Servolectric®
Connected driving with power steering

Intelligent steering assistance: The electromechanical power steering Servolectric® controls and assists vehicle steering using an intelligently controlled electric motor. Based on the steering wheel movement and the vehicular situation, the Servolectric® system reacts quickly and flexibly, and provides the necessary force.

Passenger cars and light commercial vehicles: With just three simple installation variants, the Servolectric® covers the requirements of all passenger car classes and even light commercial vehicles. The versions transfer the motor torque in different ways.

In the paraxial version, the torque is transmitted to the servo gear system (toothed-belt drive and recirculating ball gear) via a coupling. In the twin pinion version, power is transmitted from the hydraulic motor to the toothed disc located on the motor shaft. In the paraxial version, the force from the hydraulic motor is transmitted to the steering gear via a coupling.

Automated steering: With its integration of the ECU into the servodriving system, Servolectric® offers considerable potential for automated, connected steering systems. It offers the key technology for more reduced, automated functions and the fully automated vehicle of the future.

30 locations on four continents
Global presence: Robert Bosch Automotive Steering (formerly 2B Components) has 30 locations in eight countries. The company serves all global automobile manufacturers with high-performance electromechanical power steering systems.

Steering rack force (kN)
Steering speed at standstill

Performance (W)

System provider for light commercial vehicles

System and network competence: The Servolectric® offers our customers unparalleled opportunities for networking with other vehicle systems and components. This enables the Servolectric® to offer truly intelligent steering assistance as well as the innovative software that provides the basis for networking with other vehicle systems and components.

Singling out for technical progress

Innovative driver and technology leader: Robert Bosch Automotive Steering is the electromechanical power steering systems provider for passenger cars and commercial vehicles. We are actively helping shape technological progress with our innovation programs. The awards for our products, including the Laureus Innovation Award, demonstrate the innovative spirit of our team. It also shows our customers’ high levels of satisfaction.

Reliable and robust

Ensuring quality and reliability: Manufacturers all around the world trust the tried-and-tested quality of our steering systems, components, and systems. From the electric hybrid and the urban-coupled drive to high performance on the racetrack, our products are in use everywhere and have demonstrated their quality and reliability millions of times over. Numerous awards from our customers, such as the Volvo Quality through Excellence Award and the Tatuto-Motor Supplier Award, underline the trust.

Reinventing the steering column

2000
1000
200

Standard values of steering rack force and mechanical performance for all vehicle classes

Servolectric® Electromechanical steering system for a dynamic driving experience and highly automated functions

Automotive competence from a single source Bosch – your partner for steering systems
Power on demand

Servolectric® — the facts

-10% Up to 20%

Fuel consumption and CO₂ emissions

<table>
<thead>
<tr>
<th>Sport</th>
<th>0 km/h</th>
<th>0 km/h</th>
<th>0 km/h</th>
<th>max</th>
<th>max</th>
<th>max</th>
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Over 50 million

Servolectric® electric power steering system is already on the road worldwide.

System benefits

- Speed-sensitive steering assistance
- High efficiency and low system friction
- Improved steering feel and handling performance
- Lighter steering system with enhanced service life
- Optimal usage of installation space through three basic types for all passenger cars and light commercial vehicles
- Flexible packaging
- Maintenance-free

Connected mobility

- Connection with other components (e.g., battery, camera, radar) as well as vehicle control unit
- Improved safety, comfort, and convenience thanks to the ability to implement innovative driver assistance systems (e.g., Evasive Steering Support, Traffic Jam Assist, Parking Maneuver Assistant)

Automated driving

- Key technology for implementing automated driving
- Integrating the ECU into the on-board power supply of the vehicle paves the way for automated driving functions

Powertrain and electrification

- One of the key technologies for powertrain electrification
- Significant reduction in fuel consumption and CO₂ emissions

From comfortable to sporty and dynamic driving

Examples of characteristics of steering system matching on vehicles:

- Speed-sensitive steering assistance
- High efficiency and low system friction
- Improved steering feel and steering performance
- Various drive modes can be implemented in a vehicle
- Optimal usage of installation space through three basic types for all passenger car classes and light commercial vehicles
- Flexible packaging
- Maintenance-free

Fuel on demand

The Servolectric® electric power steering system consumes energy only when the driver actually turns the steering wheel. In most frequent situation — traveling in a straight line — the energy used tends to zero. Compared with conventional power steering systems (e.g., rack-and-pinion), Servolectric® achieves a weight reduction of up to 50% of components of the steering system.

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Over 50 million passenger cars with electric power steering are already on the road worldwide.

- 10%
**Power on demand**

The Servolectric® electric power steering system consumes energy only when the driver actually turns the steering wheel. In the most frequent situation – traveling in a straight line – the energy consumption is 0.

- **10%**
- **Up to 20%**

**Fuel consumption and CO₂ emissions** Compared with traditional steering systems, the Servolectric® reduces fuel consumption and CO₂ emissions. Average fuel consumption of 17 l/100 km.

**Over 50 million**

More than 50 million vehicles worldwide are already equipped with a Servolectric® electric power steering system.

---

**System benefits**

- Speed-sensitive steering assistance
- High efficiency and low system friction
- Improved steering feel and steering performance
- Clean and silent operation
- Simple integration into the vehicle control system
- Optional usage of existing space through three basic types of packaging for various vehicle classes and in commercial vehicles
- Equipment variants
- Maintenance-free

---

**Servolectric® – the facts**

- The Servolectric® electric power steering system consumes energy only when the driver actually turns the steering wheel.
- In the most frequent situation – traveling in a straight line – the energy consumption tends to zero.
- Compared with conventional power steering systems, the Servolectric® achieves a significant weight reduction.
- Servolectric® achieves a significant weight reduction compared with conventional power steering systems.
- The Servolectric® achieves this saving in part by reducing the number of components of the steering system.

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**SAE World Congress**

- Shows the potential of electric power steering systems for passenger cars and commercial vehicles worldwide.
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**Torque senso...**

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**Connected mobility**

- Connected with other components (e.g. factory, garage, etc.)
- Connected with other components (e.g. factory, garage, etc.)
- Enhanced safety, comfort, and convenience thanks to the ability to implement innovative driver assistance systems (e.g. Lane Keeping Assist, Traffic Jam Assistant, Parking Lane Assist).

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**Automated driving**

- Key technology for implementing automated driving.
- Key technology for implementing automated driving.
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**Powertrain and electrification**

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**System benefits**

- Speed-sensitive steering assistance
- High efficiency and low system friction
- Improved steering feel and steering performance
- Two-stage steering assistance to provide a cushion
- Optimal usage of installation space through three basic types of service packages for passenger cars and commercial vehicles
- Flexible packaging
- Standardization

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**Servolectric® – the facts**

The Servolectric® electric power steering system reduces energy consumption and 

- Fuel consumption and CO₂ emissions

Compared with hydraulic steering systems, the Servolectric® saves fuel and reduces CO₂ emissions by up to 10% compared to hydraulic systems. Servolectric® achieves this saving in part by reducing the number of components of the steering system.

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**From comfortable to sporty and dynamic driving**

Examples of characteristics of steering system matching on vehicles:

- **Comfort**
  - Speed-sensitive steering assistance
  - High efficiency and low system friction
- **Sport**
  - Improved steering feel and steering performance
  - Two-stage steering assistance to provide a cushion
- **Max**
  - Optimal usage of installation space through three basic types of service packages for passenger cars and commercial vehicles

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**Connected mobility**

- System integration with other components (e.g., battery, cameras, radar, as well as on-board control unit)
- Improved safety, comfort, and convenience thanks to the ability to equip the vehicle with advanced systems

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**Automated driving**

- Key technology for implementing automated driving
- Integrating the ECU into the on-board power supply of the vehicle paves the way for automated driving functions

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**Powertrain and electrification**

- One of the key technologies for powertrain electrification
- Significant reduction in fuel consumption and CO₂ emissions thanks to power-on-demand principle

---

**Over 50 million**

Servolectric® electric power steering systems are already on the road worldwide.
Intelligent steering assistance The electromechanical power steering Servolectric® control and analysis vehicle steering using an intelligently controlled electric motor. Based on the steering angle, Servolectric® controls an electric motor and thus the steering assistance and feedback information to the steering column, which provides the necessary force.

Passenger cars and light commercial vehicles With just three installation versions, the Servolectric® covers the requirements of all passenger cars (e.g., front or rear wheel drive) and even light commercial vehicles. In the Servolectric® version, the torque is transmitted to the servo gear by means of a toothed-belt drive and recirculating ball gears. An electric motor is located on the motor shaft. In the twin pinion and paraxial versions, the motor torque is transmitted to the servo gear by means of a coupling.

Automated systems With its integration of the ECU into the vehicle electrical system, Servolectric® offers considerable potential for networking with other vehicle systems and components. In the Servolectric® system, the electric motor is controlled by the electrically operated software. That provides the basis for networking with other vehicle systems and components.

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Connected systems In electric power steering systems, power assistance is calculated not just from steering torque on the steering wheel but also the many additional signals of an automated system. To this end, the Servolectric® offers new distributed control design that includes the ECU as well as the electric motor software. That provides the basis for networking with other vehicle systems and components.

Standard values of steering rack force and mechanical performance For all vehicle classes

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<td>30</td>
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Servolectric® Electromechanical steering system for a dynamic driving experience and highly automated functions

Automotive competence from a single source Bosch – your partner for steering systems

30 locations in five continents

Global presence Robert Bosch Automotive Steering (formerly ZF Lenksysteme) has 30 locations in eight countries. The reasons we have a global presence in this core automotive industry - not just components, but also complete, finely-tuned systems, which benefit from our scale economies - are in our comprehensive portfolio of competitive solutions and products. We meet the varying needs of all passenger car and commercial vehicle manufacturers with a range of steering systems, including 1,500 specialists devoted to innovation and technology leadership.

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<tbody>
<tr>
<td>Steering rack force (kN)</td>
<td>1</td>
<td>2</td>
<td>3</td>
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Servolectric® electric power steering system
Servo unit on the steering column

Product benefits

- Ideal electric power steering solution for compact and subcompact cars
- Low weight and minimal space requirements
- The steering column and servo unit are delivered to the production line ready to install

1. Upper steering column
2. Serrations for steering wheel
3. Sensor cable
4. Torque sensor
5. Worm gear
6. Input shaft connection
7. Mechanical rack and pinion steering
8. Steering intermediate shaft
9. Electronic control unit
10. Electric motor
Servolectric® electric power steering system
Servo unit on the steering column

Energy consumption*
* compared with hydraulic steering, urban traffic only, passenger car with two-liter gasoline engine, average fuel consumption of 7.7 l/100 km

-90 %

Fuel consumption and CO₂ emissions*

-10 %

Task The Servolectric® electric power steering system controls and assists the vehicle steering with the aid of an electronically controlled electric motor. Bosch developed Servolectric® with the servo unit on the steering column specifically for vehicles with lower steering effort. It is therefore the ideal electric power steering solution in the entry-level segment and is suitable for use in compact and subcompact cars as well as in mid-size vehicles.

Function The servo unit and its electronic control unit are integrated in the steering column. They are connected to the mechanical rack and pinion steering gear via the intermediate shaft with universal joints. The sensors and torsion bar are located next to the worm gear. The torque produced by the electric motor is converted, via a worm gear, into an assistance torque and transmitted to the intermediate shaft. The ideal base for these steering variants is the mechanical rack and pinion steering. Rigidity, good efficiency, and compact lightweight design are the benefits of this well-proven component of which millions have been produced. The ratio of the rack and pinion steering can be either constant or variable. Software developed by Bosch allows the electric power steering system to be programed to the customer’s own requirements. As such, a steering system with the same hardware components can be adapted for various types of application.

Variants To achieve appropriate adaptation of the electric power steering system to the particular vehicle, modular servo units are available for different performance requirements. Another option is to separate the electronic control unit from the servo unit and position it in a different location.

Configuration of the mechanical rack and pinion steering:

1 Housing
2 Steering rack
3 Input shaft connection
4 Drive pinion
5 Bellows
6 Tie rod

Servolectric® with servo unit on the steering column is configured up to this steering axle load and is therefore suitable for subcompact and compact cars as well as mid-size vehicles.
Servolectric®
electric power steering system
Servo unit on a second pinion

Product benefits

- Ideal electric power steering solution for mid-size cars
- Support for performance-optimized configuration
- Outstanding crash safety
- Robust worm gear transfers the assistance torque throughout the steering gear’s entire service life

1. Sensor cable
2. Electric motor
3. Worm gear
4. Bellows
5. Tie rod
6. Drive pinion (second pinion)
7. Electronic control unit
8. Steering rack
9. Housing
10. Input shaft connection
11. Torque sensor
12. Yoke
13. Steering pinion
Servolectric® electric power steering system

Servo unit on a second pinion

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**Energy consumption**
* compared with hydraulic steering, urban traffic only, passenger car with two-liter gasoline engine, average fuel consumption of 7.7 l / 100 km

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**Fuel consumption and CO₂ emissions**

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**Task** The Servolectric® electric power steering system controls and assists the vehicle steering with the aid of an electronically controlled electric motor. Servolectric® with the servo unit on a second pinion provides the ideal electric power steering solution for mid-size vehicles.

**Function** Installing the servo unit on the second pinion allows the physical separation of the sensor and the drive unit. The drive pinion ratio’s independence from the steering ratio paves the way for performance-optimized configuration. System performance is increased by 10 to 15 percent. And outstanding crash safety is guaranteed thanks to optimum use of the available installation space. By allowing the servo unit to rotate 360 degrees about the axes of the rack and the drive pinion using a suitable tuned worm gear, the position of the servo unit can be defined to fit the particular application.

The function of the sturdy worm gear is to convert the torque provided by the electric motor into assistance torque and to transmit that torque to the steering rack. The requirements made in the process on performance and comfort are exacting. To meet these requirements, the teeth of the worm and helical gear must remain in mesh without backlash throughout the steering gear’s entire service life. To this end, a specially developed spring damper element is used, providing optimum spring load to the worm in any driving situation.

An innovative fixed bearing is fitted to ensure that the worm can move as necessary. Thanks to its convex outer race, which is accommodated in a concave steel ring, the ball bearing can absorb high axial and radial loads and can nevertheless move easily.

In unusual driving situations and in case of abuse, the worm gear is subjected to extreme loads. To prevent the worm gear from being damaged and potentially locking up, in those rare cases, an overload safety device is provided between the helical gear and drive pinion. This provides a defined limit to the torque that can be transmitted. Software developed by Bosch allows the electric power steering system to be programmed to the customer’s own requirements. As such, a steering system with the same hardware components can be adapted for various types of application.

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**Configuration of the worm gear:**

1. Helical gear
2. Spring damper element
3. Overload safety mechanism
4. Fixed bearing
5. Worm
6. Drive pinion
7. Housing

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Servolelectric® electric power steering system
Paraxial servo unit

**Product benefits**

- Ideal electric power steering system for luxury-class vehicles, sports cars, SUVs, and light commercial vehicles
- High efficiency and low system friction

1. Housing
2. Steering rack
3. Input shaft connection
4. Sensor unit
5. Steering pinion
6. Tie rod
7. Bellows
8. Electronic control unit
9. Electric motor
10. Recirculating ball gear
Servolectric® electric power steering system Paraxial servo unit

Energy consumption*

* compared with hydraulic steering, urban traffic only, passenger car with two-liter gasoline engine, average fuel consumption of 7.7 l/100 km

-90%

Fuel consumption and CO₂ emissions*

-10%

1,600 kg

Servolectric® with paraxial servo unit is configured up to this steering axle load and is therefore also suitable for SUVs and light commercial vehicles.

Task The Servolectric® electric power steering system controls and assists the vehicle steering with the aid of an electronically controlled electric motor. Servolectric® with paraxial servo unit provides the ideal electric power steering solution for vehicles with very high steering effort – from the dynamic sports car, the upper mid-size, and luxury class, to SUVs and light commercial vehicles.

Function To transform the rotational movement of the steering wheel into a linear movement of the steering rack, the Servolectric® with paraxial drive variant uses a drive concept consisting of toothed-belt drive and recirculating ball gear. Both drive stages are highly efficient. The recirculating ball gear is a system in which the ball chain is returned through a channel integrated in the ball recirculating nut. The recirculating ball gear generates minimal noise during operation. The slip-free toothed belt is also extremely quiet while still being able to transmit high levels of torque safely.

Due to the combination of recirculating ball gear and toothed-belt drive, Servolectric® with paraxial drive is ideally suited for varying customer requirements. The flexible positioning options of the servo unit enable the best-possible use of the installation space available in the vehicle. Software developed by Bosch allows the electric power steering system to be programmed to the customer’s own requirements. As such, a steering system with the same hardware components can be adapted for various types of application.

Configuration of the recirculating ball gear:

1 Steering rack
2 Ball recirculating nut
3 Toothed disc, large
4 Ball return channel
5 Ball chain

1,600 kg

Servolectric® with paraxial servo unit is configured up to this steering axle load and is therefore also suitable for SUVs and light commercial vehicles.
**Servolectric® electric power steering system**

**Steering motors**

**Product benefits**

- Highly precise steering assistance
- Highly efficient electric motor thanks to state-of-the-art materials
- Extremely compact size
- Optimized noise performance and torque ripple of the electric motor
- Optimal adaptation to customer requirements thanks to graded output ratings and modular design of the powerpack

1. Housing
2. Electronic control unit
Task: Electronic control and steering assistance that uses Servolectric® simply requires an easy-to-use medium: electric current. The electric motor provides the universally available, reliable, and economical energy supply. The newly developed generation of brushless electric motors provides the assistance calculated by the Servolectric® electronic control unit with high precision and in accordance with the particular driving conditions.

Function: Depending on the variant, the motor torque is transferred in various ways. On the paraxial variant the torque is transmitted to the servo gear system (toothed-belt drive and recirculating ball gear) via a toothed disc located on the motor shaft. On the Servolectric® steering column variant and the twin pinion variant, the torque is transmitted to the worm gear by means of a coupling.

Variants: The same motor and stator components are used for all Servolectric® steering variants. Various motor designs in the ratings 2 Nm to 8 Nm can be produced by modifying the interfaces and housings.

Configuration of the electric motor for the paraxial steering variant:

1. Busbar Cover
2. Housing
3. Spring washer
4. O-Ring

The available torque covers the requirements of all passenger cars and light commercial vehicles.

Power output available depending on the vehicle class for the graded variants of the steering motors.
Servolectric®
electric power steering system
Electronic control unit

Product benefits

- Intelligent, rapid calculation of steering assistance and corrections within milliseconds
- Facilitates implementation of innovative driver assistance systems
- Integration into vehicle electrical system via CAN bus or FlexRay™
- Fully integrated and hermetically sealed unit

1. Control electronics with heat sink
2. Input filter unit
Servolectric® electric power steering system  Electronic control unit

32-Bit-microprocessor  Flash memory

New assistance functions that network with the vehicle electrical system

**Task** The electronic control unit (ECU) is the intelligent heart of the Servolectric® electric power steering system. On the basis of the steering signal recorded by the torque sensor, the ECU calculates the optimum assistance and forwards this information to the electric motor. The ECU also processes a range of vehicle parameters and calculates necessary steering corrections within milliseconds.

**Function** The ECU links the electric power steering with the vehicle electrical system and with various other vehicle components. This means the electric power steering can access parameters such as speed, steering angle, wheel speed, and yaw rate. On this basis, the ECU can constantly calculate the vehicle’s longitudinal and lateral guidance as well as the optimum steering assistance, and intervene to carry out corrections in emergencies with the aid of driver assistance systems. The manufacturer decides which driver assistance systems are used in the vehicle and what their role is. This opens up a way to influence the vehicle’s lateral guidance in hazardous situations using the electric power steering, thus preventing accidents or mitigating their effects.

**Technical characteristics**

<table>
<thead>
<tr>
<th>Processor</th>
<th>32-bit microprocessor</th>
</tr>
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<tbody>
<tr>
<td>Storage technology</td>
<td>Flash</td>
</tr>
<tr>
<td>Connectivity options</td>
<td>CAN-Bus, FlexRay™</td>
</tr>
<tr>
<td>Current</td>
<td>60 to 110 A</td>
</tr>
</tbody>
</table>

**How the control unit works:**

1. Steering signal is recorded by torque sensor and forwarded to the control unit
2. Optimum assistance and motor control calculated
Servolelectric®
electric power steering system
Torque sensor

**Product benefits**

- Highly precise measurement of the steering torque for exacting safety requirements placed on electric steering systems
- Extremely robust digital interface to the electric steering system’s ECU

1. Clock spring
2. Steering pinion
3. Internal plug
4. Index magnet (optional)
5. Index sensor (optional)
6. Pole wheel
7. Input shaft
8. Torsion bar
9. Sensor module
**Task** The torque sensor in the Servolectric® electric power steering system measures the torque the driver applies to the steering wheel. Based on this data, the electronic control unit calculates the steering assistance which the electric motor needs to apply.

**Function** The sensor sits on the steering pinion. A pole wheel is fitted on the input shaft, which is connected to the steering pinion by means of the torsion bar. If the driver applies torque on the steering wheel, the torsion bar is rotated and, in turn, the magnet relative to the sensor. The sensor consists of magnetoresistive elements whose resistance changes as the field direction changes. In the process, the voltage traces a sine and cosine graph as the magnet is rotated. The direct rotation angle of the torsion bar is then calculated by means of an inverse tangent function. The sensor’s measuring range lies between +/-8 and +/-10 Nm. A mechanical angle limiter prevents the torsion bar from being overloaded where higher steering torques are applied.

**Variants** Optionally, an index magnet and an index sensor can be fitted to the torque sensor. The index sensor delivers a signal to the ECU for each full turn of the steering wheel.

The ECU together with the torque sensor can calculate the steering angle on the basis of sensor data with this **precision**.

**Temperature range** -40°C bis +125°C

The torque sensor in the electric power steering system works absolutely reliably over this **temperature range**.

**Technical characteristics**

<table>
<thead>
<tr>
<th>Measurement principle</th>
<th>Magnetoresistive effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>PAS – robust digital two-wire current interface</td>
</tr>
<tr>
<td>Signal transmission</td>
<td>With clock spring</td>
</tr>
<tr>
<td>Measuring range</td>
<td>between +/-8 Nm and +/-10 Nm</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-40°C bis +125°C</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0,1 Nm at 2 Nm/°</td>
</tr>
<tr>
<td>Resolution</td>
<td>Electrical</td>
</tr>
<tr>
<td>Torsion bar stiffness</td>
<td>2,0 to 2,5 Nm/°</td>
</tr>
<tr>
<td>Calibration function</td>
<td>Data is stored in the sensor</td>
</tr>
<tr>
<td>Steering angle</td>
<td>Can be displayed as an option with index extension</td>
</tr>
</tbody>
</table>
Three installation versions, the Servolectric® covers the requirements of all passenger car classes and even light commercial vehicles. In the paraxial version, the torque is transmitted to the servo gear by means of a coupling. In the twin pinion and steering column versions, the torque is transmitted to the worm system (toothed-belt drive and recirculating ball gear) via a toothed disc located on the motor shaft. In the twin pinion and steering column versions, the toothed disc is located on the motor shaft. In the twin pinion and steering column versions, the toothed disc is located on the motor shaft.

**Automotive competence from a single source Bosch – your partner for steering systems**

**System provider and technology leader**

Bosch is the world’s leading manufacturer of steering systems. Bosch drivers enjoy being on track for the long haul. Bosch’s electromechanical steering systems set the pace and course in steering systems throughout the global automotive industry. As the world’s leading manufacturer of steering systems, Bosch offers a comprehensive steering systems portfolio of connected solutions and products for passenger cars and commercial vehicles, including the familiar servo-electric steering (EPS). As the world’s leading manufacturer of steering systems, Bosch offers a comprehensive steering systems portfolio of connected solutions and products for passenger cars and commercial vehicles, including the familiar servo-electric steering (EPS).

**Staying on track for the long haul and pulling together**

Long-term partnership is at the heart of the successful cooperation between Robert Bosch Automotive Steering and its customers. Thanks to our decades of experience and expertise, our core competences in steering are valued for many vehicle classes. Thanks to our decades of experience and expertise, our core competences in steering are valued for many vehicle classes. As part of the Bosch Mobility Solutions business sector, we are also able to network our solutions in-house with the entire range of vehicle systems, such as engine management or driver assistance systems, to provide tangible benefits.

**Servolectric® Electromechanical steering system for a dynamic driving experience and highly automated functions**

**Intelligent steering assistance**

The electromechanical power steering systems by Bosch are intelligently controlled electric units. Based on the steering wheel angle, the steering angle, and the road condition, the Servolectric® ensures steering assistance and forwards the information to the steering column, which provides the necessary force. Bosch – your partner for steering systems

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