ES63x
Lambda modules

The ES630/ES635 (single-channel) and ES631/ES636 (dual-channel) Lambda Modules support Bosch's broadband oxygen sensors, including Bosch's LSU ADV sensor with expanded measurement range and fast response characteristics, Bosch's LSU 5.1 lambda lean sensor, and NTK's ZFAS®-U2 broadband lambda sensor. They measure lambda values in the range between 0.6 and 16. Thanks to adjustable limitation of Nernst and pump voltages, the LSU ADV and LSU 5.1 sensors can be operated with optimum effectiveness using the ETAS Lambda Modules. The algorithm used by the ES63x modules to regulate the pumping current can be adapted to suit the specific sensor. Thanks to a TEDS code inside the sensor or wiring connection, the devices recognize the sensor type, preventing improper sensor operation. The devices automatically detect sensor and wiring defects.
From ES63x onward, the Lambda Modules record the pumping current at a rate of 2 kHz. In the same phase, they use this measurement to calculate the oxygen content in the exhaust gas as well as the values and reciprocals of the λ and air-fuel ratio variables. For the conversion, it is also possible to specify and store application-specific characteristic curves. The fast scan rate enables the devices to respond to sensor signal changes with fast displays and fine timeline resolution.

The ES63x modules are equipped with a high-performance sensor heater. The ES63x modules control and regulate the sensor heater. To enable the rapid-acting LSU ADV sensor to attain its operating temperature within 5 seconds, the power supply provides a heating current of up to 5 A in the range between 0 V and 18 V. To protect the measuring sensor, the sensor heater's operation may be allowed to continue beyond the point at which the measuring units within the modules have been shut off. Similarly, the heater can be powered up independently of the measurement function by an external signal (typically "Engine On"). The modules monitor both the sensor temperature and internal resistance while supplying relevant output data.

Measurement of Atmospheric and Exhaust Pressure

All ES63x modules are capable of measuring the atmospheric pressure by means of an integrated sensor. To the modules

At a Glance

ETAS Lambda Module for the precise determination of lambda values, air-fuel ratios, and oxygen concentrations in exhaust gas

Available in single- or dual-channel versions

Compatible with Bosch broadband lambda sensors, including Bosch's LSU ADV sensor with expanded measurement range and fast response characteristics, Bosch's LSU 5.1 lambda lean sensor, and NTK's ZFAS®-U2 broadband lambda sensor

Integrated measurement of air pressure

Optional measurement of exhaust gas pressure

Automatic compensation of lambda sensor signal when pressure changes

Bright display for standalone operation

Measurement, ECU calibration, and diagnostics using INCA

Open interfaces for integration into existing tool landscapes

ES635 and ES636, an external pressure sensor can be connected in addition. With this external sensor, pressure changes within the exhaust or air system can be measured. Influences of atmospheric and exhaust pressure changes on the lambda measurement can automatically be compensated by the lambda modules. Independently of lambda measuring, pressure signals are available for further analyses. As an example, on the basis of an air pressure measurement, the height profile of a test drive can be recorded. By means of the external sensor, the pressure in the turbo charger can be measured.

Broad Range of Application

All module variants possess a display and can be used on their own. Grouped around the display, there are six control buttons, which can be used to configure the device and the display. The display shows two measurement values and the operating mode at the same time. In addition, it is possible to output a linearized signal with voltage values in the range between 0 V and 10 V at an analog output.
Via Ethernet, the ES63x Lambda Modules can be connected directly to a PC with suitable measurement software or with other ETAS compact hardware modules. The Lambda Modules supply the measuring host PC simultaneously with values for various measured variables. Their data acquisition is automatically synchronized with other ETAS measurement modules.

The Lambda Modules are supported by ETAS's INCA development tools, the integrated environment for measurement, ECU calibration, and diagnostics, the INTECRIO and ASCET-RP prototyping tools, and the ES910 prototyping and interface module. All devices have an RS-232 interface and support the SMB protocol.

By virtue of XCP-on-Ethernet, the Lambda Modules provide a standardized data transmission interface through which the devices can easily be integrated into existing measurement environments. The vehicle-compatible modules can be operated in an expanded temperature range between -40 °C (-40 °F) and 70 °C (158 °F).

Lambda Oxygen Sensors

The functional principle of lambda oxygen sensors is based on the oxygen ion conductance of zirconium oxide at high temperatures. In the case of wideband zirconia sensors, the oxygen concentration of the test gas inside the Nernst cell is set to $\lambda = 1$. This is accomplished by pumping – i.e., injecting or extracting – oxygen ions into or from the test gas. The size and direction of the pumping current facilitate the accurate definition of lambda values. Wideband zirconia lambda sensors provide oxygen control in both rich and lean mixture ranges. Due to their continuous measuring characteristics, these sensors enhance the dynamics of the classic lambda control loop. The LSU wideband sensors from Bosch work reliably at temperatures above 600 °C (1112 °F). They are designed for a permanent duty cycle at exhaust gas temperatures of up to 930 °C (1706 °F) and short-term peaks of up to 1030 °C (1886 °F). As the sensors incorporate an internal heater, they are operational with cold exhaust flow and functional within a few seconds of starting a cold engine. The effect of the heater minimizes the influence of the exhaust temperature on the sensor signal.

Reference Measurement

Automotive vehicle and engine development deploys wideband zirconia probes in conjunction with precision lambda oxygen measuring devices, which determine the lambda value from the pumping current, for test and calibration purposes. The lambda measurements obtained in this manner become the basis for calibrating the lambda control of engine control units. For over a decade, ETAS has been offering lambda meters for Bosch-manufactured LSU wideband lambda oxygen sensors. The lambda reference instruments are standard parts of the measuring instrumentation for test bench and in-car testing.

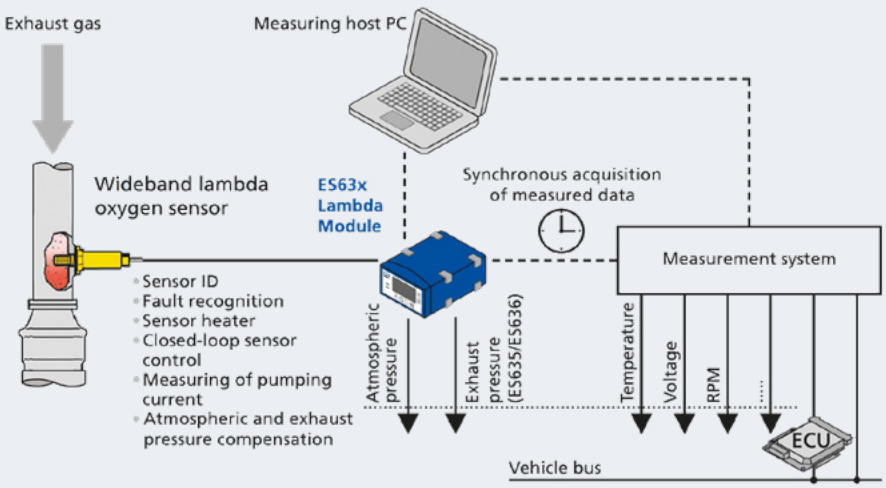

Figure 1:
Lambda Modules ES630/ES635 (1 channel) and ES631/ES636 (2 channels) are connected to a wideband lambda oxygen sensor. To compensate for pressure effects, all modules provide a built-in sensor to measure the atmospheric pressure. As an option, ES635 and ES636 modules can be connected to a pressure sensor mounted in the exhaust system. The devices may be deployed as standalone units or function as components of a measuring system.

Technical Data

Item	Characteristics	Features
Sensor interface	Channels	1 (ES630/ES635) / 2 (ES631/ES636), including control and supply of sensor heater
	Supported lambda oxygen sensors	Robert Bosch LSU 4.2, LSU 4.9, LSU5.1, LSU 5.2, LSU ADV-D, LSU ADV-G and NTK ZFAS®-U2, NTK ZFAS®-U3
	Sensor connection	The different lambda oxygen sensors are connected by different adapter cables to the ES63x modules. The sensor type is coded in the adapter cable or LSU ADV sensor delivered by ETAS. The sensor type will be automatically detected by the modules.
	Measurement signals and ranges[1]	Lambda λ: 0.6 to 33 1/λ: 1.67 to 0.0625 Air-fuel ratio A/F: 8.5 to 200 Fuel-air ratio F/A: 0.005 to 0.118 Oxygen content O_2: 0 % to 25 % Pump current I_p of the λ sensor: -10 mA to 10 mA Ambient pressure P_{amb}: 600 hPa to 1150 hPa External pressure sensor P_{ext}(ES631/ES636): 500 hPa to 3000 hPa
	Measurement sampling rates	0.5 Samples/s to 2 kSamples/s P_{amb}: 1 Sample/s
	Monitoring signals and ranges	Internal resistance of the λ sensor R_i: 0 Ohm to 2000 Ohm[1] Temperature of sensor ceramic T_{cer}: 500°C to 1000°C
	Monitoring sampling rates	0.5 Samples/s to 20 Samples/s
	Heater supply	0 V to 18 V / typ. 5 A
Oxygen sensor supply and control	Sensor heater supply and control	Configurable for each channel, possible to keep sensor at operational temperature also when module is off
	Heatup curve	Output voltage configurable in equidistant steps by use of a csv-file. Width of the steps is a multiple of 50 ms. Maximum step width: 500 ms.
	Pump current controller	Programmable for adaptation on future sensors
Display	Type	Dot matrix vacuum fluorescence display (128 x 64 pixels)
	Layout	Display of 2 signals plus status message
	Keyboard	On front panel, 6 keys: 4 x softkey, 1 x up, 1 x down
Analog output	Channels	1 (ES630/ES635) / 2 (ES631/ES636), electrically isolated
	Output voltage	0 V to 10 V
	Output signal	λ, 1/λ, A/F, F/A, O_2, I_p, P_{amb}, P_{ext}, R_i, T_{cer}, configurable by software
	Output impedance	Virtually 0 Ohm, short circuit protected and protected against external voltages of up to 28 V
	Output current	max. 10 mA

[1] Minimum values, actual values depend on the characteristic curve of the individual lambda oxygen sensor.

Technical Data

Item	Characteristics	Features
Host interface	Ethernet	100 Mbit/s Base-T Ethernet, Full-Duplex required, XCP-on-UDP/IP protocol, for each input channel measurement signals of different type can be provided concurrently to host system
	IP address	Dynamic via INCA or configuration tool (default 192.168.40.44)
	RS-232, SMB protocol	38400 bit/s, 8 bits in parity, 1 stop bit
Power supply module	Operating voltage	6 V to 50 V DC
	Power consumption (at 13.5 V DC)	6.5 W typ. (ES630/ES635) 7.5 W typ. (ES631/ES636)
Power supply sensor heater	Operating voltage	9 V to 28 V DC
	Power consumption (at 13.5 V DC)	9 W typ. (one LSU 4.9 sensor exposed to air, ES630) 18 W typ. (two LSU 4.9 sensors exposed to air, ES631)
Size and weight	Dimensions (H/W/D)	72 mm x 128 mm x 174 mm / 2.8 in x 5 in x 6.9 in
	Weight	905 g / 2.00 lb (ES630), 920 g / 2.03 lb (ES635) 1055 g / 2.33 lb (ES631), 1085 g / 2.39 lb (ES636)
Environment	Temperature range	-40 °C to +70 °C (-40 °F to +158 °F) (operation) -40 °C to +85 °C (-40 °F to +185 °F) (storage)
	Altitude	Up to 5,000 m / 16,400 ft
	Tested for	Mechanical shock, vibration, fall, temperature shock, temperature alteration according to DIN EN 60068 res. ISO 16750
Software	Supported by INCA V6.1 (ES63x) / INCA V7.1 and up by add-on (part of the ES63x delivery), INTECRIO V4.0 (ES63x) and up, ASCET-RP V6.1.3 (ES63x) and up, HSP V10.5 and up.	
Compatible ETAS compact hardware modules	Prototyping and Interface Module ES910, Network and Interface Modules ES51x and ES59x, Network Module ES600, Measurement Modules ES4xx	

For complete ordering information and accessories for the ES610 module, please refer to www.etas.com/ES610. For more information, please contact your local ETAS representative.

ETAS Locations Worldwide

Germany
Stuttgart (Headquarter)

Brazil
São Bernardo do Campo

Canada
Waterloo

France
Saint-Ouen

India
Bangalore
Pune

Italy
Bari
Modena
Turin

Japan
Nagoya
Utsunomiya
Yokohama

Korea
Seongnam-si

P.R. China
Beijing
Changchun
Chongqing
Guangzhou
Shanghai
Wuhan

Sweden
Gothenburg

United Kingdom
Derby
York

USA
Ann Arbor

www.etas.com

www.etas.com/ES630

ETAS-PGA/MKC2_SLE/11_2017