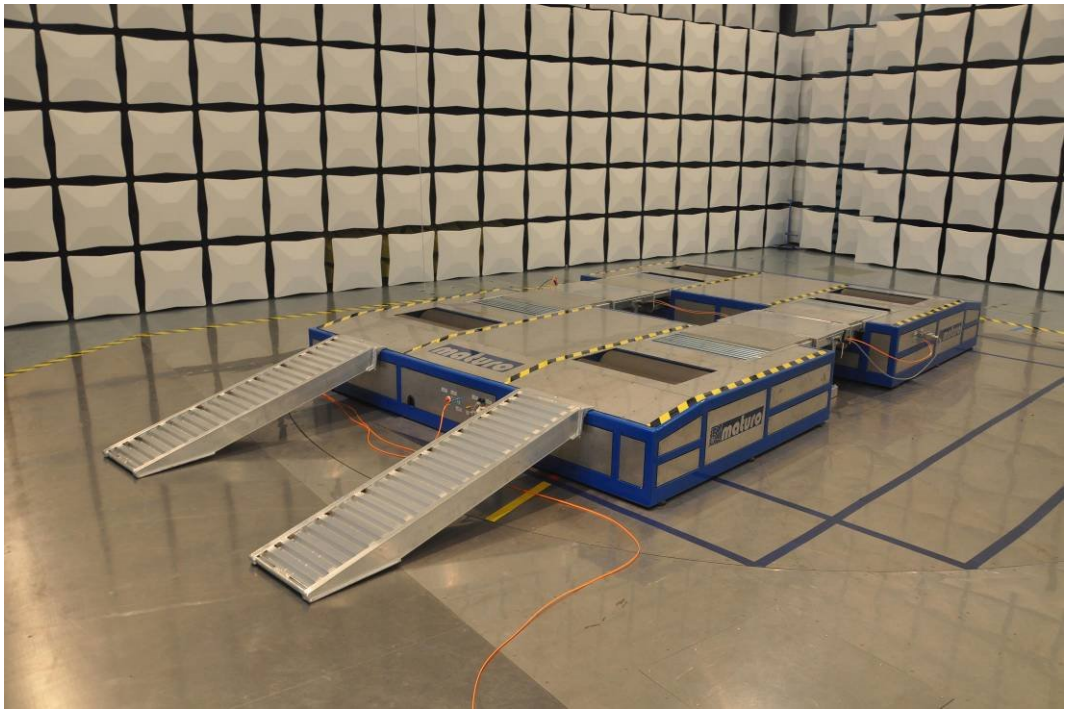
maturo GmbH
Am Kalvarienberg 24 • 92536 Pfreimd • Germany

Technical Description

Dynamometer F-DYN 4WD-3t

Free-standing on top of hall floor or turntable



Specifications:

- **Free-standing version**
- **For use in anechoic chambers for EMI and EMC measurements**
- **2 active axles, for cars with rear /front – or four wheel drive with or without limited slip differential**
- **4 independently controllable roller pairs**
- **Also for electric vehicles and motorcycles**
- **Electrical coupling/synchronisation of all rollers**
- **Removable, fixed on the turntable cover plates**
- **With loading ramps and bridges between both axles**
- **Cooling fan, robot system, exhaust extraction system, and more available**

Information presented enclosed is subject to change as product enhancements are made regularly. Please contact maturo for current specifications. Pictures included are for illustration purposes only and do not represent all possible configurations.

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Index

1) Dynamometer DYN 4WD-3t

1.1) Technical Data:

Permissible axle load		1.500 kg (each axle)
Max speeds for cars		100 km/h
Speed measurement accuracy		+/- 0.1 km/h
Wheel track between the front wheels		1200 to 2100 mm
Wheelbase between the front and rear wheel		1400 to 3200 mm
Diameter car wheels	min.	400 mm
	max.	800 mm
Diameter rollers (4 roller pairs)		240 mm
The surface of the rollers is flame-coated		
The rollers are static heaved up to 2000 rpm		
Complete weight	approx.	2500 kg
Overall Height	approx.	400 mm

Specifications: Active axles

4 Asynchrony Servomotors/-generators	each	22 kW (total 44 kW per axle)
4 Vector frequency inverter	each	37 A
Voltage/current consumption		2x 380-400 V/ 63 A/ 3phase
4 Break resistors cooled by fan		
Acceleration/ deceleration	max.	1.0g from 10 to 60 km/h
	max.	0.5g from 60 to 100 km/h

EMC Performances:

Emission:
10 dB under the limits of CISPR 12 and CISPR 25

Frequency range	150 kHz – 1 GHz
Measurement distance	10 m

Emission, electrical:
6 dB under the limit of SAE J551-5: 2004-01, GB/T 18387-2008

Frequency range	9 KHz – 30 MHz
Measurement distance	3 m

Emission, magnetic:
6 dB under limit of SAE J551-5: 2004-01, 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

System Controller:
PC with serial communication to the dynamometer and Dynamo-Software

1.2) Brief Description:

General:
The Dynamometer F-DYN 4WD is constructed as a freestanding dynamometer, which can be fixed onto a turntable or a stand-alone system. Two active elements are used for cars with rear/front wheel drive. Each car wheel is driven by a separate motor/generator. It can be used for acceleration/retardation and in an endurance mode.

EMI/EMC:
The Dynamometer F-DYN 4WD is prepared to be used in an anechoic chamber for EMI and EMC measurements. All electronic components are located in a separate box, which is shielded, and radio interference suppressed. The RF- Emission is less than 10 dB under limit “B” of CISPR 12 and 25. The immunity against field strength up to 200 V/m is guaranteed.

Control Unit
Each active element has two micro controller to control the frequency inverters and for the speed measurement system. The element is connected to the system controller via fibre optic links. The system controller PC is equipped with an IEEE interface to be connected to a host computer. Forward/backward turning and acceleration/retardation is programmable, speed profiles can be created. ABS test sequences are possible.

Safety and Emergency Function:
The maximum speed is limited by inverter function controller and by the internal micro controller. The temperature on the motors and inside the electronic box is being watched. Two emergency switches are located close to the stand and in the control room. In case of an emergency, the main power will be switched off.

Structure:
The 4 independent roller pairs of the dynamometer are integrated into a “self-contained” frame, which minimizes the dynamic energy output to the turntable.

Signal lamp

The signal lamp in control room shows the state of the dynamometer:

Green continuous	-> Emergency is ok
Green flashing	-> Emergency pressed
Orange continuous	-> Dc voltage link off
Red continuous	-> Dc voltage link on
Red flashing	-> Dynamometer is started

Rollers:
The rollers are static heaved up to 2000 rpm and flame-coated.
Balance quality: Q 2.5 according to VDI 2060

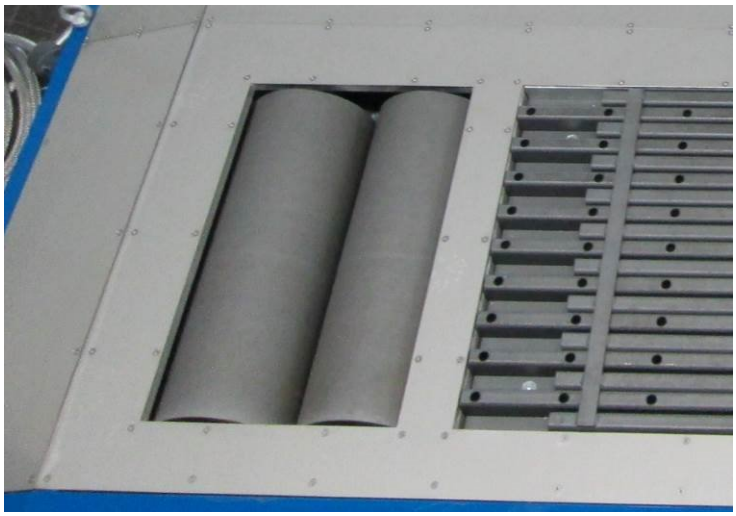


Figure: Double roller system

ABS and ESP tests:
The dynamometer DYN 4WD allows ABS and ESP testing of vehicles up to an acceleration or deceleration of 1.0 g (10 m/s²)

Fixing elements:
The system is equipped with four lashing straps to fixing of the vehicle while running.
Spring hooks allow an easy connection to the four fastening bolts.
The fixing elements are integrated into the structure of the system and are adjustable to the specific vehicle sizes.
The straps are made of electrically neutral material.
Length adjustment: from 1.0 to 6.0 m
Tensile strength: 5000 N

Figure: Fixing system

Loading and Unloading:
To drive the car on the stand and into the rollers two free adjustable ramps and must be used. The ramps are removable while the test is running.

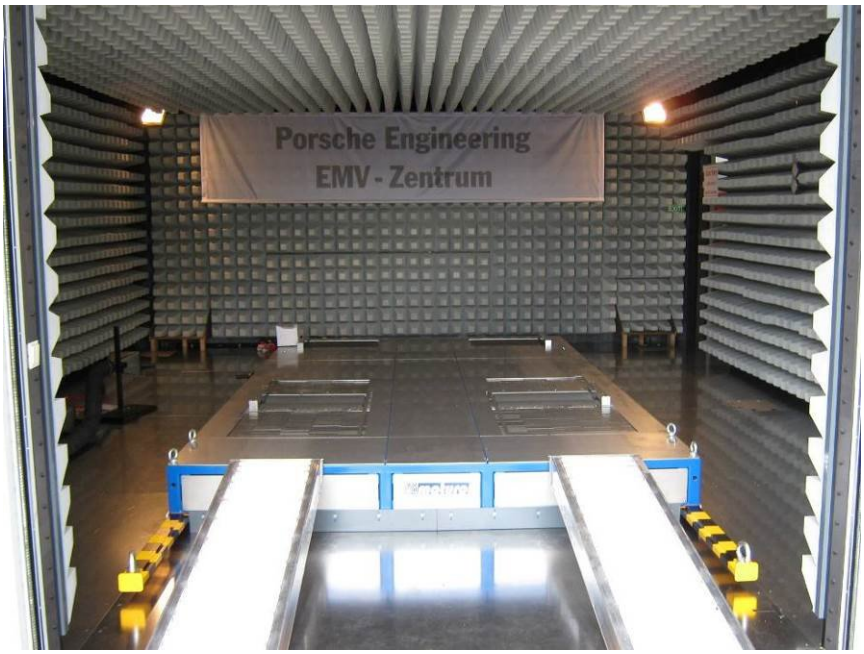


Figure: Loading ramps

Single-wheel drive for motorcycles testing:
The Dynamometer F-DYN 4WD is equipped with a function for testing motorcycles or any other motorised two-wheeler.
The system and the software allow the selection of the operation of only one single roller.

Figures: Testing of motorcycles

2) Software and functions of the Dynamometer:

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
- Street (road) simulation
- Simulation of uphill and downhill driving
- ABS, ESP testing with acceleration/deceleration of up to 1.0g
- Single-wheel drive fort wo-wheelers

The software includes:

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

3) Software Description (Example)

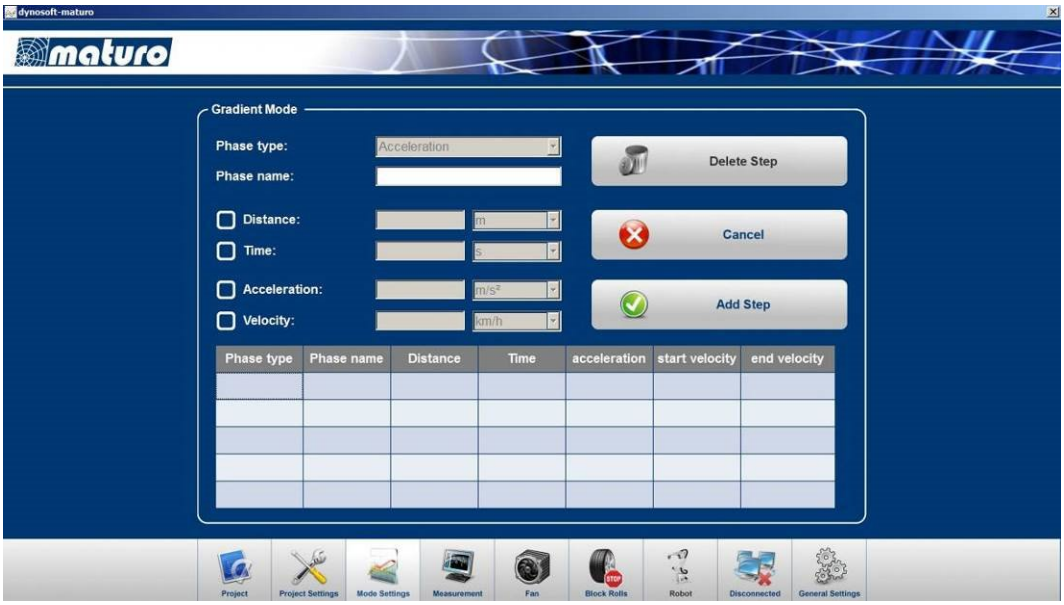
3.1) Operation modes:

The following modes are available:

- Constant Velocity - „ConVelo“ driving with constant speed
- Gradient Mode - „GarVelo“ performing a driving profile; e.g. for ABS testing
- Road Simulation - „RoadSim“ for road simulation with counter torque
- Measurements
- Block Rolls - “Block Rolls” to drive in and out with car

3.2) Constant Velocity:

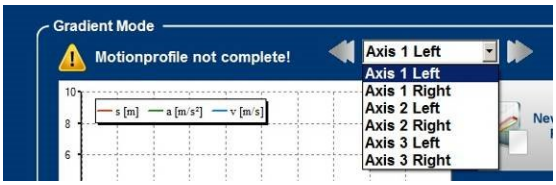
At the operating mode “ConVelo” it is possible to set a certain speed, acceleration and deceleration. These values are limited by the limits of the dynamometer or the limits of the used vehicle.



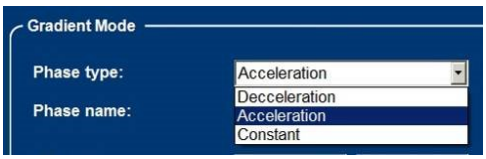
This mode can be activated with the “Start” key and stopped with the “Stop” key.
The current values of speed and torque are displayed for each motor.
The speed curve is displayed as a graph.

3.3) Gradient Mode:

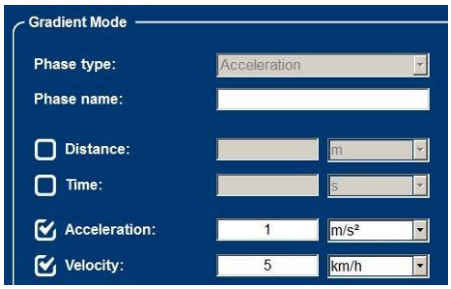
At this mode individual profiles for all wheels can be set and activated



The profiles can be set in this window and are progressively made up by the “Phase type”.
It distinguishes between acceleration, constant and deceleration.

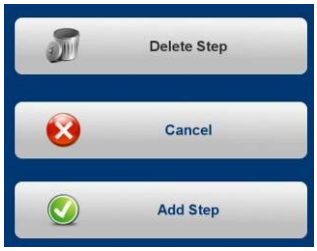


For each phase type certain start- and endpoints must be allocated.

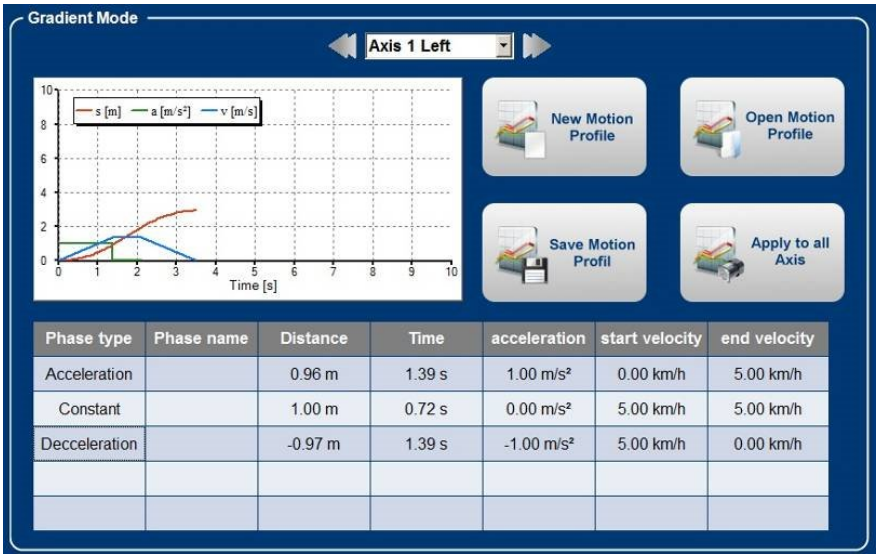


Acceleration/Deceleration
There are different possibilities of combinations. E.g. it is possible to set “Velocity” and “Acceleration” or “Distance” and “Time”. The program calculates in each case, according to the specific values, the parameters of the phase type.
In general there are always values at the phase types “Acceleration” and “Deceleration” required.

Constant
At “Constant” only one value can be set. This can either be “Time” or “Distance”.

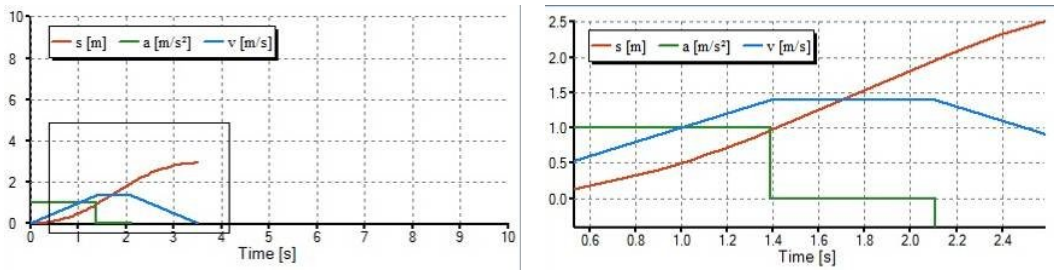


The created profile can be stored with “Save Motion Profile” and can be enabled again at each other profile or axle with “Open Motion Profile”.
With “Apply to all Axes” it is possible to transfer the current profile to all other motors with one step.



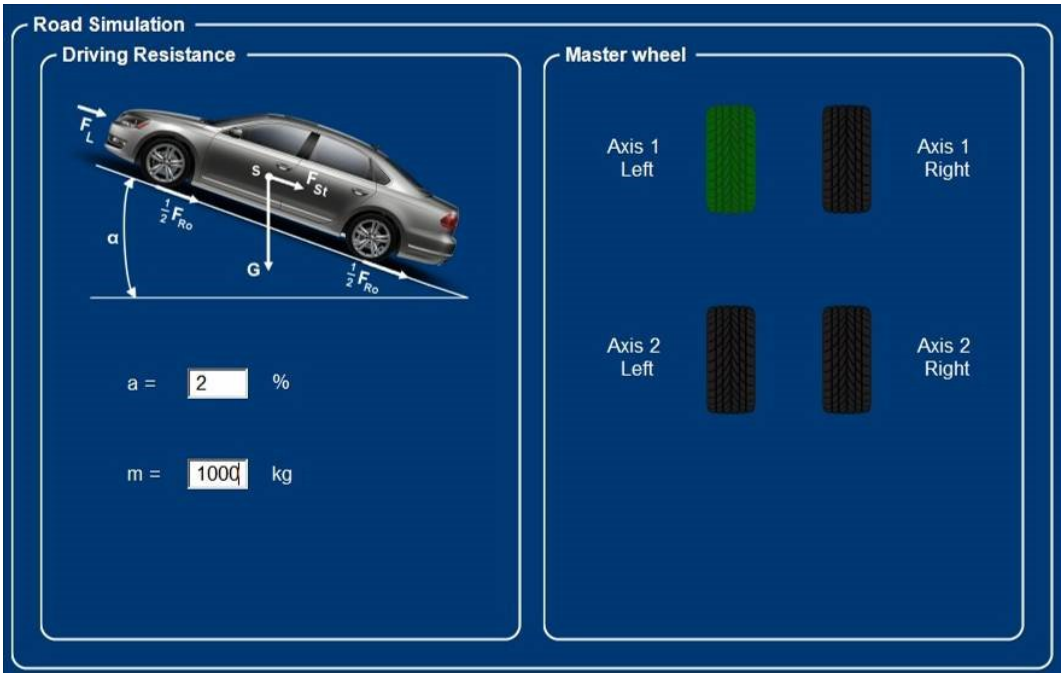
Phase type	Phase name	Distance	Time	acceleration	start velocity	end velocity
Acceleration		0.96 m	1.39 s	1.00 m/s²	0.00 km/h	5.00 km/h
Constant		1.00 m	0.72 s	0.00 m/s²	5.00 km/h	5.00 km/h
Decceleration		-0.97 m	1.39 s	-1.00 m/s²	5.00 km/h	0.00 km/h

All individual steps of the profile are indicated in a list. Additionally the profile is displayed a graph, showing the parameters speed, acceleration/deceleration and distance.



Details of the graphs can also be explored in detail by moving the mouse cursor from top left to lower right– with left mouse button pressed. The selected area is automatically enlarged.
With the reverse procedure from lower right to top left the display can be reduced to the original size again.

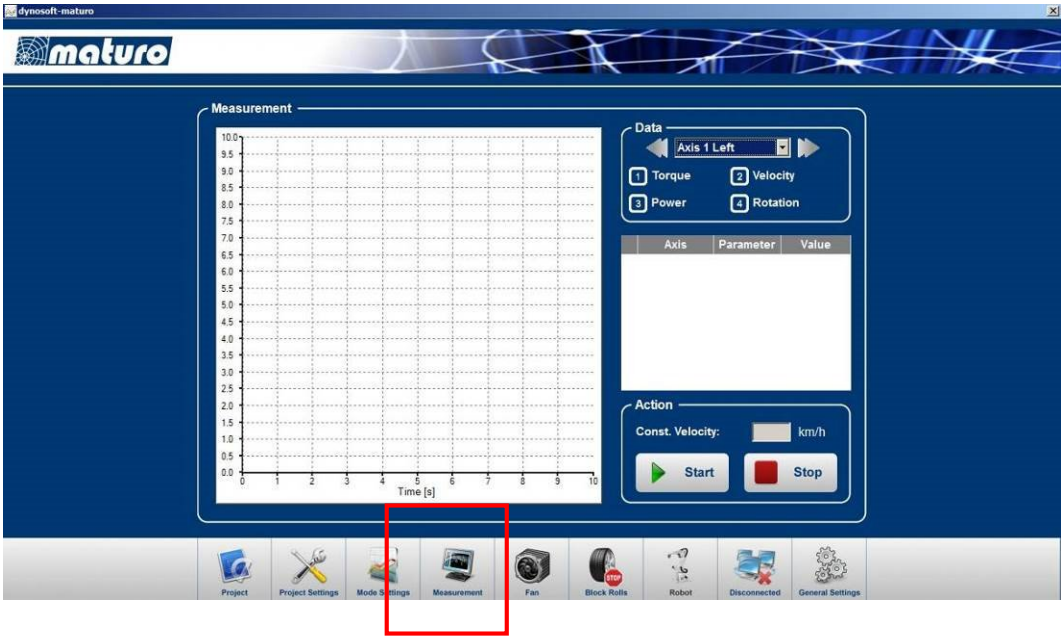
3.4) Road Simulation:



With the parameters a [%] for the gradient and m [kg] for the weight the resistive torque is calculated. This resistive torque is limited by the maximal torque of the motors.

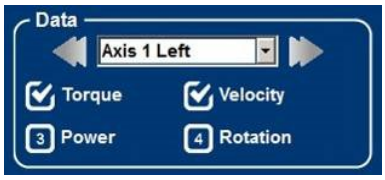
With the selection of the “Master wheel” it is determined which wheel is used as reference wheel for the speed transmission to the passive axles.

3.5) Measurement:



With this icon the measurement can be started.

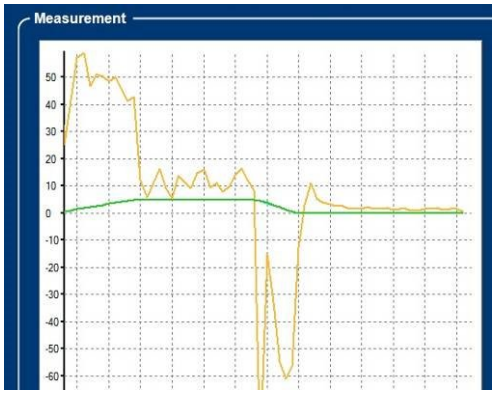
To control the current parameters of the dynamometer, all current parameters of the motors can be called up.
First select the individual motor by using the drop down menu or the arrow button.



Now the following parameters can be selected:

- Torque [Nm] current torque of the motor
- Velocity [km/h] current speed of the wheel
- Power [W] current power of the motor
- Rotation [rpm] current revolutions of the vehicle wheel, which is calculated at the tire size entered before

The actual measurement can be started with the “Start” button and stopped with the “Stop” button.



The selected parameters can be displayed as a graph.
Details of the graphs can also be explored in detail by moving the mouse cursor from top left to lower right– with left mouse button pressed. The selected area is automatically enlarged.
With the reverse procedure from lower right to top left the display can be reduced to the original size again.

3.6) Block Rollers:

In order to drive in or out the vehicle from the dynamometer, all rollers of the dynamometer must be blocked. With icon “Block Rolls” this function can be activated. The maximum torque is applied to the motors that the rollers are blocked.

Block Rollers can be started

Block Rollers has started and can be released again by pushing the icon again

4) Cooling Fan System (optional):

Shielded fans provide a sufficient cooling for the tyres and the motor of the vehicle under test.
The plastic air scoop on top of the turntable is used to detour the airflow.
The fan speed can be set either proportional to the roller speed (up to 60 km/h) or to a constant speed by the NCD Controller.

Figure: Cooling Fan System

Technical Data:

Wind speed		60 km/h
Adjustable according to the vehicle speed		
Air flow		10.000 m³/h
Outlet opening of air scoop		1.0 x 0.3 m
Material of air scoop		Plastic and wood
Current consumption	max.	16A
Power consumption		380-400 V/ 50-60 Hz/ 3-phase
Operating Temperature		5°C to 40°C
Total weight	approx.	60 kg

With guide plates for adjustment of the direction of the wind
4 lockable castors for easy movement of the system

5) Utility requirements for the system

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

- 2x 380-400 V/ 3-phase / 63 Amps
  For the dynamometer
- 1x 380-400 V/ 3-phase/ 16 Amps
  Optional for the cooling fan system

5.2) Control lines:
Fibre optic control lines and feed troughs through the shielded are included

5.3) Power connection outside the chamber

- 1x 208-230 V/ single-phase/ 16 A
  For PC with installed software
- 1x 208-230 V/ single-phase/ 16 A
  Optional for robot
- 1x 380-400 V/ 3-phase/ 16 Amps
  Optional for exhaust extraction system

5.3) Compressed air:
For brakes of the dynamometer for loading and unloading the vehicle.
And optional for Compact Antenna Mast or in combination with a robot.

The requirement for compressed air is as follows:
- Air pressure: 6 bars
- Capacity: approx. 0.4 m^3/h

6) Option: Robot for Accelerator, Brake and Clutch pedal:

Fig.: Example picture of Robot

Application

- Driving of vehicles on chassis dynamometers for EMC tests
- Actuation of pedal positions to external, analogue set-points

Specifications

- Due to pneumatically operation no EMC emission
- Emergency-Off safety principle
- Safe non-energized basic positions. The accelerator, brake and clutch pedals are released
- Quick snap-in mechanism of pedal actuator for individual settings
- Easy mounting in the vehicle
- Automatic control by a digital control system (PC compatible software is included)

Technical Data

Stroke distance accelerator adjustable	0 to 100 mm
Strength	200 N
Stroke distance brake adjustable	0 to 125 mm
Strength	350 N
Stroke distance clutch adjustable	0 to 150 mm
Strength	350 N

Power consumption	208-230 VAC, 50/60 Hz, single-phase
Current	approx. 0.5A
Fuse	T 2A, 250V
Compressed Air Supply	via pressure regulator and ½ inch quick connector
Signal Pressure	0.2 – 1.0 bar
Nominal Pressure	5 bar
Lengths of lines	Air tube 5 m from Dynamometer to Robot
Operating Temperature	5°C to 40°C
Total weight of actuator	approx. 25 kg

Brief description

The Robot R-ABC allows the stepless adjustment of the accelerator and brake pedal inside EMC Chambers preferably in combination with chassis dynamometers.

The R-ABC can be controlled directly from NCD controller with the software included.

The control allows the adjustment and storage of different test cycles and applications.

The NCD and drive unit are located outside the chamber and is only connected to the actuator with two compressed air tubes in order to avoid any EMC emissions.

Test report on

Maturo Dynamometer F-DYN 4WD

at TÜV Süd, Senton

Index

1) Picture of Test setup:

Fig.1: Test setup for measurements from 30 MHz to 1 GHz

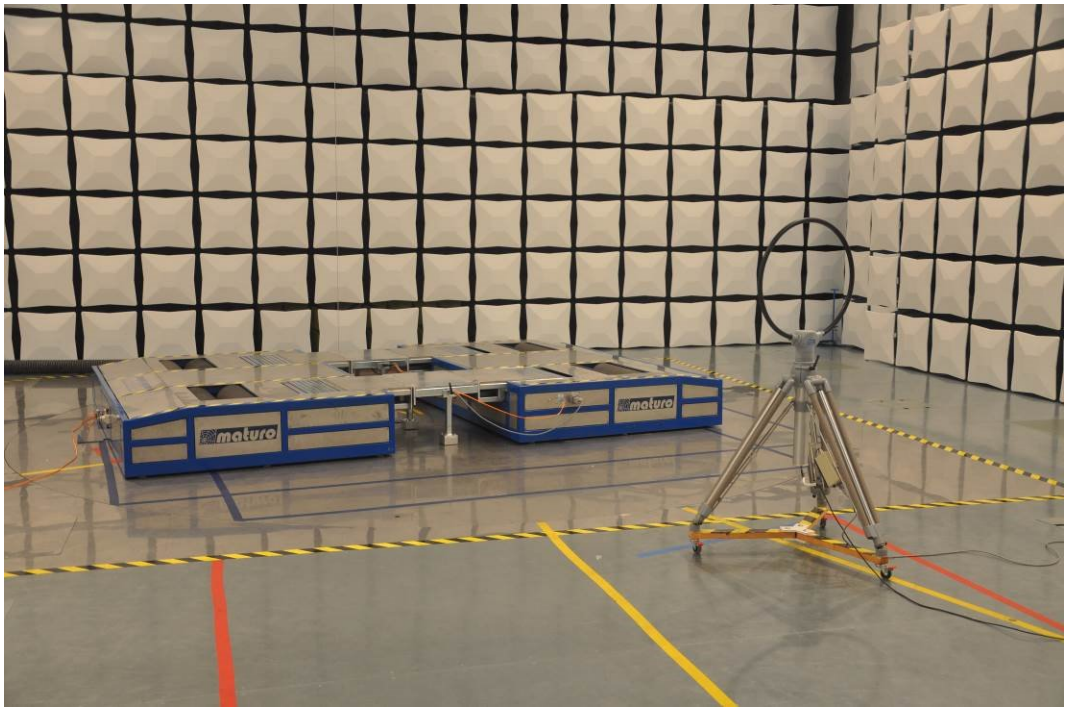


Fig.2: Test setup for measurements from 9 kHz to 30 MHz

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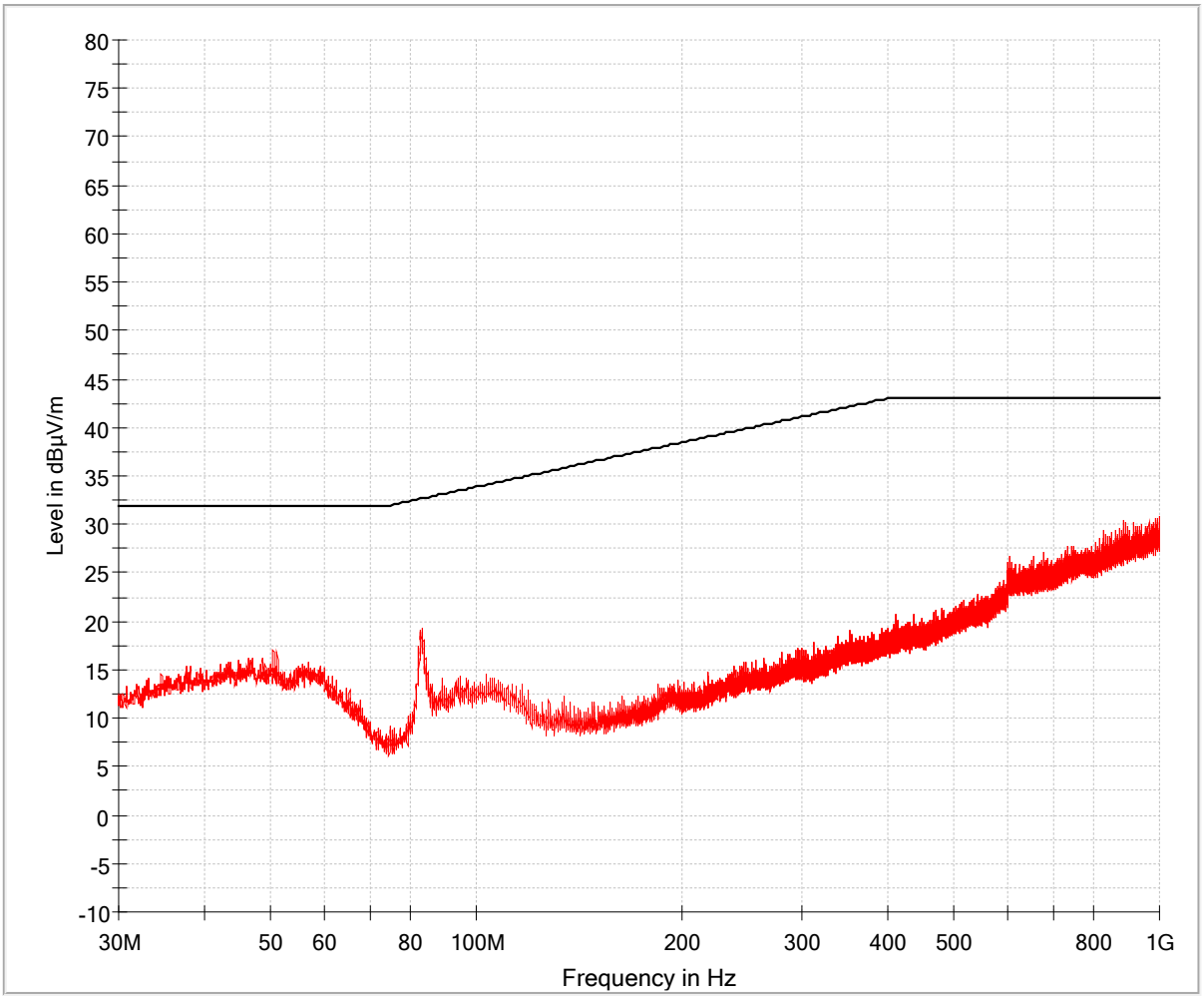
Messung von gestrahlten elektromagnetischen Störungen aus Fahrzeugen nach Richtlinie 2009/19/EG (CISPR 12)

Prüfling:	F-DYN4WD	Messplatz:	Absorberhalle Kabine 8
Auftraggeber:	maturo GmbH	Messentfernung:	10 m
Prüfdatum:	17.11.2011	Antennenhöhe:	3 m
Prüfaufbau:	ohne Fahrzeug	Drehpositionen:	-107°, +73°

Betriebsart: Stand by
Polarisation: horizontal



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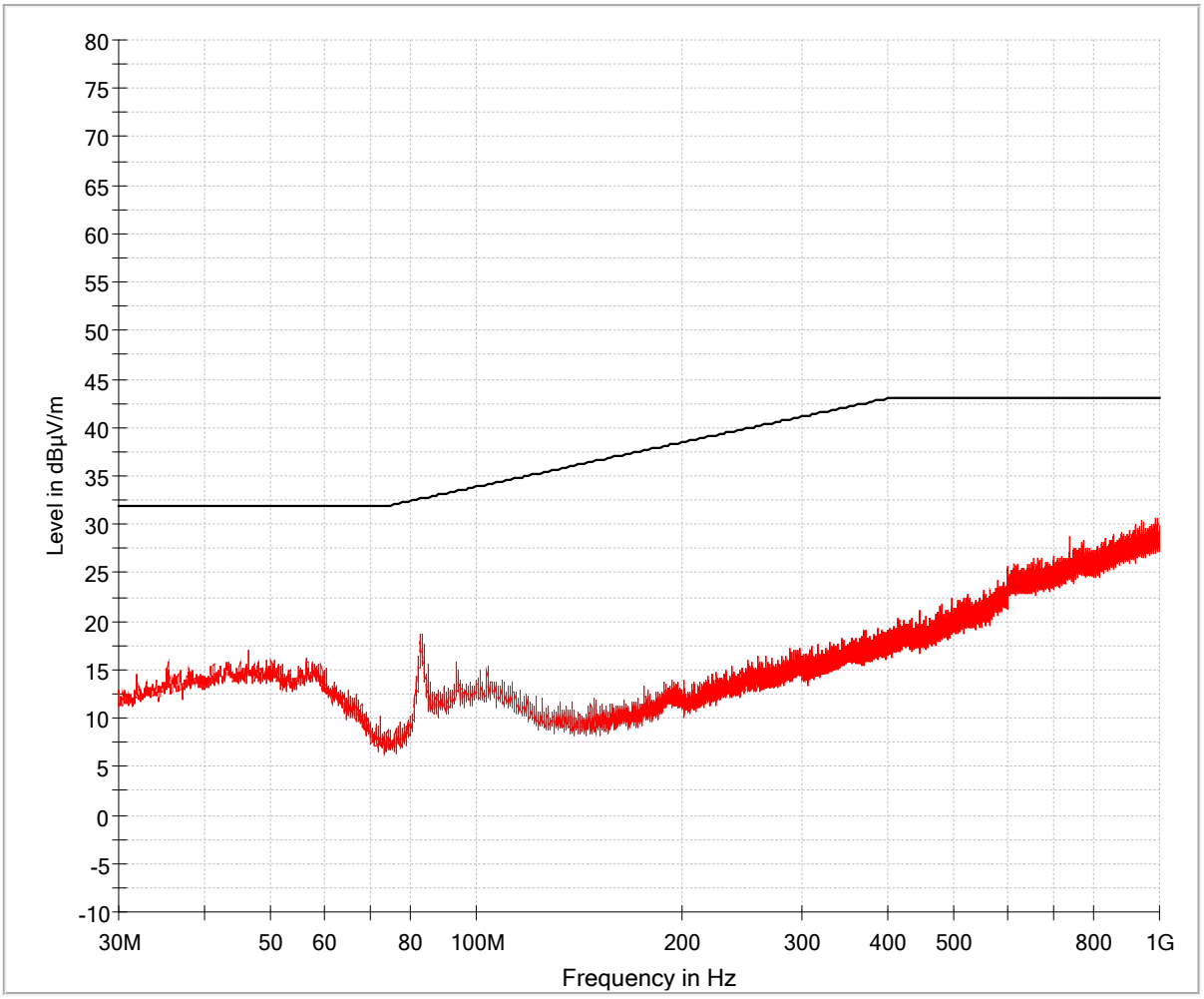
Prüfdatum:	17.11.2011	Antennenhöhe:	3 m
Prüfaufbau:	ohne Fahrzeug	Drehpositionen:	-107°, +73°

Betriebsart: 50 km/h
Polarisation: horizontal



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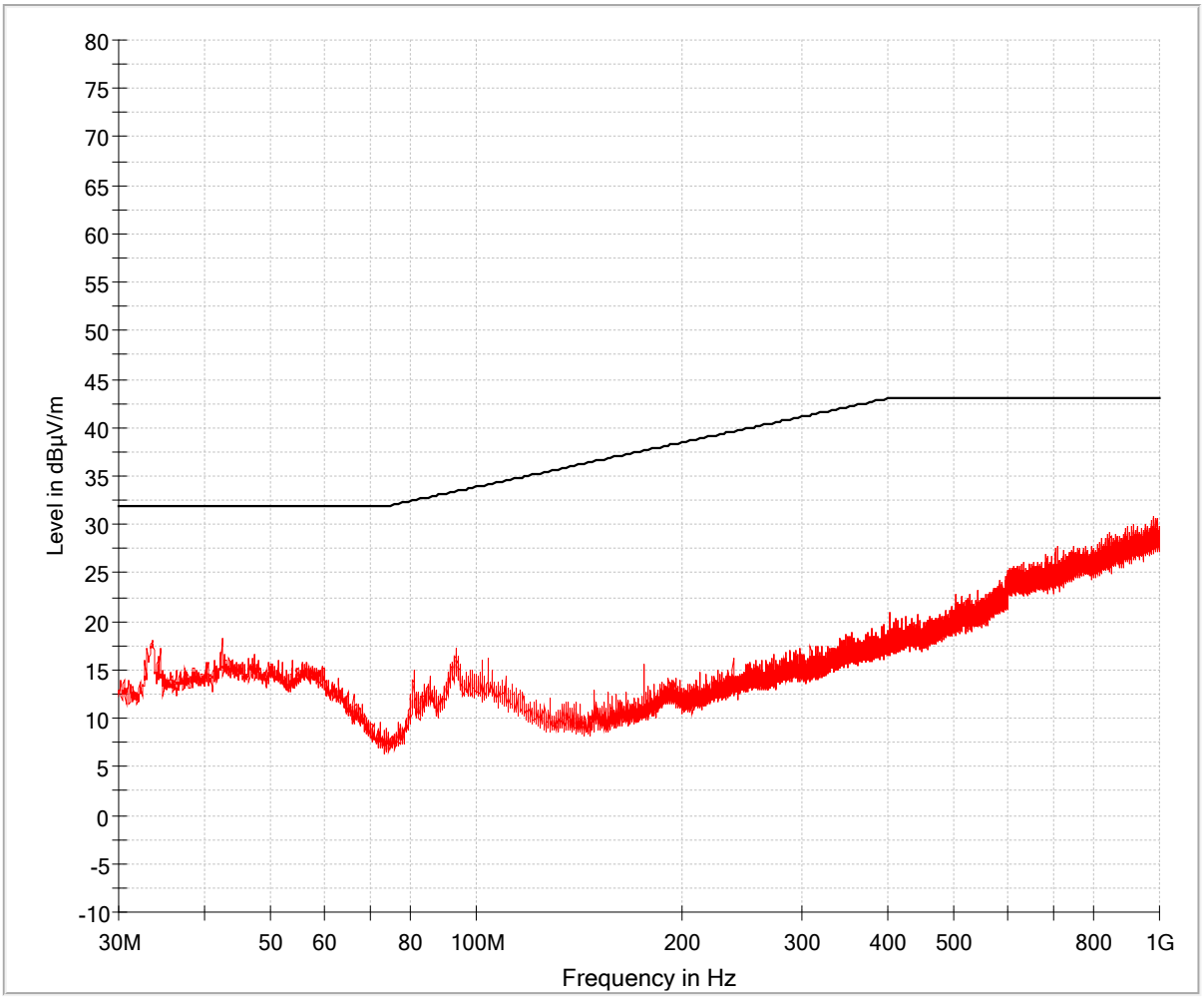
Auftraggeber:	maturo GmbH	Messentfernung:	10 m
Prüfdatum:	17.11.2011	Antennenhöhe:	3 m
Prüfaufbau:	Netzleitung intern verlegt und direkt am Drehtisch angeschlossen	Drehpositionen:	-17°, +163°
Betriebsart:	Stand by		
Polarisation:	vertikal		



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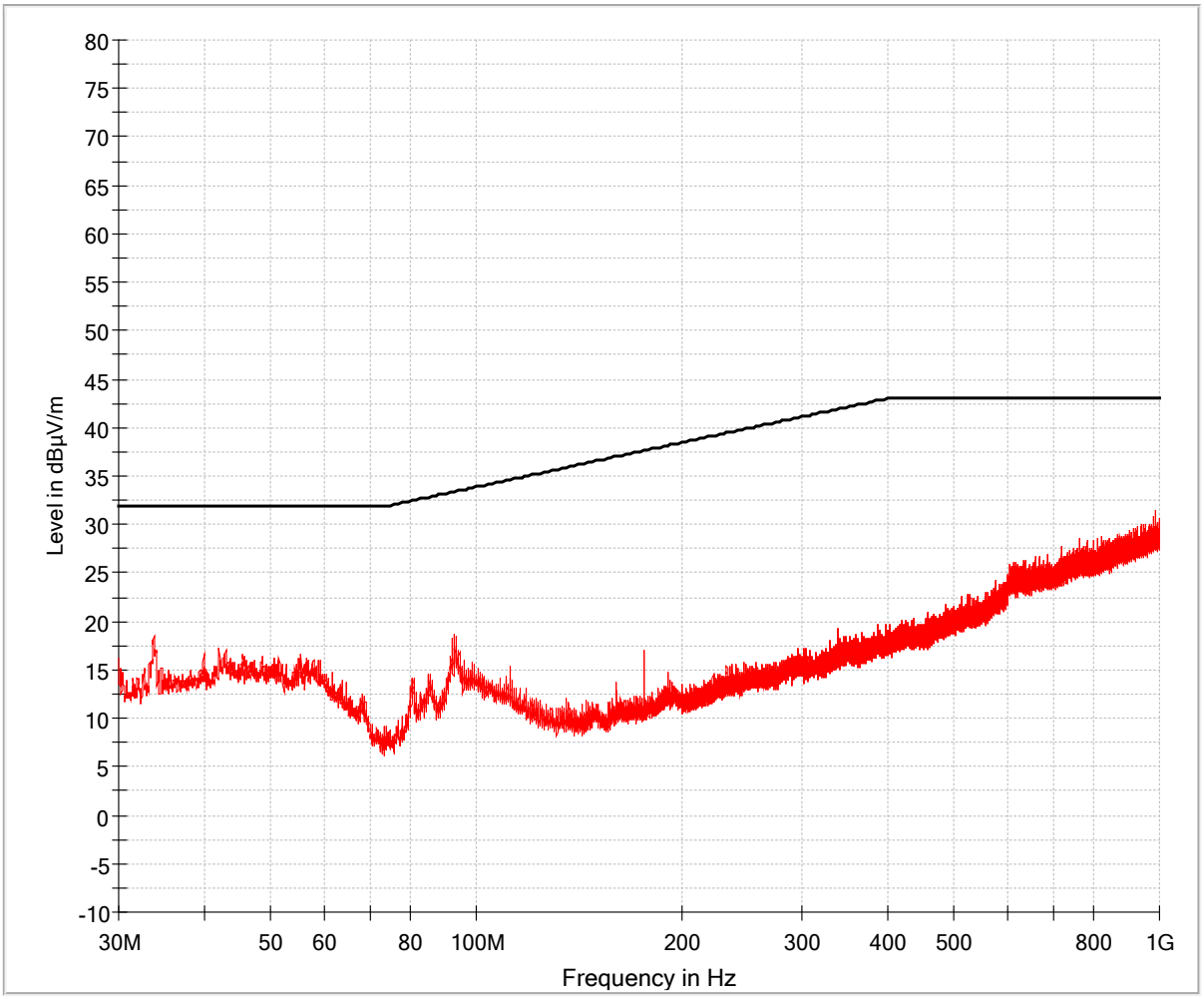
Prüfdatum:	17.11.2011	Antennenhöhe:	3 m
Prüfaufbau:	Netzleitung intern verlegt und direkt am Drehtisch angeschlossen	Drehpositionen:	-17°, +163°
Betriebsart:	50 km/h		
Polarisation:	vertikal		



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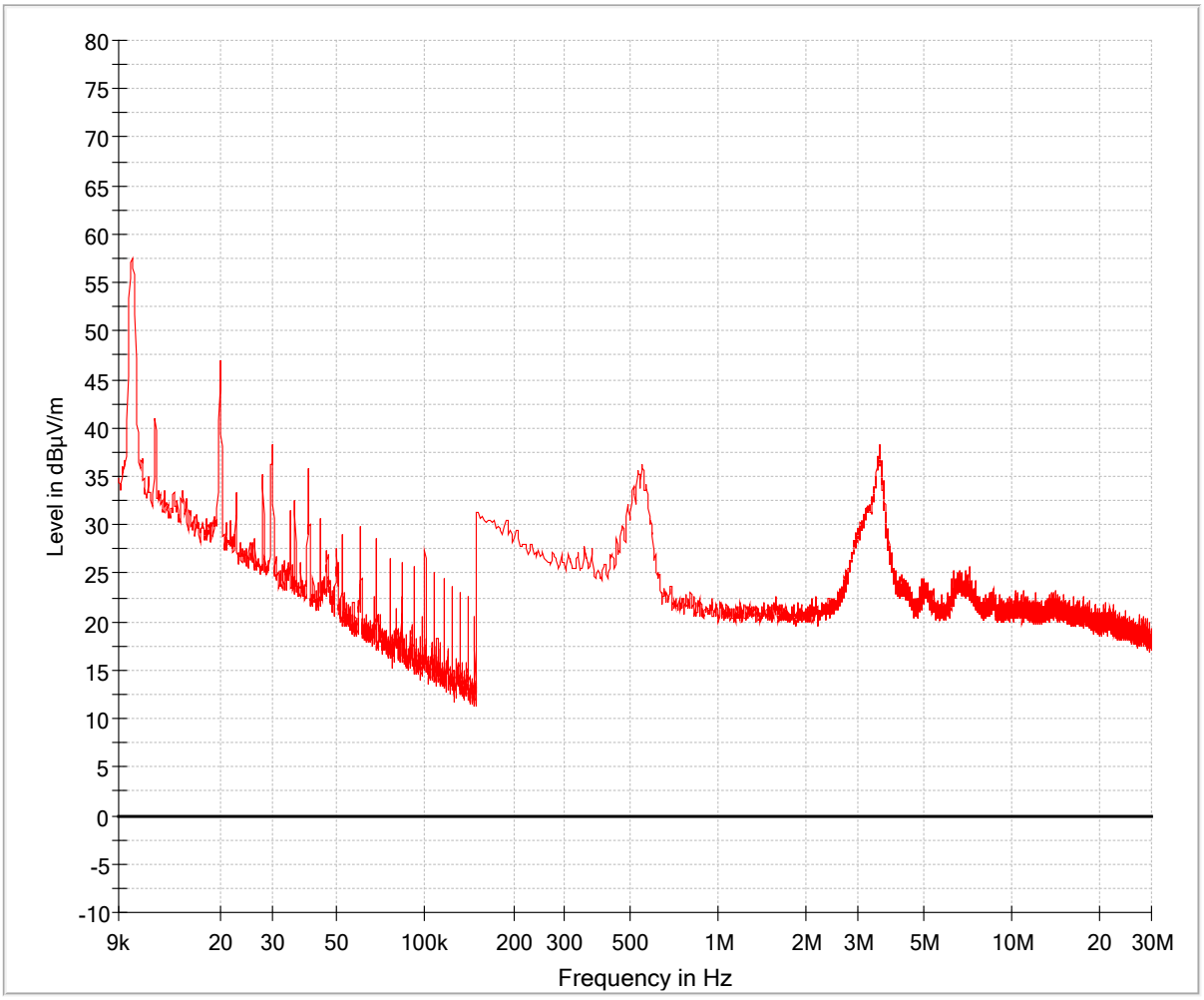
Messungen 9 kHz – 30MHz

Prüfling:	F-DYN4WD	Messplatz:	Absorberhalle Kabine 8
Auftraggeber:	maturo GmbH	Messentfernung:	3 m
Prüfdatum:	17.11.2011	Antennenhöhe:	1 m
Prüfaufbau:	Gekürzte Netzleitung intern verlegt und direkt am Drehtisch angeschlossen	Drehpositionen:	-17°, +163°
Betriebsart:	Stand by		



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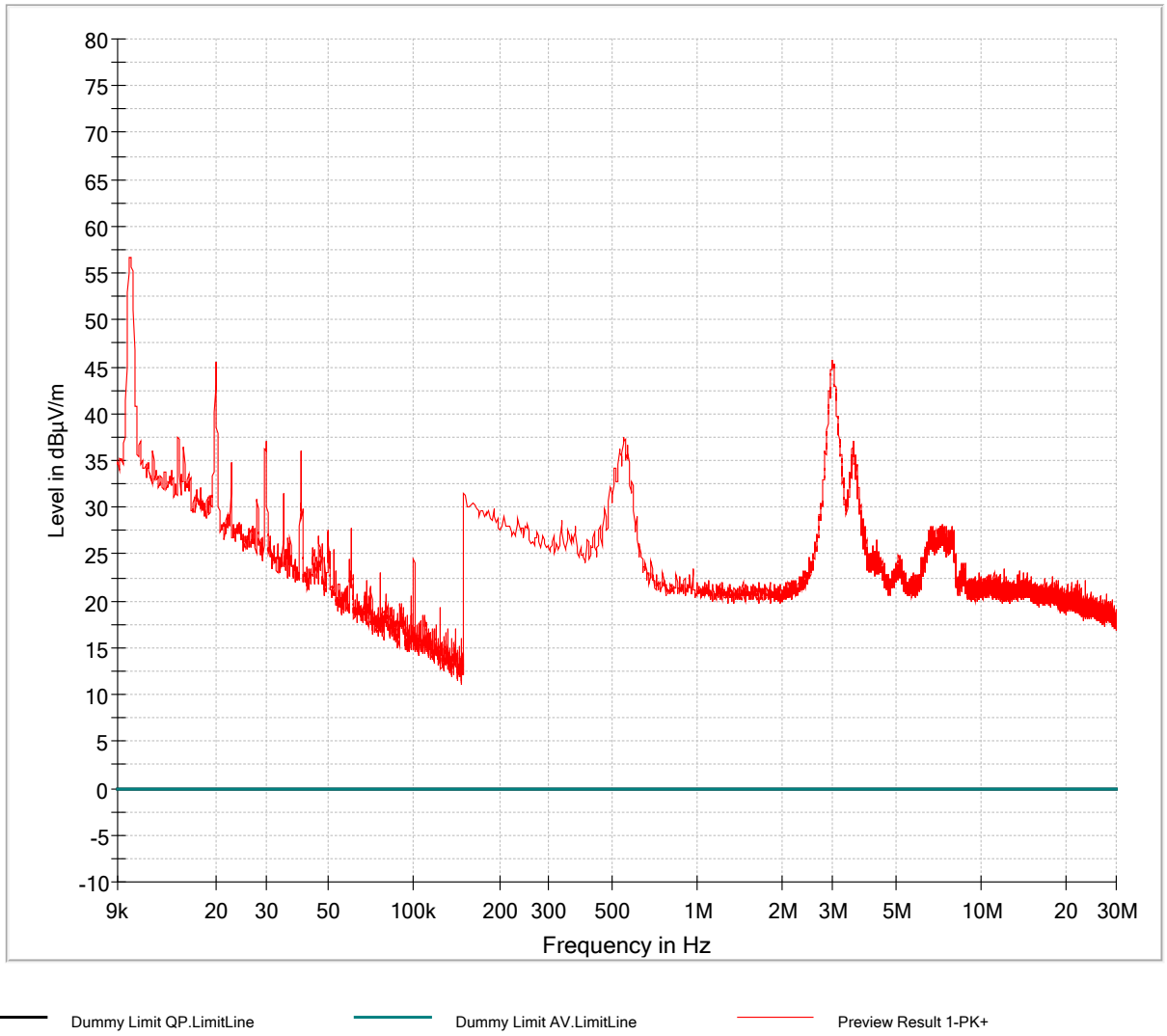
Prüfdatum:	17.11.2011	Antennenhöhe:	1 m
Prüfaufbau:	Gekürzte Netzleitung intern verlegt und direkt am Drehtisch angeschlossen	Drehpositionen:	-17°, +163°
Betriebsart:	50 km/h		



8) Interpretation of measurement results at TUEV Sued, Senton:

1) Measurement results from 30 MHz to 1 GHZ

The measurement results according to CISPR 12 show that our system does not exceed +5 dB compared to the ambient noise level of the chamber.

2) Measurement results from 9 kHz to 30 MHZ

In order to receive comparable results according to CISPR 12 with the measurements in the range from 30 MHz to 1 GHz, the measurements between 9 kHz to 30 MHz were also made at the electrical field strength dBµV/m.

The conversation factor from electrical to magnetic field strength (dBµA/m) is -51.5dB; this factor is valid for all frequencies.
E.g. 30dBµV/m means -21.5dBµA/m.

Additionally this measurement was carried out with a measurement distance of 3 m at an antenna height of 1 m. At the measurement between 30 MHz to 1 GHz the measurement distance was 10 m at an antenna height of 3 m.
This arrangement at the lower frequency range causes a higher electrical field strength of approx. 10 dB.

The band width between 9 to 150 kHz is different to higher frequencies, which causes additional more visible peaks in this range.

9) Magnetic field test results according to standard SAE J551-5-2004

The graph below shows the magnetic field test results from 9 KHz to 30 MHZ of a turntable with integrated active dynamometer at BYD, China

Standard: SAE J551-5-2004
Test Distance: 3m
Antenna Height: 1m
Antenna Polarization: Z
Dynamometer Status: 50km/h (all three axles run)

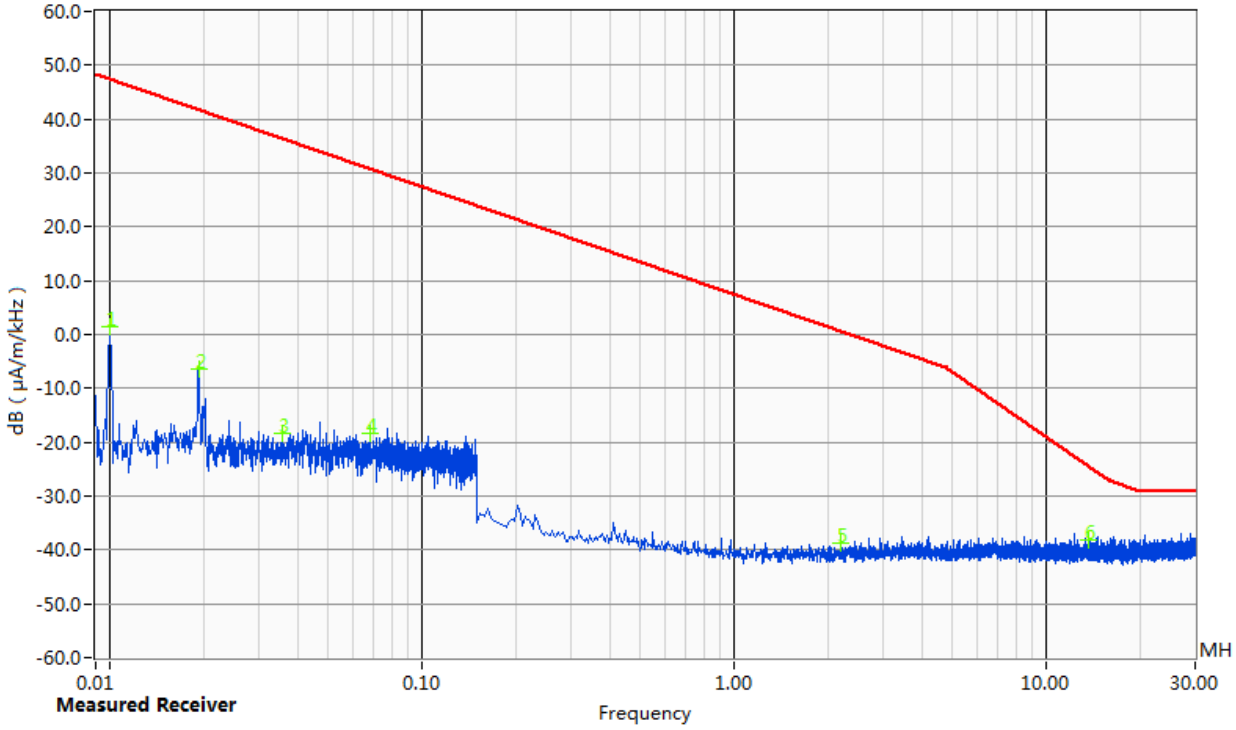


Figure B-3 （Magnetic field Test, PK detector, Z polarization, 9kHz～30MHz）

注： SAE J551-5-2004 -PK PK Curve + PK Point

10) Electric field test results according to standard SAE J551-5-2004

The graph below shows the electric field test results from 9 KHz to 30 MHZ of a turntable with integrated active dynamometer at BYD, China

Standard: SAE J551-5-2004
Test Distance: 3m
Antenna Height: 1m
Antenna Polarization: Vertical
Dynamometer Status: 50km/h (all three axles run)

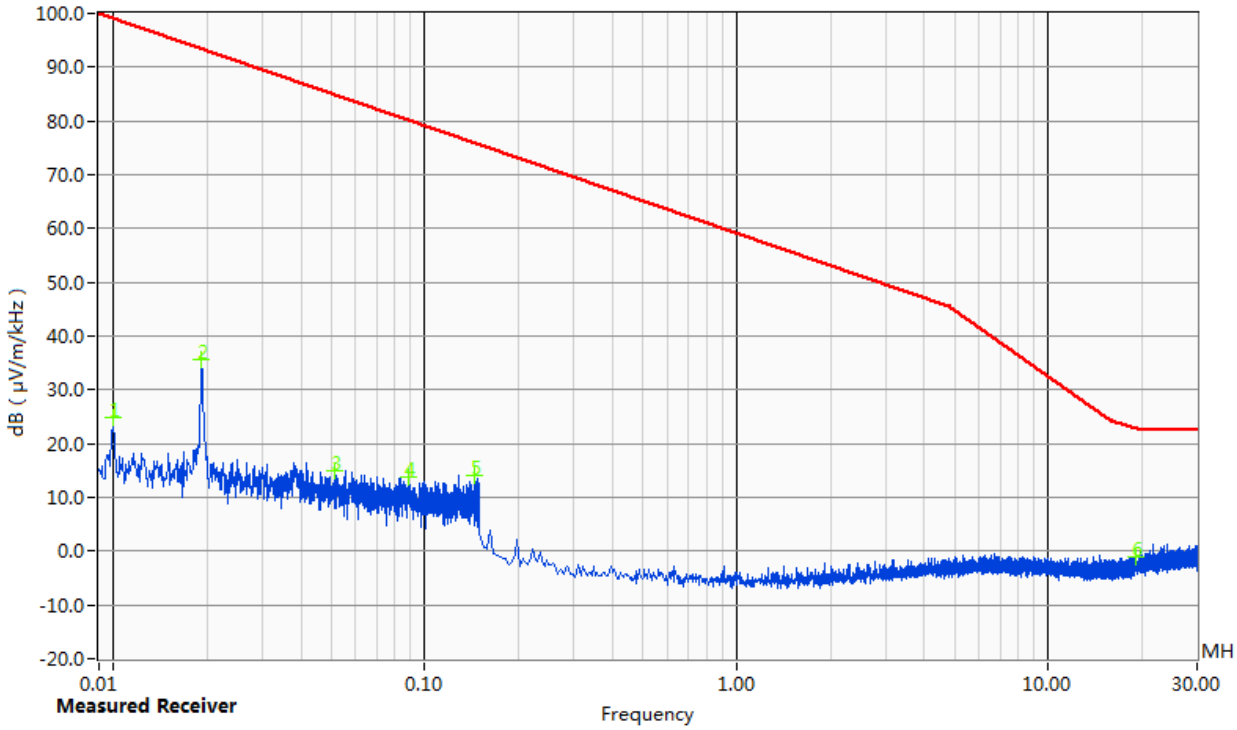


Figure B-4 （Electric field Test, PK detector, Vertical polarization, 9kHz～30MHz）

注： SAE J551-5-2004 -PK PK Curve + PK Point

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Notes