DRIVING EMBEDDED EXCELLENCE

ES400

Measurement Modules

At a glance

- Measurements at the signal source minimize errors due to interference and damping
- Damage-free keyhole instrumentation of test vehicles
- Very small form factor and smart stacking concept
- Rugged, water, dust, and temperature proofed modules
- Scalable and easy to configure measuring setups
- High data acquisition rate
- Open protocol (XCP-on-Ethernet)
- Seamless integration with INCA, INTECRIO, and third party tools

In both, road testing and test bench situations, engineers use a multitude of sensors to monitor vehicle functions. Sensor signals usually require long cable runs to connect with measurement modules. In the vehicle, this means routing heavy cable harnesses through the bulkhead into the vehicle's interior. This wiring technique not only calls for extensive modifications of the vehicle body – the substantial installation and setup efforts also represent a significant cost factor.

Damage-free Keyhole Instrumentation of Test Vehicles

With the measurement modules of the ES400 product family, ETAS provides a solution that overcomes the need for destroying the vehicle body to run sensor cables. The ES400 modules are designed for installation in the immediate proximity of sensors or signals being measured (Figures 1 and 2). The modules' very small form factor facilitates installation even in otherwise unsuitable voids and corners of the vehicle's engine compartment, body, or chassis. This minimizes sensor cable lengths and eliminates long sensor cable harnesses. Only a single data acquisition cable has to enter the vehicle's interior through a "keyhole" (Figure 3).

Test Bench Deployment

Established practice with modular test bench concepts is to mount the test candidates on pallet systems, and to set up the required connections with the test bench using predefined interfaces. To save valuable test bench time, test objects –engines, for example – are equipped with the necessary sensors and measuring modules prior to their installation at the test bench. The arrangement of modules in close proximity to the sensors and the fact that the data cable represents the only interface to the test bench host computer provides to easily check the measurement setup on the pallet offline. The efficient test preparation plus their immunity to ambient conditions in terms of vibrations, oil vapor, exhaust gas, and water which are often met at test benches makes the modules of the ES400 family ideally suited to test bench deployment.

Small Form Factor and Minimum Sensor Cable Length

The ES400 Family

ES400 module housings are water and dustproof as per IP67 and impervious to acceleration and impact, such as from flying rocks. All connectors are water and dustproof. The modules feature a working temperature range of between –40 °F and 248 °F (–40 °C and +120 °C). The short sensor cables minimize signal distortion. Thanks to extremely low temperature coefficients and the electrical isolation of individual measurement channels, measurement readings are largely independent of ambient temperature and ground loops. The ES400 product family comprises five members which are optimized for the acquisition of different types of signals.

ES410 – A/D Module

The ES410 offers eight electrically isolated analog input channels with an input voltage range between ±100 mV and ±60 V and sampling rates between 0.5 Hz and 10 kHz. ES410 input signals can be passed through a high quality configurable FIR filter of 8th order to suppress signal noise and avoid aliasing effects. Signal oversampling is supported by independent setting of corner frequency and sampling rate.

ES411 – A/D Module with Sensor Supply

The ES411 offers 4 analog input channels with ES410 characteristics. In addition, due to the integrated DC-power supply output for each channel, active sensors can be powered directly by the ES411 module.

ES420 – Thermo Module

The ES420 module supports thermocouples of type B, E, J, K, N, R, S, and T to enable measurements in the required temperature range. With type B thermocouples, temperature values of up to 1820 °C (3308 °F) are possible. To provide for the capture of fast temperature changes, the configurable sampling rate of each channel is up to 50 Hz.

ES430/ES432 – Lambda Module

The ES430 and ES432 modules support lambda (l) measurement in combination with the Bosch LSU 4.9 and ADV-G (ES432) lambda oxygen sensor. Based on the sensor signals, ES430/ES432 not only provides the host system with digital measurements of l, but also 1/l, A/F, F/A, Ip and O2 simultaneously. In addition, one signal can be put out as analog voltage. The ES430/ES432 operates the sensor at constant temperature to ensure reliable measurement accuracy. To prevent damage or degradation of the sensor element, the ES430/ES432 provides for heating of the sensor even during standby mode.

ES441 – Counter and Frequency Module with Sensor Supply

The ES441 offers 4 digital input channels for counter, timer, and frequency measurements. For sensor supply, ES441 provides a DC-power output for each channel. ES441 is able to derive multiple types of measurement signals simultaneously from the same physical input.

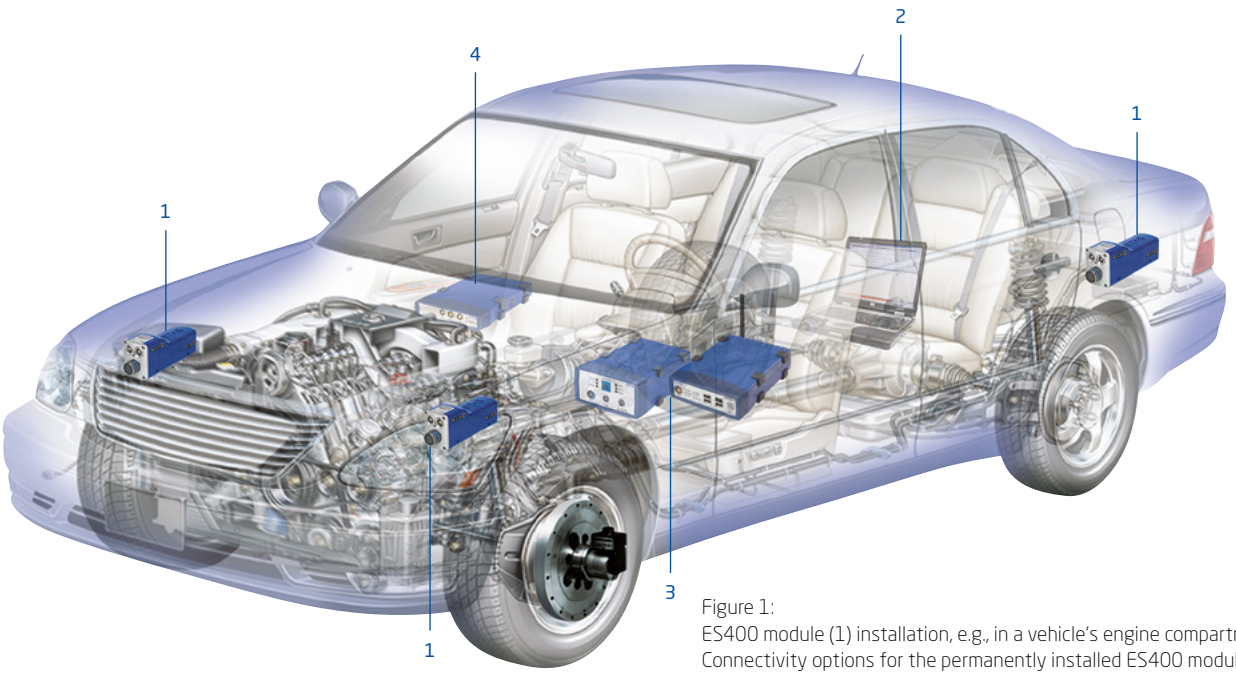


Figure 1:
ES400 module (1) installation, e.g., in a vehicle's engine compartment. Connectivity options for the permanently installed ES400 modules include a laptop PC (2), the ES715 and ES720 Drive Recorders (3), or the ES910 Rapid Prototyping Module (4).

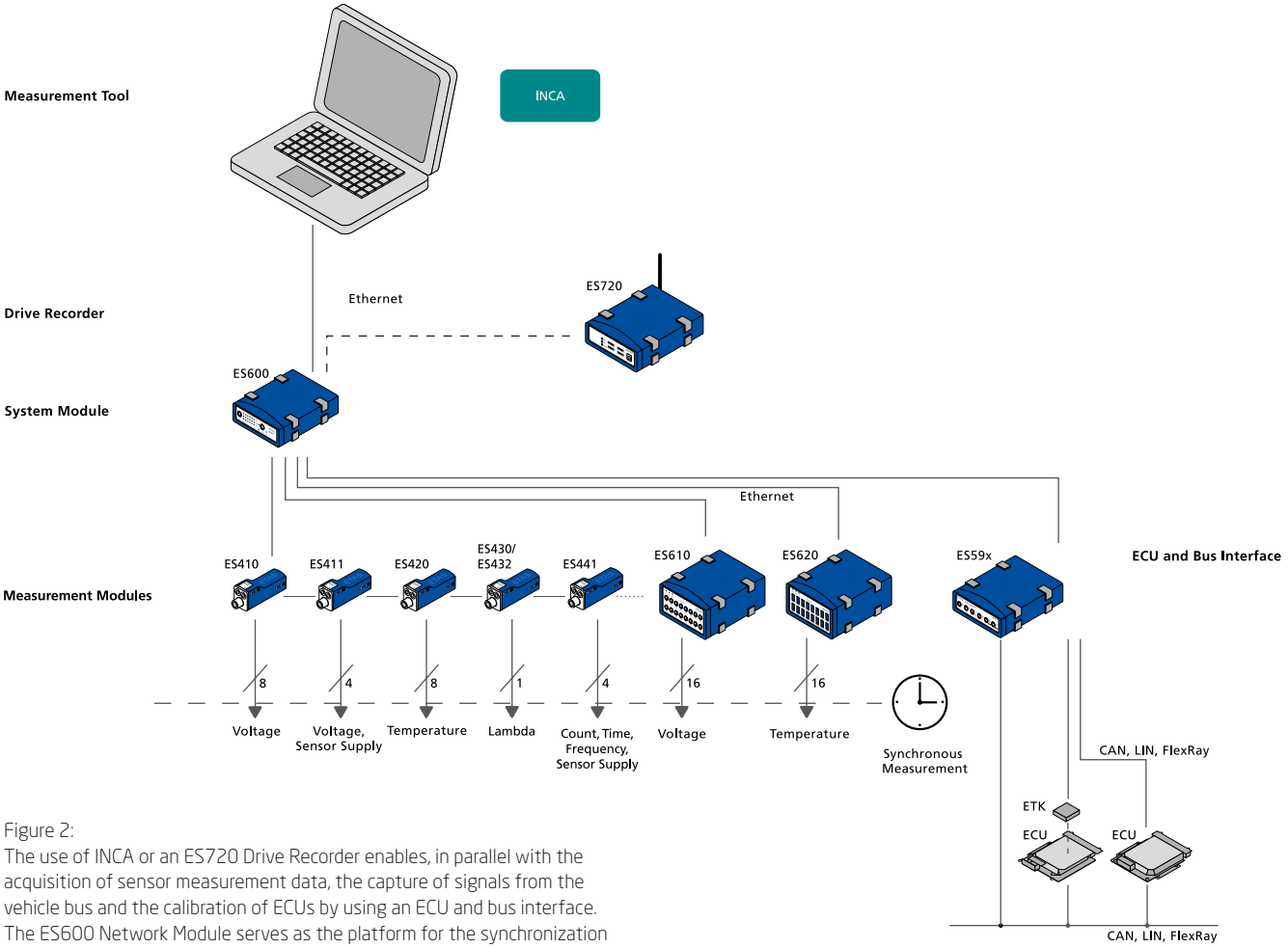


Figure 2:
The use of INCA or an ES720 Drive Recorder enables, in parallel with the acquisition of sensor measurement data, the capture of signals from the vehicle bus and the calibration of ECUs by using an ECU and bus interface. The ES600 Network Module serves as the platform for the synchronization of ES400 with ES600 modules using a shared synchronization mechanism.

Minimum Cabling Effort

Connecting Distributed Measurement Modules

Setting up a daisy chain of distributed ES400 modules mounted close to the signal sources requires minimum cabling effort. The same single cable carries both operating power and data. ETAS provides many cable options to interconnect modules with different distances. To support the configuration and maintenance of an ES400 measuring system, LEDs allow for on-demand visual identification of each module ("Look-at-Me"). All connectors are located on the front panel. Module housings feature cast-in eyelets for easy module attachment close to measuring points using cable ties. If several modules are needed at a given position, they are quickly combined to a module block by means of captive fasteners in the module housings.

A 100 Mbit/s Ethernet link transfers measurement data from several ES400 modules with a sampling rate of up to 10 kHz. All modules in a measuring system – whether an ES400 chain, multiple ES400 chains or a configuration also containing ES600 measurement modules – are synchronized with an accuracy of 1 µs. In combination with an ETAS ECU and Bus Interface, such as an ES590 module, sensor and ECU data can be acquired very easily and accurately synchronized. When the PC is powered down or disconnected, the ES400 modules automatically enter the power saving stand-by mode.

Supported by Industry Leading Tools

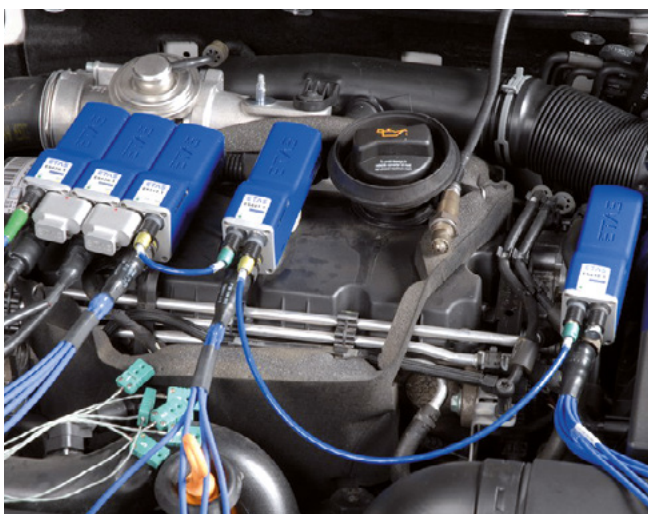
The ES400 modules are integrated with the INCA Measuring, ECU Calibration and Diagnostics Environment by ETAS. In parallel with one or more ES400 measuring chains, additional ETAS compact modules can be interfaced with INCA by using the compact ES600 Network Module. The diagram in Figure 2 shows an example of a parallel operation using one ES59x Interface Module and compact measurement modules of the ES600 series. As an alternative to INCA, an ES715 or ES720 Drive Recorder can be used to log ES400 measurement data.

Access to the ES400 modules is also possible from within an INTECRIO rapid prototyping experiment due to the full integration of ES400 modules with the ES910 Rapid Prototyping Module (Figure 3). Switching between measuring and prototyping applications is easily accomplished by simply taking the data transfer cable to the ES910 module.

The ES400 modules are not only supported by the ETAS tools INCA and INTECRIO. By use of the standardized XCP-on-Ethernet protocol and a standalone configuration tool provided by ETAS, they can also easily be integrated with any third-party applications that support XCP-on Ethernet. Currently, ES400 modules are supported by the applications MM6 from Robert Bosch Chassis Systems Control, DEWESoft from DEWETRON, PROVEtech: VA from MBtech Group, and CANape from Vector.

Reliable Partner

At ETAS, our worldwide presence ensures our ability to provide local support for the wide range of needs of a global customer base. Our deep technical expertise and extensive knowledge, combined with a broad installed product base are reflected in our technically mature and highly capable product line. Thousands of automotive engineers and technicians worldwide understand the value of partnering with ETAS and rely on ETAS tools to do their jobs.



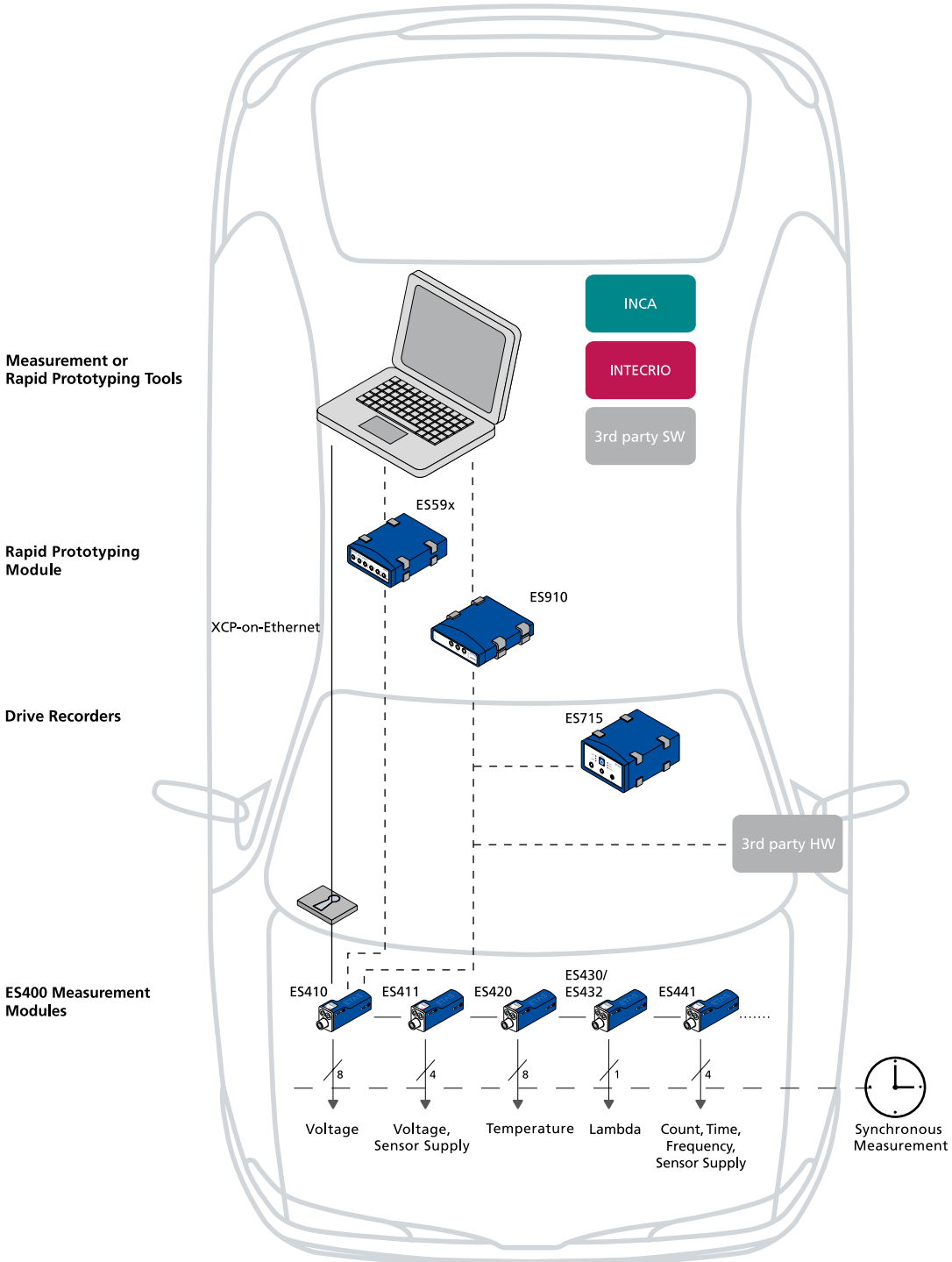
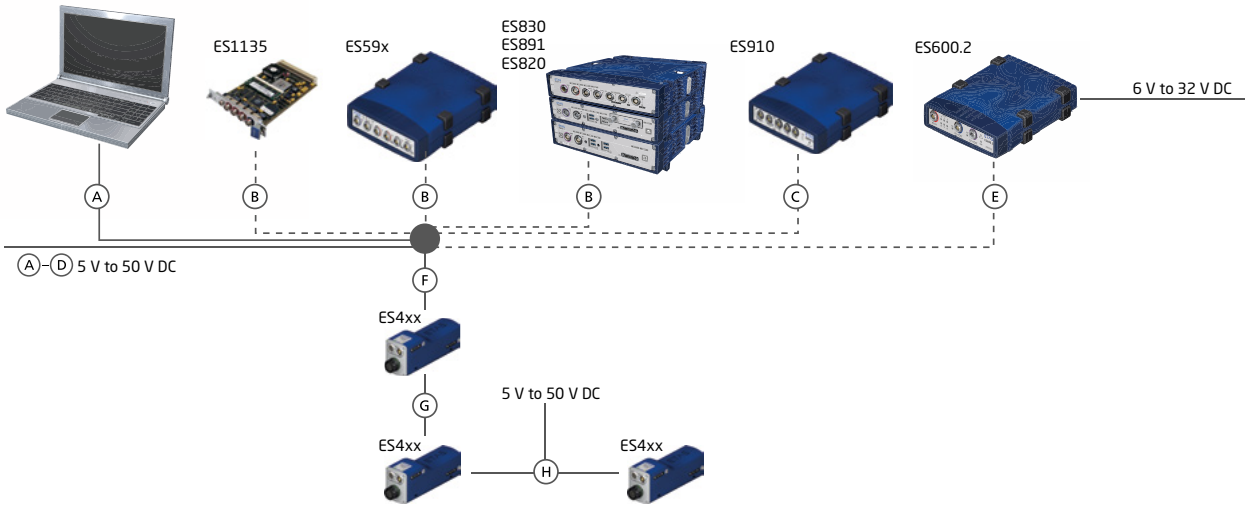


Figure 3:
ES400 modules mounted in the engine compartment are connected through a "keyhole" to the PC in the vehicle interior. As an alternative to the PC hosting the INCA measurement, INTECRIO rapid prototyping, or third party application, the modules can deliver their data to the ES910 Rapid Prototyping Module or an ES720 Drive Recorder. XCP-on-Ethernet facilitates the integration with software tools or hardware devices from third-party manufacturers.



Ordering Information – ES400 System Cables

Caption	Order Name/Cable Type	Short Name	Order Number
Host Connection			
A	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
A	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	Ethernet Connection and Power Supply Cable, Lemo 1B FGF – Lemo 1B FGL - Banana (8mc-8fc+2mc), 3 m/9.8 ft	CBEP420-3/CBEP425-3	F-00K-105-292/972
C	Ethernet Chain Connection and Power Supply Cable, Lemo 1B FGL – Lemo 1B FGA – Banana (8fc-8mc-2mc), 0.5 m / 1.6 ft	CBEP430-0m5	F-00K-104-928
D	Ethernet ES71x Connection and Power Supply Cable, Lemo 1B FGD – Lemo 1B FGL (8mc-8fc-2mc), 3 m / 9.8 ft	CBEP450-3	F-00K-105-678
E	Ethernet PC Connection Cable, Lemo 1B FGF – Lemo 1B FGL (8mc-8fc), 3 m / 9.8 ft	CBE400-3	F-00K-104-920
Ethernet Extension Cable			
F	Ethernet Extension Cable, Lemo 1B PHL – Lemo 1B FGL (8mc-8fc), 3 m / 9.8 ft	CBEX400-3	F-00K-105-294
Module Interconnection			
G	Ethernet Chain Connection Cable, Lemo 1B FGA – Lemo 1B FGL (8mc-8fc), 0.45 m / 1.5 ft	CBE430-0m45	F-00K-104-923
G	Ethernet Chain Connection Cable, Highly Flexible, Lemo 1B FGA – Lemo 1B FGL (8mc-8fc), 0.14 m, 0.3 m / 0.46 ft, 1 ft	CBE431-0m14/-0m3	F-00K-105-676/-685
G	Ethernet Chain Connection Bridge, Lemo 1B FGA – Lemo 1B FGL (8mc-8fc)	ES4xx_BRIDGE	F-00K-105-684
H	Ethernet Chain Connection and Power Supply Cable, Lemo 1B FGL – Lemo 1B FGA – Banana (8fc-8mc-2mc), 0.5 m / 1.6 ft	CBEP430-0m5	F-00K-104-928
Protection Caps for unused ES400 Connectors			
	Cap to protect unused Souriau sockets against dirt and water	CAP_SOURIAU_8STA	F-00K-105-303
	Cap to protect open Lemo 1B sockets against dirt	CAP_LEMO_1B	F-00K-105-298
	Cap to protect open Lemo 1B sockets against dirt and water	CAP_LEMO_1B_LC	F-00K-105-683

Ordering Information – ES400 Modules

Order Name/Cable Type	Short Name	Order Number
ES410 - A/D Module		
A/D Module (8-CH)	ES410.1	F-00K-105-691
Accessories:		
Analog Input Splitter Cable, Souriau 8ST12-35 – 8 x open wires (22mc-2c), 2 m / 6.5 ft	CBAV480-2	F-00K-105-686
Analog Input Splitter Cable, Souriau 8ST12-35 – 8 x BNC (22mc-2fc), 0m2 / 0.7 ft	CBAV401-0m2	F-00K-105-687
Analog Input Splitter Cable, Souriau 8ST12-35 – 8 x BNC (22mc-2mc), 2 m / 6.5 ft	CBAV403-2	F-00K-105-688
ES411 - A/D Module with Sensor Supply		
A/D Module with Sensor Supply (4-CH)	ES411.1	F-00K-104-485
Accessories:		
A/D Module with Sensor Supply (4-CH)	ES411.1	F-00K-104-485
Analog Input Splitter Cable with BNC Plug, Souriau 8ST12-35 – BNC (22mc-4x2fc), 0m3 / 1 ft	CBAV400-0m3	F-00K-104-916
Analog Input Splitter Cable, Souriau 8ST12-35 – open wires (22mc-4c), 2 m / 6.5 ft	CBAV411-2	F-00K-104-918
Analog Input Splitter Cable, Souriau 8ST12-35 – LEMO 1B PHG (22mc-4x6fc), 0m3 / 1 ft	CBAV413-0m3	F-00K-105-682
ES420 - Thermo Module		
Thermo Module (8-CH)	ES420.1	F-00K-104-403
Accessories:		
Thermocouple Splitter Cable Type K, 0.3 m / 1 ft	CBATK400-0m3	F-00K-104-409
ES430/ES432 - Lambda Module		
Lambda Module (1-CH)	ES430.1	F-00K-105-922
Lambda Module (1-CH)	ES432.1	F-00K-106-622
Accessories for ES430/ES432:		
Bosch Lambda Sensor LSU4.9, 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 LSU4.9, Souriau 8ST12-35 – RB150 (Code A) – Banana – BNC (22mc-6fc+2mc+2mc), 5 m / 16.4 ft	CBAL455-5	F-00K-106-308
Accessories for ES432:		
Lambda Sensor LSU ADV-G for Gasoline Engines, Protection Tube TP3, Trapezoid plug, Code A7, 300 Ohms, 1 m / 3.3 ft	LSU_ADV_G	F-00K-106-409
Lambda Sensor Cable LSU ADV, Souriau 8ST12-35 – Trapezoid plug, Code A7 – Banana – BNC (22mc-7fc+2mc+2mc), 3 m / 9.8 ft	CBAL463-3	F-00K-106-310
ES441 - Counter and Frequency Module with Sensor Supply		
Counter and Frequency Module with Sensor Supply (4-CH)	ES441.1	F-00K-105-785
Accessories:		
Analog Input Splitter Cable with BNC Plugs, Souriau 8ST12-35 – BNC (22mc-4x2fc), 0m3 / 1 ft	CBAV400-0m3	F-00K-104-916
Analog Input Splitter Cable, Souriau 8ST12-35 – open wires (22mc-4c), 2 m / 6.5 ft	CBAV411-2	F-00K-104-918
Analog Input Splitter Cable, Souriau 8ST12-35 – LEMO 1B PHG (22mc-4x6fc), 0m3 / 1 ft	CBAV413-0m3	F-00K-105-682

Technical Data

General	
Dimensions (H x W x D)	51,5 x 40 x 142 mm / 2.0 x 1.6 x 5.6 in 37,5 x 40 x 129 mm / 1.5 x 1.6 x 5.1 in (tapered rear)
Weight	350 g / 0.77 lb
System	
Max. number of modules	254 in one chain
Synchronization accuracy	1 µs to another ES400 or ES600 measurement module
Environment	
Temperature range	–40 °C to +120 °C (–40 °F to +248 °F) (operation) –40 °C to +125 °C (–40 °F to +257 °F) (storage)
Protection class	IP 67 (with cables connected)
Altitude	Up to 5,000 m / 16,400 ft
Tested for	Mechanical shock, vibration, fall, temperature shock, temperature alteration, storage in humidity, salt fog attack, impact from flying rocks, according to DIN EN 60068 res. ISO 16750
Power supply	
Operating voltage	5 V to 50 V DC (–40 °C to +85 °C), 6 V to 50 V DC (+85 °C to +120 °C)
Host interface	
Connection and protocol IP adress	100 Mbit/s Base-T Ethernet, Full-Duplex required, XCP-on-UDP/IP Dynamic via INCA or config. tool (default 192.168.40.44)
Software	
	Supported by INCA V5.4.1 and up via add-on (part of ES4xx delivery), INTECRIO V3.x, ES400 configuration and integration tool for XCP applications.

ETAS-PGA/MKC2_EMB/05_2018

Info For a complete product overview and details on how to order ES400, please visit www.etas.com/es400
Alternatively, your ETAS contact will be able to provide you with further information.