

KiBox[®] To Go

Type 2893A...
with KiBox Cockpit Software

Measurement and Evaluation System for Combustion Analysis on Test Benches and in Vehicles

The KiBox is a complete combustion analysis system for mobile use on the road under extreme ambient conditions and on engine test benches.

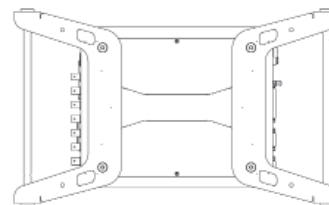
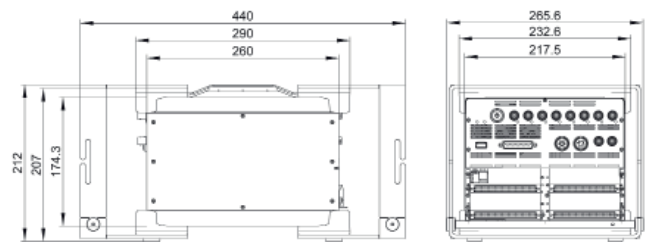
Special advantages of the KiBox To Go

- Time-based combustion analysis system with real interpolation of angle nodes
- No external crank angle encoder required
- Real-time calculation of combustion analysis parameters (predefined or individually programmed via user formula)
- Limit value monitoring with data storage
- "Endless Measurement" capable
- Convenient integration with ETAS INCA¹⁾, VECTOR CANape and ATI VISION; alternatively: CAN result output
- Support of all common interfaces for test bench automation systems
- Measurements and analyses can be configured in a very simple way; any error messages displayed are easy to understand
- The measurement data is analyzed in the KiBox, avoiding the need for a dedicated PC to be used for combustion analysis; the KiBox can be directly connected to the application PC
- Standalone operation without a PC is also possible

Description

The KiBox from Kistler makes the quality of combustion in the individual cylinders visible. The combustion parameters are conveniently integrated into the application system and synchronized with other measurement data and ECU control parameters via a PC software interface. This software interface is initially available for the widely used INCA application software produced by ETAS. Alternatively, combustion analysis parameters can be output via a CAN port.

In addition to the online display of signals and results that are typical for combustion analysis (TDC-corrected cylinder pressure, pV diagram, tables, etc.) you can display the combustion analysis results also in INCA together with ECU variables.



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¹⁾ Integrated Calibration and Acquisition System of ETAS Group

Application

The additional information regarding combustion, fuel injection, and ignition can be used to develop and optimize engine maps within the ECU application system. Alternatively, the KiBox can be used as a standalone system for combustion analysis in vehicles or on a test bench. Combustion diagnostics enable problems that arise in the vehicle on the road to be characterized and resolved efficiently. On engine test benches,

the KiBox assists in all tasks of mechanics, thermodynamics and calibration. Used as a monitoring system, the KiBox detects any limit value violations, reports these to the automation system and saves the raw data along with a pre-event and post-event history.

Data streaming enables a complete exhaust or fuel economy drive cycle to be recorded, in order to minimize CO₂ emissions.

System Components

Overview of the complete combustion analysis system:

1. Cylinder pressure sensors and adapters, e. g. measuring spark plugs or glow plug adapters
2. Current clamp for injection and ignition timing
3. Crank angle adapter for connecting to the stock engine crank position sensor
4. Gb Ethernet connection to laptop with INCA or similar software
5. KiBox with amplifier modules

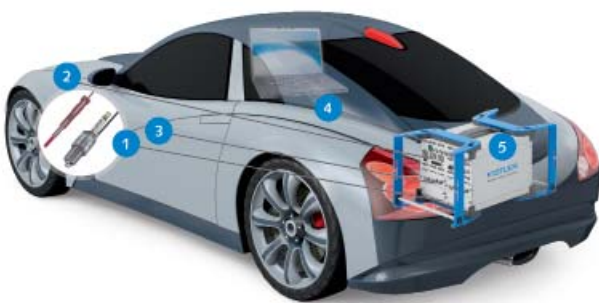


Fig. 1: Arrangement of the system components with connection to the user laptop

Display of Combustion Analysis Results

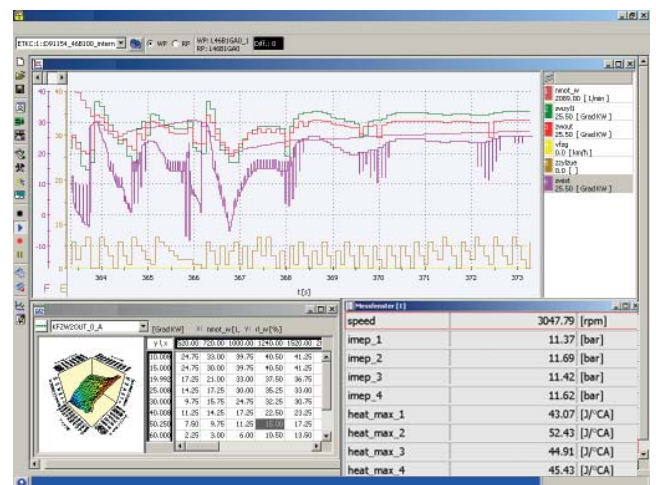


Fig. 2: Screen showing combustion analysis parameters, integrated and synchronized in INCA

KiBox® Signal Processing

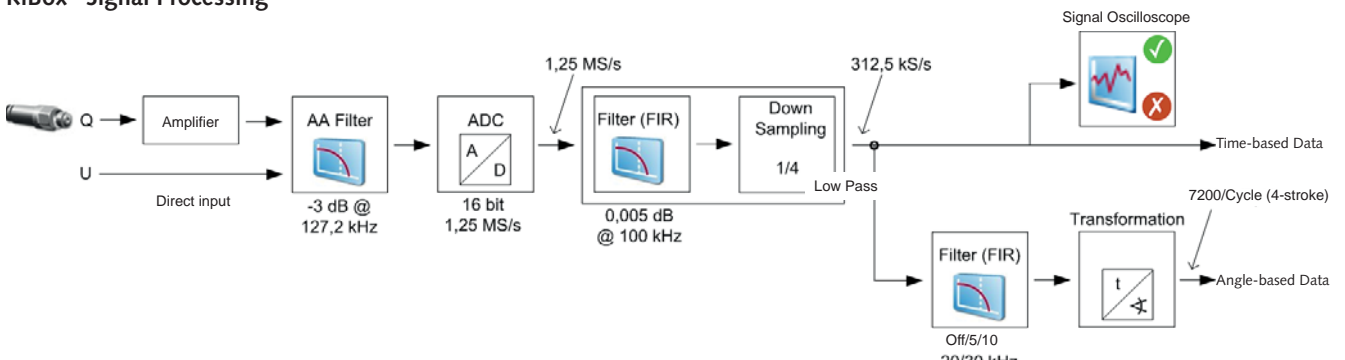


Fig. 3: KiBox® signal processing, using a cylinder pressure signal as an example. The system architecture simultaneously offers time-based and angle-based data with precise TDC reference.

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Technical Data

Weight

Basic system without amplifier, approx.	kg	6
Basis system with 4x amplifier, approx.	kg	7

Ambient Condition

Temperature range	°C	-30 ... 50
	°F	-20 ... 120
Relative humidity, non-condensing	%	0 ... 95
Power supply	VDC	10 ... 36
	VAC	100 ... 250
Power consumption, approx.	W	60

Connections on the Front Panel

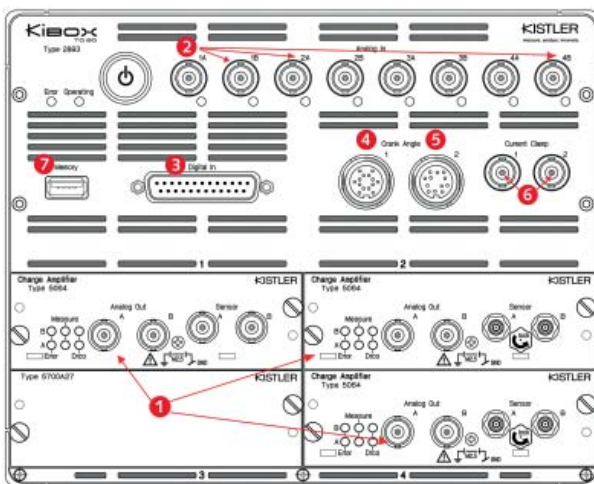


Fig. 5: Connections on the front panel

- 1 *Measuring amplifier slots*
4 each with 2 channels, 8 channels in total
(Kistler Type 4665B..., 5064C11, 5064C12, 5064C13)
- 2 *Analog inputs*
8, BNC
- 3 *Digital inputs*
1, 25 pin connector
- 4 *Crank and trigger input 1*
1, for Kistler crank angle adapter set Type 2619A11
- 5 *Angle input and trigger input 2*
1, for optical crank angle encoders (Kistler Type 2614B..., AVL Typ3 365/720 or 365/360)
- 6 *Analog inputs for current clamps*
2, BNC for current clamp Type 2103A11 or Type 2105A...
- 7 *USB interface*
1, for a memory stick or mass storage device

Connections on the Rear Panel

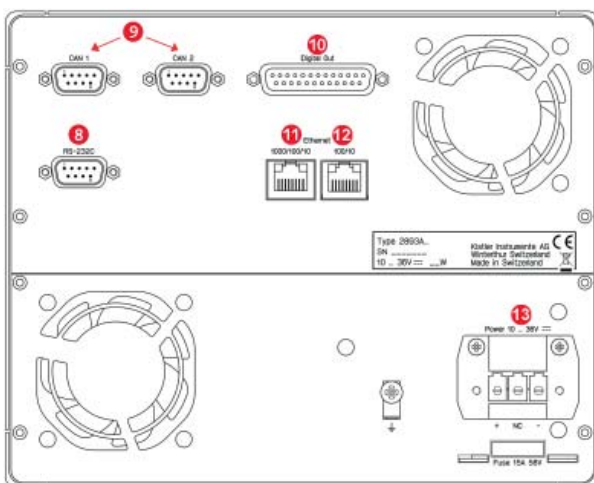


Fig. 6: Connections on the rear panel

- 8 *RS-232C interface*
1, RS-232C (male)
- 9 *CAN 1 & CAN 2 Interface*
2, D-Sub 9 pin (male)
- 10 *Digital outputs*
1, D-Sub 25 pin (female)
- 11 *Ethernet 1 000/100/10*
1, 1 000 Base-T, standard connection KiBox – PC
- 12 *Ethernet 100/10*
1, 10/100 Base-T
- 13 *Power supply*
1, connection, 10 ... 36 VDC

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The information corresponds to the current state of knowledge. Kistler reserves the right to make technical changes. Liability for consequential damage resulting from the use of Kistler products is excluded.

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Tel. +41 52 224 11 11, Fax +41 52 224 14 14, info@kistler.com, www.kistler.com
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Input Channels

A maximum of 8/16²⁾ analog voltage signals can be recorded on the KiBox via the measuring amplifier slots or the BNC connectors located at the top of the front panel. Additionally 2/4²⁾ analog inputs for current clamps are also available, as well as 8/14²⁾ digital input channels.

Perfectly synchronized measurement data is generated, thanks to phase corrections applied to each internal amplifier (charge amp. and piezoresistive amp.).

When Kistler sensors are used with PiezoSmart®, each measurement channel is automatically adjusted to the sensitivity of the individual sensor, completely.



Fig. 7: Type 5064C12



Fig 8: Type 4665B

Measuring Amplifier Slots

Amplifier slots	4/8 ²⁾ slots for max. 8/16 ²⁾ amplifier channels
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2-Channel Charge Amplifier

Number of channels		2
Frequency range (20 V _{pp})	kHz	≈0 ... >200
Measuring range	pC	±100 ... 100 000
Drift compensation operating range	1/min	≈100 ... 20 000

For amplifier specifications see separate data sheet for Type 5064C12 (doc. no. 5064C_003-047).

2-Channel Piezoresistive Amplifier

Number of channels		2
Frequency range (20 V _{pp})	kHz	≈0 ... >90
Amplifier		10 ... 270
Sensor temperature output analog	mV/°C	10
	Hz	1
	°C	±2,5 (max. error)
Sensor supply (I ref)	mA	1 or 4

For amplifier specifications see separate data sheet for Type 4665B (doc. no. 4664B_003-204).

Analog Inputs for Any Voltage Signals

Number of channels		8/16 ²⁾
Input voltage range	V	-10 ... 10
ADC resolution	bit	16
ADC sampling rate (per channel)	MHz (MS/s)	1,25
Low-pass filter	kHz	Off/5/10/20/ 25/30/35/40

Analog Inputs for Current Clamps

Number of channels		2
Input voltage range	V	-1 ... 1
ADC resolution	bit	12
ADC sampling range (per channel)	MHz (MS/s)	2,5
Bandwidth	kHz	125

Current Clamp

Suitable for ignition and injection timing measurements on gasoline and diesel engines; can be clamped to ignition or injector cables.

Type		2103A11	2105A30
Bandwidth	kHz	100	100
Power supply	V / VDC	9 (battery)	9 ... 36 (external)
Voltage output	V / mV/A	±1	30/20/40
Weight	grams	200	10

For additional information see separate data sheet for Type 2105A... (doc. no. 2105A_000-953).

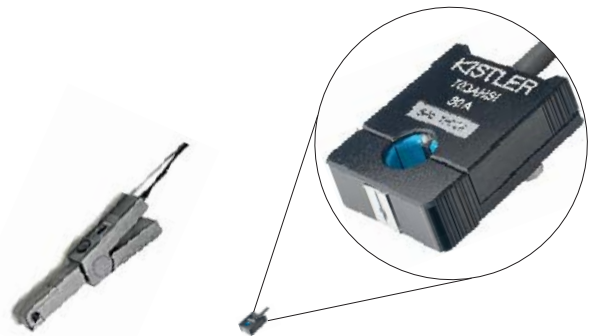


Fig 9: Current clamp Type 2103A11 (left), Type 2105A30 (right)

²⁾ with series connection of 2 devices by means of auxiliary hardware

Crank Angle Connections

Angle and Trigger Inputs

Connection 1	Kistler crank angle adapter Type 2619
Connection 2	Optical crank angle encoder (LVDS), Type 2614B/2614C - other with 600 impulses/360° KW - other with 1 200 impulses/360° KW - AVL 365/360 - AVL 365/720
Sampling rate	40 MHz

Crank Angle Adapter Set Type 2619A11

Analog crank angle signals are converted into a digital LVDS pulse train, for angle and TDC processing in a KiBox.



Fig. 10: Processing of the engine's stock crankshaft position sensor



Fig. 11: Crank angle adapter set Type 2619A11

Connectable sensor types		Trigger wheel with Hall or (inductive) VR sensor, (invertible signal)
Internal resistance	kΩ	200 ... 250
Input voltage range		
Hall	V	0 ... 100
Inductive	V	-100 ... 100
Overload range	V	-200 ... 200
Supported number of crank angle marks		20-1, 24-1, 24-2, 30-2, 36-1, 36-2, 36+1, 60-1, 60-2, 90-1, 120-1, 120-2, 36-2-2, 60-1-1, 60-2-2, 60+1+1, 36-2-2-2, 60-1-1-1, 60-2-2-2
Crank angle resolution	° CA	0,1
Auflösung OT-Bezug	° CA	0,01
Analoger Signalausgang		Analog sensor signal for diagnostic purposes with KiBox oscilloscope function
Degree of protection		IP65 (dust-proof and splash-proof)

Digital Input Channel

Digital Inputs for Any Signals

Number of channels		8/14 ²⁾
Sampling rate	MHz	2,5
Min. pulse duration	µs min.	3,2
ADC sampling rate (per channel)	MHz (MS/s)	2,5
Bandwidth	kHz	125
Input circuit		electrically isolated, floating
Input voltage, max.	V	±30
Input level low	V	<1
Input level high	V	>4,5

Laptop Requirements (Host PC)

PC operating systems		Windows® Vista, Win-Windows® Vista (SP1), Windows® 7 (32/64 bit), Windows® 8/8.1
Min. free hard-disk space	GB	1
Min. RAM	GB	2
Min. screen resolution	pixels	1 280 x 1 024
PC interface		1 Gigabit Ethernet

²⁾ with series connection of 2 devices by means of auxiliary hardware

Measurement and Processing Power

Measurement and Processing Power

Resolution of measurement data	kHz °CA	312,5 0,1
Speed range	1/min	≈0 ... 15 624

Local Memory for Measurement Data and Processed Results

RAM for measurement data	MB	400
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Measuring Duration

	Time data, angle data and results	Angle data and results
Manually saved	Up to 1 000 combustion cycles (1 Signal, 2 000 1/min)	Up to 7 000 combustion cycles (1 Signal, 2 000 1/min)
Automatically saved	500 combustion cycles and up to 30 s before engine started / after engine stopped	Up to 2 000 combustion cycles
Streaming mode (MDF4)	Continuous until USB data storage is full	Continuous until USB data storage is full

Table 1: Possible duration of measurements incl. data backup (data backup as files)

Result Interfaces to Application Systems

Interface	OHI 3 (ETAS software interface to INCA 6.1, 6.2.0, 6.2.1, 7.0, 7.1, 7.2) Kistler driver software OHI3 is included in the standard scope of delivery; Kistler driver software for other systems on request
Data Synchronisation	Time stamp from the operating PC, assignment fro each combustion cycle
Definition of timestamp	End of the combustion cycle
Uncertainty	Approx. 5 ms (<< 1 combustion cycle)

Test Bench Interface

Type	AK based ASCII text protocol or DCOM
Interface	- RS-232C (ASCII text protocol only) - Ethernet
Multi-client capability	yes

Data Files / File Format

Read / write	.open-File (Kistler open binary file format) ³⁾ – supported Matlab, DIAdem, Uniplot and Turbolab
Write only	MDF4 (USB streaming mode)
Datenkonvertierung	I file (AVL binary format), DAT (MDF3.2), ASCII tables (comma separated values)

CAN Interfaces

Number	2
Max. transmission rate	1 Mbit/s max.

Digital Outputs

Number	8 channels
Output circuit	electrically isolated, floating

³⁾ see description of .open file format

System Components and Type Numbers for the Vehicle Combustion Analysis System Type 2893AK1

Included Accessories	Type/Art. No.
• KiBox signal processing platform	2893A121
• Blind front panel	5700A27
• 10/100/1000 Ethernet switch with 5 connections	5.211.569
• Connecting cable 2 pin., l = 2 m	5.590.314
• Gigabit Ethernet cable 1:1, l = 1 m	1200A117A1
• Gigabit Ethernet cable 1:1, l = 5 m	1200A117A5
• Gigabit Ethernet cross cable, l = 5 m	1200A125A5
• Power cable, l = 2 m	7.620.433
• Power supply 100 ... 240 VAC; 50 ... 60 Hz	5781A4
• Power cable	Z16687
• D-Sub, 25 pin (m)	5.510.416
• D-Sub, 25 pin (f)	5.510.427
• Wheeled case for KiBox To Go	5.070.143
• KiBox Cockpit software on CD	7.643.034
Optional Accessories	Type/Art. No.
• Charge amplifier	5064C1...
• Piezoresistive amplifier	4665B1
• Blind front plate	5700A27
• Crank angle adapter set	2619A11
• Cascading set: LVDS splitter box incl. 2x CA1/CA2 cable and synchronisation cable	2633A100 / 2633A200
• TTL-LVDS converter	Z21209
• Current clamp set	2103A11
• Voltage supply module and signal summer for current clamp Type 2105A30	2105A10
• Amplifier module for current clamp Type 2105A30	2105A20
• Current clamp, miniature version	2105A30
• Power cable for Type 2105A10	2105A40
• Piezosmart extension cable, l = 0,5 m	1987BN0,5
• Piezosmart extension cable, l = 7 m	1987BN7
• Piezosmart extension cable	1987BFT...
• Extension cable, BNC pos. – BNC neg., l = 0,5 m	1603BN0,5
• Extension cable, BNC pos. – BNC neg., l = 7 m	1603BN7
• Coupling Triax pos. – BNC pos.	1704A4
• Coupling Triax pos. – BNC neg.	1704A1
• Tablet PC holder	KCD14539
• 12 V distribution box SMALL	12552
• 12 V distribution box BIG	11371
• Main connection, 3 pin, coded	1599

Software, Services & Training for the Vehicle Combustion Analysis System

Software ⁴⁾	Type
• DIAdem	2843A41
• TIGER	2843A3
• Turbolab	2843A2
• Uniplot	2843A1
Services	
• KiBox local calibration	9961E05-L1
• KiBox rent	9957E05-1
• KiBox service on the road: planning, preparation and realization of on-site combustion measurements by a Kistler expert	9968E05-D1-1 / 9968E05-D1-2
Training	
• KiBox Level A (Basic) user training	9966E05-E4-12
• KiBox Level B (Experts) user training	966E05-E5-12
• Handling of cylinder pressure sensors	9966P01-E1-12
• Basics on cylinder pressure measurements	9966P01-D0-E3-0

⁴⁾ optional software for offline data display (third-party suppliers), .open files compatible

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