Ei800 Series Process GC

Gas chromatographs for on-line gas analysis

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The Ei800 Process GC provides fast and accurate on-line monitoring of various process gases, and delivers concentrations and calculated values related to the composition.

The instrument can be programmed for continuous unattended process monitoring as well as manual gas analysis.

The Ex-certified micro process GC is extremely compact, yet its capabilities are massive. The applied micro GC chips enable analysis times of less than a minute.

Ei800 Series Micro Process GC

Very short analysis times
The Ei800 Series micro process GC accommodates one to four gas chromatograph (GC) units working in parallel, each performing a different GC analysis under individually optimized conditions. Each GC unit contains a state-of-the-art microchip-based injector and a thermal conductivity detector (TCD) combined with a proven microbore GC column, and is set with optimal chromatography conditions. This enables a compact instrument as well as very short analysis times of typically less than a minute.

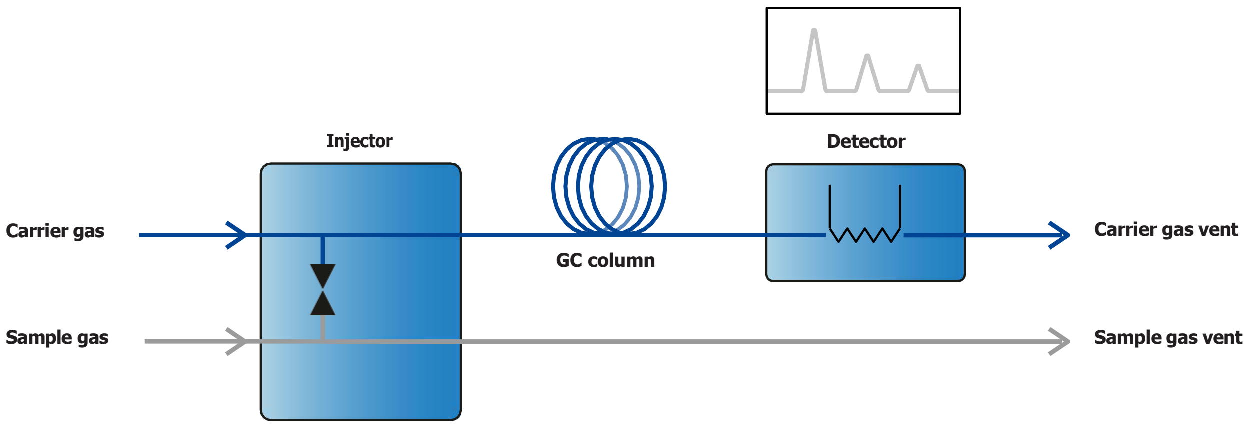
Continuous monitoring
The instrument is designed for continuous monitoring and therefore works in a stand-alone configuration using the integrated processor on a future-proof operating system based on Linux RT, without the need for a separate controller to give commands. In addition, dedicated InteliSense PC software can be used to analyze the collected data in further detail and to change operation settings. The PC can be connected to the process GC at any location via a network connection.

Versatile instrument
By selecting different columns in the GC units, a wide range of gas analysis applications can be served. The instruments are factory tested with standard gas components, but users can change gases and optimize methods and thus applications using the InteliSense PC software. Methods can be optimized for client-specific applications using the automatic parameter variation tool in the software.

Compact device
The compact instrument has a volume of only 10 l and weighs less than 30 lbs., so it is very easy to transport and can be deployed anywhere for gas analysis if local power and gas cylinders are available.

Ei800 Series micro gas chromatography

The gas analysis is conducted by means of gas chromatography, a proven analysis method for determining the chemical composition of a gas mixture. A small volume of the sample gas is injected into the carrier gas and this mixture flows through a GC column, where the gas components are separated and individually detected, resulting in a chromatogram. From this chromatogram, the components' concentrations and other values are calculated.



Gas chromatography – schematically

Robust enclosure
The ATEX /IECEx-certified Ei800 is housed in an explosion-safe marine-grade aluminum IP65 enclosure.

Tubeless process GC
A one-piece manifold replaces tubing found in traditional process GCs. This adds to the robustness and performance of the process GC, as fewer connections reduce possible sources of leakage. In fact, the GC column is the only "tube" inside the instrument.

Fast exchange of cartridges
The cartridge, which contains the GC units, can be replaced by the end user. The replacement is simple and can be done within 10 minutes. Approximately two hours after cartridge replacement, the Ei800 is fully operable again.

Stream selector
The process GC has a built-in stream selector to connect up to four streams and/or calibration gas bottles. This integrated stream selector switches between the different gas inlets, so only one stream is introduced into the process GC at a time. The stream selector has a double block and bleed design, so there are virtually no history or cross contamination effects between the different gas streams.

After the stream selector, the selected sample gas together with the carrier gas is led in parallel through all GC units.

In addition, an external (VICI) 16-port multi-stream selector can be connected and controlled from the instrument software.

Injector
Time-controlled injection is used, with an integrated array of pneumatically controlled micro membrane valves. This makes injection extremely accurate and reproducible, and provides short analysis times.

Both the sample gas and the carrier gas flow continuously into the GC and through the chips of all GC units. Inside these chips is a small chamber called the sample loop, through which the sample gas is continuously flowing.

At injection, this sample loop is closed off, pressurized by carrier gas pressure, followed by a release towards the columns. The advantage of this principle is that sample gas is injected at controlled carrier gas pressure, and consequently there is no measurement error caused by a pressure variation.

Detector
The in-house-fabricated detector chip is a Thermal Conductivity Detector (TCD), a robust device featuring simplicity, a large dynamic range, a general response to both organic and inorganic species and a non-destructive character. The temperature-controlled micro TCD – with 2 × 24-bit digital detector electronics – automatically adapts to different gases and is protected against overheating. Micro- chip TCD technology results in a detection limit better than 0.5 ppm (for pentane).

Back-flush to detector
The Ei800 process GC is equipped with back-flush to detector technology. This increases the analytical column lifetime because polluting or reactive components are prevented from entering the column.

Moreover, by using a second detector, both fore-flush and back-flush chromatograms run in parallel, which reduces the analysis time even more. For example, a standard natural gas C_6+ analysis is conducted every 45 seconds.

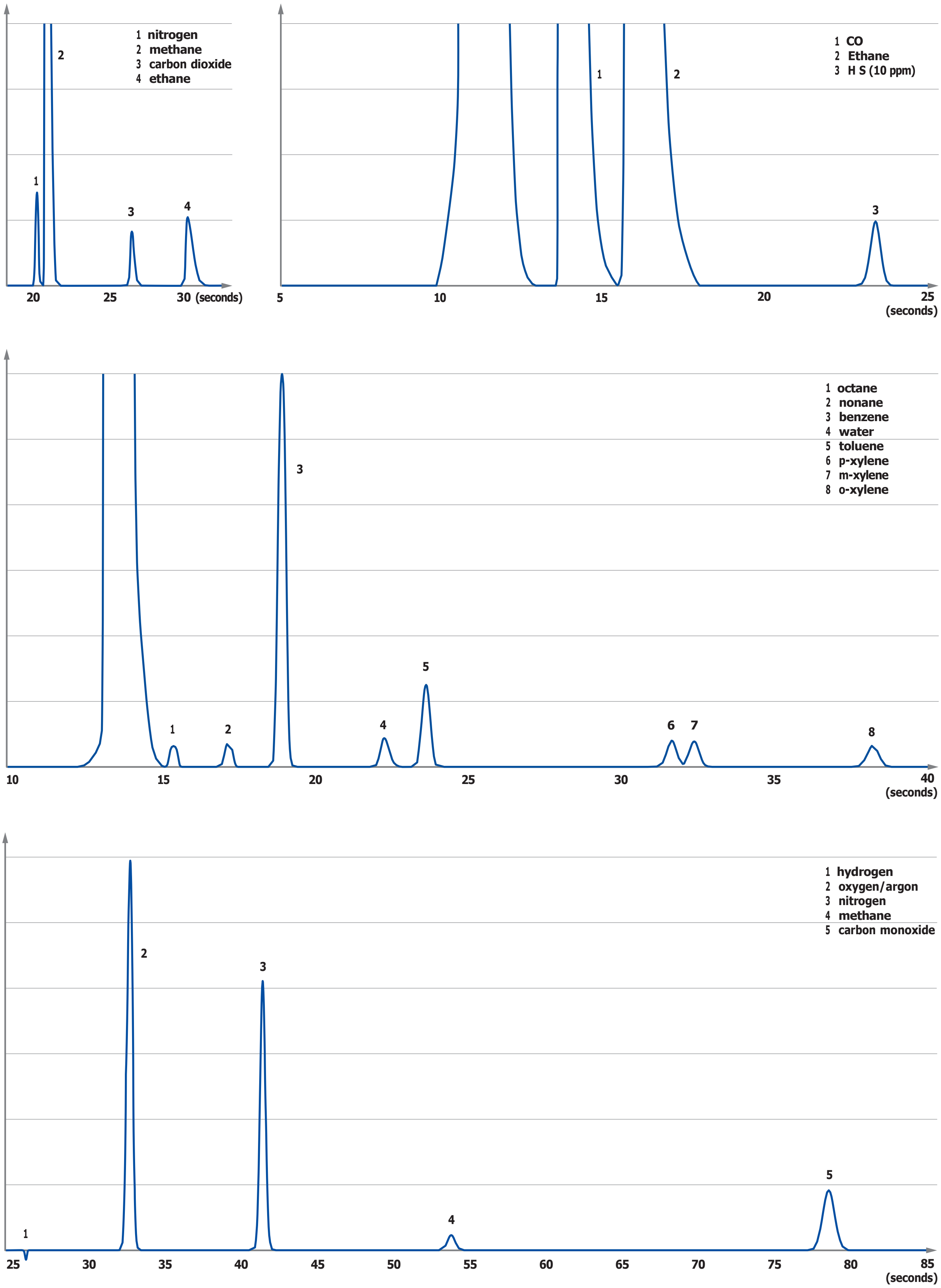
Fastloop
So that changes in the gas composition can be followed in near real-time, the Ei800 process GC features a fastloop. For sample flow refreshment, the fastloop increases the incoming sample flow by connecting a parallel gas channel which reduces the overall sample flow resistance.

Low carrier gas consumption
The gas port connections are 1 /16" VICI Valco fittings. Typical carrier gas consumption is less than 15 ml/minute during an analysis. By applying optimal measurement settings, the use of carrier gas can be limited to one gas bottle every three years.

Helium, argon, nitrogen or hydrogen can be applied as carrier gas.

Instruments with multiple GC units have two separate carrier gas inlets, to which two different carrier gases can be connected. The second carrier gas port leads to one specific GC unit. The instrument control adapts automatically, without the need for any hardware adaptation.

Sample pump as an option
Optionally, a vacuum sample pump can be integrated into the Ei800, located inside the GC before the sample vent. It creates a continuous sample flow by drawing sample gas into the instrument, which is required for samples at atmospheric pressure. The sample pump can be combined with the stream selector and the fastloop line.



Example chromatograms: C_1-C_2 NGA on P column (top left), C_3-C_5), H_2S on U column (top right), BTEX on Wax column (mid) and H_2, O_2, N_2, C_1 and CO on M column (bottom)

Operation and data processing

Stand-alone or manual operation
Ei800 Series analyzers are designed for on-line continuous monitoring, so stand-alone and unattended operation is possible, though they can also be manually operated.

Data processing and communication
The detector data is processed by an integrated processor. The autonomous running instrument generates data that is further communicated to the outside world by MODBUS or TCP protocols using RS485, RS232, Ethernet or Digital I/O ports. Ei800 Series analyzers can be connected to supervisory systems (such as SCADA) using these ports. Data is also stored on the GC and can be retrieved at any time.

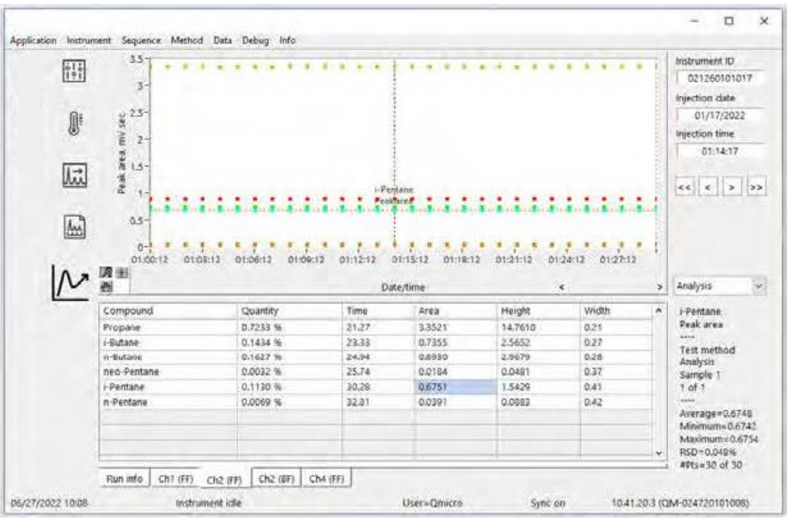
InteliSense PC software for data analysis and changing settings
Upon delivery, Ei800 Series analyzers are supplied with InteliSense software, which can be used for setting, tuning and programming the process GC, after which it runs as a stand-alone instrument. Multiple methods can be programmed in an automatic sequence. Furthermore, this software provides facilities to analyze the collected data in detail. The communication between the Ei800 and the Windows PC is over a (wired) LAN connection.

The InteliSense PC software is able to:

- View and change instrument and method settings
- Perform calibration or validation runs
- Perform multi-level calibration with polynomial fitting
- Perform single or multiple analysis runs
- Analyze collected data in detail
- Show trend plots of measurement data and calculated results
- Recalculate results
- Export results data (to a delimited ASCII spreadsheet) for further processing.

Trends
The software is able to show a trend plot for the results of a series of analyses for a selected parameter, such as quantity, time, area, height, width or a status parameter of the instrument at run start.

Historical data
All method parameters, analysis results, calibration results, calculated values and alarms can be stored with date and time stamp for at least two years, with a memory storage of up to 256 GB inside the Ei800. This facilitates problem-solving, may help to comply with legislation and enables observation of long-term trends.



InteliSense software trend view screen sample

Areas of application

Applications

By selecting column and GC method combinations, the fast and accurate process GC can be used for a wide range of applications, including:

- Natural gas C_6+, C_9+, C_{12}+
- Natural gas extended with sulfur compounds, BTEX
- Natural gas odorants
- Mud logging
- Liquefied petroleum gas (LPG)
- Syngas
- Flare gas /flue gas
- Landfill gas
- Biogas, Renewable Natural Gas (RNG)
- Refinery gas
- Dissolved gas analysis (DGA) /TOGA
- Fuel cell, hydrogen
- Coal mine gas
- Impurities in gases
- Industrial process gas

Columns

Column	Components
M	Permanent gases, CH_4, CO
U	Hydrocarbons C_1–C_3 saturated and unsaturated, CO_2, sulfur compounds
P	Hydrocarbons C_3–C_{12}, sulfur compounds
W	Polar volatile solvents, light aromatics (BTX)
A	Light hydrocarbons C_1–C_5 saturated and unsaturated
T	Odorants (THT) in natural gas

Natural gas

When delivered to end users like gas-fired power plants or energy companies that supply natural gas for home heating, the gas composition needs to be known to determine the calorific value of the natural gas. For each analysis the calorific value can be calculated and reported. Extended natural gas applications, such as C_9+, C12+, sulfur compounds and BTEX, can be analyzed in one and the same instrument.

Calculated values for natural gas applications*

- Normalized components
- Unnormalized sum
- Superior and inferior heating value
- Wobbe index
- Relative density and density
- Molar mass
- Compressibility
- According to ISO 6976:2016

Biogas/RNG

At any point where biogas is added to the natural gas distribution network, it needs to be assured that the biogas composition complies with minimum requirements. With the Ei800, a versatile biogas or RNG composition analysis can be performed every 45 seconds.

Hydrogen

Injecting sustainably produced green hydrogen into natural gas streams provides another way to reduce green-house gas emissions. As the hydrogen concentration may vary over time, near-real-time monitoring of the gas composition of this natural gas /hydrogen blend is needed to determine its calorific value. A notable advantage is that hydrogen in all concentrations > 50 ppm can be analyzed using helium as carrier gas, so a full natural gas with hydrogen analysis requires only one carrier gas. For low hydrogen concentrations < 50 ppm, argon carrier gas can be used.

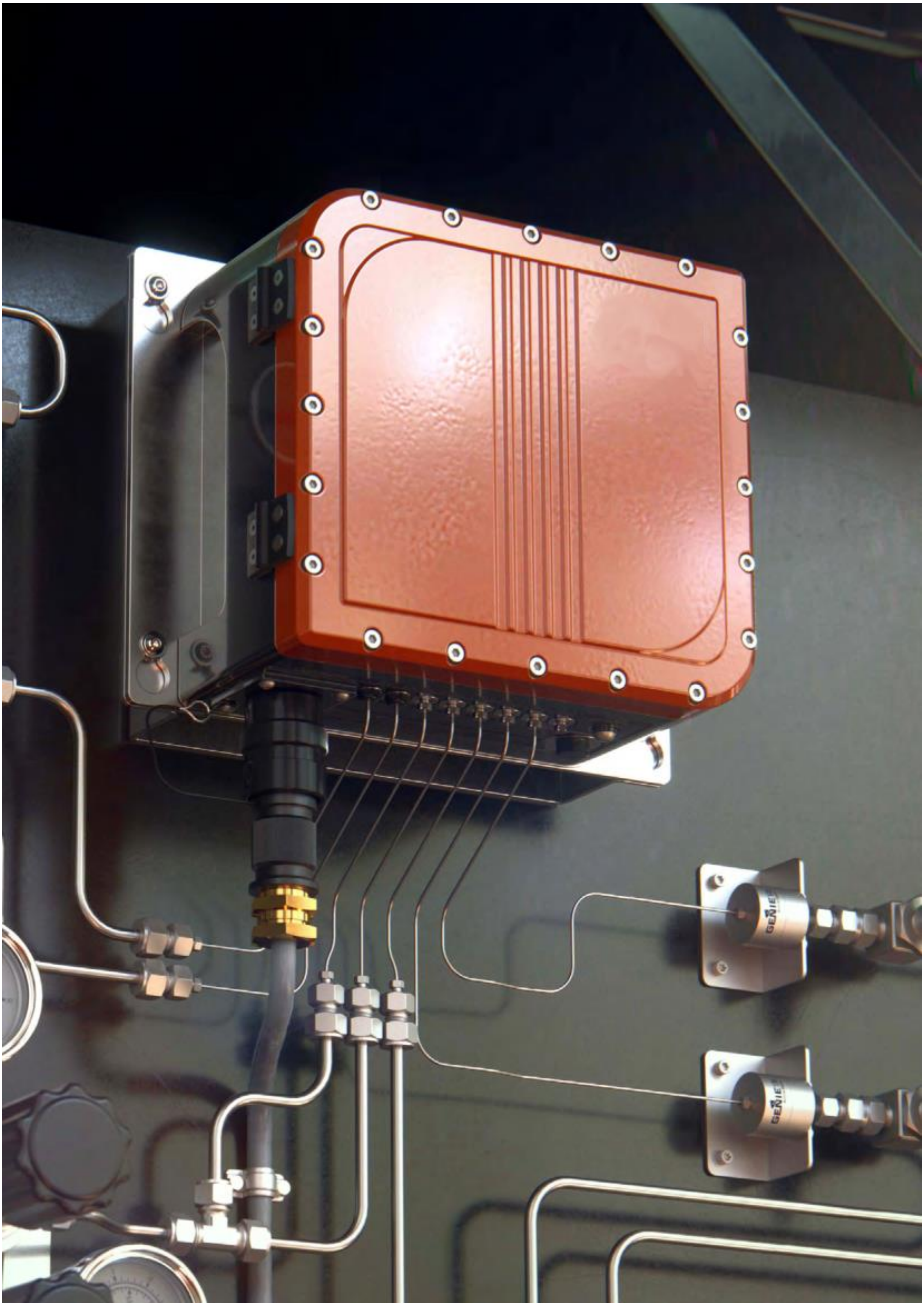
In addition, for fuel cell and hydrogen generation applications, impurities in pure hydrogen can be analyzed quickly and accurately.

The compact Ei800 Series Process GC provides a solution for all of these gas applications – and more.

Technical specifications

Ei800 Series

Specifications	Values
Cycle time	15 to 60 s (typical)
Repeatability of concentration	< 0.05 % RSD (typical, concentration dependent)
Calorific value calculation for natural gas	ISO 6976:2016, GPA 2172, ASTM D3588: ± 0.025% repeatability
Operating temperature	−20 to 55 °C / −4 to 131 °F
Storage temperature	−20 to 60 °C / −4 to 140 °F
Moisture	5 to 95 %
Dust / water protection	IP65 (only valid with receptacle cap / mating connections)
Power supply	20 to 28 VDC
Power consumption	20 W nominal, 75 W max
Dimensions	289 × 258 × 122 mm / 11.4 × 10.2 × 4.8"
Weight	< 15 kg / 33 lb. (without mounting brackets)
Gas ports	1 / 16" VICI Valco
Carrier gas	He, Ar, N_2, or H_2
Carrier gas input pressure	65 ± 5% psi
Carrier gas consumption	15 ml / minute typical
Sampling	Pressurized or atmospheric (integrated pump)
Sample pressure	1 to 30 psi (but < column head pressure)
Sample streams	4 (option for more)
Detectors	Fore-flush and back-flush micro TCD
Detection limit	500 ppb to 100% (application dependent)
Communication ports	2 × MODBUS over RS485
	1 × MODBUS over RS232
	1 × MODBUS over TCP / LAN
	Ethernet
	2x Digital I / O
Memory storage	Up to 256 GB
Certifications	CE ATEX/IECEx Ex II 2G Ex db IIB+H2 T4 Gb; NEC&CEC Class I, Div. 1, Groups B,C and D, T4 (pending)
Meteorological approval	OIML R 140 class A compliant, PTB certified by German partner
Explosive atmospheres – Part 0	EN 60079-0 (2012) + A11: 2013
Explosive atmospheres – Part 1: protection "d"	EN 60079-1 (2014)
Conducted & radiated emission (to 1 GHz SAC)	EN 55011 (2009) + A1 (2010)
ESD	EN-IEC 61000-4-2 (2009)
Radiated immunity	EN-IEC 61000-4-3 (2006) + A1 (2008) + A2 (2010)
EFT & surge	EN-IEC 61000-4-4 (2012) & EN-IEC 61000-4-5 (2014)
Conducted immunity	EN-IEC 61000-4-6 (2014)
Power frequency magnetic field	EN-IEC 61000-4-8 (2010)



Contact

Ohio Lumex · 30350 Bruce Industrial Parkway, Cleveland, Ohio 44139

440-264-2500 · mail@ohiolumex.com · www.ohiolumex.com