

# EMEC PROTOTYPING



Development Test Bench for Test and Evaluation of MDU- and HUB-Motors

- DIN EN 15194
- Le1
- Dynamic
- Flexible
- Scalable



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# System Test of electric Bicycles

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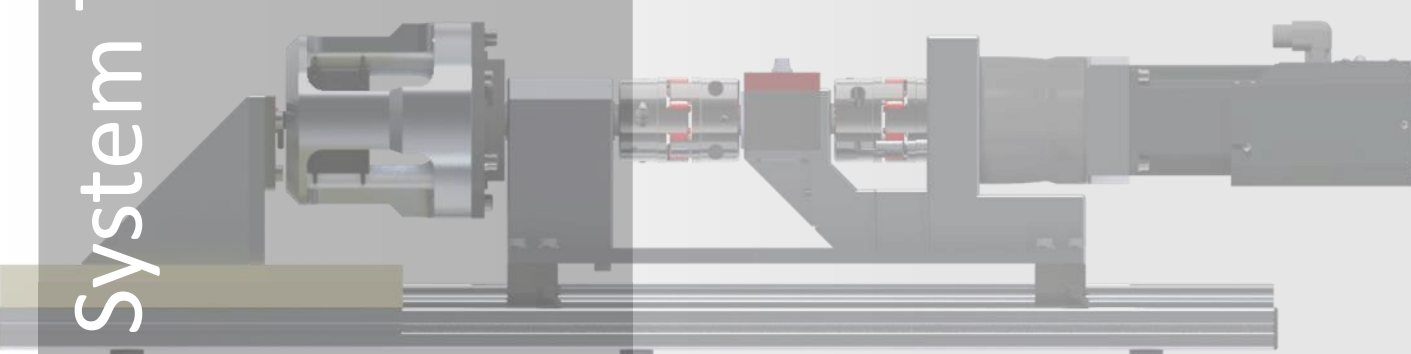
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## Introduction



The most important indicators in the concept phase, the planning and development of electric bicycles are quality and safety. Due to the short development cycles, a high degree of flexibility in testing and verification is required. The Development Test Bench is compact and built on industry standards. It allows you to perform a reliable and comprehensive review and analysis of your quality requirements and the applicable safety standards of e-bikes, pedelecs and S-pedelecs.

EMEC Prototyping offers you a highly dynamic, adaptive and scalable system test that grows with your needs along the value chain.

## Range of Application

- Determining the Range/Efficiency Measurement
- Check of max. support performance to EPAC-Norm
- Determining of the power curve
- Investigation of overheating behavior under high load (driving uphill)
- Test for quality assurance / Research & Development
- Implementation of dealer/customer feedback
- Verification & Assurance of safety standard **DIN EN 15194**

## Deployment Scenarios

Full automated test cycles are possible

Checking the Performance of Pedelec Motors

Laboratory and Development Tests



## Technical Design

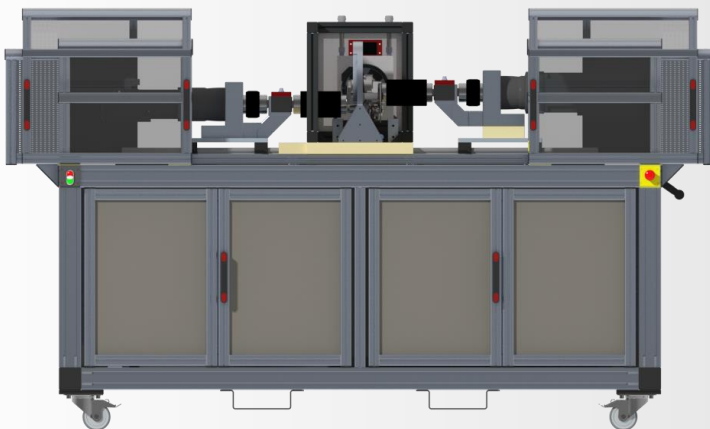


### Hardware of the Basic configuration

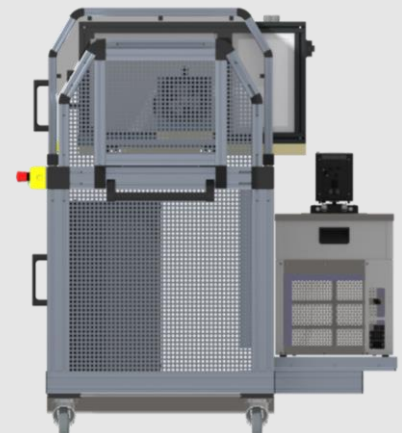
The motor test bench was developed for detailed testing of e-bike motor units. Tests during development, endurance and tests to check the fatigue strength, as well as tests as part of the quality process can be performed.

The test bench is controlled by a PC integrated in the control cabinet. This simultaneously records the internal drive measured values. The test bench is further equipped with several independent measuring shafts for recording torque and speed as well as temperature sensors. All measured values are recorded and logged via the control computer.

View: front



View: side right



Dimensions of test bench  
(max.)

Height: 1.500 mm  
Lenght: 2.530 mm  
Width: 1.300 mm

Hardware being used

Frame: item, Kamp & Kötter, igus and much more  
Control Cabinet: Rittal, Siemens, Block, Phoenix and much more  
Servodrives: Beckhoff or Fanuc  
Control: Beckhoff  
Measurement: ETH, Burster and much more



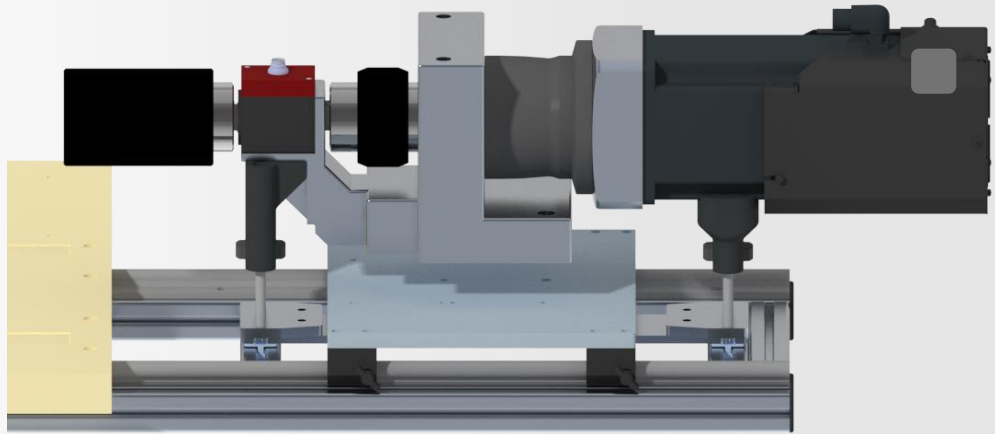
## Technical Design

### Brake Unit

Rated torque: 150 Nm  
Rated speed: 300 rpm  
Max. velocity (20" Wheel Size): 30 km/h  
Rated Power: 4500 W

Servodrive: Beckhoff or Fanuc  
Torque Measurement: ETH Messtechnik

Movable in X- direction  
Coupling with adapter for connecting the HUB-Motor



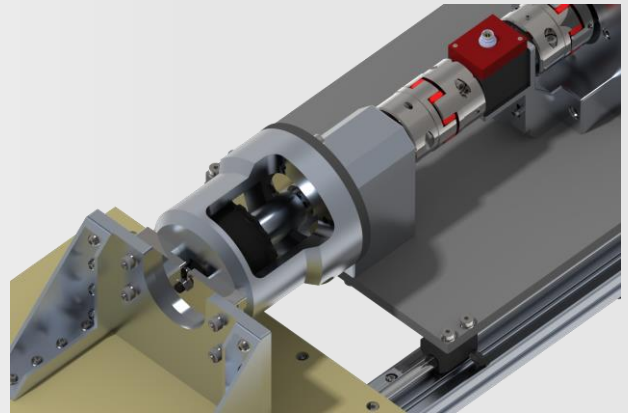
## Technical Design



### Assembly Kit Type I Cable left side

The assembly Kit Type I consists of:

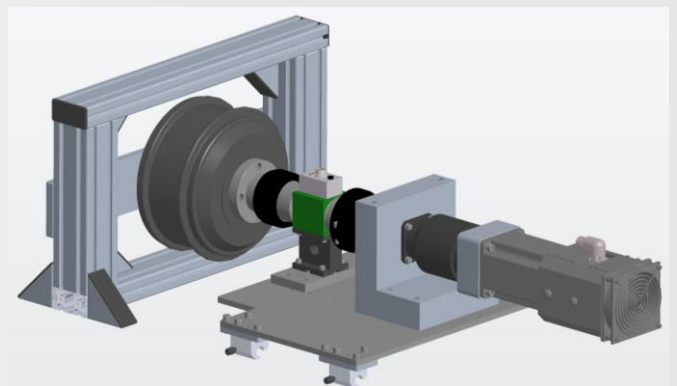
- Torque support
- Flange plate for centring on the cassette of the motor
- Disc brake bracket for attaching the motor to the brake unit



### Assembly Kit Type II Cable right side

The assembly Kit Type II consists of:

- Torque support
- Flange plate for centring on the brake disc flang of the motor
- Coupling to connect to the Brake Unit



## Technical Design

### Sensorics

#### Mechanical Measurements

- Torque Sensor
- 1x Torque Sensor for the brake unit
  - Precision of 0,1 % of max. value
  - Resolution of 16 bit  $\pm$  0,38 mV

- Speed Sensor
- 1x Speed sensor encoder per Servodrive
  - 2048 increments per rotation
  - Angle resolution of 0,175 °

#### Electrical Measurements

- Current Sensor
- 1x Current Sensor
  - Precision of 1 % of max. value (higher available)
  - Resolution of 0,1 A

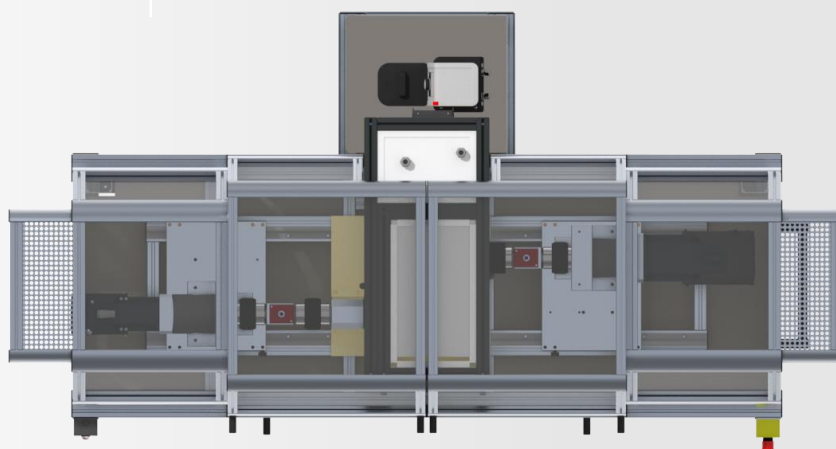
- Voltage Sensor
- 1x Speed sensor encoder per Servodrive
  - Precision of 1 % of max. value (higher available)
  - Resolution of 0,1 V

#### Temperature Measurement

- Temperature Sensor
- 4x Temperature Sensors
  - Type PT1000
  - Type K

#### Safety

- Safety Sensor
- non-contact contact switch for working area



View: top

## Software



Description **Laboratory and Development**

Requirement User-specific adjustment possibilities of all parameters like:

- Velocity
- Power Brake unit

Analysis

- Storage of measured data in .csv-files
- Loading stimulus .csv-file for predefined test profiles
- Display of measurement values in user interface





## User Interface

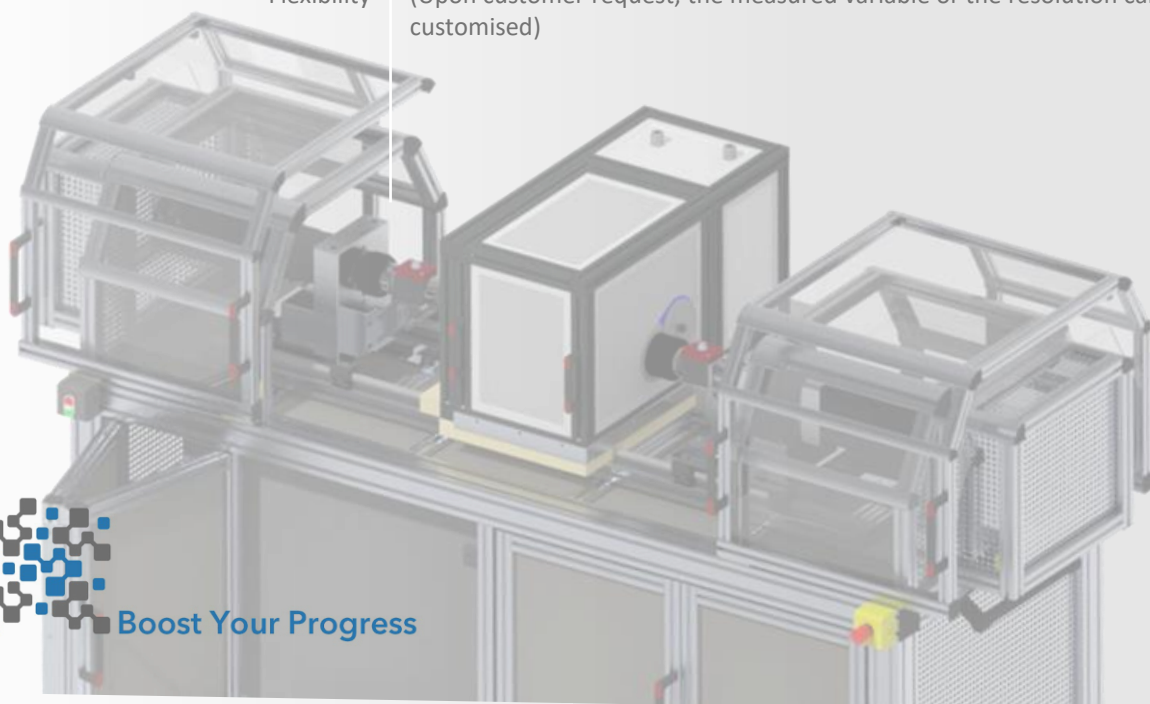
The screenshot displays the E-Mobility E-Bike Profstand user interface. Key components include:

- Header:** Logo placeholder and 'EMEC Boost Your Progress' branding.
- Control Panel:** A digital timer showing 0:2:53 (h:min:s), a 'Remaining Time' progress bar, and 'Supply' status (Activated, Voltage: 0.00 V).
- Temperatures:** Four temperature readouts (Temp 1-4) ranging from 24.80 to 25.20.
- State:** Three indicator lights for Emergency Stop (green), Light-barrier (green), and Motor enabled (red).
- Target Velocity:** Sliders for 'Const. Velo.' (25 km/h) and 'Dyn. Model' (45 km/h), and a 'Powered Axle' dropdown.
- Servomotor Teach-In:** Position (%) control and teach-in buttons.
- Test Mode:** A dropdown menu set to 'Direct' and a stimulus file path.
- Start/Stop:** Large green 'Start' and red 'Stop' buttons.
- Plot Legend:** Legend for Torque Pedal (blue), Cadence Pedal (green), and Power Pedal (red).
- Road Section:** Parameters for Gravity (Mass Driver, Mass Vehicle, Additional Mass, Inertia Wheel, Increase %), Drag (Drag Coefficient, Air Density, Frontal Surface, Relative Wind), and Rolling Resistance (Cwmatc, RRC, Perimeter Wheel).
- Rider Section:** Target Power Motor (W), Torque Drive (Nm), Torque Modulation, Backpedal Torque (Nm), and Backpedal.
- Plot Area:** A graph showing Torque, Cadence, and Power over time (0-120s).



## Measured Quantities

Drive Torque	Resolution : 0,1 Nm	
Drive rotational speed	Resolution: 0,1 rpm	
Drive Power	[W]	
Brake force (rear wheel)	[N]	
Battery current	[A]	
Pedelec Voltage	[V]	
Pedelec Power Output	[W]	
Actual Pedelec Efficiency Drive Unit (calculated)	%	
Temperature	In °C, °F or K	
Pedelec Drive Torque	At rear wheel in the basic configuration. Calculated with input specification Instantaneous and r.m.s. value (selectable)	
System friction	Calculated with calibration routine, effective value	
Drive Total Distance	Remains saved after switching off the system, manually resettable	
Driven Tour Distance	Auto-reset at system reboot, or manually reset	
Flexibility	(Upon customer request, the measured variable or the resolution can be customised)	



## Additional Add-Ons, Mechanical



### General Add-Ons

A.1

Drive Unit for  
pedalling torque

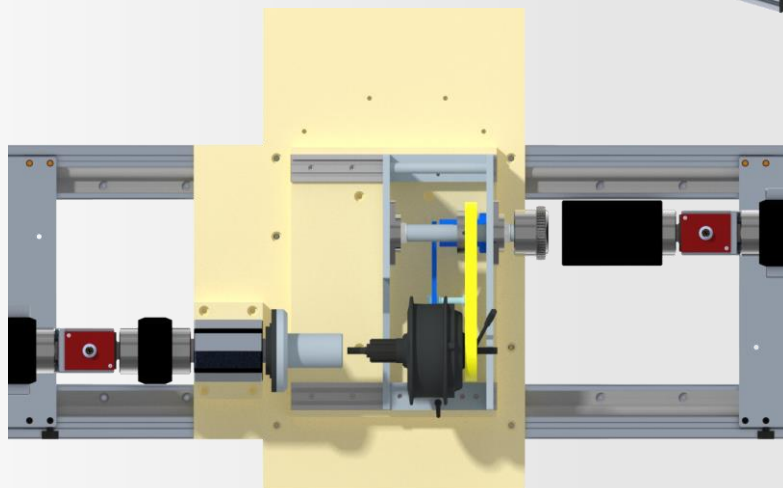
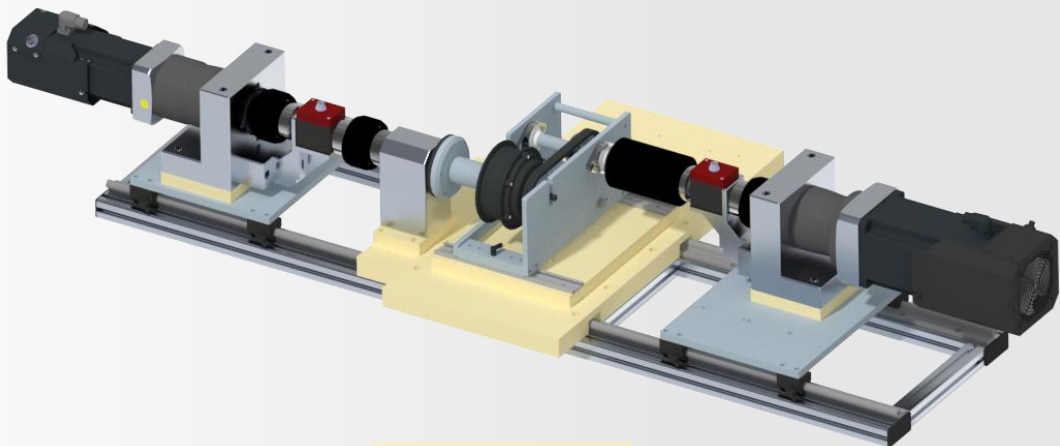
Rated torque: 150 Nm  
Rated speed: 150 rpm  
Rated Power: 1885 W

Servodrive: Beckhoff or Fanuc  
Torque Measurement: ETH Messtechnik

Movable in X- direction

Drive by chain or belt

Coupling with adapter for connecting the HUB-Motor

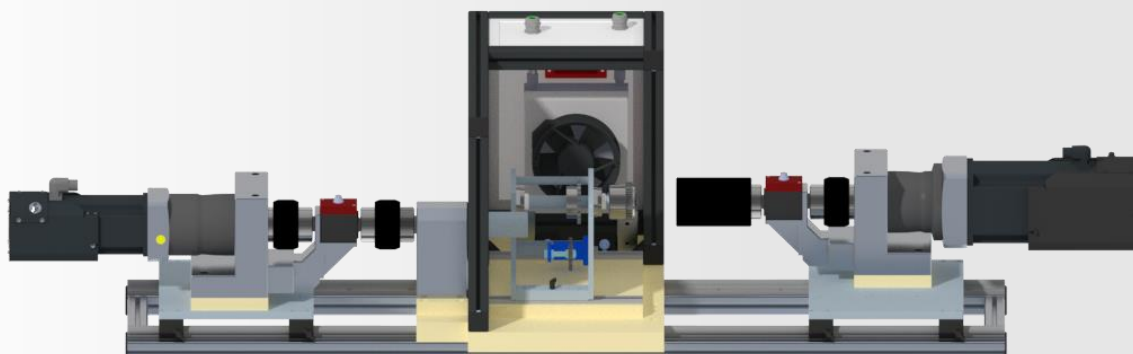
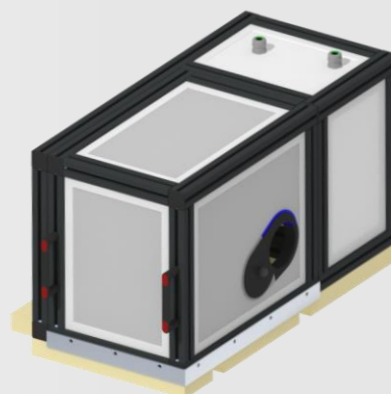


## Additional Add-Ons, Mechanical

### General Add-Ons

A.2 Assembly Kit | Assembly Kit Type I or Assembly Kit Type II

A.3 Climate Chamber | Integration of a climate chamber to simulate temperature between  
- 10 to + 60 °C  
- Simple disassembly and assembly  
- For with and without Drive Unit



## Additional Add-Ons, Mechanical

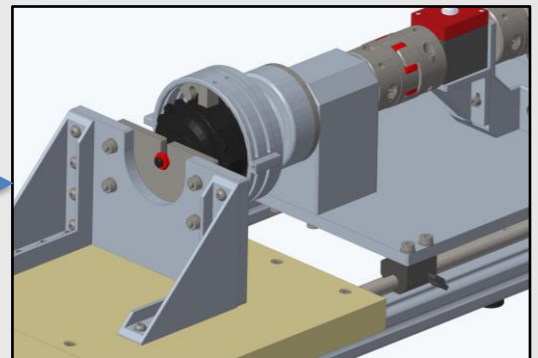
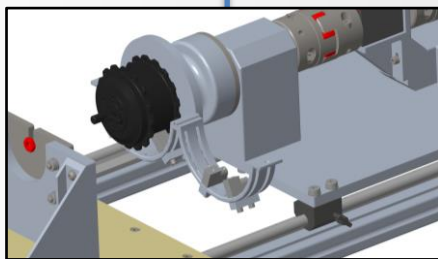
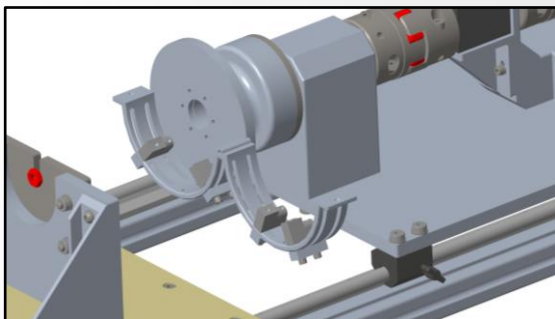
### General Add-Ons

A.4

EoL Extension

Integration of a Quick-Change-System for simple set up the test bench

- Quick-Change-System for the HUB-Motor of the Customer
- Automatically starting test cycle after setting up the test bench
- Possibility to switch between EoL user interface and development user interface



A.4.1





S-Pedelec / WMTC

Extension Fully automated EoL Test bench

- Automated fixing and placement mechanism (electrical or pneumatic) from the storage
- Hub motor storage outside the testbench
- Good and Fail motor storage outside the testbench
- Automated wiring of the Hub motor inside

## Additional Add-Ons, Software

### Software Add-Ons

- |     |                          |  |   |
|-----|--------------------------|--|---|
| C.1 | User Interface           | User interface can be customised according to the customer's requirements and corporate design.  |    |
| C.2 | Automatic Operations     | Automatic running with predefined tests according to DIN EN 15194<br>It's also possible to create automatic operations according to customer requirements. |    |
| C.3 | Automatic Protocol Creat | After running a predefined test according to DIN EN 15194 a protocol is created which includes all relevant measurements and diagrams                      |  |
| C.4 | CAN Communication        | CAN interface for listen to CAN and send to CAN  |  |
| C.5 | I/O's                    | Analogue and digital inputs and outputs that can be switched via the user interface  |   |

## Additional Add-Ons, Service

### Service Add-Ons

#### D.1 DAKS Calibration of the Measuremet Equipment

Calibration of the measurement technology according to the “Deutsche Akkreditierstelle” DakKS. All sensor types are possible.

- Torque sensor
- Current sensor
- Voltage sensor
- Temperature sensor
- Load cells



#### D.2 Service outside warranty

EMEC engineer is working on site

#### D.3 Support remote

EMEC engineer is working remote on the your test bench and help you to fix problems or makes customer-specific changes to the user interface or software.

## More of EMEC Prototyping

### Customer requests

If you have any other requests or suggestions to add to our portfolio, please do not hesitate to contact us. We can respond to most of our customers' wishes and solve your problems concerning pedelec test.

### Updates



- Roller Dynamometer for Pedelecs and S-Pedelecs
- Components test bench for all tests of DIN EN 19154 and ISO 4210
- EoL test Battery test rig with charge/stop cycles monitoring
- CAN-Bus evaluation as HiL – test rig

### Range of Services

- Test bench rental
- Test services in our test lab on our motor test rig and roller dynamometer or components test bench
- EMC-measurement of complete systems with our partner
- Drive benchmark test
- Real test drives for practical testing
- Environmental test systems
- Custom test setups



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