MATURO DYNAMOMETER

Technical Description

Dynamometer DYN 4WD – 3t

Customer	Project

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2   DYNAMOMETER FREESTANDING (DYN-F)

2.1   Technical Data of the Dynamometer F-DYN 4WD – 3t

TYPE	DYN – 30 kW
Axis distance	1400 mm – 3200 mm
Vehicle weight / axis load	3000 kg / 1500 kg
Dimensions in mm (L x W x H)	approx. 4000 x 2500 x 400
Total weight	approx. 2500 kg
Roller diameter	240 mm
Roller properties	Flame coated surface (road-like) static heaved up to 2000 rpm Balance quality: Q 2.5 according to VDI 2060
Track width	1000 mm to 2300 mm
Maximum speed	120 km/h
Speed measurement accuracy	+/- 0.1 km/h
4 asynchronous servomotors/-generators	each 30 kW (total 60 kW per axis)
4 single axis inverters	Rectifier or rectifier/regeneration function
Voltage consumption	380 V – 480 V / 3 phase
Current consumption	2 x 125 A
2 power supply devices	one per axis
Acceleration / deceleration	max. 1.0 g from 10 km/h to 60 km/h max 0.5 g from 60 km/h to 100 km/h

The Dynamometer F-DYN-4WD is constructed as a freestanding stand-alone dynamometer, which can optionally be fixed onto a turntable. Two active axes are used for vehicles with rear/front or four-wheel drive with or without limited slip differential. The four roller pairs are independently controllable, and each pair is driven by a separate motor, which also can work as a generator while the car is driven. The generated energy can be feedback to the power supply. .

2.2 EMC/EMI suitability

The F-DYN-4WD is especially designed not to influence EMC and EMI measurements. Therefore, the electronic components are inside a shielded, radio interference suppressing box which is placed inboard the dynamometer.

EMC Performances Emission 10 dB under the limits of CISR 12 and CISR 25	
Frequency range	150 kHz – 1 GHz
Measurement distance	10 m
Emission, electrical 6 dB under the limits of SAE J551-5: 2004-1, GB/T 18387-2008	
Frequency range	9 kHz – 30 MHz
Measurement distance	3 m
Emission, magnetic 6 dB under the limits of SAE J551-5: 2004-1, GB/T 18387-2008	
Frequency range	9 kHz – 30 MHz
Measurement distance	3 m
Immunity	
Continuous field strength	200 V/m
Frequency range	10 kHz – 18 GHz

All the design and manufacture of vehicle test bench is in accordance with standards below:
Ambient Noise requirements according to standards of CISR12/15, SAE J551-5.
Vehicle velocity, acceleration, load, road simulation requirements and power grids requirements according to standards of CISR12, ISO11451, ECE R10, SAE J551, GB14023, GB18387, IEC61000-4-3, GB/T 14549.
Furthermore, it is tested based ECE R10 and GBT18387.
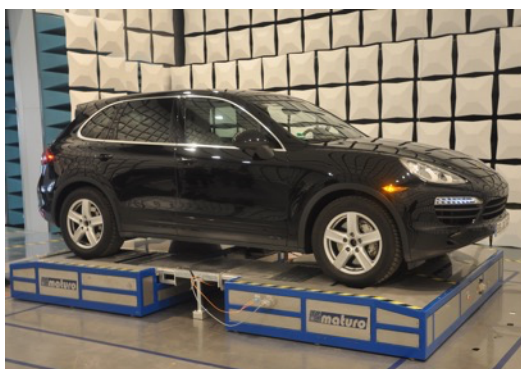
2.3 Brief description

Preserving the surroundings

Due to minimize the dynamic energy to the surrounding of the F–DYN-4WD, the four independent roller pairs are integrated into a "self–contained" frame.

Twin rollers

- compact design of complete system
- quick test setup
- simple vehicle fixing

Loading and unloading

- two free adjustable ramps for driving the vehicle on the dynamometer
- removable for the tests
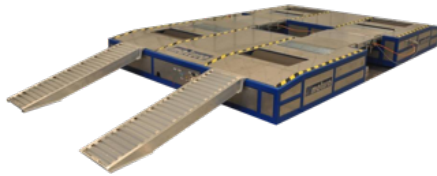
Tire safety cover

- Non-metal material
- Adjustable for different wheel tracks

Fixing points incl. lashing straps

- to fix the vehicle during tests
- lashing straps made of non-metal material
- shieldable fixing points integrated in the turntable cover plates

Accessories included

- Four lashing straps to fix the vehicle while running. They are integrated in the system structure and are adjustable to each specific vehicle and made of neutral material.

  Tensile strength: 5000 N

  Length adjustment: 1.0 m – 6.0 m

- Roller blocking system for easy loading or unloading of the vehicle
- Safety cover for tires
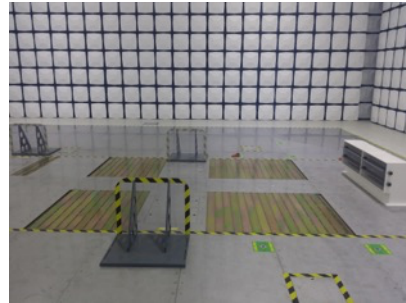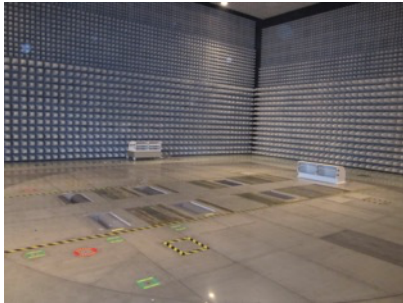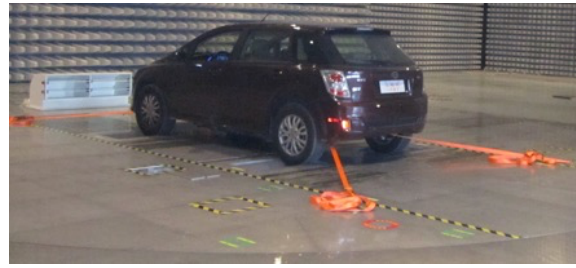
Accessories upon request:

- Speed sensor
- Increased permissible vehicle/axis weight
- Mechanical axis coupling to prevent triggering the vehicle's safety systems in the vehicle, e.g. ABS or ESP
- Clamping device for motorcycle
- Cooling system to keep the motor and/or the tires cool during testing

Stand-alone or turntable integrated cooling fan system (optional)

- adjustable guide plates for wind direction
- different maximum air flows and maximum wind speeds available, e.g. 20 000 m^3/h and 80 km/h
- wind speed optionally adjustable or automatically adjusted depending on vehicle speed
- The stand-alone option is equipped with four wheels for easy movement and made of plastic and wood.
- The integrated option is also removable (resulting hole can be covered by the incl. stainless steel plates) and the materials above the dynamometer cover plates are plastics.

Robot R – AB for accelerator and brake pedal (optional)

- Remote controlled vehicle driving on chassis dynamometer for EMC tests
- Actuation of pedal positions to external, analogue setpoints
- Safe non–energized basic positions
- Quick snap–in mechanism of pedal actuator for individual settings
- Easy mounting in vehicle
- No EMC emission due to pneumatic operation

Technical data	
Stroke distance accelerator stepless adjustable Strength	up to 100 mm 200 N
Stroke distance brake stepless adjustable Strength	up to 125 mm 350 N
Power consumption	208 VAC – 230 VAC, 50Hz / 60 Hz, single phase
Current consumption	approx. 0.5 A
Fuse	2 A, 250 V
Compressed air supply	via pressure regulator and 0.5 inch quick connector
Signal pressure	0.2 – 1.0 bar
Nominal pressure	5 bar
Length of lines	Air tube 5 m from dynamometer to robot
Operating temperature	5° C – 40° C
Total weight	approx. 25 kg

3   Software and Controller

The maturo controller DynSoft is developed by maturo engineers based on long experience. The in-house software is able to control all maturo dynamometers and their accessories, e.g. the cooling fans, the robot and so on. It will be delivered with an industrial PC and communicate with the devices by fiber optics.

Due to the fact that the controller and the software are exclusively produced, developed and constantly enhanced by maturo, software maintenance or troubleshooting in case of failing components can be done very fast, optionally with a remote service unit, for minimal downtimes.

The included software contains the following functions:

- Emergency stop
- Start cycle / stop cycle
- Speed control of the rollers
- Speed control of the ventilator
- Force at the rim (in Nm)
- Distance gone from the start of the cycle (in km)
- Cycle recording (profile)

To allow the following test cycles:

- Constant velocity
- Velocity gradient
- Simulation of uphill and downhill driving
- Tractive force control
- Friction force control
- Positive and negative rotation control
- ABS, ESP testing
- Road load simulation based on the GB/T 18387 standard

The software includes:

- PC-Controller with keyboard, mouse and monitor
- The DYN-Software is pre-installed at the PC
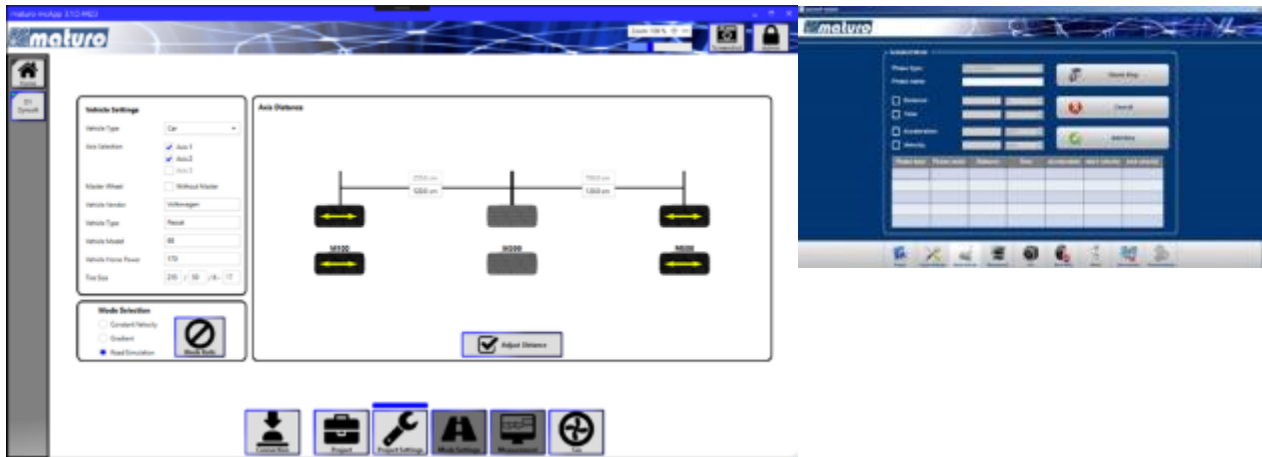
Operating modes:

In all operation modes, the difference between road and roller friction can be easily corrected by the electric motors. The different friction leads to a different torque against the vehicle. The DynSoft transfer this difference to the electric motors in such a way that the friction load for the vehicle on the dynamometer is almost the same as on the road.

- Recuperation mode: The dynamometer drives with constant speed and can load vehicle batteries. It is possible to set a certain acceleration, deceleration or speed.
- Gradient mode: Individual profiles, which can be set for each wheel independently
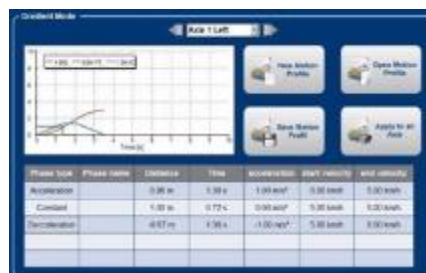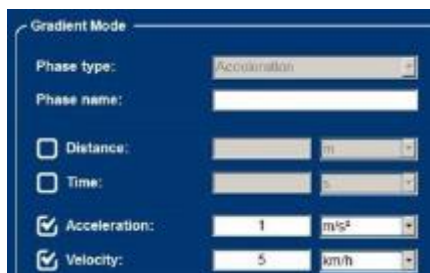
- Road simulation: The resistive torque is adjusted by the so-called coefficient setting method (A, B, C) based on the GB/T 18387. This means that the weight of the vehicle is set, and the software generates the coefficients automatically. Additionally, the coefficients can be set manually and independently of the weight.
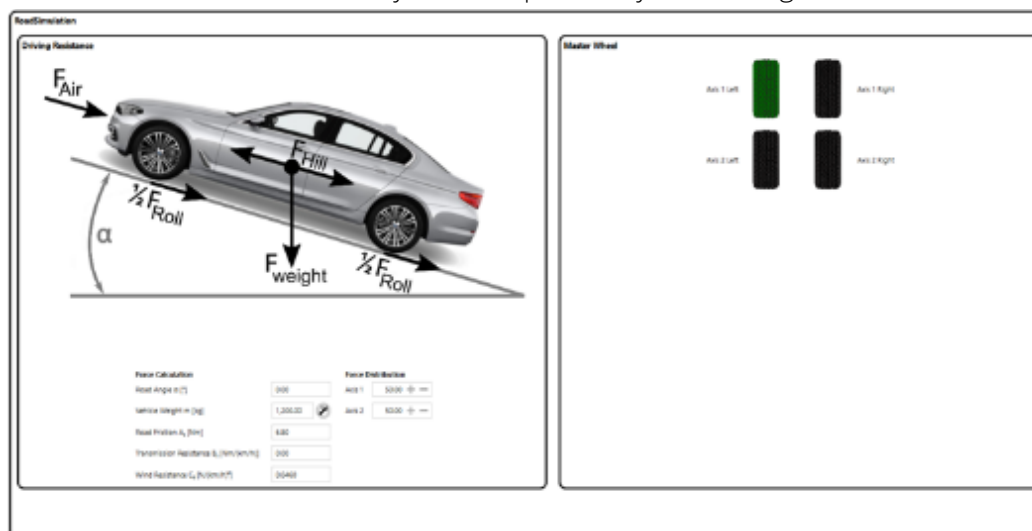
Additional to the coefficient setting method, a road angle and the force distribution at more wheel drives could be also set.

As example see the following picture. Herein, the vehicle weight is set to 1200 kg and the three coefficients are generated automatically.

Force Calculation		Force Distribution	
Road Angle α [°]	0.00	Axis 1	50.00 + −
Vehicle Weight m [kg]	1,200.00	Axis 2	50.00 + −
Road Friction A_s [Nm]	6.80		
Transmission Resistance B_s [Nm/(km/h)]	0.00		
Wind Resistance C_s [N/(km/h)^2]	0.0460		

The coefficients are stored in an external list, which could be edit by customer. Different values more or less are possible. For example, see the extract of that list:

	A	B	C	D	E	F
1	ns1:A	ns1:B	ns1:C	ns1:MassRangeLower	ns1:MassRangeUpper	
2	3,8	0	0,0261	-3,40282E+38	480	
3	4,2	0	0,0282	480	540	
4	4,4	0	0,0296	540	595	
5	4,6	0	0,0309	595	650	

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- Measurement: For each single wheel the following parameters can be measured and visualized in a graph:
  - Current torque of the motor in Nm
  - Current speed of the wheel in km/h
  - Current power of the motor in W
  - Current rotations of the vehicle wheel in rpm

- Roll blocking mode for easy setup of the vehicle
- ESP/ABS mode (optional): Different torque on rollers for testing the ESP and ABS function

Control inside the chamber with HCU

The handheld control unit HCU is connected inside the chamber at the turntable for fine adjustments of:

- The maturo robot
- Axle distance adjustment of the dynamometer

4 Highlights and advantages

- The software DynSoft is developed completely by maturo engineers

- Due to the in-house software very short response time in case of service

- Axis distances (between axis 1 and 2) automatically adjustable over DynSoft

- Full functionality of the Handheld control unit

  o Stay in the chamber and control all functions of the dynamometer, such as the axe distance, roller speed and so on

- Twin roller system for short setup-time, tire-sparing design and due to lower moment of inertia quick reaction to velocity changes

- Maintenance-free energy chain

- Exclusively well-known suppliers with subsidiaries all over the world

  o Short delivery times for spare parts

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5 Utility requirements for the system

Filters

The following filters have to be provided by the chamber manufacturer for the operation of the system.

For the dynamometer	
Voltage	380-400 V/ 3-phase
Current consumption	250 A

Compressed air

For the roller brake system compressed air is required. Optionally, it is also necessary for the robot and when the system is used in combination with a pneumatic Antenna Mast.

Compressed air requirements	
Air pressure	6 bar
Capacity	Approx. 0.4 m^3/h