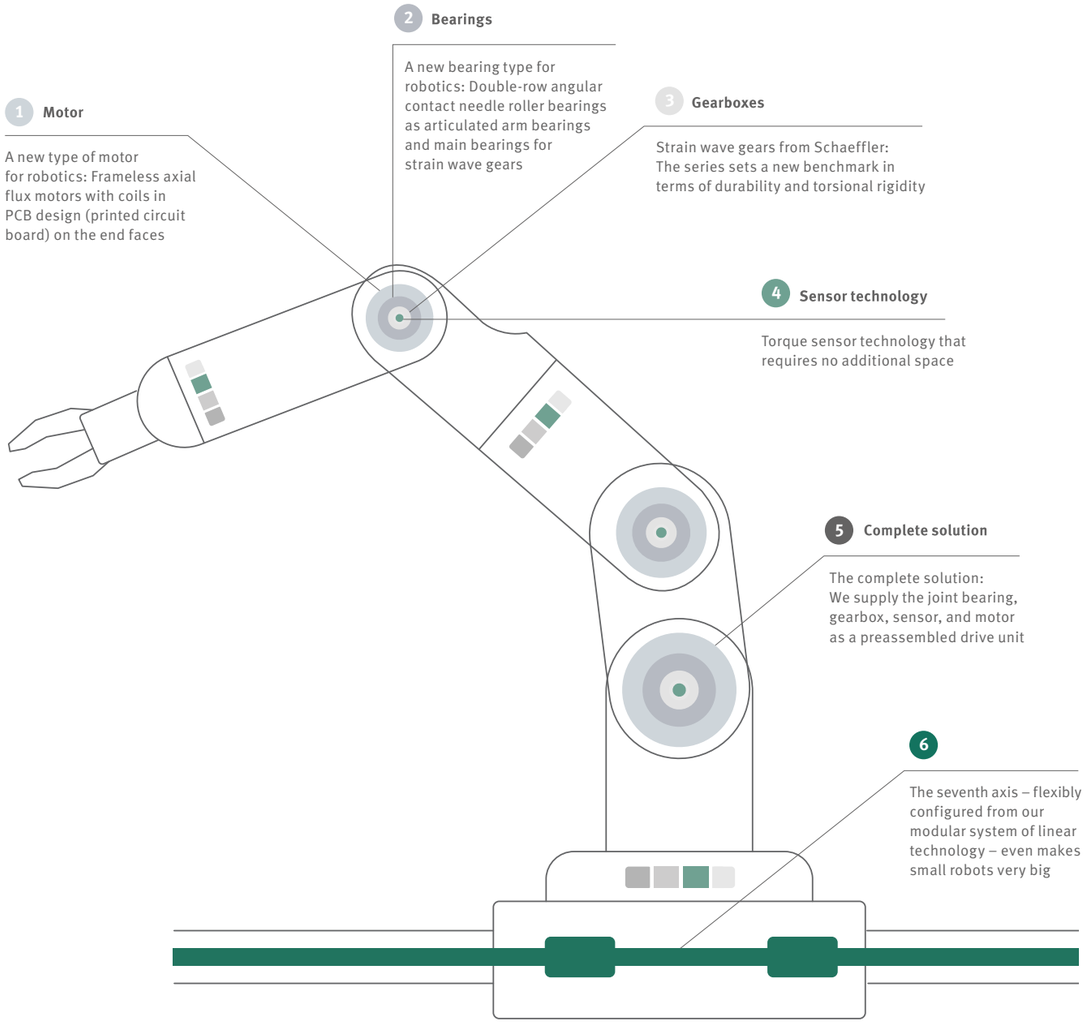
The relatively new discipline of lightweight robotics is focused on manufacturing industry’s persistent demands for even more productivity, flexibility, availability, and process reliability. The increasing digitalization of production processes, the simple integration of robots into production systems, and the capability for human-robot collaboration has led to the development of a very dynamic market segment for lightweight robots to perform a wide range of handling and assembly processes.

Schaeffler has set itself the objective of becoming a major partner for the lightweight robotics sector in a few years – with innovative solutions for joint bearings, joint gearboxes, and electric motors. These types of components are particularly in demand for realizing even more compact robots with longer reaches and higher load carrying capacities.

Completely new solutions were required for setting a new benchmark in these disciplines. For example, several technologies and many years of process experience gained from our developments in automotive and electronic component production were integrated into the robot components presented here. Expertise from a wide range of business divisions enabled us to make significant leaps forward in the development of robotics and to combine these with high cost-effectiveness and an outstanding level of quality.

Solutions for each axis

Our system components for lightweight robots and cobots



Symbiosis between gearbox and main bearing support
Significant leaps forward in the development of lightweight robotics are mainly possible if the articulated arm bearing support, gearbox, and motor are developed from scratch and additional degrees of freedom arise in the design solution. Schaeffler is in the unique position of having all the expertise and technologies required here: Rolling bearing expertise, gearbox design, gear tooth design, development of new motor topologies and integrated sensors, production technologies in volume production applications, coating methods, etc.

The products for lightweight robotics presented here are genuine new developments and not just adaptations of existing solutions: A new type of rolling bearing for articulated arms, a new series of strain wave gears using production technologies from our Automotive business sector, new drive motors, which originated from the field of electronic component production, and integrated torque sensors based on thin-layer technology.

Components for all axes
Schaeffler offers all the important system components for lightweight robots and cobots – pivot bearing supports and articulated arm bearings for each of the six axes and suitable gearboxes and motors. The components can be purchased from us individually or as preassembled and tested assemblies.

XZU double-row ang. contact needle roller bearings

A new bearing type for articulated arms and strain wave gears

Schaeffler has developed a completely new bearing type specially for the articulated arms of lightweight robots and cobots: The double-row XZU-series angular contact needle roller bearing. The new series was optimized for outstanding tilting rigidity and reduced, uniform frictional resistance. One of the special features: The angular contact needle roller bearings have the same cross-section as the crossed roller bearings that are frequently used and can be used as a 1-to-1 replacement. This means that redesigns are not required. You can use XZU bearings as articulated arm bearings and as the main bearing support of articulated arm gearboxes. With a large number of rolling elements, rigid line contact, and an internal support distance provided by two separate raceways, XZU bearings allow more compact articulated arms and higher load carrying capacities.

A new bearing type for robotics:
The double-row angular contact needle roller bearing with particularly high tilting rigidity

Product characteristics

- Very large number of rolling elements with line contact
- Internal support distance provided by two
- Separate raceways in an X arrangement, 45° contact angle

–› Outstanding tilting rigidity (+30%) and load carrying capacity in comparison with crossed roller bearings

Advantages for your cobot

- Higher permissible load carrying capacities
- Longer reach
- More compact articulated arms
- Higher dynamics possible, shorter positioning times

- Cage-guided rolling elements

–› 20% less friction in comparison with crossed roller bearings

–› Best frictional and running behavior

- Very precise arm movements
- Easier controllability

- Optimized lubricant distribution due to lubricant reservoir

- Reduces the load on seals, no egress of grease

- Identical cross-section in comparison with crossed roller bearings
- Aligned hole pattern

- Compact design, can be used as 1-to-1 replacement for crossed roller bearings, simplified redesign
- Simple mounting

Tune your cobot with XZU.

RTWH series of DuraWave prec. strain wave gears

An enabler for a leap forward in the development of lightweight robotics

Schaeffler has used the highly rigid XZU angular contact needle roller bearings and flexsplines with optimized design and manufacturing processes to develop new strain wave gears, which have exceptionally high precision, torque density, and an outstandingly long operating life. The optimized 3D gear tooth geometry of the flexsplines allows a more even load distribution over the gearing and ensures complete tooth meshing. The precision gearing is also produced using forming technology. This offers significant advantages in terms of grain flow and surface quality, and leads to material solidification. A special alloy steel and the combined heat treatment and surface treatment ensure an outstandingly high level of fatigue strength, wear resistance, and durability of the flexspline. Overall, this enables the transmission of particularly high nominal torques and an outstandingly long operating life for the gearbox.

Schaeffler offers the new RTWH DuraWave strain wave gears in the four sizes 14, 17, 25, and 32. The series covers ratios of 100 to 160 and torques of 25 to around 900 Nm.

The design principle is not new but has been developed from scratch by Schaeffler: Durable precision strain wave gears

Product characteristics	Advantages for your cobot
• **Flexspline:** Optimized 3D tooth geometry • Outstanding fatigue strength and wear resistance • Optimized load distribution over the gearing	• Wear-resistant and clearance-free • Outstandingly long operating life of the gearbox • High level of overload protection, high peak torques
• High torsional rigidity • XZU double-row angular contact needle roller bearings as main bearings	• Reduced oscillation, good controllability • Very high tilting rigidity of the pivot bearing support • High positioning accuracy and short positioning times
• Clearance-free throughout the entire operating life • High tooth quality and pitch accuracy	• Suitable for highly-dynamic applications
• Available as geared motor unit • Customized design of the spline ring	• Simple design and development, short development times

Speed up your cobot.

UPRS-series PCB motors

Overcoming limits with new technologies

Schaeffler's new frameless UPRS-series motors offer a smaller design envelope, reduced weight, a higher torque density, and increased dynamics. These motors are designed as axial flux motors. The conventional coils in PCB design (printed circuit board) enable a very high torque density and excellent heat dissipation to the outside. The weight of the active components was reduced through the use of innovative materials. The reduced weight and improved performance data of the motors lead to significantly improved overall dynamics.

Schaeffler's UPRS series of PCB motors is currently available in the four sizes 14, 17, 25, and 32 with outside diameters from 53 to 115 mm and axial lengths from just 21 to 33 mm.

The motors, which are matched to the specific DuraWave gearbox size, are offered as geared motor units. Schaeffler's UPRS motors can also be supplied separately at the customer's request. As is usually the case with frameless motors, the bearing supports of the adjacent construction are also used. This reduces both the design envelope and the weight.

A new type of motor for robotics: Axial flux motor with coils in PCB design

Product characteristics	Advantages for your cobot
• 60 % higher torque density – in comparison with standard motors in robotics	• Up to 30% higher payload • Increased productivity due to up to 80% higher speeds
• Extremely short, compact and light design • Modular design	• Low design envelope requirement • Easy to integrate into the design • Four different sizes can be used in various joints • Can be quickly modified to suit customer-specific requirements
• No measurable cogging torque	• Very uniform, smooth movements • Significantly improved convenience in teaching mode
• Improved heat conduction	• High energy efficiency • Low operating costs

Power your cobot.

MDKUVE Range Extender

The seventh axis – an extended arm in production

The advantages of the seventh axis are clear: Smaller robots can be used at close range; if travel distances are long, the costs for additional robots can be saved in certain circumstances. In addition, new areas of production can often be fully automated due to the larger working range that is made possible by the seventh axis. Schaeffler offers driven linear actuators as individual complete solutions for these applications. MDKUVE tandem actuators are offered in the three sizes (15, 25, and 35) and with a triple toothed belt drive. The plug-and-play-ready linear axis is supplied with a servo gear motor, cable track solution, a floor or ceiling installation kit, and an adapter plate for the robot. The tandem actuators have a carriage, which is supported on two four-row linear recirculating ball bearing and guideway assemblies (KUVE-B) arranged in parallel. The large profile section and the wide support distance of the two linear recirculating ball bearing and guideway assemblies provides a high level of rigidity. Optionally, the standard toothed belt drive (MDKUVE..-3ZR version) can be replaced by a ball screw drive (MDKUVE..-KGT version). A travel measurement system can be implemented by agreement.

Customized configuration: Our seventh axis

Product characteristics	Advantages for your cobot
• Travel distance up to 18 m	• The extended operating range opens up new areas of application for lightweight robotics
• Complete solution that is ready to install and operate	• No design outlay for the machine operator
• The linear axis is suitable for flexible configuration • Individual customer interface (linear carriage) • Highly extensive range of accessories, including travel measurement systems and braking and clamping elements	• Cost savings • Simple portfolio extension • New functions
• Carriage drive system with three toothed belts	• Also suitable for use as a vertical axis
• Standard four-row linear recirculating ball bearing and guideway assemblies - Six-row linear recirculating ball bearing and guideway assemblies (KUSE) are available as an option	• Scalable in terms of rigidity and positioning accuracy

Maximize the range and efficiency of your robot.

The future is within reach with Schaeffler’s innovations

RTTWH sensor-based DuraWave strain wave gear

Qualified for automated processes and collaboration

Lightweight robots, which are used in collaboration with humans – so-called cobots – are currently the strongest-growing market segment in the robotics sector. Torque sensors that are integrated into the articulated arms make cobots sensitive and in this way allow new applications. The sensors also ensure the safety of people by monitoring and limiting the forces generated by the cobot.

With torque sensor technology that is fully integrated into the strain wave gear, Schaeffler offers a solution for cobots that has no effect on the design envelope. Robots can be equipped with and without torque sensor technology without significant design and mounting outlay. Sensotect sensor technology is based on a submicrometer-thin, microstructured and expansion-sensitive PVD coating.

Because no adhesives are used for fixing, the measurement system is particularly thermally stable and resistant to ageing.

Based on a PVD coating:
The new torque sensor technology

Product characteristics	Advantages for your cobot
• Compact design with integrated microelectronics and embedded AI	• No additional space required • 1-to-1 replacement for non-sensor based RTWH DuraWave gearbox • Very simple upgrade for non-sensor-based cobots • Reduced weight as complete system due to elimination of additional components • Available in four different sizes • Ideal for use in collaborative applications • No influence on the mechanical system and the torsional rigidity
• High precision Sensotect coating with submicrometer-thin structure	• Excellent long-term stability of the sensor technology throughout the entire operating life • Insensitive to temperature
• Direct torque measurement • Minimum deviation in hysteresis and linearity deviation	• High sensitivity • Precise torque measurement for very high requirements

Increase the precision of your cobot.

Always on the move: The history of robots

Of players and helpers
Automaton, machine, robot, humanoid, android, cobot – no matter what names the artificial entertainers and workers have been given and what they imply, the foundations of this success story brimming with innovations were laid as far back as 3,000 years ago.

Robotics timeline

1000 BC

Let someone else do the job … an idea captured in many ancient tales and mythologies in the form of artificial creatures lending a helping hand to the gods – like robots are to humans today.

1740

Jacques de Vaucanson (1709–1782) was a French engineer who dreamed of creating an artificial human that would function as accurately as possible. It was to remain a dream. At least his mechanical flute player performed a repertoire of twelve songs using a mechanical pin roller moving in two directions. Even truer-to-life was Vaucanson's mechanical duck with more than 400 movable parts.

1810

The trumpeter created by the Dresden instrument maker Friedrich Kaufmann (1785–1865) is deemed to be the first real humanoid robot and was even a step ahead of human trumpeters: The machine was able to produce dyads of the same intensity and high purity or, as a contemporary of Kaufmann wrote, "of truly heavenly harmony."

1948

In the robots Elmer and Elsie created by William Gray Walter (1910–1977), light- and touch-sensitive sensors, like nerve cells, controlled a motor. This enabled the tortoise-like machines to actually find their way around obstacles and therefore they're regarded as the first electronic autonomous robots.

2014

In the summer of 2014, the Japanese company Softbank presented Pepper which, according to the company, was the world's first social humanoid robot able to recognize faces and basic human emotions. Today, far more than 10,000 of the beady-eyed humanoids are in use worldwide. The interactive helpers are well on their way toward becoming a mass product.

You can find more information here:
https://www.schaeffler-tomorrow.com/tomorrow/543/index.html

Schaeffler Technologies AG & Co. KG
Georg-Schäfer-Straße 30
97421 Schweinfurt
Germany
www.schaeffler.de
info@schaeffler.com

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