



Driving Automotive Testing Excellence Around The World

360 Degrees of Testing Coverage

TOYO Automotive Test Solutions . . .



PowerTrain Testing



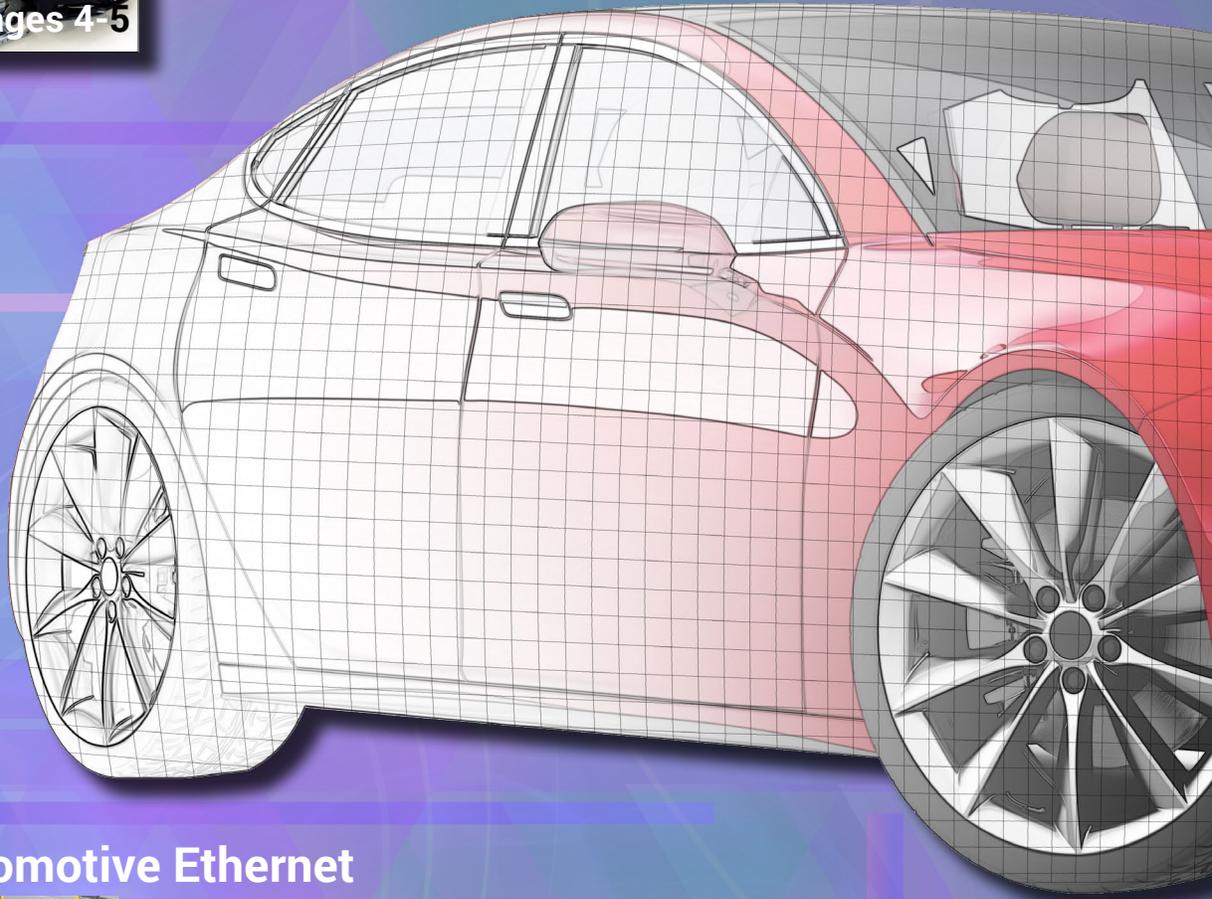
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Driving/Road Simulator



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Automotive Ethernet



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ADAS Testing & Validation



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Automotive Cybersecurity



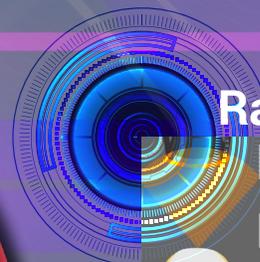
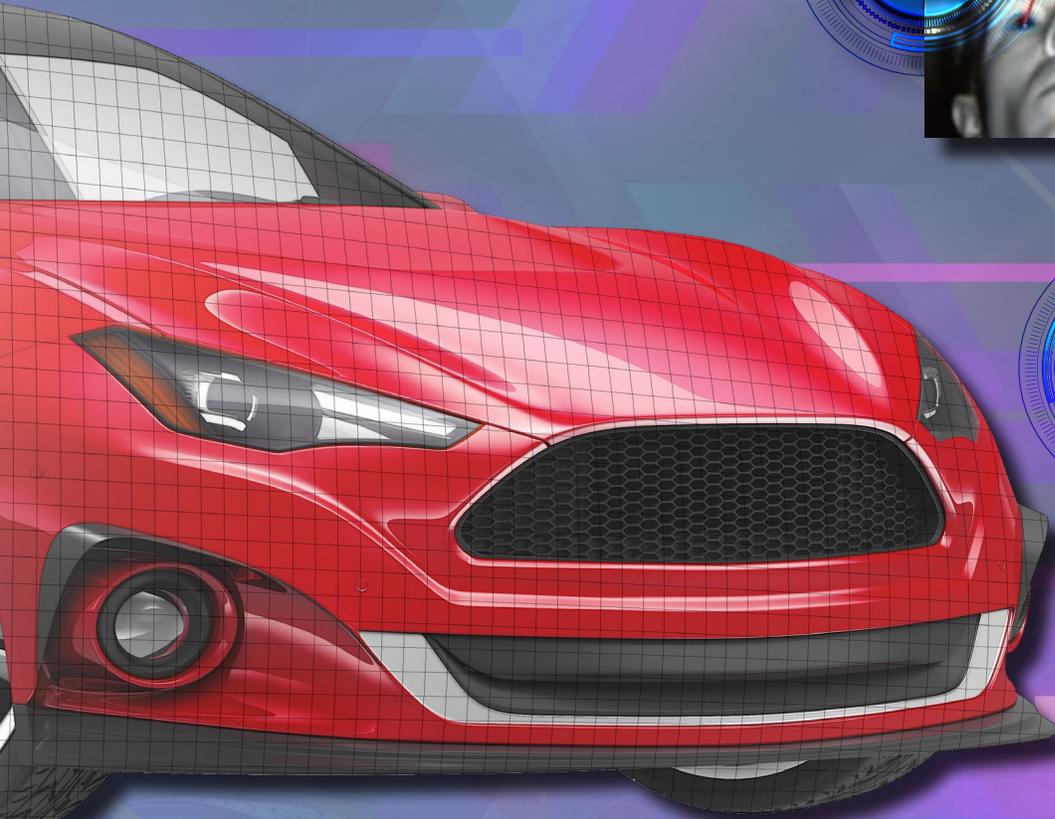
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Driving/Monitoring Systems



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Radar Processing



queue assistance
active cruise control

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EMC | OTA



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ROTOTEST CHASSIS DYNAMOMETERS

New Paradigm for “Road Load Simulation Testing”

MINIMUM INFRASTRUCTURE REQUIREMENTS

Compared with conventional roller-type chassis dynamometers (CDM), the ROTOTEST Energy system (*figure 2a*) does not require a large facility such as an underground pit. With a level floor plan (e.g. garage) and power (@400V, 3 phase) being the main requirements, a full battery of tests can be carried out. This dramatically lowers cost and provides flexibility. Please note that additional equipment may be needed to support the ROTOTEST test environment. This includes (but not limited to) cooling and exhaust infrastructure.

 [Chassis Dynamometer Set Up](#)

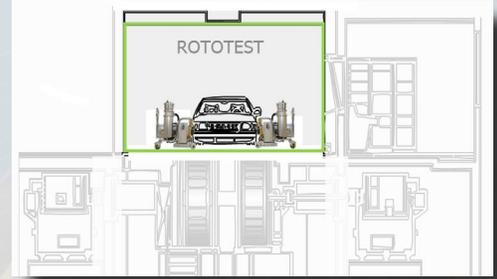
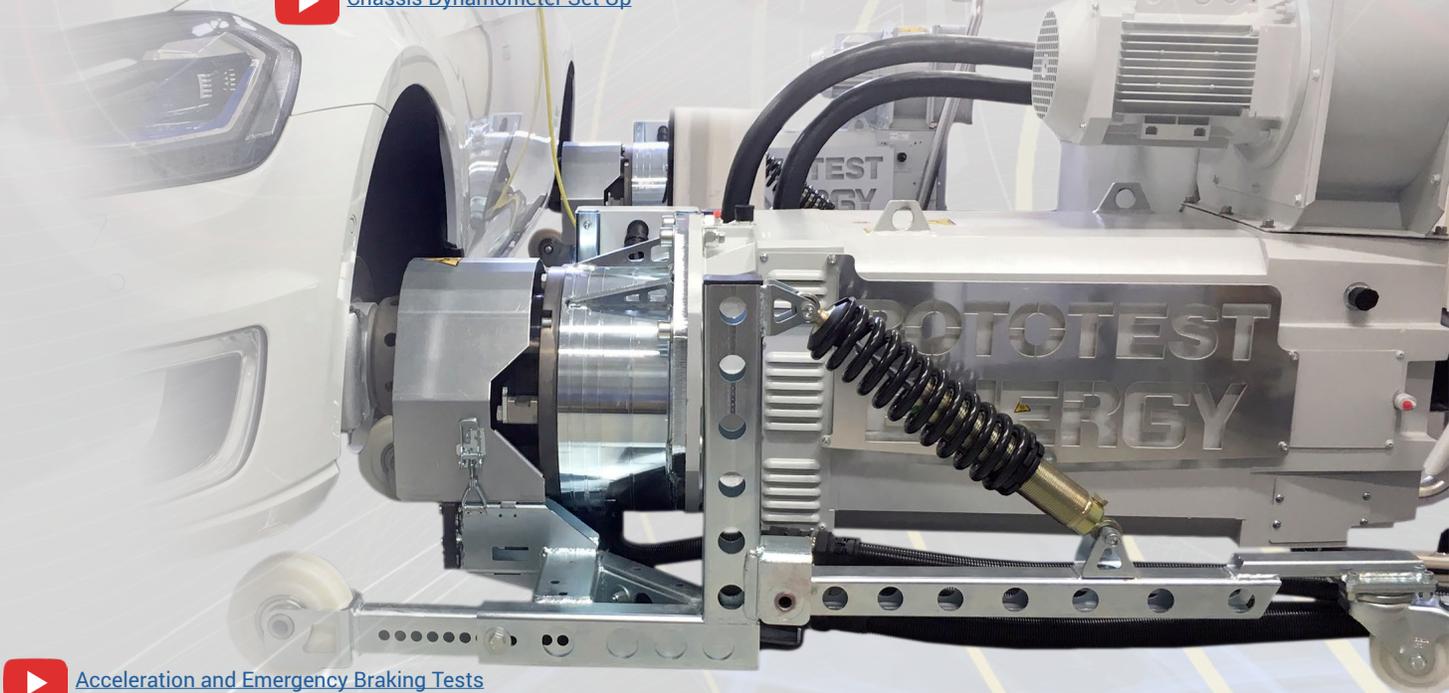


Figure 2a: Does Not Require Large Facility



 [Acceleration and Emergency Braking Tests](#)

PERFORM AND VALIDATE EPA CERTIFICATION REQUIREMENTS

Rototest Dynamometers support EPA driving cycles such as FTP and US06. And the requirements for tolerances and response. Furthermore, the solution can be used for certification testing according to Federal Regulation 40 CFR Part 86 Section 86.108.

STEERING OPERATION CAPABILITY

Due to its unique structure, ROTOTEST Energy provides a bench test with steering operations. This is something not typically achievable with conventional CDM. The steering angle can be rotated to +/- 20 degrees (*see figure 3b*). You can simulate driving situations including steering operation, evaluate for ADAS, autonomous car, etc.

MEASUREMENT SYSTEM WITH HIGH ACCURACY AND REPEATABILITY

When it comes to conventional roller-type chassis dynamometers, measuring torque directly in the hub position brings many advantages including high accuracy and constant repeatability. With no interference from the automobile's tires, this system achieves high repeatability, which is important for performing benchmark testing. In addition, this unit can be automatically tilted in order to adjust the torque measurement line.

SUPPORT FOR ELECTRIC AND HYBRID VEHICLES

In addition to supporting automobiles with gas combustible engine, Rototest dynamometers also support newer electric and hybride vehicles.

 [ROTOTEST Energy - WOT Tesla Model S](#)

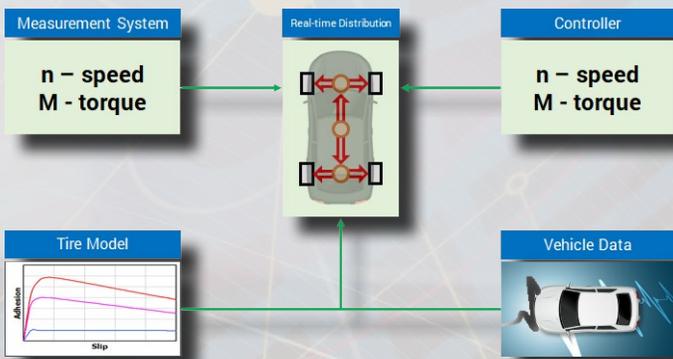


Figure 3a: Real-time Torque Distribution



ROTOTEST Standard Model

500 KW - 250 KW MODEL FOR ROAD LOAD SIMULATION

ROTOTEST Energy 500-250 4WD consists of each 500 kW, 250 kW dynamometer axle. It can be used for 4WD and 2WD. Because of its repeatability, accurate results can be obtained from the benchmark test. Several power models are available depending on your specified requirements.

ROTOTEST Climate Model



BUILT-IN CLIMATE PROTECTION (CP) MODEL (-31° TO 105° F; -35° TO 40° C)

This model has an expanded operational temperature range of -31° to 105° Fahrenheit (-35° to 40° Celsius). This system can be used in a climate chamber. The EV performance can be used in very low temperature environments to evaluate how such vehicles respond in such conditions.

ROTOTEST NVH Model



LOW NOISE MODEL FOR NOISE AND VIBRATION TEST

ROTOTEST Energy NVH can be customized by removing blowers for cooling and covered with sound insulation boxes. The model can also be installed in semi-anechoic chambers.

MODULE FOR VARIOUS TEST REQUIREMENTS

By utilizing a state of the art 4Q control system and the ROTOTEST Active Inertia technology, the vehicle's inertia can be simulated electronically to replicate true road conditions. In addition to being able to simulate different types of driving patterns, each tire can be modeled using a "magic formula" (see figure 3a).

- Constant torque, constant speed
- Sweep
- Road load simulation
- Individual torque control, etc.

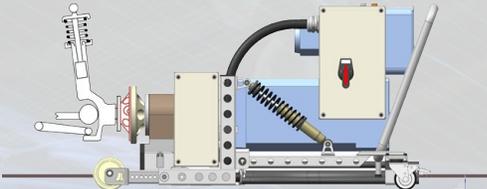


Figure 3b: Structure of Direct Hub Coupling

NOISE & VIBRATION TEST

Even very low noise levels can negatively impact NVH measurements. Compared with traditional roller type dynamometers, there is next to no tire noise generated by the ROTOTEST units.

THE REAL VIDEO DRIVE PLAYER

Powerful and Unique Driving (ROAD) Simulator

In partnership with Iwane, TOYO Corporation engineered the Real Video Drive Player (RVDP), a powerful and unique driving simulator (see figure 6a). It is one of the few professional simulators that incorporates and uses actual road videos (that you pre-record ahead of time) (figure 6b) providing a simulation experience that comes very close to actually driving on a real road except it all takes place inside a lab (see figure 6c).



Figure 6a: the Real Video Drive Player Simulator in Use

The RVDP has many important capabilities. One key feature is the roving viewpoint. You only need to record a video just once but it is possible to simulate lane changes, turns, height positions and seat positions and have those changes automatically adjusted for. Up to 360 degrees of simulation environment is available on demand.



Figure 6b: 360 degree Camera to Shoot Road Videos

The RVDP helps reduce the cost and delays associated with automobile development.



Figure 6c: Real Road Test in a Simulated LAB Environment

SIMULATED DRIVING USING ACTUAL PRE-RECORDED VIDEOS OF REAL ROADS AND HIGHWAYS

- Invokes the feeling of real driving
- Provides linked vehicle speed
- Offers linked steering
- Perform lane changes

RECORD THE ROADWAY JUST ONCE

- One time for one way (but depends on road width)
- Incorporates anti-shake technology
- Linked GNSS feature

CHANGEABLE VIEW POINT

- Simulate driver seat location - left or right
- Simulate height position (sport car (low) - truck (high))

VARIOUS CUSTOMIZATION OPTIONS

- Up to 360 degree view
- Monitor size adjustments

PROFESSIONAL RECORDING SERVICE

- We can help record videos on just about any requested course
- Support the recording of vehicle data and video



SMART EYE SOLUTION Driver Monitoring System (DMS)

The TOYO Smart Eye's Driver Monitoring System (DMS) solution offers eye tracking software for integration in passenger cars and other vehicles to facilitate better safety and other functions that improve the user experience. It is the next generation of eye tracking technology.

Today, a large number car manufacturers have included the technology into their automobiles. Smart Eye is the market leader within the Automotive industry, paving the way for high performance reliability, precision, optimized costs and availability.

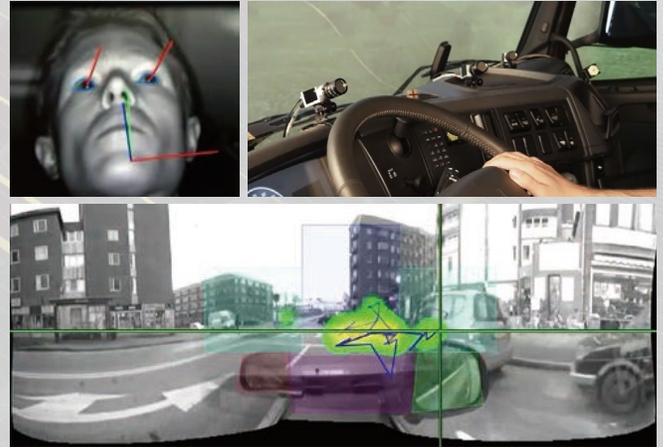
Our new cameras can assist in gathering even more insightful data from tracking a subject's eyes. Smart Eye Pro dx cameras have a more compact size, smaller footprint, and are lighter weight. These features grant the new cameras access to even more locations while being less intrusive to your research process.

The DMS helps understand the behavior characteristics of drivers. It helps answer such questions as what is the driver looking at and how do they respond; what is the driver impact for new automobile features.



Smart Eye provides the following features:

- Exceptional robustness and data availability
- Features the smallest form factor and fits anywhere
- Enhanced resolution
- Larger headbox ensures the best in the industry data availability
- Reduced setup and configuration time by letting the camera determine the correct exposure (new autoexposure feature)
- Ability to measure direction of eye gaze (angel, vector), head position and angle, pupil diameter, and much more



AEM PORTABLE VECTOR ANALYZER WITH PORT DENSITY Single-pair Ethernet Automotive Cabling Testing with AEM

TOYO offers automotive designers a cost-effective Automotive Ethernet Test Compact and portable analyzer designed to meet the requirements of characterizing balanced DUTs in an accurate, simple, and cost-effect way.

Measurements of multi-port and single-port DUTs; coax and balanced twisted-pair cables, cabling links and assemblies are standard features (see right side).

The analyzer also Adheres to Open Alliance, BroadR-Reach, 802.3bw, 802.3bp and 802.3ch (draft) for the following s-parameter tests:

- Link segments and components; cables, connectors, and wire harnesses
- Open Alliance VNA Reference Measurements
- Equipment connector interfaces (ECU, MDI)
- Transmitter's and receiver's AEM-Test

High data rates and reliable communication are essential for the automotive communications channels with increasing use of artificial intelligence.

Automotive manufacturers are rapidly adopting Single-pair Ethernet (SPE) for in-vehicle communications. Standardization bodies like IEEE and OPEN Alliance have made great progress in defining specifications and test procedures for single pair Ethernet cabling systems for automotive use.



TOYO's MMVNA performs mixed-mode S-parameter testing in single-ended or dual-ended configuration. The easy to customize Linux based programming interface, and configurable measurement parameters make MMVNA an ideal tool for automotive cabling test.

Advanced Driver Assistance Systems are automated systems, which increase safety features for avoiding collisions. With real-time measurement of parameters from up to three vehicles and at better than 2 cm positional accuracy, the DualCar allows manufacturers to easily verify the effectiveness of their ADAS.

Data from two or more vehicles provides very accurate position and distance information relative to each other and/or fixed object, which is the basis for an ADAS test system. A standard Wi-Fi access point is used to send data, so that a wide area can be covered.

Due to the video module the measured parameters can be graphically overlaid in real-time onto the recorded video, providing a clear visual reference to the performance of the test.

The CAN module allow to read CAN messages and transmits measured parameters on the bus.

KEY FEATURES

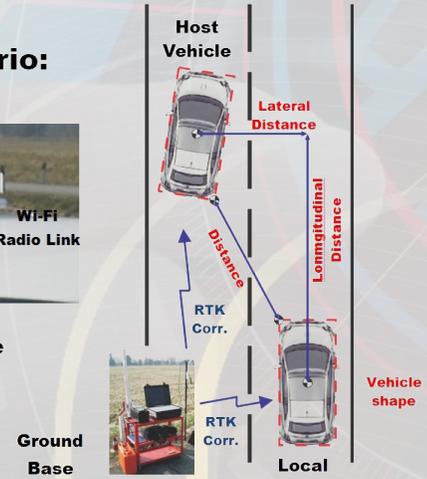
- All ADAS test can be done using the same hardware
- Real-time calculation of relative distance, speed, acceleration, time to collision, etc.
- Due to RTK (RealTime Kinematic) features for GPS receiver the DualCar provides a better than 2cm position accuracy
- The moving base features allows to test ADAS applications on the open road providing a 2cm position accuracy on relative distance between vehicles and obstacle
- CAN bus, analog input and acquired video synchronization
- Online data transfer, real-time data exchange from target vehicle to VUT and vice-versa
- Ready to be integrated with NaviControl autonomous driving system
- Expandability and modularity

Vehicle-to-Vehicle Measurements

Typical real scenario:



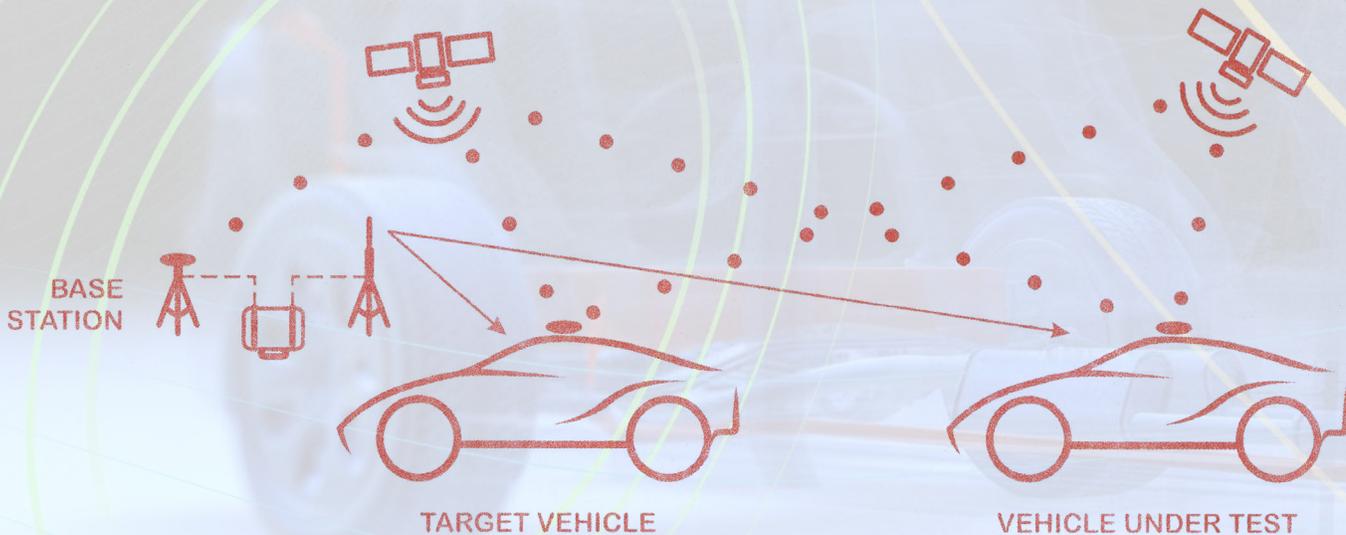
On the roof vehicle installation



DUALCAR: A FLEXIBLE SYSTEM FOR MANY TESTS

ADAS TESTING: Every modern vehicle is equipped with advanced driver assistance systems (ADAS). One of the challenges of ADAS testing is to precisely measure relative position and velocity from car to car when testing longitudinal control systems and to track the car in the testing of lateral control systems.

VEHICLE 2 VEHICLE MEASUREMENT: At the core of the DualCar system is the GNSS receiver IMU aided, connected via radio telemetry to an RTK Base Station, or to another DualCar system acting as a 'moving base'. DualCar measurement chain allow NCAP confirmation tests.



ASGARD1 Automated Signature Generator for Automotive Radar Verification

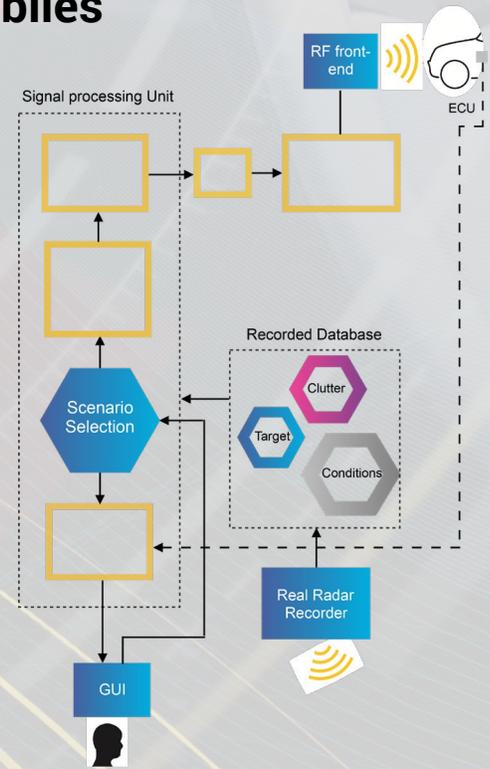
Radar Signal Processing for Automobiles

ASGARD1 is a unique radar test and verification solution which provides in-lab facility to evaluate radar sensors, driver assistance systems and autonomous driving for their performance, availability and reliability. A block diagram how ASGARD1 works is shown on the top right. Key features include:

- Test solution based on real hardware vehicle in the loop (HIL/VIL) setup
- Reproducible test scenarios and access to ground truth
- Specification of test scenarios through a GUI
- Pre-recorded data base including signatures of thousands of radar targets and scenarios for automotive testing
- Combining multiple of existing scenarios for creation of new test scenarios
- Verification of multi-beam automotive radars
- 24 GHz or 77 GHz RF front-end including a sub-system for obtaining radar signal parameters and antenna beam information.

The applications for ASGARD1 in the automobile vertical is nearly unlimited. Here are but just a few of them.

- **Verifying Safety Standards:** AEB (EuroNCAP), ACC (ISO 15622), FCW (ISO 15623), Collision mitigation system (ISO 22839)
- **R&D:** data generation for training of DNNs in automotive applications; micro-motion signature generation for target identification applications
- **End-Of-Line Testing:** evaluation of radar-based automotive safety functions in separate packages; validation of radar sensors; verification of autonomous vehicles
- **Calibration System:** adjustment of sensor alignment
- **Individual Test Suites:** test scenarios for algorithm development for ADAS (Advanced Driver Assistance Systems) and AD (Autonomous Driving)



SYNESIS Cyber Security Appliance

Detect Security Threats in Connected Cars

Just as you take steps to protect your corporate data center and networks from cyber threats, you should do the same for connected automobiles that rely on Ethernet.

SYNESIS is a cyber security analyzer and recorder that continuously capture network traffic. SYNESIS, being an all-in-one packet capture system, is easily deployed in data centers, remote site branches, and test labs as a physical appliance. Configuration is minimal so it can be installed and capturing high speed traffic in minutes.

Existing network tools just can't keep up with today's traffic rates caused by increased user demand for bandwidth intensive applications and evolving standards. The result oversubscription of tools which leads to misdiagnosis. Only SYNESIS is able to capture and analyze all network packet data completely and at high granularity.

In an automotive R&D environment, SYNESIS can be used in the development of connected cars. SYNESIS is available in a number of form-factors and configuration and can be tailored designed for your individual environment.



AUTOMOTIVE EMC TESTING SOLUTIONS

EMC Testing Systems for Automobiles

TOYO develops original EMC measurement software for vehicles and vehicle components. Our EMC test system for vehicles and vehicle components allow you to perform all the measurements required for this application, ranging from pre-compliance to full compliance tests.

EMI TEST SYSTEM

The system is used for testing the electromagnetic radiation disturbance emitted from the GH automobile with test frequency rang of 150KHZ-18(40GHz) and automobile components, receiving signals by arranging antenna into the EMC chamber and then performing the test by an EMI receiver. The corresponding standards are:

- CISPR 12 2007 (ED6)
- CISPR 25 2016 (ED4)
- ECE R.10
- AEMCLAP (Automotive EMC Laboratory Recognition Program)
- Common Standards Used by Automobile Manufactures (TOYOTA: TSC, NISSAN: NDS, FORD: ES-XW7T-1A278-AC, EMC_CS_2009, GM: GMW3097,D.C: DC-11224, BMW: GS 95002 etc.)

EMS TEST SYSTEM

The system is used for performing radiated immunity test for automobile and automobile components in a frequency range of 10KHZ-18GHz. In accordance with the following regulations and standards, a 100V/m field strength is generated with the test distance below 2m. The corresponding standards are:

- ISO 11452-1, ISO11452-2
- ECE R.10
- AEMCLAP (Automotive EMC Laboratory Recognition Program)
- Common Standards Used by Automobile Manufactures (TOYOTA: TSC, NISSAN: NDS, FORD: ES-XW7T-1A278-AC, EMC_CS_2009, GM: GMW3097, D.C: DC-11224, BMW: GS 95002 etc.)

OTHER IMMUNITY TEST SYSTEM

There are a variety of tests for the vehicles and vehicle components. We propose a system with the needs of our customers. We also propose a system for electric vehicles, hybrid vehicles corresponding standard.

For Vehicles Test

ISO11451-3 Portable radio, near electromagnetic field immunity test
 ISO11451-4 BCI test
 ISO10605 ESD test

For Vehicle Components Test

ISO11452-3 TEM CELL test
 ISO11452-4 BCI test
 ISO11452-5 Stripline test
 ISO11452-7 DPI (direct injection) test
 ISO11452-8 Magnetic field immunity test
 ISO11452-9 Portable radio, near electromagnetic field immunity test
 ISO11452-10 Audio band conduction immunity test
 ISO11452-11 Reverberation chamber test
 ISO7637-2,3 Transient surge power fluctuation test
 ISO10605 ESD test

EP9/VE: Emission measurement software
 2004/104/EC Emission measurement
 95/54/EC Emission measurement
 CISPR12, 25 Emission measurement
 SAE J551/1113 Emission measurement
 JASO Emission measurement
 Vehicle manufacturers' internal standards



VI5/RS : Immunity Test Software

- 2004/104/EC Radiated immunity
- 95/54/EC Radiated immunity
- SAE J551/1113 Radiated immunity
- JASO Radiated immunity
- ISO 11451/2 Radiated immunity
- Vehicle manufacturers' internal standards (e.g. GM, FORD, D.C.)

M5/CS : BCI Immunity Test Software

- 2004/104/EC BCI immunity
- 95/54/EC BCI immunity
- SAE BCI immunity
- JASO BCI immunity
- ISO 11451/2BCI, DRFI
- Vehicle manufacturers' internal standards (e.g. GM, FORD, D.C.)

AUTOMOTIVE TEST SOFTWARE

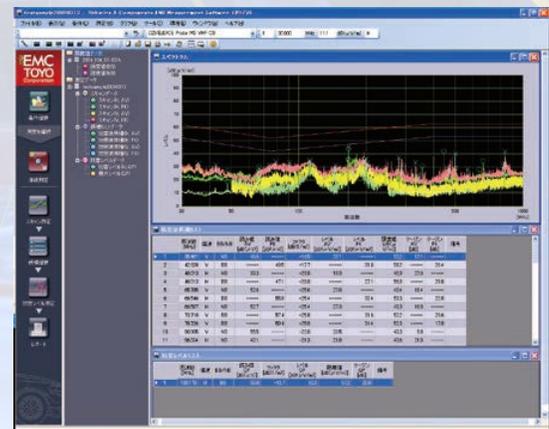
Throughout the world, more than 650 TOYO systems are in use. Supporting a wide range of needs, from design improvement to final qualification test, TOYO continues as the world's first choice in integrated EMC test systems and software.

EP9/VE Type: EMI Test Software for Automobile and Automobile Parts.

Corresponding Standards:
 CISPR12, Ed .6
 CISPR25, Ed.3

V15/RS Type: Radiated Immunity Test Software of Automobile

IM5/CS Type: Immunity Test Software



OTA (OVER THE AIR)

Mobile phones are very popular in China, Japan and South Korea, so the trend for processing radio-frequency performance test of mobile phones is increasingly strengthened. Accordingly, the Cellular Telecommunications Industry Association (CTIA) has clearly defined the test method of OTA radio-frequency performance in the test planning file. Such file defines the test method of mobile phones, the requirement of test environment as well as the evaluation method based on Equivalent Isotropic Radiated Power (EIRP) and Equivalent Isotropic Sensibility (EIS).

Such file further comprise a method for testing the transmission power and the receiving power of FOMA(Freedom Of Mobile Multimedia Access) specified by NTT DoCoMo, therefore the file is suitable for the test of input and power input (EIRP/EIS measurement) (measuring report).

Compatible Wireless Device Instrument

E5515 C (Agilent Company)

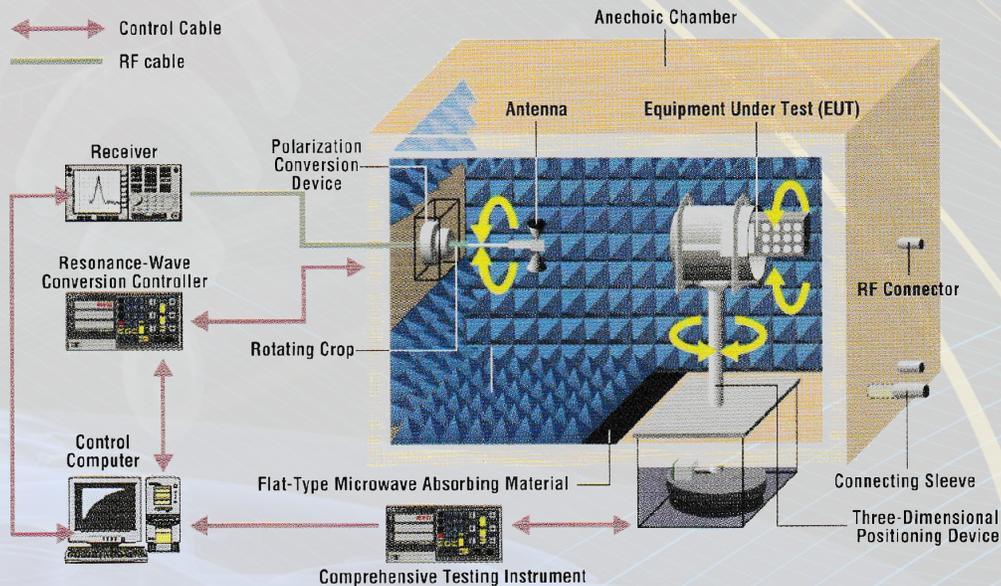
Relative wireless communication modes: W-CDMA, HSDPA, CDMA200a, 1xEV-DO, IS-95, GSM, GPRS, EGPRS, TIA/EIA-36, AMPS mobile phone tester

MTB820A (Anritsu Company)

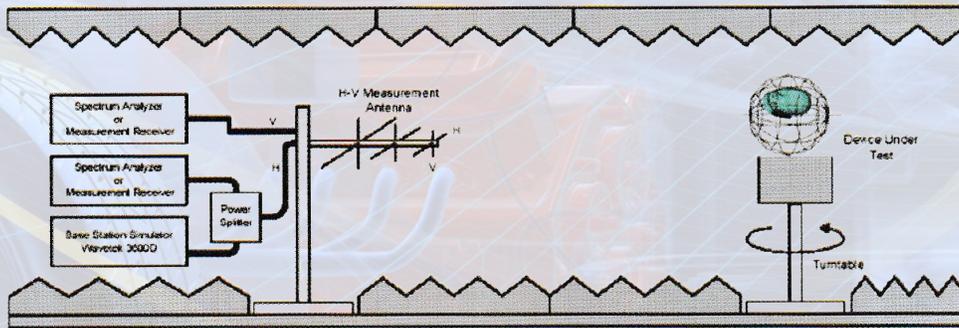
Relative wireless communication modes: W-CDMA/HSDPA, GSM/GPRS/EGPRS, cdma2000-1x(IS-2000), CDMA20001xEV-DO, PDC and PHS/Strengthened PHS mobile terminal

SYSTEM CONFIGURATIONS OF EIRP EIS (MEASURING REPORT), EIRP TEST (CTIA) AND EIS TEST (CTIA)

When processing EIRP measuring (CTIA) and EIRP/EIS measuring (measuring report), the antenna direction drawing can be measured by the methods of setting the azimuth axis as the stepping axis and setting the roll axis as the scan axis. Sometimes, the azimuth axis is also set as the scan axis. At this time, the transmitting power of mobile phone must be set to the maximum value. As for EIS measuring (CTIA), the Output level of measuring instrument of wireless device must be adjusted; exactly, the azimuth axis and the stepping axis must be retained at specified positions so that the bit error ratio of such position can be measured. While using the external attenuator, the level of which must be adjusted as the output level for the measuring instrument of wireless device. Except the wireless tester which uses the succedaneum of receiver, the configuration device and the antenna direction diagram share the same test system. The wireless device tester is taken as the mobile phone of base-station simulator via connection for measuring the transmitting power and bit error ratio of mobile phone. In general, the receiver (spectrum analyzer/network analyzer) can be also used for measuring the transmitting power of wireless phone by connecting with the wireless device tester of mobile phone.



System Configuration Diagram for EIRP Measuring (CTIA) Report, EIS Measuring (CTIA) Report and EIRP/EIS Measuring Report



Free Space (Quoted from CTIA Certification Program Test Plan for Mobile Station Over the Air Performance)

TOYO Corporation

Quest for Precision

ABOUT TOYO CORPORATION

TOYO Corporation (TSE: 8151) is a Japanese technology company headquartered in Tokyo, Japan, with subsidiaries in the United States and China. Since its founding in 1953, TOYO has become the leading distributor of advanced measurement instruments and systems in Japan. TOYO also engages in original product designs and develops advanced solutions for many of markets that it serves including automotive, sustainable energy, and cyber security industries. TOYO's innovative products are used by many leading companies in Japan, the United States and APAC countries, helping TOYO's customers accelerate development, reduce time-to-market, and improve product quality.

The company serves major market segments including:

- Automotive Test and Measurement
- Information Communication Technology/Cyber Security Services
- Mechatronics/Noise & Vibration/Sensors
- Materials/Energy
- Electromagnetic Compatibility/Antenna Systems
- Ocean/Defense & Security
- Software Quality and Productivity
- Nano Imaging
- Medical Systems



TOYOTech

TOYOTECH LLC

TOYOTech LLC, founded in Fremont, California in 2015, is a wholly owned local subsidiary of TOYO Corporation. TOYOTech provides the customers in the US and several other countries with TOYO Corporation's self-developed products incorporating the know-how and technologies accumulated over many decades, as well as TOYOTech's own-developed products that are unique in the markets – these include test and measurement solutions for automobile, new materials, ICT, and EMC applications among others.

At the same time, TOYOTech keeps a keen eye on the newly emerging technologies and up-to-date information in Silicon Valley, a holy site of innovation, actively collaborating with startups and seeking M&A opportunities.



Note: Products available for United States Markets.

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