

## ES63x Lambda-Modules



The one- and two-channel Lambda Modules ES630/ES635 (one channel) and ES631/ES636 (two channel) support the Bosch-manufactured LSU lambda wideband sensors, including the new LSU ADV sensor, as well as the NTK sensor ZFAS-U2. They measure lambda values ranging between 0.6 and 16. The adjustable limits of both Nernst cell and pumping voltages provide for optimum operation of the LSU ADV sensor by the lambda meter modules. The algorithm used by the ES63x modules for controlling the pumping current can be adapted to suit specific sensors. 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.

The lambda meters scan the pumping current at a 2 kHz sampling rate, and then use the same frequency to determine the oxygen content in the exhaust gas, as well as the values and reciprocals of the variable  $\lambda$  and the air-fuel ratio. The conversions can be based on distinctive application-specific characteristics which can be downloaded to the device. The fast scan

rate enables the new devices to detect sensor signal changes with fine time resolution.

The ES63x modules are equipped with a high-performance 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 meter 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

Highly accurate Lambda meters (single and dual-channel versions)

Supports wideband lambda oxygen sensors from Bosch, including LSU ADV, and NTK ZFAS-U2

Integrated measurement of atmospheric pressure

Optional measurement of exhaust pressure

Automatic compensation of lambda oxygen sensor signal for pressure changes

Bright display for stand-alone operation

Measuring, ECU calibration, and diagnostics with INCA

Open interfaces and documented drivers for integration in existing toolscapes

LA4 compatible

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.

### Wide Range of Application

All ES63x lambda modules feature a display which facilitates their use in a standalone configuration. The bright display is surrounded by six control buttons used for manually configuring the device and the measured-value display. The screen simultaneously displays two measured values and the operating mode. Also, a linearized signal with voltages between 0 V and 10 V can be taken from an analog output.

Using an Ethernet connection, the ES63x lambda meters can be directly linked to a

PC running suitable measuring software, or interfaced with miscellaneous ETAS compact devices. The modules simultaneously provide the measuring host PC with the values of different measured variables. The data acquisition of the lambda meters can be synchronized with other measuring modules.

The lambda modules are supported by INCA (the integrated environment for measuring, ECU calibration and diagnostics) and by the INTECRIO prototyping tool. All modules feature an RS-232 interface and support the SMB protocol. In the event that an LA4 lambda meter in an existing measurement hardware configuration must be changed out, it can be easily replaced by an ES63x module.

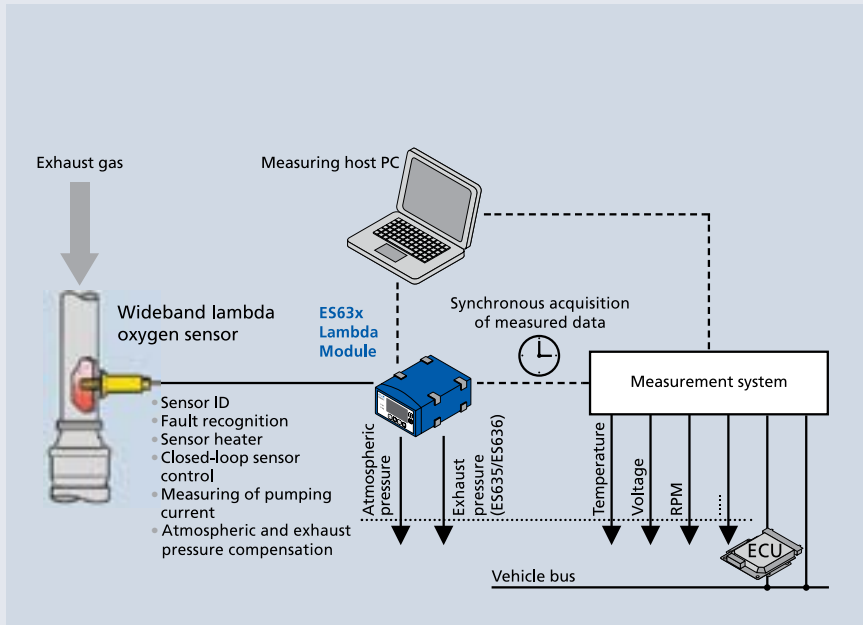
With the XCP-on-Ethernet protocol, the lambda modules provide a standardized data transfer interface as a simple means of easily integrating the devices in an existing measuring environment. The vehicle-compatible modules can be operated in an extended temperature range between -40 °C (-40 °F) and 70 °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 4.7, LSU 4.9, LSU ADV-G, and NTK ZFAS-U2
	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 <sup>1</sup>	Lambda $\lambda$ : 0.6 to 16 $1/\lambda$ : 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 <sub>2</sub> : 0 % to 25 % Pump current I <sub>p</sub> of the $\lambda$ sensor: -10 mA to 10 mA Ambient pressure P <sub>amb</sub> : 600 hPa to 1150 hPa External pressure sensor P <sub>ext</sub> (ES631/ES636): 500 hPa to 3000 hPa
	Measurement sampling rates	0.5 Samples/s to 2 kSamples/s P <sub>amb</sub> : 1 Sample/s
	Monitoring signals and ranges	Internal resistance of the $\lambda$ sensor R <sub>i</sub> : 0 Ohm to 2000 Ohm <sup>1</sup> Temperature of sensor ceramic T <sub>cer</sub> : 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

<sup>1</sup> Minimum values, actual values depend on the characteristic curve of the individual lambda oxygen sensor.

## Technical Data

Item	Characteristics	Features
Sensor control	Heater 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	$\lambda$ , $1/\lambda$ , A/F, F/A, O <sub>2</sub> , I <sub>p</sub> , P <sub>amb</sub> , P <sub>ext</sub> , R <sub>i</sub> , T <sub>cer</sub> , 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
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 V6.2.0 (ES630/ES631) / INCA V6.2.1 (ES635/ES636) and higher via add-on (part of ES63x delivery), INTECRIO V3.1 (ES630/ES631) / INTECRIO V3.2 (ES635/ES636) and higher, support ES63x configuration and integration tool for XCP applications, C-based library for integration into software applications that don't provide any XCP-on-Ethernet driver functionality and LabVIEW® driver in preparation	

## Ordering Information<sup>1</sup>

Order Name	Short Name	Order Number
Lambda Module (1-CH)	ES630	F-00K-106-296
Lambda Module (2-CH)	ES631	F-00K-106-297
Lambda Module (1-CH)	ES635	F-00K-106-675
Lambda Module (2-CH)	ES636	F-00K-106-676
<b>Optional Accessories</b>		
<b>Standalone operation</b>		
Power Supply Cable, Lemo 1B FGL -Banana (8mc-2mc), 2 m / 6.6 ft	CBP630-2	F-00K-106-312
<b>PC connection</b>		
Ethernet PC Connection and Power Supply Cable, Lemo 1B FGL – RJ45 – Banana (8fc-8mc+2mc), 3 m / 9.8 ft	CBEP410-3	F-00K-104-927
Ethernet PC Connection and Power Supply Cable, Power Feeder close to PC, Lemo 1B FGL – RJ45 – Banana (8fc-8mc+2mc), 5 m / 16.4 ft	CBEP415-5	F-00K-105-680
<b>Connection to ES59x, ES600, ES720 und ES1135</b>		
Ethernet Connection and Power Supply Cable, Lemo 1B FGF – Lemo 1B FGL – Banana (8mc-8fc+2mc), 3 m / 9.8 ft	CBEP420-3	F-00K-105-292
Ethernet Connection and Power Supply Cable, Lemo 1B FGF – Lemo 1B FGL – Banana (8mc-8fc+2mc), 3 m / 9.8 ft	CBEP425-3	F-00K-105-972
<b>Connection with ES600 Network Module</b>		
Ethernet PC Connection Cable, Lemo 1B FGF – Lemo 1B FGL (8mc-8fc), 3 m / 9.8 ft	CBE400-3	F-00K-104-920
Ethernet PC Connection Cable, Highly Flexible, Lemo 1B FGF – Lemo 1B FGL (8mc-8fc), 0m5 / 1.64 ft	CBE401-0m5	F-00K-106-128
<b>Connection with ES400 and ES63x measurement modules</b>		
Ethernet Chain Connection Cable, Lemo 1B FGA – Lemo 1B FGL (8mc-8fc), 0m45 / 1,48 ft	CBE430-0m45	F-00K-104-923
Ethernet Chain Connection Cable, Highly Flexible, Lemo 1B FGA – Lemo 1B FGL (8mc-8fc), 0m14; 0m3 / 0,46 ft, 0,98 ft	CBE431-0m14/0m3	F-00K-105-676/-685
Ethernet Chain Connection Cable, Lemo 1B FGA – Lemo 1B FGL (8mc-8fc), 0m5 / 1.6 ft	CBEP430-0m5	F-00K-104-928
<b>Protection caps</b>		
Protection cap for Lemo 1B sockets	CAP_LEMO_1B_LC	F-00K-105-683
Protection cap for Souriau sockets	CAP_SOURIAU_8STA	F-00K-105-303

<sup>1</sup> In addition to single modules and accessories, we are also offering package deals with modules, cables and sensors. Please refer to the ETAS website for complete information ([www.etas.com](http://www.etas.com)).

## Ordering Information

Order Name	Short Name	Order Number
<b>Ethernet connection cable</b>		
Ethernet Extension Cable, Lemo 1B PHL – Lemo 1B FGL (8mc-8fc), 3 m / 9,84 ft	CBEX400-3	F-00K-105-294
<b>SMB connection</b>		
SMB Connection Y-Cable, DSUB – DSUB – DSUB (15fc-9mc-9mc), 0m3 / 1 ft	CBAS100-0m3	F-00K-106-313
<b>LSU 4.2 lambda oxygen sensor and LSU 4.2 / LSU 4.7 sensor cables</b>		
Bosch Lambda sensor LSU 4.2 for Lambda Meter with universal connector, 1 m / 3.3 ft	LSUS_42	0-258-007-151
Lambda Sensor Cable LSU 4.2 and LSU 4.7, Souriau 8ST12-35 – RB130fl – Banana – BNC (22mc-6fc+2mc+2mc), 3 m / 9.8 ft	CBAL410-3	F-00K-106-302
Lambda Sensor Cable LSU 4.2 and LSU 4.7, Souriau 8ST12-35 – RB130fl – Banana – BNC (22mc-6fc+2mc+2mc), 5 m / 16.4 ft	CBAL410-5	F-00K-106-303
Lambda Sensor Cable LSU 4.2 and LSU 4.7, Souriau 8ST12-35 – RB130rd – Banana – BNC (22mc-6fc+2mc+2mc), 3 m / 9.8 ft	CBAL411-3	F-00K-106-304
<b>LSU 4.9 lambda oxygen sensors and sensor cables</b>		
Bosch Lambda sensor LSU 4.9, SR4, RB150 Code1, 300 Ohms, 1 m / 3.3 ft	LSUS_49	0-258-017-025
Lambda Sensor Cable LSU 4.9, Souriau 8ST12-35 – RB150 (Code 1) – Banana – BNC (22mc-fc+2mc+2mc), 3 m / 9.8 ft	CBAL451-3	F-00K-105-926
Lambda Sensor Cable LSU 4.9, Souriau 8ST12-35 – RB150 (Code 1) – Banana (22mc-6fc+2mc), 3 m / 9.8 ft	CBAL452-3	F-00K-106-127
Lambda Sensor Cable LSU 4.9, Souriau 8ST12-35 – RB150 (Code A) – Banana – BNC (22mc-6fc+2mc+2mc), 5 m / 16.4 ft	CBAL455-5	F-00K-106-308
<b>LSU ADV lambda oxygen sensors and sensor cables</b>		
Lambda Sensor LSU ADV for Gasoline Engines, Protection Tube TP3, ETAS plug, 300 Ohms, 1 m / 3.3 ft	LSU_ADV_G	F-00K-106-409
Lambda Sensor Cable LSU ADV, Souriau 8ST12-35 – ETAS plug – Banana – BNC (22mc-7fc+2mc+2mc), 3 m / 9.8 ft	CBAL463-3	F-00K-106-310
<b>NTK ZFAS®-U2 lambda oxygen sensor cable<sup>2</sup></b>		
Lambda Sensor Cable ZFAS®-U2, Souriau 8ST12-35 – RB150 (Code 1) – Banana (22mc-6fc+2mc), 3 m / 9.8 ft	CBAL472-3	F-00K-107-313
<b>External pressure sensor and extension cable</b>		
Pressure Sensor	PS63	F-00K-106-679
Extension Cable for Pressure Sensor PS63, 3 m	CBAX100-3	F-00K-106-680

<sup>2</sup> NTK ZFAS®-U2 lambda oxygen sensors are not provided by ETAS.

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

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