

Test cell # 2: AVL PUMA test system equipped with following measurement and control modules.

Speed and torque control.

Load unit	Measurement range	Accuracy
Zöllner eddy current dynamometer	0 – 500 kW from 2400 – 8000 RPM 0 – 2000 Nm from 1100 – 2400 RPM	± 0.2 % of full scale for the total system

32 input channels for temperature, voltage, resistance and current measurements.

Sensor / signal	Measurement range	Accuracy	Measurement rate Values / second
Pt100, Pt 1000	-50 to 650 °C	-50 to 200 °C ± 0,1 °C 200 to 650 °C ± 0,2 °C	1, 5, 10
Thermocouple Type K Other types; J,R,S,T,B,E	-200 to 1370 °C	± 0,5°C	1, 5, 10
Voltage	± 11 V	1 mV	1, 5, 10, 100
Current	± 20 mA	10 µA	1, 5, 10, 100
Resistance	20 to 200 Ω	± 0,2 Ω	1, 5, 10
	200 to 2000 Ω	± 2 Ω	1, 5, 10

Strain gage	Max. bridge Detuning	Accuracy	Supply voltage	Measurement rate Values / second
120 Ω	± 35 mV/V	± 5 µV/V	0.58 V	1, 5, 10
35 Ω	± 15 mV/V	± 2,5 µV/V	1.34 V	1, 5, 10
3,5 Ω	± 8 mV/V	± 1.25 µV/V	2.63 V	1, 5, 10

16 input channels for pressure measurement.

Sensor / signal	Number of sensors	Measurement range	Accuracy	Measurement rate Values / second
Pressure	3	-300 to 300 mbar	For ambient Temp. -20 to 80 °C ± 0.1 % FSO	0.1, 0.2, 0.5, 1, 2, 5, 10
	8	-1 to 2.5 bar		
	4	0 to 10 bar		
Barometric press.	1	800 to 1200 mbar	± 0.5 mbar	

Air mass flow meter

Measuring principle	Measurement range	Accuracy
Hot film anemometer	0 – 2400 kg/h	± 1 %

4 input channels for speed and frequency measurement.

Sensor / signal	Measurement range	Accuracy	Measurement rate Values / second
Frequency	1 Hz to 300 kHz	25 ppm	1, 10 ,100
	10 Hz to 300 kHz		
	100 Hz to 300 kHz		
Period	< 10 s	25 ppm	0.1, 1, 10, 100
	< 1 s		
	< 0.5 s		
	< 0.01 s		
Speed (e.g.: 100 pole pulse wheel standstill recognition 0.1 RPM recognition of direction of rotation)	1 to 15000 RPM	< 0.1 RPM	1, 10 ,100
Event	2 ³² Events Input freq. < 300 kHz	1	Measurement time 1 to 10000 s

16 digital inputs and 16 digital outputs for processing digital control signals.

Input voltage	5 – 24 VDC
Relays	5 A, 50V

4 analog outputs for demand value setting from the automation system.

Specification	Output signal type	
	Voltage	Current
Signal range	-11 to 11 V	± 25 mA
Resolution (16 bit)	336 µV	763 nA
Max. error at 25 °C	± 2 mV	± 10 µA
Max. error from 0 to 45 °C	± 4 mV	± 12 µA
Setting time	3.5 ms on 0.1 %	
Load	≥ 1100 Ω	≤ 500 Ω

AVL emission bench for raw exhaust measurements.

Exhaust component	Measurement range	Accuracy
CO	0 – 2500 ppm	Repeatability 1 % FS
	0 – 10 %	Linearity 1 % FS
THC	0-540 ppm	Repeatability 1 % FS
	0 – 10 %	Linearity 1 % FS
NO / NOx	0 – 1500 ppm	Repeatability < 0.5% FS
	0 – 1 %	Linearity < 1 % FS
CO2	0 – 16 %	Repeatability 2 % FS Linearity 1 % FS
CO2 EGR (for EGR meas.)	0 – 16 %	Repeatability 1 % FS Linearity 1 % FS
O2	0 – 25 %	Repeatability < 1 % FS Linearity < 1 % FS

Diesel exhaust smoke measurement.

Measuring principle	Measurement range	Accuracy
AVL Opacimeter 439	Light absorption 0 - 10 / m	$\pm 0.0025 / m$
	Opacity range 0 - 100 %	$\pm 0,1 \%$

Dynamic fuel meter (AVL 733S)

Measuring principle	Measurement range	Accuracy
Gravimetric measuring principle	0 - 150 kg/h	$\pm 0,1 \%$