maturo GmbH
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Technical Description

Dynamometer DYN 6WD_I

Integrated into

Turntable TT 11.0-30t-DYN

Specifications:

- **Integrated dynamometer into turntable**
- **For use in anechoic chambers for EMI and EMC measurements**
- **3 active axles, for cars and busses with rear /front – or four wheel drive**
- **6 independently controllable roller pairs**
- **Independent rotation of dynamometer and turntable**
- **Various designs and specifications on customer request available**
- **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 6WD_I

Fig.: Turntable with integrated dynamometer at Nissan, USA

1.1) Technical Data:

Permissible axle load		15.000 kg (each axle)
Max speeds for cars with axle load of 1500 kg		150 km/h
for busses		100 km/h
Speed measurement accuracy	+/-	0.1 km/h
Wheel track between the front wheels		1000 to 2900 mm
Wheelbase between axles:		
Axle 1 to axle 2 (for 2 axle cars and small busses)		2200 mm – 5300 mm
Axle 1 to axle 3 (for 2 axle buses)		4100 mm – 6500 mm
Axle 2 to axle 3 (for 3 axle buses)		1200 mm – 1900 mm
Axle distance between axle 1 and 3	max.	8000 mm
Diameter car wheels	min.	400 mm
	max.	850 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		

Specifications: Active axles

6 Asynchrony Servomotors/-generators	each	44 kW (total 88 per axle)
6 Vector frequency inverter	each	100 A
Voltage/current consumption	6x	380-400 V/ 100 A/ 3phase
6 Break resistors cooled by fan		

Acceleration/ deceleration	max. 1.5g from 10 to 60 km/h (cars with axle load of 1500 kg) max. 1.0g from 10 to 100 km/h (busses) max. 0.5g from 100 to 150 km/h (cars with axle load of 1500 kg)

EMC Performances:

Emission:
More than 15 dB under the limits of CISPR 12 and CISPR 25

Frequency range	30 MHz – 1 GHz
Measurement distance	10 m

Emission, electrical:
More than 15 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:
More than 10 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 DYN 6WD_I is constructed as a chassis dynamometer, which can be integrated into a turntable. Three active elements are used for vehicles with rear/front or four-wheel drive as well as 3 axle vehicles. The six roller pairs are independently operational. Each vehicle wheel is driven by a separate motor/generator system. It can be used for acceleration/retardation and in an endurance mode.

EMI/EMC:
The Dynamometer DYN 4WD_I 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 more than 15 dB under limit “B” on CISPR 12 and CISPR 25. The immunity against continuous 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 or LAN interface for remote control with a measurement software.

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 motor power will be switched off and the motors come to a standstill.

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.
The surface of the rollers is comparable with road surface.
Balance quality: Q 2.5 according to VDI 2060

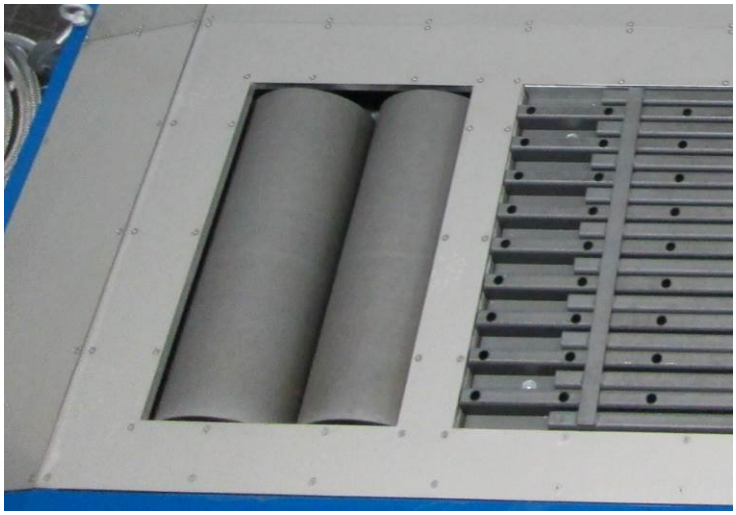
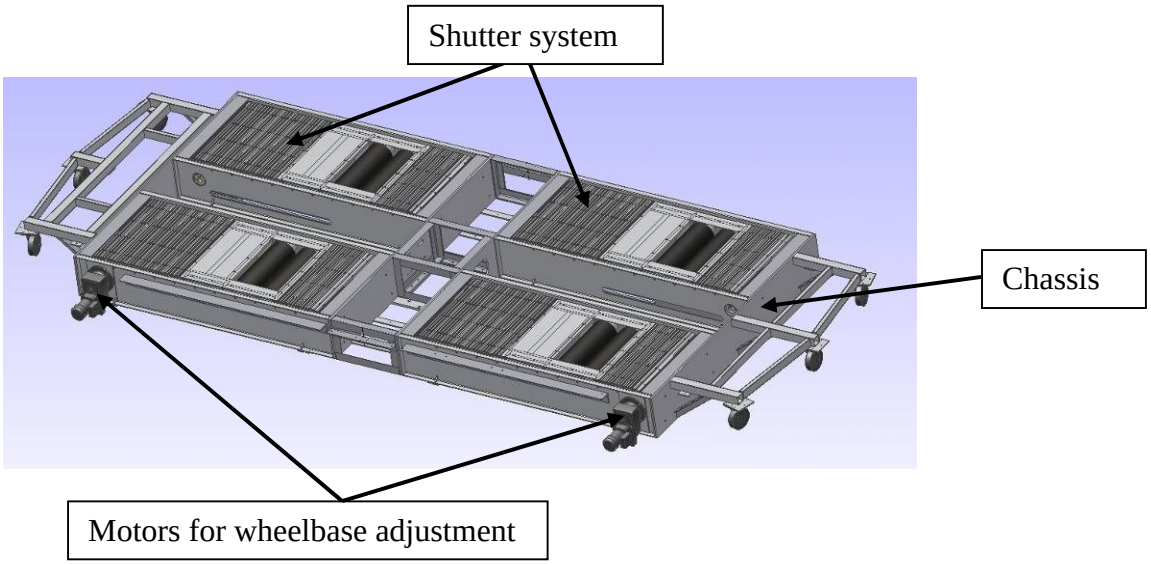


Fig.: Double roller system

ABS and ESP tests:
The dynamometer DYN 4WD allows ABS and ESP testing of vehicles up to an acceleration or deceleration of 1.5 g (15 m/s²).

Structure:
The 6 independent roller pairs of the dynamometer are integrated into a “self-contained” frame, which minimizes the dynamic energy output to the turntable.
The frame itself is placed into the turntable as pre-assembled assembly group for an easy installation of the system.



Wheel Base:
Independent adjustment of the front and rear axle allows to adjust the position of the vehicle in respect to the centre of the turntable.
Adjusting speed: approx. 20 mm/s
Positioning accuracy: +/- 2 mm
Operation of the wheel base adjustment is only possible at a standstill of the dynamometer.

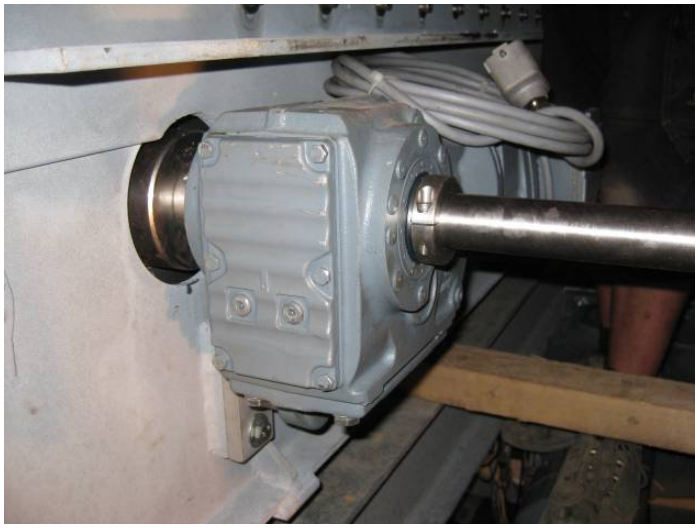


Fig.: Motor for wheelbase adjustment

Shutter system in track area:
An overlapping “roller-type shutter” connection between the axles avoid gaps at the surface in every position of the wheelbase.
Each element is connected with conductive material to the turntable surface and the next element. The max. permissible axle load in the track area is 15.000 kg.

Fig.: Shutter System

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


Fig.: Fixing system

Single-wheel drive for motorcycles testing:
The Dynamometer DYN 6WD 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.

Fig.: Testing of motorcycles

Cooling fan system:
Shielded fans provide a sufficient cooling for the tyres and the motor of the vehicle under test.
A removable plastic air scoop on top of the turntable is used to detour the airflow.
The fan speed can be set either stepwise to the roller speed (up to 60 km/h) or to a constant speed by the dyno software.
Installation of the cooling fans is below the cover
Wind speed: 60 km/h
Air flow: 10.000 m³/h

Fig.: Cooling fan system

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 1.5g
- 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)

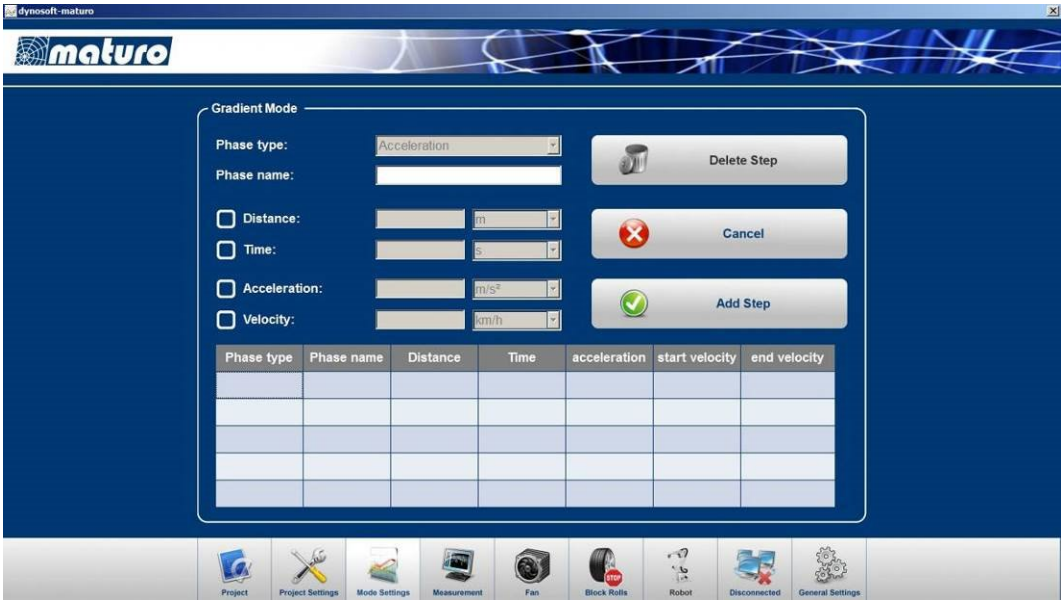
3.1) Operation modes:

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:

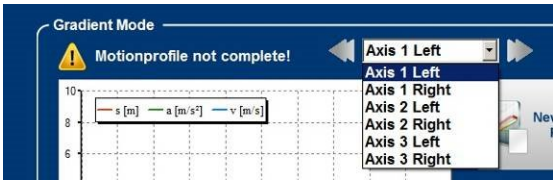
At the operating mode “ConVelo” it is possible to set a certain speed, acceleration and deceleration. These values are limited by the limits of the dynamometer or the limits of the used vehicle.



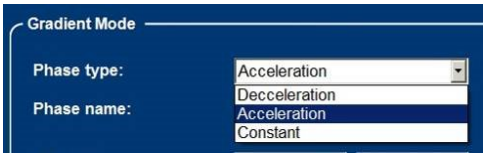
This mode can be activated with the “Start” key and stopped with the “Stop” key.
The current values of speed and torque are displayed for each motor.
The speed curve is displayed as a graph.

3.3) Gradient Mode:

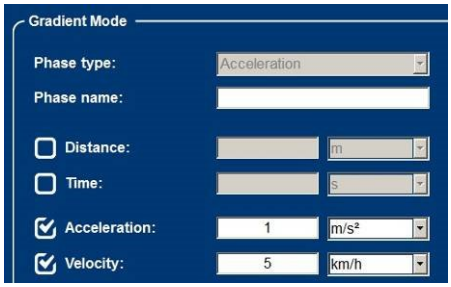
At this mode individual profiles for all wheels can be set and activated



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

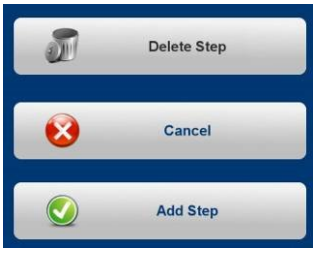


For each phase type certain start- and endpoints must be allocated.

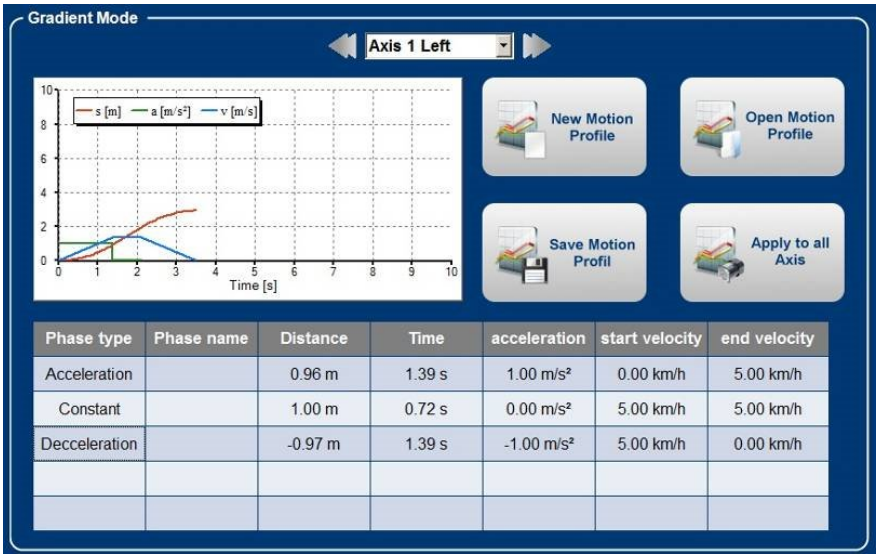


Acceleration/Deceleration
There are different possibilities of combinations. E.g. it is possible to set “Velocity” and “Acceleration” or “Distance” and “Time”. The program calculates in each case, according to the specific values, the parameters of the phase type.
In general there are always values at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

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

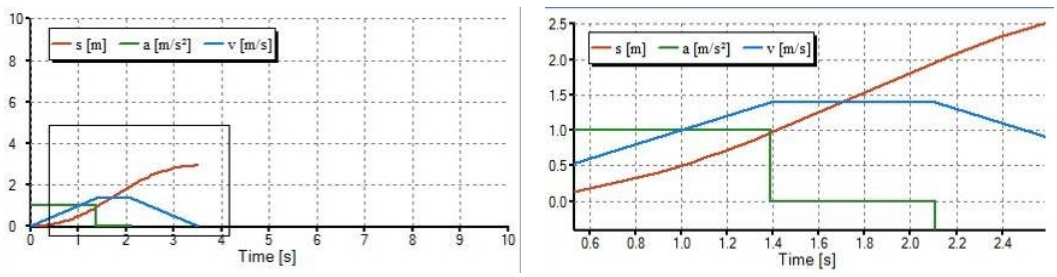


The created profile can be stored with “Save Motion Profile” and can be enabled again at each other profile or axle with “Open Motion Profile”.
With “Apply to all Axes” it is possible to transfer the current profile to all other motors with one step.



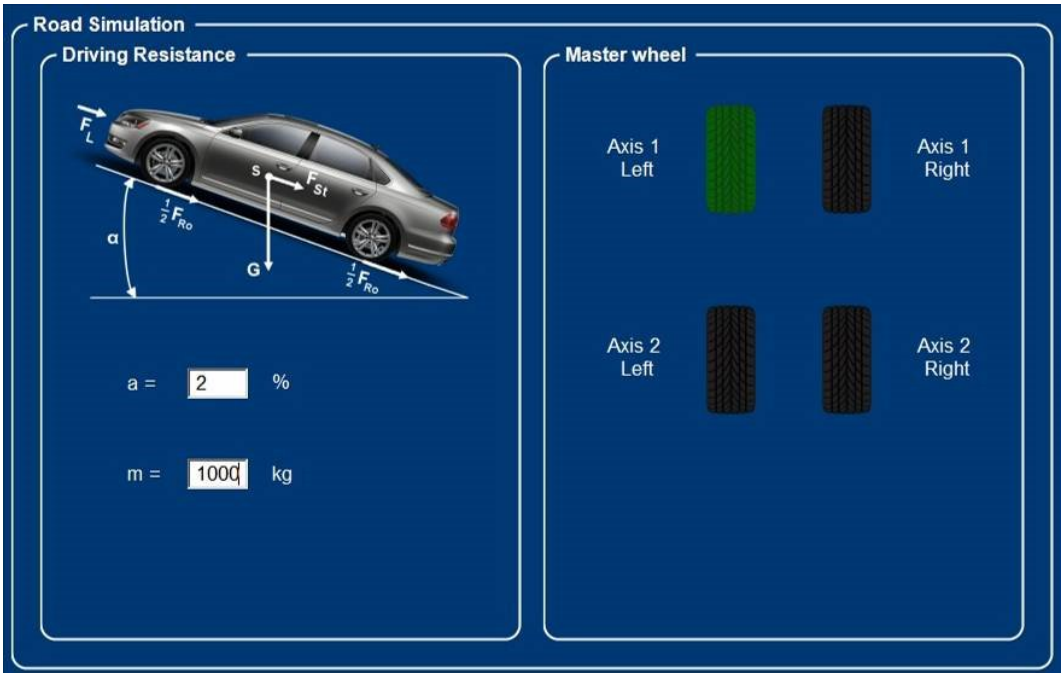
Phase type	Phase name	Distance	Time	acceleration	start velocity	end velocity
Acceleration		0.96 m	1.39 s	1.00 m/s²	0.00 km/h	5.00 km/h
Constant		1.00 m	0.72 s	0.00 m/s²	5.00 km/h	5.00 km/h
Decceleration		-0.97 m	1.39 s	-1.00 m/s²	5.00 km/h	0.00 km/h

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.

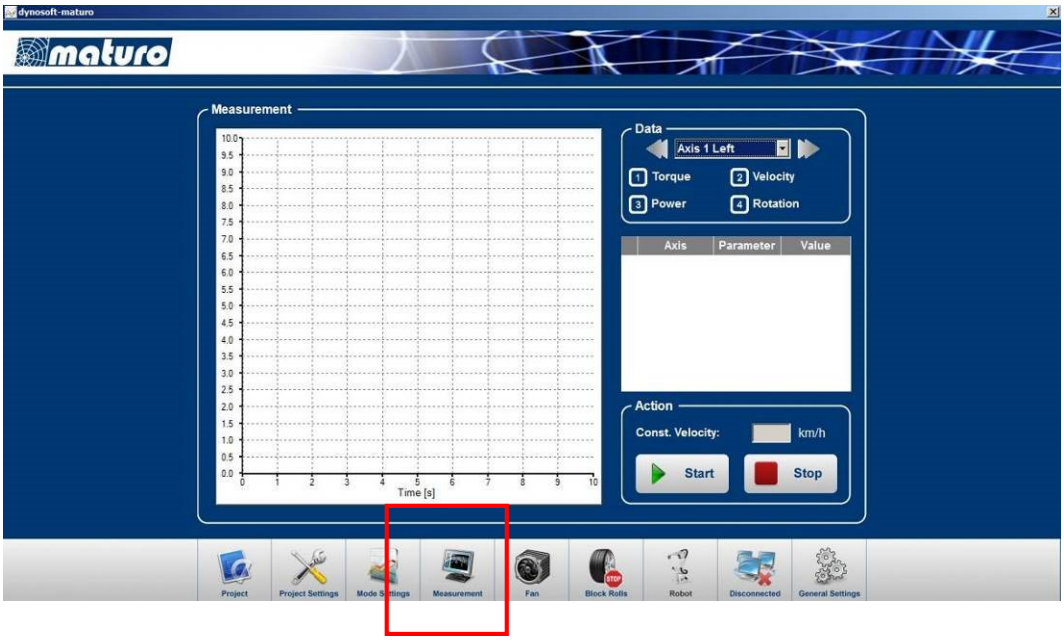
3.4) Road Simulation:



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.

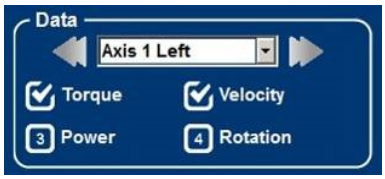
With the selection of the “Master wheel” it is determined which wheel is used as reference wheel for the speed transmission to the passive axles.

3.5) Measurement:



With this icon the measurement can be started.

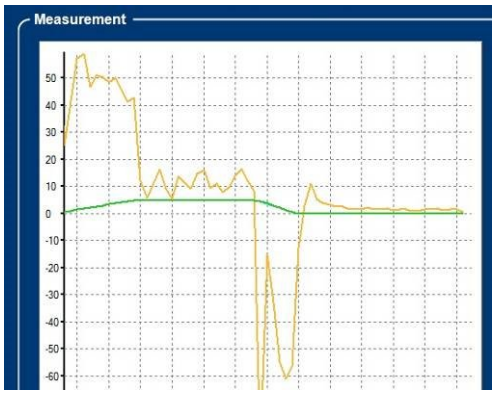
To control the current parameters of the dynamometer, all current parameters of the motors can be called up.
First select the individual motor by using the drop down menu or the arrow button.



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) Turntable TT 11.0-30t-DYN

4.1) Technical Data:

Diameter	11.0 m
Payload	30.000 kg (additional to dynamometer)
Point load	3.000 kg (at 300 x 200 mm) No other loads within an area of radius 1m
Height	2.5 m
Material cover plate	stainless steel
Rotating speed infinitely adjustable between	0.1 to 0.5 rpm
Positioning accuracy	+/- 0.5°
Rotating angle	+/- 200° or (0° to 400°)
Turntable drive	Helical-bevel gear
Motor	Servo motor, frequency inverter
Interference suppression:	20 dB under limits EN 55022 class B

Fig.: Drive unit assembly of turntable

Control cable		Plastic optical fibre cable 980/1000 µm
Attenuation of fibre cable		625 nm
Current consumption	max.	63A
Voltage, current consumption		380 - 400V, 50/60 Hz, 3-phase
Concentricity tolerance		+/- 3 mm
Elevation tolerance		less than 5 mm
Ground plane connecting every		50 mm
Square form environment (for easy connection to ground plane)		12.0 x 12.0 m
Temperature working range		+10 °C...+35 °C
Accessories		**Interface to NCD Controller** 1.5 m power supply cable Service manual

4.2) Brief description:

The turntable TT **11.0-30t-DYN** is especially designed for flush mounted installation at intermediate levels in electromagnetic absorption chambers. The framework design allows the possibility to integrate a chassis dynamometer.

A 380 mm diameter opening in the centre of the turntable provides the capability to insert power supply for testing.

The **IEEE 488.2 (GPIB) bus** provides an additional control option for all functions, when operated with the **NCD Controller.**

Movement:
The rotation of the turntable can also be carried out while the chassis dynamometer is in operation. The angle is measured by a position encoder.

Safety for EUT:
For the safety of the EUT, the turntable is equipped with an acceleration/deceleration function for start and stop ramps to avoid jerky movements

Emergency switch:
The turntable is equipped with an integrated emergency switch, which can be connected at the turntable perimeter.

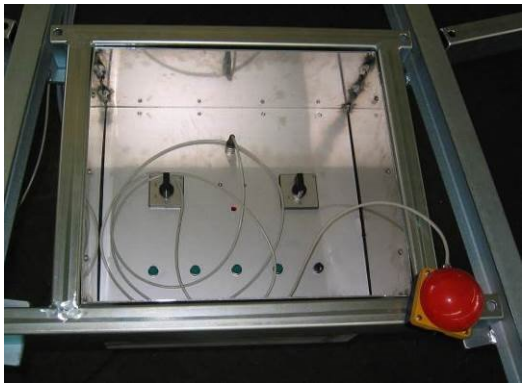


Fig.: Emergency Switch

Limit switches:
The turntable is equipped with a limit switch and positioning switch system to guarantee the exact positioning of the turntable. An “overturning” of the system is prevented by using limit switches.

Fig.: Limit switch system

Power supply in the centre of the turntable:
It is possible to integrate various types of connectors for the power supply of the EUT

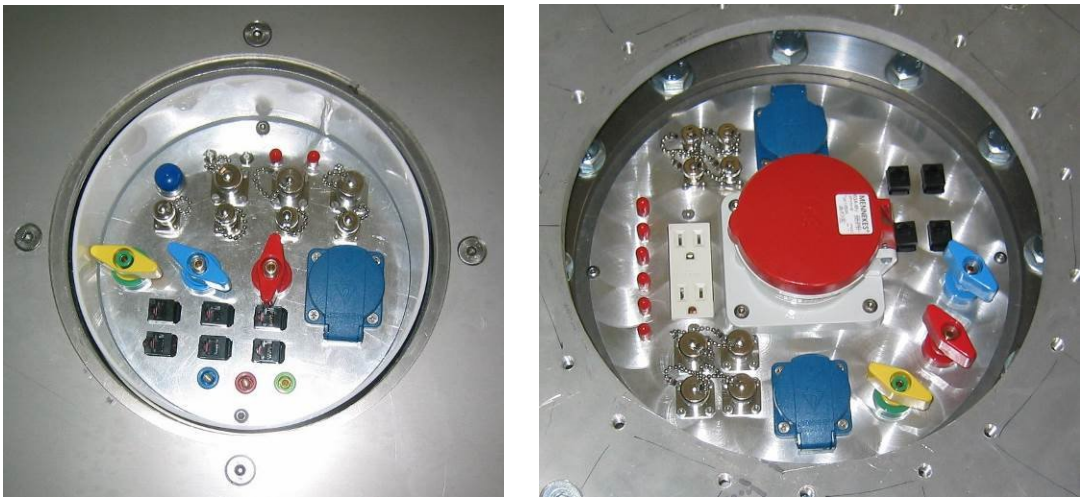


Fig.: Power supply in the centre for EUT

Connection to the ground plane:
There is a long-lasting, maintenance-free contact systems included:
Material: hollow core copper beryllium tubing

Fig.: Contact system between the turntables and to the ground plane

Heavy-duty roller bearing:
A heavy-duty roller bearing in the centre of the turntable supports high axial and radial loads.

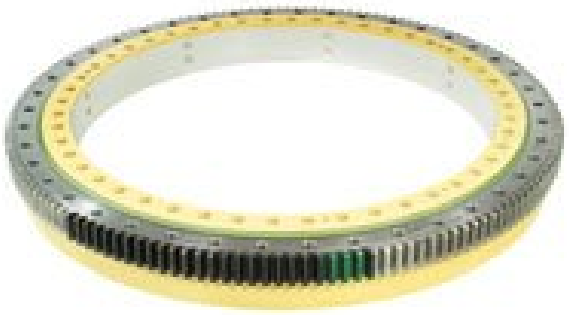


Fig.: Heavy-duty roller bearing

Heavy-duty castors:
Roller bearing heavy-duty castors at the turntable structure additionally support the high axial forces at the outer diameter of the turntable.

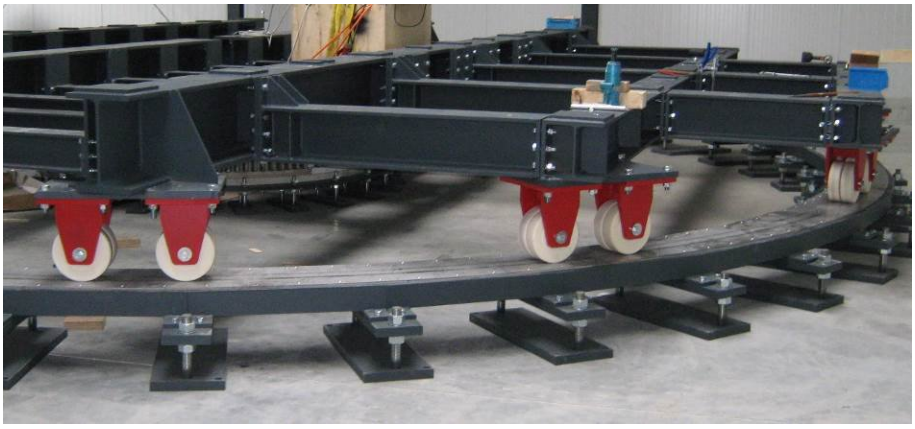


Fig.: Heavy-duty castors

Roller track:
The heavy-duty castors run along a height adjustable runway structure at the edge of the turntable.
The structure is made of a welded steel structure and a stainless steel runway for a low noise operation.

Fig.: Height adjustable runway

Turntable structure:
Solid welded steel construction; parts are assembled with screws (for easy transportation).
The complete structure is either pre-coated and painted or galvanised for long-lasting performance of the system.

Fig.: Turntable structure made of solid welded steel

Covering and tolerances:
The covering is made of stainless steel, the gap between the turntable and the ground plane less than 5 mm.
The radial run out is within a tolerance of +/- 3 mm.
The height differences are within a range of 10 mm or better.

Fig.: Stainless steel cover plates

Service hatch:
There is a service hatch at the rim of the turntable, which allows easy access above the turntable for maintenance works. The opening is covered with a removable stainless steel cover and is equipped with a ladder.
Size: approx. 0.8 m x 0.8 m

Fig.: Service hatch

5) Noise measurement result of system

5.1 According to CISPR 12 Standard

The graph below shows the EMC test results from 30 MHz to 1 GHZ of a turntable with integrated active dynamometer at Nissan, USA

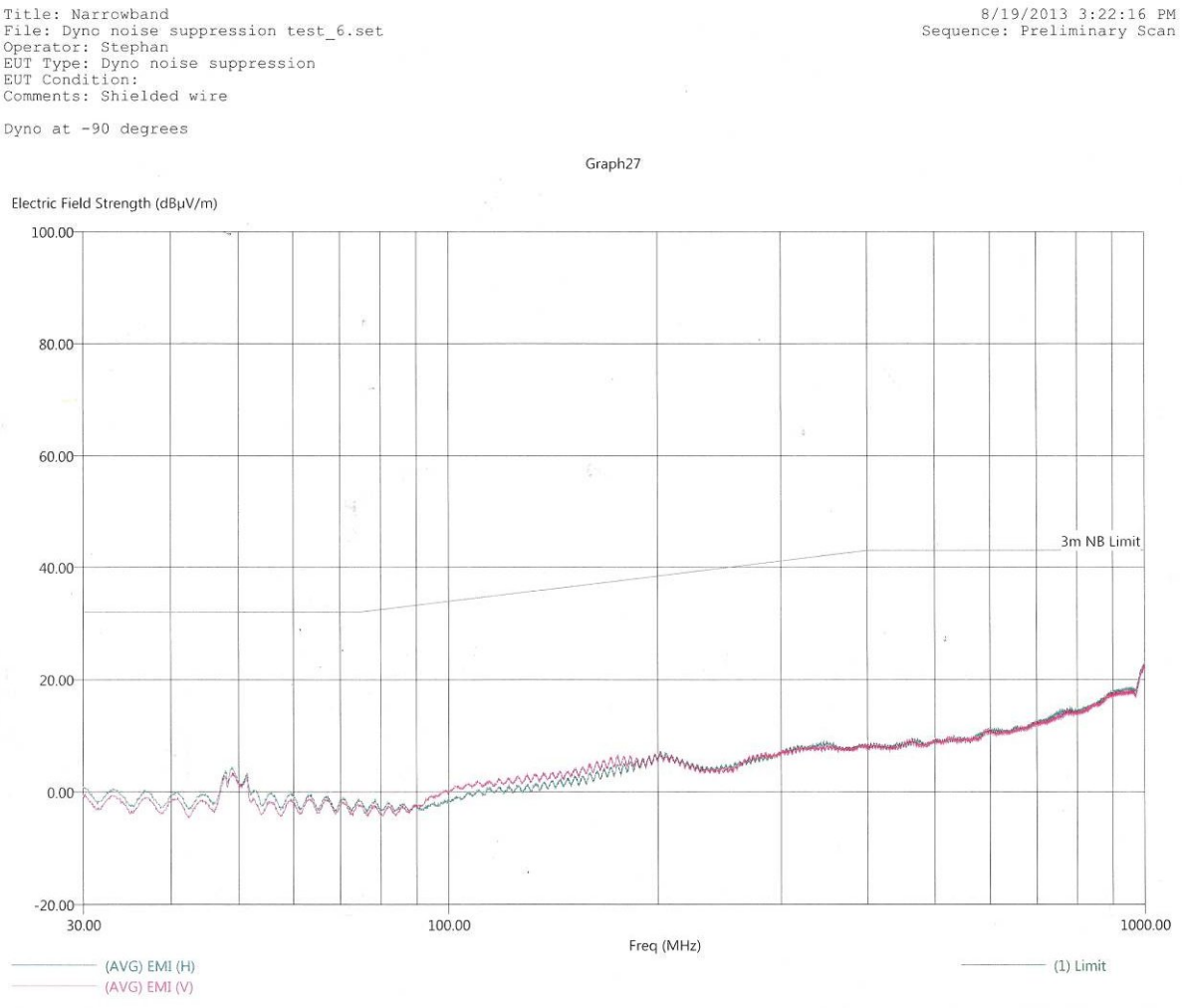


Fig.: EMC measurement of turntable with integrated dynamometer

5.2 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)

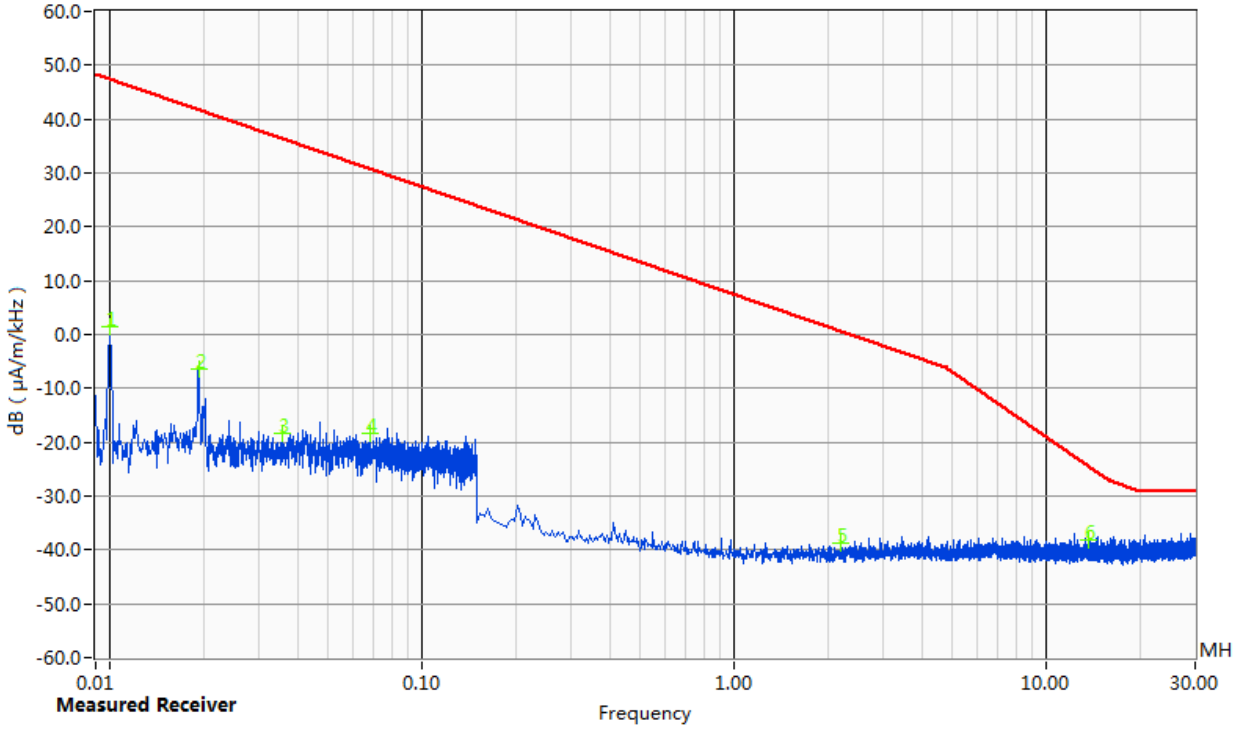


Figure B-3 （Magnetic field Test, PK detector, Z polarization, 9kHz～30MHz）

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

5.3 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)

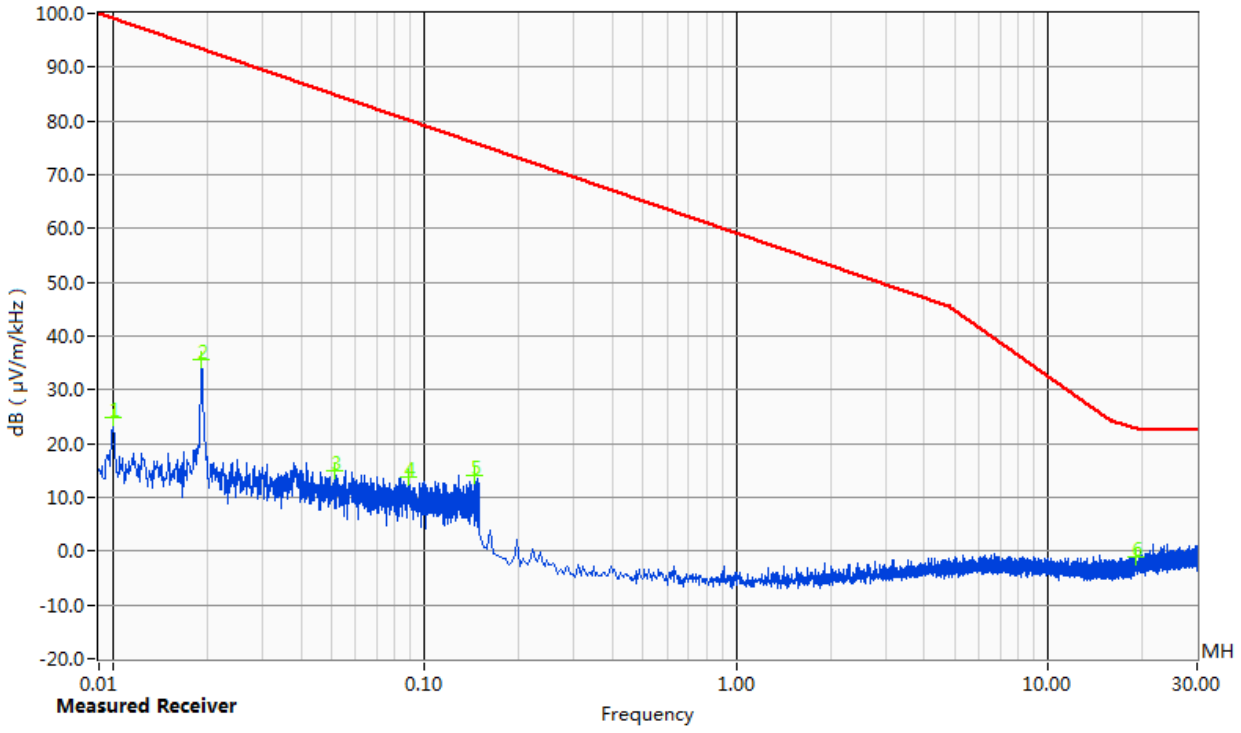


Figure B-4 （Electric field Test, PK detector, Vertical polarization, 9kHz～30MHz）

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

6) Utility requirements for the system

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

- 6x 380-400 V/ 3-phase / 100 Amps (total 600 Amps are required)
  For the dynamometer
- 1x 380-400 V/ 3-phase / 63 Amps
  For the turntable
- 1x 380-400 V/ 3-phase/ 32 Amps
  For the cooling fan system

6.2) Pit requirement:

- Dimensions: 11900 x 11900 mm (L x W)
- Depth: 2500 mm
- Loading capacity: 7000 kg/m²

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

6.4) Exhaust extraction:
Connection tube with honeycomb in the shielded wall for connection of the exhaust hose
Dimension needs to be discussed

6.5) Compressed air:
For pneumatic Antenna Mast and optional in combination with a robot

The requirement for compressed air is as follows:
- Air pressure: 6 bars
- Capacity: approx. 0.4 m³/h

7) Exhaust extraction system:

The exhaust extractions system includes the following components:

- Movable exhaust pipes mounted above the cover; the pipe is attached rear left and rear right to the vehicle area
- Fixed exhaust pipe fixed underneath the cover; provided up to the honeycomb in the shielded wall of the pit
- Adapters to connect the exhaust pipe to the honeycomb

Fig.: Principle of exhaust gas extraction system

8) Option: Power supply for EUT:

The state-of-the-art energy chain is equipped with wheels and rollers at the bottom and the side walls for a smooth and low-maintenance running.

The power supply for the EUT is distributed by an energy chain (movable cable duct) to the connection boxes (access panels). The access panels are located at the perimeter of the turntable for easy access. Power supply outside the turntable centre provided by 2 access panels with a size of approx. 0.4 m x 0.3 m.
It is possible to integrate various types of sockets and connectors for the power supply of the EUT.

Fig.: Principle of energy chain

9) 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.

10) Controller NCD

The Multiple Control Device **NCD** is suited for the operation of up to 8 devices with multiple axis of motion. Those devices can be any combinations of antenna masts, turntables, cable guide rails or any other positioning equipment.

This controller NCD permits the operation in manual, semi-automatic and remote control mode via IEEE 488.2 (GPIB bus), or optionally other interfaces, of multiple devices simultaneously.

Fig.: NCD with option “tip-up handle”

10.1) Technical Data

Data interfaces		IEEE 488.2 (GPIB-Bus) and Ethernet (Optional available: USB, RS232, etc.)
Transmission		Fibre optic cable (up to 2000 m distance)
Transfer rate		Real time 100 Mbit/s (fast Ethernet)
Display		5.7“ TFT Touch screen-Display
Voltage		100-240 VAC, 47-63 Hz, single phase
Current consumption	max.	70W
Fuse		2x T 0.63A
Size (W X D)		19” Rack mount and table unit (427 x 300 mm) (Optional with tip-up carry handle)
Height		3 HE (133 mm)
Temperature range		5°C - 40°C
Total weight	approx.	8 kg
Accessories		1.5 m power supply cable, Service manual

10.2) Brief description of NCD

The multiple control device NCD works with Agilent, R&S, Teseq and other software. The IEEE 488 (GPIB) is available as a standard interface device. Other interfaces available upon request.

- **User-friendly, time-saving function keys**
  The function keys F1 to F10 allows the implementation of individual, customer-specific sequence programs for user-friendly, times-saving handling and operation. The individual programs can be stored and accessed by one function key.

- **Error analysis based on error codes**
  Diagnosis via USB interface possible
  Optional analysis via internet and Ethernet interface possible

- **USB interface**
  Updates easily implemented by USB stick
  Possibility to plug in a computer mouse and keyboard

- **Easy operation with touch panel**
  Fast and reliable operability based on touch panel technology
  Layout of touch screen display can easily be adjusted according to customers' request

- **Position keys**
  With the position keys Up/DOWN, CW/CCW and VER/HOR the positioners can easily be moved in manual mode.

- **Real-time capable**
  Each program cycle will finished in the default time frame be no matter how many devices are controlled at the same time. Due to this feature no overflow of commands can happen when using fast remote computers.

- **Handheld control unit**
  Easy implementation of standard or customer-specific handheld control units possible

- **Precise Display Accuracy**
  The display resolution is highly precise with position readout increments of 1 mm respectively 0.1 degree.
  Higher resolutions possible upon request.

- **PLC-Update**
  It is possible to update the Software of the Controller easily via the USB port.
  maturo can provide a new boot project, if required, which can be copied to an USB stick.

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Notes