

## Innovative Testing Equipment

### GSE 4.0 Gear Shift Robot



# The GSE 4.0 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. More than 150 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 product family GSE 4.0 from ATESTEO offers you highly dynamic shifting robots for use on drivetrain and transmission test benches. The high-frequency control of the robots enable the fully automated shifting of vehicle transmissions. Depending on the model of the system, the mechanical connection occurs via the original shifting cables or the gear lever. The use of state-of-the-art interfaces (EtherCAT, CAN) enables seamless integration into your testing environment. Numerous safety functions assist in implementing the safety concept of the entire test bench facility. The use of exclusively industrial-strength components assures high availability and allows fail-safe operation worldwide on numerous test benches from ATESTEO and its customers.



## **GSE 4.0 Highline — the highly dynamic gear shifting robot**

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. The ATESTEO shifting robot GSE 4.0 Highline supports the entire spectrum of gear shifting.

The gear shifting unit GSE 4.0 Highline from ATESTEO is a highly dynamic shifting robot for use on drivetrain and transmission test benches. Its high-frequency control of force, position, and speed enables fully automatic and realistic shifting of all types of vehicle transmissions.



## **GSE 4.0 Function — the highly functional shifting robot**

The gear shifting robot GSE 4.0 Function is an affordable, flexible, and durable shifting actuator for use on drivetrain and transmission test benches. Its high-frequency control of position and speed enables the fully automatic shifting of vehicle transmissions with shifter/selector cables.



# GSE 4.0 Highline shifting robot

The GSE 4.0 Highline 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.



## GSE 4.0 Highline-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 EtherCAT slave interface, and other interfaces for the higher-level automation.



## Human-like shifting behaviour

Experience from analysing human behaviour when shifting gears with the ATESTEO GSA system was the basis for developing gear shifting patterns of the force-controlled GSE 4.0 Highline. The highly dynamic simultaneous control of force and speed during the shifting event enables the simulation of how human drivers change gears.





## GSE 4.0 Function shifting robot

The GSE 4.0 Function actuator consists of two linear motion units driven by servomotors for the shifter and selector direction. Speed and position values are acquired by absolute encoders integrated into the servomotors. The shifting forces can optionally be determined by load cells integrated into the ends of the linear motion units. With the aid of adapters, the original cables can be attached to the actuator. An automatic learning process, which lasts only a few minutes, concludes the logical integration of the test specimen.



### Automated learning process

The automated learning process of the GSE 4.0 Function actuator seeks all available gear shift positions. The shift gates and interlocks (reverse) are automatically recognised. The zero-force end positions of the gears are automatically determined by the control software. After the learning process has finished, the user can make corrections to the gear positions if needed and connect the gear positions to each other by foot point (routing). Further, the optional extension set "mechanical force decoupling," with its mechanical play, can create disengagement between the actuator and the shifting system of the transmission. After a gear has been engaged, even strong vibrations or movements of the test specimen and underdeveloped inner shifting systems do not prevent a gear end position without load at the shift forks.

### Electronics of the GSE 4.0 Function

Components such as servo amplifiers to control the motors and hardware necessary for signal acquisition are part of the system electronics. The electronics are integrated into the robot. Routing wires and cables is therefore reduced to a minimum.



# Equipment

## GSE 4.0 Controller

The GSE 4.0 Controller is an industrial computer in 19-inch format. The GSE 4.0 control software, which runs on a real-time operating system, controls the gear shifting process using the EtherCAT master interface, simultaneously controlling forces (Highline model only), position, and speeds. The system communicates via CAN interface with the higher-level automation and communicates via a network interface with the GSE 4.0 App.



## GSE 4.0 Tablet

The industry-strength GSE 4.0 Tablet is designed for use in rough environments. 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. It is also used to set up the gear positions.



## GSE 4.0 App

The intuitive user interface of GSE 4.0 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 GSE 4.0 App can additionally be executed on a connected Windows® PC.



Get an insight into how our actuators work in our video at: [atesteo.com/en/testing-equipment/actuators/](https://atesteo.com/en/testing-equipment/actuators/)

# Characteristics

Group	Characteristic	GSE 4.0 Highline	GSE 4.0 Function
Software	Synchronous force control	Closed loop control (force sensor)	Open loop control (motor current)
	Speed control	Yes	Yes
	Position control	Yes	Yes
	Human shift behavior	Yes	No
	Automated learning	No	Yes
	Number of positions (waypoints, gear positions)	64	64
	Number of parameter sets	10	10
	Post-process shift quality analysis	Optional	No
Electronics and mechanics	Force measurement	Yes	Optional
	Travel measurement	Yes	Yes
	Force decoupling	Yes (by lifting the gripper)	Optional (for shift cable)
	Height adjustment	Yes	No
	Digital outputs	Optional	Optional
	Power supply	230 VAC	230 VAC
	Mechanical interface	Shift knob	Shift/Select cables
Specifications	Shifting force (max.) (Peak load / Continuous duty)	500/300 N	2,000 / 750 N
	Selecting force (max.) (Peak load / Continuous duty)	500/300 N	2,000 / 750 N
	Shifting travel	280 mm	200 mm
	Selecting travel	320 mm	200 mm
	Z-axis travel	70 mm	No
	Shifting speed (max)	1,200 mm/s	1,200 mm/s
	Position accuracy	0.1 mm	0.1 mm
Interfaces for automation	CAN	Yes	Yes
	EtherCAT	Optional	Optional
	Analogue	Optional	No
Safety	Emergency off	Yes	Yes
	Safe torque off (STO)	Yes	Yes



Excellence in drivetrain testing

**Would you like to learn more about our products, solutions, and services in the areas of measurement systems, vehicle applications, and actuators? Just call us at +49 2404 9870-570 or send us an email to [equipment@atesteo.com](mailto:equipment@atesteo.com). Your personal ATESTEO contact will be pleased to assist you.**

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