TOYO Corp.Group

ROTOTEST Energy 4WD Series
Low Inertia Hub-mounted VIL Dynamometer
DATASHEET

INTRODUCTION
The ROTOTEST® Energy is hub-mounted vehicle-in-the-loop (VIL) dynamometer is a four-quadrant system that connects to each drive wheel hub. Its features include loss-free torque transducers, high-resolution speed sensors, and fast direct-coupling to vehicle wheel hubs. Used in various applications, from replicating dynamic road maneuvers to advanced driver-assistance system (ADAS) testing, it offers models for different power and torque requirements. With time-saving features like integrated vehicle models and quick setups, it streamlines development tasks and adapts easily to facility upgrades or relocations.

A low inertia hub-mounted steering dynamometer system such as the ROTOTEST Energy 4WD provides accurate, dynamic measurements with minimal inertia effects makes it invaluable for enhancing vehicle performance and safety. This dynamometer system supports detailed analysis and optimization of the steering system, suspension, and overall vehicle dynamics, playing a vital role in the development of modern, high-performance cars, mid-size SUVs and light duty trucks. It integrates with IPG CarMaker®, a leading car simulation solution.

Rototest Energy 4WD with Natural Steering Capability

DESCRIPTION
The turn-key system comes with four dynamometer units, drives, main power supply cabinet (MPU), control cabinet (SCU) with UPS, operator PC, and real-time controller, excluding electrical installation cabling. It offers outstanding performance-to-price value, integrating cutting-edge industrial electrical and control equipment from Rototest's partner, ABB. Engineered for durability and low maintenance, the system operates with ROTOTEST DynoVision™ for intuitive control and ROTOTEST Datmon™ for versatile measurement and reporting. Data is displayed in real-time, including analog and digital values and sweep charts.

Steering can be conducted while driving -- a feature we called ***Natural Steering*** (Steering force feedback). For applications where a natural steering feeling with realistic steering forces are desired, the dynamometer units can be equipped with an optional electrical servo system. This system provides an unprecedented natural steering motion on the vehicle's wheels as well as its steering wheel and this without any modification of, or connection to, the test vehicle. Typical applications include automated driving such as Parking Assistance and ADAS Lane Keep Assist (LKA). The system is as standard supplied with a generic steering model but can be extended to allow higher model fidelity or even external control such as from external real time systems or hardware-in-the-loop simulations (HiLs).

KEY ADVANTAGES AND BENEFITS
LOW INERTIA DESIGN:
1. Minimized Rotational Mass: The dynamometer is engineered with reduced rotational mass to closely replicate real-world driving conditions without adding significant inertia to the vehicle's wheels
2. High-Frequency Response: The low inertia allows the device to accurately measure rapid changes in forces and moments, essential for dynamic testing scenarios

MEASUREMENT CAPABILITIES:
1. Forces and Moments: It measures forces in multiple directions (vertical, lateral, longitudinal) and moments (torques) acting on the wheel hubs
2. Precision Sensors: Utilizes high-precision sensors, such as strain gauges or piezoelectric sensors, to capture detailed data

APPLICATIONS INTEGRATED WITH IPG CARMAKER:
1. Vehicle Dynamics Testing: Used to assess and enhance vehicle handling, stability, and responsiveness
2. Steering System Development: Provides critical data for designing and optimizing steering systems, ensuring precise control and feedback
3. Suspension Analysis: Helps in evaluating and improving suspension systems for better ride comfort and performance
4. Tire Performance Testing: Assists in understanding tire behavior under dynamic loading conditions, aiding in tire design and optimization

INTEGRATION AND COMPATIBILITY:
1. Testing Setups: Can be integrated into various testing environments, including laboratory setups, proving grounds, and on-road testing
2. Data Acquisition Systems: Compatible with advanced data acquisition systems for real-time data collection and subsequent analysis

BENEFITS:
1. **Enhanced Accuracy:** The low inertia design minimizes the impact of additional forces on the measurement results, leading to more accurate and reliable data
2. **Improved Realism:** Accurately simulates real-world driving conditions by minimizing the additional inertia effects
3. **Dynamic Testing:** Suitable for capturing high-frequency changes in forces and moments, making it ideal for dynamic testing applications

USE CASES AND IMPORTANCE
- **Research and Development:** An essential tool for automotive R&D, providing engineers with precise data to improve vehicle performance, safety, and comfort
- **Performance Tuning:** Helps in fine-tuning vehicle dynamics for better handling and stability
- **Safety Testing:** Contributes to the development of safer vehicles by providing detailed insights into the behavior of the steering and suspension systems under various conditions

CHARACTERISTICS
- High torque capacity for high dynamic load simulations
- Power capacity to handle high performance vehicles at full load
- Symmetrical configuration for equal capacity on both axles

STANDARD FEATURES
MEASUREMENTS:
- True Measurement Technology™
- Direct Torque Measurement™
- Dead Weight Calibration
- Front end Torque Transducer
- ROTOTEST Absolute Torque™
- High-Definition Speed™, HDS Power capacity to handle high performance vehicles at full load

TEST VEHICLE COOLING:
- Integrated Head Wind™ (optional)

ELECTRICAL SYSTEM:
- Complete Regenerative Drive
- ABB Direct Torque Control, DTC
- LCL Line Filter
- Individual AC Drive
- EMC filter (2nd env. Cat C3 / (optional 1st env. Cat C2))

DYNAMOMETER MOUNTING:
- Perfect Dynamometer Connection™
- Advanced Dynamometer Suspension™
- Adjustable Pivot Centre™

SYSTEM CONTROLS:
- Dynamometer controller (ROTOTEST HDC - High Dynamic Controller)
- Natural Torque Distribution™, NTD (Basic)

PORTABILITY:
- All units wheel supported

FUNCTIONAL DESIGN:
- Negligible Parasitic Losses™
- Low Inertia
- Tyre Safe™

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SPECIFICATIONS

Maximum System Performance (at 20° C)			
	Power (Maximum Absorbed/Generated)	2WD	800 kW / 1072 bhp (momentary)
			540 kW / 734 bhp (continuous)
		4WD (50/50 split)	800 kW / 1072 bhp (momentary)
			800 kW / 1072 bhp (continuous)
	Torque (Maximum Absorbed/Generated at Hubs)	2WD	10000 Nm / 7376 lb-ft (momentary)
			4000 Nm / 2950 lb-ft (continuous)
		4WD (50/50 split)	20000 Nm / 14751 lb-ft (momentary)
			8000 Nm / 5901 lb-ft (continuous)
	Speed (Maximum Hub Speed)	2WD & 4WD	2700 rpm
	Vehicle Speed (Equivalent, Wheel dia 650 mm). *Note: may be limited by continuous power*	2WD & 4WD	330+ km/h / 205+ mph
	Measuring Accuracy	Torque Accuracy Class	Better than 0.1 (std) / 0.05 (opt)
		Speed Uncertainty	Less than 0.025%
		Measurement repeatability	Better than 0.05%
	Maximum Load	3,500 kg per Axle	

NATURAL STEERING SPECIFICATIONS

Performance			
		Wheel Hub	Steering wheel. *Note: with 14:1 ratio)*
	Steering Angle Range	Up to +/- 45 deg	Up to +/- 630 deg
	Steering Angle Acceleration	Up to +/- 40 deg/s2	Up to+/- 560 deg/s2
	Steering Angle Speed	Up to +/- 22 deg/s	Up to 308 deg/s
	General	Housing	RITT AL steel enclosure RAL 7035
		Electrical power supply	3-phase+PE 400/460 VAC, 50/60Hz, 15A max

SYSTEM DETAILS

Main Parts		
	Dynamometer Units	2 axles of Energy
	System Central Unit	1 of SCU4E with Uninterruptible Power Supply (UPS)
	Main Power Unit	1 of MPU4-___ with Drives, Converters and main supply connectors
	Standard Accessories Kit	▪ Operators PC, monitor & keyboard ▪ Electrical cables (excluding power supply) ▪ Torque rod for calibration ▪ Wheel Adapters, 4 studs ▪ Wheel bolts M12x1.5 bolts ▪ User and service manual (English)
ROTOTEST DynoVision Test Modules		
	Constant Speed	includes: DynoVision Test Module that controls speed to a pre-set value independent of load
	Road Load Simulation	includes: DynoVision Test Module that Simulates on-road conditions, considering vehicle inertia (mass) and resistance caused by aerodynamic drag, tyre rolling resistance and road gradient
ROTOTEST DynoVision Report Modules		
	Calibration Report	includes: DynoVison Report Module that Documents all details relating to calibrating procedure

TEST CELL (SITE) REQUIREMENTS

General		
	Installation Type	Above-ground, dynamometer units completely on-wheels, manoeuvrable by a single person
	Electrical Power supply	
	Control System (SCU)	single, 1 phase, 240 VAC (8A) or 120 VAC (16A)
	AC Drives/Motors	one, 3-phase+PE, 380-500 VAC, 50/60Hz, 1x 950 kVA
	Additional Cooling	Active cooling (regenerative / air-cooled)
	Maximum Axle Load	3,500 kg
Operating Environment		
	Ambient Temperature Range	+15° C to +40° C
	Relative Humidity	10% to 90%, non-condensing
	Altitude	< 1000 m above sea level. *Note: Higher altitude is possible but may degrade continuous performance under certain conditions*

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