Innovative Testing Equipment
GSE4_{HDC} Gear Shift Robot
The GSE\textsubscript{HDC} System

ATESTEO is the leading specialist for drivetrain testing along with automotive product validation and drivetrain testing-related engineering and equipment. Internationally, we rank first among the partners of the automotive industry and automotive suppliers. Our employees’ great technical proficiency during customer-specific tests reliably ensures the operation and the quality of gear transmissions and their components. We are everywhere where transmission development in the automotive industry takes place. 130 test benches in Germany and China, along with representations in the USA and Japan make possible smoothly solving a range of measurement, test engineering, and analytical challenges at all times.

The GSE\textsubscript{HDC} from ATESTEO is a highly dynamic gear shift robot for drivetrain and transmission test benches. Its high-frequency control of force, position, and speed enables the fully automated and realistic shifting of all kinds of vehicle transmissions. Its adaption uses the original gear lever and state-of-the-art interfaces (EtherCAT, CAN), therefore it can be seamlessly integrated into your testing environment. High availability is ensured by using solely components suitable for industrial use, ensuring fail-safe operation at numerous ATESTEO and customers’ test benches around the globe.
The challenges of modern transmission testing place ever growing demands on modern shift actuators. While a few years ago, enabling a secure shift of gears was sufficient, these days, realistically simulation of human gear shifting behaviour takes priority. Do you need a gear shift device that covers all disciplines?
**GSE4<sub>HDC</sub> robot**

The GSE4<sub>HDC</sub> gear shifting robot consists of two linear motion units driven by servomotors for the shifting and selecting direction. Speed and position values are collected by the absolute encoder integrated in the servomotors. The determination of the shifting forces takes place through a customised force measuring device integrated in the gripper axis. To recognise the gear lever, the gripper is additionally equipped with a magnetic sensor. The height of the gear shifting robot foot can be adjusted to adapt the robot to various assembly situations.

**GSE4<sub>HDC</sub> Servo**

A 19-inch industrial rack contains the servo amplifier to drive the motors and the necessary hardware for capturing and processing signals. The back of the servo rack contains all electrical power connections, the Ethernet slave interface, and the interfaces for the higher-level automation.

**GSE4<sub>HDC</sub> controller**

The GSE4<sub>HDC</sub> controller is an industrial computer in 19-inch format. The GSE4 control software executed on the real-time operating system controls the gear shifting sequence over the EtherCAT master interface, controlling forces and speeds at the same time. The system communicates via CAN interface with the higher-level automation and communicates via a network interface with the GSE4 APP.

**GSE4 tablet**

The industry-strength GSE4 tablet is designed for use in rough environments and complies with MIL specifications. It has a high-resolution touchscreen. Mounted on the accompanying docking station, the tablet is used for parameter setting and displaying outside the test room. When directly connected to the GSE4HDC robot, the tablet serves to teach the gear positions.
The intuitive user interface of GSE4 APP makes all necessary parameters available, clearly arranged. All characteristic values such as the shifting forces and speeds can be set gear by gear and stored as projects in any required number. Besides the numerical representation of current measurement values and parameters, the software also makes additional graphics windows available. Displaying the gear lever positions “learned” by the robot enables the visual control of the learning phase, while presenting the shifting force over the shifting travel serves the rapid analysis of the individual phases of the shifting event. Optionally, the GSE4 APP can additionally be executed on a connected Windows® PC.

Human-like shifting behaviour

The experiences drawn from the analysis of human shifting behaviour with the ATESTEO GSA system are the basis for the development of the GSE4HDC shifting strategies. The highly dynamic simultaneous control of force and speed during the shifting event enables the simulation of how human drivers change gears.

Characteristics

- Rapid adaptation to the original shift lever (MT, AMT, AT, DCT, CVT)
- Integrated force measuring device for the direction of shifting and selection
- Vibration resistant stiff mechanism
- Shaft with low inertia and low friction
- Dynamic synchronous force control
- Realistic simulation of how human drivers shift gears
- Reproducible gear shifting behaviour
- Release of the gear lever after the shift event
- Learning procedure on the robot via touchscreen control
- CAN bus, digital and analogue interfaces for master host system
- Interface for objective evaluation of the gear shift quality (GSA system)

GSE4HDC by the numbers

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel path of shifting direction</td>
<td>280 mm</td>
</tr>
<tr>
<td>Travel path of selecting direction</td>
<td>320 mm</td>
</tr>
<tr>
<td>Tracking device area of the gripper</td>
<td>70 mm</td>
</tr>
<tr>
<td>Static shifting force</td>
<td>300 N</td>
</tr>
<tr>
<td>Dynamic shifting force</td>
<td>500 N</td>
</tr>
<tr>
<td>Shifting speed (max.)</td>
<td>1,200 mm/s</td>
</tr>
<tr>
<td>Positioning precision</td>
<td>0.1 mm</td>
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<tr>
<td>Voltage</td>
<td>230 VAC</td>
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<tr>
<td>Power</td>
<td>3,000 VA</td>
</tr>
<tr>
<td>Frequency</td>
<td>50/60 Hz</td>
</tr>
</tbody>
</table>
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