The SITRANS CV gas chromatograph (GC), which is based on the innovative analytical technology of the MicroSAM, is an analyzer that has been specially developed for natural gas analysis. The device concept enables the higher and lower calorific value, standard density and Wobbe index (according to ISO, AGA 8, Gost standard) to be determined in a way that is not only cost-effective, but also quick, precise and reliable.

**Benefits**

Flexible installation: The rugged and compact design enables installation in even extreme areas of application, such as offshore exploration, or directly at the pipeline. The SITRANS CV has the certification required (such as explosion protection or splashwater protection) to meet the requirements of these applications.

Like the MicroSAM, the SITRANS CV consists of a basic unit and an analysis module, which, if necessary, can be replaced in as short a time as possible. Combined with low power and gas consumption, this keeps operating costs down.

Notable features of the CVControl software, which has been specially developed for calibration-related applications, includes its ease of operation and transparency.

The automatic method optimization integrated in the software increases the repeatability of the calorific value measurement and reduces the cost of ownership.

The serial RS 485/RS 232 and Ethernet interfaces enable communication with both the control system and a flow computer.

Like the MicroSAM, the unit's high analytical capability can be attributed to narrow-bore capillary columns, live injection, live switching and in-line detection.

**Application**

- Analysis of natural gas in power plants:
  - For quality control
  - For turbine optimization
  - Pipeline monitoring
- Analysis of natural gas when opening up sea beds (off-shore plants).
- Analysis of bio-natural gas in preprocessing plants
- Analysis of natural gas in liquefaction and regasification plants (LNG Regasification and Storage)
- Determination of calorific value in natural gas for power plants, in gas transfer stations, or during turbine optimization
- Analysis of calorific value in natural gas preparation plants

**Design**

**Enclosure**

- EEx-d version standard
- Heating adjustable from 60 to 165 °C (isothermal)
- Decentralized installation close to sampling point

**Analytical modules**

The compact analytical modules contain all the functional components of a chromatograph. The SITRANS CV operates with:

- Live injection
- Valveless live switching on microchip basis
- Standardized analytical modules
- Multidetection through use of up to 8 micro thermal conductivity detectors in smallest possible areas (e.g. on all column/purging outputs and injection)

**Function**

**Live injection**

The SITRANS CV has a two-stage injection system. Using a micro injection valve, a defined quantity of sample is first brought up to the carrier gas pressure. This eliminates the pressure-dependent error in the dosing quantity present with conventional systems. In the second stage, the sample is transferred to the column by a valveless micro injection system (live dosing). The result is an “active” injection.

The injection volume can be varied time-controlled, and exactly matched to the column requirements.

**Valveless live column switching**

Because of the high dead volume of conventional valves, only the valveless version can be considered for a miniaturized system. In this case, the generation of differences in flow using several electronic pressure regulators at appropriate positions of the column setup causes a change in the flow directions. (The system operates according to the Wheatstone principle, but pneumatically.) The functions “Cut” and “Backflushing” can then be implemented free of dead volume.

**The column system**

The separation system consists of up to three separation columns connected in series. Micro TCDs or micro live circuits are installed in sequence (“inline”) upstream and downstream of the individual columns. Three electronic pressure regulators supply the columns with carrier gas and carry out the switching functions (injection, backflushing and cut).

By using narrow-bore capillary columns, the separation at high resolution is carried out within a much shorter time, approx. factor 2 to 3 compared to standard capillary columns.

**Electronic pressure regulators**

A high pressure stability together with rapid changing rates in the hPa range are required for precise and fast switching. This is achieved in the electronic pressure regulators by means of a piezo actuator.

**Detector**

The micro TCDs (silicon wafer technology) work on the principle of continuous measurement of the different thermal conductivities of the carrier gas and the components to be measured. The measurement can be carried out without falsification by avoiding catalytic effects on the heating wires and maintaining a constant flow velocity. This permits constant flow detection, i.e. without qualitative or quantitative loss of substances.
Process Gas Chromatographs
SITRANS CV

Modules
The standardized application modules generally feature live injection and live switching functions, detectors and separation columns.

Application
The SITRANS CV is a storage product. Precalibration is carried out at the factory, using helium and argon (as the carrier gas) and a calibration gas. The measured components and switching functions (live injection, backflushing, cut) are saved in the GC. The calibration process itself should be performed during commissioning on-site.

Measurements can be made within the following working ranges:

<table>
<thead>
<tr>
<th>Component</th>
<th>Checked working range (%)</th>
<th>Possible working range (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>57...100</td>
<td>50...100</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0...22</td>
<td>0...25</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>0...12</td>
<td>0...20</td>
</tr>
<tr>
<td>Ethane</td>
<td>0...14</td>
<td>0...20</td>
</tr>
<tr>
<td>Propane</td>
<td>0...5</td>
<td>0...15</td>
</tr>
<tr>
<td>i-butane</td>
<td>0...0.9</td>
<td>0...10</td>
</tr>
<tr>
<td>n-butane</td>
<td>0...1.8</td>
<td>0...10</td>
</tr>
<tr>
<td>Neopentane</td>
<td>0...0.1</td>
<td>0...1</td>
</tr>
<tr>
<td>i-pentane</td>
<td>0...0.12</td>
<td>0...1</td>
</tr>
<tr>
<td>n-pentane</td>
<td>0...0.12</td>
<td>0...1</td>
</tr>
<tr>
<td>Hexane+</td>
<td>0...0.08</td>
<td>0...3</td>
</tr>
<tr>
<td>Hexane</td>
<td>0...1</td>
<td></td>
</tr>
<tr>
<td>Heptane+</td>
<td>0...1</td>
<td></td>
</tr>
<tr>
<td>Octane</td>
<td>0...1</td>
<td></td>
</tr>
<tr>
<td>Nonane+</td>
<td>0...1</td>
<td></td>
</tr>
<tr>
<td>Helium</td>
<td>Concentration can be entered as a fixed value in the components list</td>
<td></td>
</tr>
<tr>
<td>H₂S</td>
<td>&lt; 500 ppm</td>
<td>No measured component</td>
</tr>
<tr>
<td>High/low calorific value</td>
<td>Calculated</td>
<td>Calculated</td>
</tr>
<tr>
<td>Density and relative density</td>
<td>Calculated</td>
<td>Calculated</td>
</tr>
<tr>
<td>Wobbe index</td>
<td>Calculated</td>
<td>Calculated</td>
</tr>
<tr>
<td>Compressibility factor</td>
<td>Calculated</td>
<td>Calculated</td>
</tr>
<tr>
<td>Normalisation factor</td>
<td>Calculated</td>
<td>Calculated</td>
</tr>
</tbody>
</table>

Oxygen

<table>
<thead>
<tr>
<th>Component</th>
<th>Possible working range (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>&gt; 80</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>&lt; 8</td>
</tr>
<tr>
<td>Ethane</td>
<td>&lt; 6</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>&lt; 4</td>
</tr>
<tr>
<td>Propane</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Butane</td>
<td>&lt; 1.2</td>
</tr>
<tr>
<td>Oxygen</td>
<td>&lt; 3</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>&lt; 3</td>
</tr>
</tbody>
</table>

Table 2: Measuring range of the additional measured component oxygen of the extended calorific value analysis (see Article No. 7KQ3105-1)

The remark in footnote 1 about the detection of oxygen and nitrogen is not valid in the case of an extended calorific value analysis. In this case, all components from the Table 1 "Measured components and performance parameters for Pos. 8_0 (master setup, standard calorific value analysis in accordance with ISO 6976-1995)” plus oxygen are detected and quantified.

For the analysis of biomethane the following components and their working ranges are measured (Table 3).

<table>
<thead>
<tr>
<th>Component</th>
<th>Possible working range (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>&gt; 80</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>&lt; 8</td>
</tr>
<tr>
<td>Ethane</td>
<td>&lt; 6</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>&lt; 4</td>
</tr>
<tr>
<td>Propane</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Butane</td>
<td>&lt; 1.2</td>
</tr>
<tr>
<td>Oxygen</td>
<td>&lt; 3</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>&lt; 3</td>
</tr>
</tbody>
</table>

Table 3: Measured components, working ranges and calibration gas for the analysis of biomethane
For analysis of natural gas with backflush summation, the following components and working ranges are measured:

<table>
<thead>
<tr>
<th>Component</th>
<th>Possible working range (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>50 ... 100</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0 ... 25</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>0 ... 20</td>
</tr>
<tr>
<td>Ethane</td>
<td>0 ... 20</td>
</tr>
<tr>
<td>Propane</td>
<td>0 ... 15</td>
</tr>
<tr>
<td>i-butane</td>
<td>0 ... 10</td>
</tr>
<tr>
<td>n-butane</td>
<td>0 ... 10</td>
</tr>
<tr>
<td>Neopentane*</td>
<td></td>
</tr>
<tr>
<td>i-pentane</td>
<td>0 ... 1</td>
</tr>
<tr>
<td>n-pentane</td>
<td>0 ... 1</td>
</tr>
<tr>
<td>Hexane+</td>
<td>0 ... 3</td>
</tr>
<tr>
<td>H₂S</td>
<td></td>
</tr>
<tr>
<td>Density and relative density</td>
<td>Calculated</td>
</tr>
<tr>
<td>Wobbe index</td>
<td>Calculated</td>
</tr>
<tr>
<td>Compressibility factor</td>
<td>Calculated</td>
</tr>
<tr>
<td>Normalization factor</td>
<td>Calculated</td>
</tr>
</tbody>
</table>

Concentration range (mol.%) | Repeatability according to ISO 6974-5 (2001); Mol fraction (%), absolute
---|---
50 < \( x_i < 100 \) | 0.03 ... 0.035
1 < \( x_i < 50 \) | 0.011 ... 0.03
0.1 < \( x_i < 1 \) | 0.006 ... 0.011
\( x_i < 0.1 \) | < 0.006

Table 4: Component and measuring ranges for the analysis, including backflush summation

* Because the neopentane concentration is very small in practice, this component is not calibrated and is measured with the relative response factor of isopentane. For this reason, a possible working range is not indicated.

Analyses within the checked working range as well as the quality parameters resulting from these (upper and lower calorific values, density and relative density, Wobbe index, compression and normalization factors) correspond to the requirements listed below.

Measurements within the scope of the possible working ranges (Table 1 "Measured components and performance parameters for Pos. 8_0 (Master setup, standard analysis of calorific value in accordance with ISO 6976-1995)", right column, and Table 2 "Measuring range of the additional measured component oxygen of the extended analysis of calorific value (see Article No. 7KQ3105-1)") are possible. However, checking of the repeatability and correctness has not been carried out by the official German body "Physikalisch technischer Bundesanstalt (PTB)".

Table 5: The repeatability of the measured components complies with ISO 6974-5 (2001) – Annex B (Article No. 7KQ3105-0, 7KQ3105-1)

The repeatability of the calorific value and standard density achieve a relative standard deviation of < 0.01 %. SITRANS CV for the analysis of biomethane achieves a relative standard deviation of < 0.05 %.

The calibration gas is an extremely important factor for consideration in terms of the MPE (maximum permissible error), and has a significant effect on the accuracy of the overall measuring system. For this reason, SITRANS CV - based on a comparative measuring procedure - can never be more accurate than the calibration gas used. Other parameters besides the accuracy data on the calibration gas certificate are important for the accuracy of a system. Examples of these include the optimum gas composition, the ambient temperatures of the calibration gas cylinders during transportation and operation, potential condensation of, for instance, higher hydrocarbons in a calibration gas cylinder, and the functionality of the sample preparation system.

Under optimum conditions, the SITRANS CV achieves an MPE of < 0.1 % for the calorific value and the standard density, whereby the system for measuring biomethane produces an MPE of < 0.5 %.

SITRANS CV is designed for measuring with various configurations; the calibration gases required for this purpose are shown below. (Table 6, Measurement and calibration gas components):
## SITRANS CV – Overview of possible configurations and the required calibration gases

<table>
<thead>
<tr>
<th>Carrier gas</th>
<th>He</th>
<th>He</th>
<th>Ar</th>
<th>He</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzer module</td>
<td>C09</td>
<td>C01</td>
<td>C01</td>
<td>C13</td>
</tr>
<tr>
<td>Calorific value analysis</td>
<td>C09</td>
<td>C01</td>
<td>C01</td>
<td>C13</td>
</tr>
<tr>
<td>C6+ with oxygen</td>
<td>C09</td>
<td>C01</td>
<td>C01</td>
<td>C13</td>
</tr>
<tr>
<td>Basic Bio-CH₄</td>
<td>C09</td>
<td>C01</td>
<td>C01</td>
<td>C13</td>
</tr>
<tr>
<td>Extended calorific value analysis Bio-CH₄</td>
<td>C09</td>
<td>C01</td>
<td>C01</td>
<td>C13</td>
</tr>
<tr>
<td>C6+ backflush</td>
<td>C09</td>
<td>C01</td>
<td>C01</td>
<td>C13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Article No.</th>
<th>7KQ 3105-0</th>
<th>7KQ 3105-1</th>
<th>7KQ 3105-2</th>
<th>7KQ 3105-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>-</td>
<td>-</td>
<td>M CR</td>
<td>-</td>
</tr>
<tr>
<td>Oxygen</td>
<td>-</td>
<td>-</td>
<td>M CR</td>
<td>-</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>M CR</td>
<td>M CR</td>
<td>M CR</td>
<td>M CR</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>M CR</td>
<td>M CR</td>
<td>M CR</td>
<td>M CR</td>
</tr>
<tr>
<td>Methane</td>
<td>M CR</td>
<td>M CR</td>
<td>M CR</td>
<td>M CR</td>
</tr>
<tr>
<td>Ethane</td>
<td>M CR</td>
<td>M CR</td>
<td>-</td>
<td>M CR</td>
</tr>
<tr>
<td>Propane</td>
<td>M CR</td>
<td>M CR</td>
<td>-</td>
<td>M CR</td>
</tr>
<tr>
<td>Isobutane</td>
<td>M CR</td>
<td>M CR</td>
<td>-</td>
<td>M CR</td>
</tr>
<tr>
<td>Butane</td>
<td>M CR</td>
<td>M CR</td>
<td>-</td>
<td>M CR</td>
</tr>
<tr>
<td>Neopentane</td>
<td>M¹</td>
<td>M¹</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Isopentane</td>
<td>M CR</td>
<td>M CR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pentane</td>
<td>M CR</td>
<td>M CR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Group C6+</td>
<td>M² CR</td>
<td>M² CR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Group C6+ backflush</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>M² CR</td>
</tr>
</tbody>
</table>

| Separate measurement of Group C6 and Group C7+ | M³ CR³ | M³ CR³ | - | - |
| Separate Groups C6, C7, C8, C9 | M⁴ CR⁴ | M⁴ CR⁴ | - | - |

### Caution!

Use of the SITRANS CV with a carrier gas different to that of the supplied solution can lead to faults and to the destruction of the analysis module. Depending on the composition of the calibration gas, external heating for the calibration gas cylinder may be necessary.

- **M** Measured
- **CR** Required as calibration component; composition see catalog PA 01 – SITRANS CV - Function
- **M¹** Neopentane is measured with the response factor of isopentane; for direct calibration of neopentane: see operating instructions
- **M²** Group C6+ is measured with the relative response factor of n-hexane
- **M³ CR³** Groups C6 and C7+ are measured separately and calibrated with n-hexane and n-heptane, respectively
- **M⁴ CR⁴** Group C6, Group C7, Group C8, Group C9 are measured and calibrated separately

Table 6: Overview of device versions and available measurement configurations and the calibration gas compositions required for them
### Technical specifications

**Climatic conditions**
- Permissible ambient temperature: -20 ... +55 °C (depending on oven temperature)
- Permissible storage/transport temperature: -30 ... +70 °C
- Permissible relative humidity: Max. 90 %
- Protection against dust and moisture:
  - According to EN 60529/IEC 60529: IP 65
  - According to NEMA 250: NEMA 4X

**Power supply**
- Power supply: 24 V DC (18.5 ... 30.2 V)
- External fuse: T2.5 A
- Power consumption, typical: 18 W
- Power consumption, maximum: 60 W

**Dimensions and weights**
- Width x depth x height: 360 x 300 x 220 mm (approx. 14” x 12” x 9”)
- Weight: 15 kg (35 lb.)

**Mounting**
- Installation on: Post, pipe or wall
- Distance from wall or next chromatograph: 300 mm (12”)
- Distance from ceiling or floor: 200 mm (8”)

**Electromagnetic compatibility**
- Noise suppression: According to CISPR 11 / EN 55011 / DIN VDE 0875 Limit class B
- EMC immunity: According to IEC 60801 / DIN VDE 0843
- Conducted interferences on AC supply lines:
  - According to Part 4 (burst): 2 kV
  - According to Part 5 (ms pulses), line against line: 1 kV
  - According to Part 5 (ms pulses), line against ground: 2 kV
- Conducted interferences on signal lines:
  - According to Part 4 (burst): 1 kV
  - Immunity to static discharge: 8 kV
  - Immunity to fields:
    - According to Part 3 and Part 6: 10 V/m

**Safety**
- Electrical safety: IEC 61010 / DIN VDE 0411
- Explosion protection: ATEX and IEC Ex:
  - IL 2 G Ex d IIIC T4 Gb
  - Class I, Zone 1, Group IIB + H2 T4
  - Class I, Div 1, Groups B, C, D T4
  - Factory Sealed

**Oven**
- Number/type: 1 / isothermal
- Purging with N₂: Possible
- Dimensions (D x H): 160 x 10 mm
- Max. heating power: 35 VA
- Temperature range: 60 ... 165 °C
- Temperature stability: ± 0.1 °C (60 ... 165 °C)
- Temperature accuracy: Approx. ±0.5 °C
- Retention time variations per 10 °C change in ambient temperature: Approx. ±0.3 %
- Warm-up period from 30 ... 100 °C: 10 minutes
Process Gas Chromatographs
SITRANS CV

Columns and gases
- Separating column switching
- Multifunctional diaphragm valve
- Gas connections
- Pressure regulators
- Solenoid valves for control of diaphragm valve
- Carrier gas

Multidimensional chromatography with backflushing and cut in live system

- For injection and backflushing
- Swagelok 1/8"
- Max. 4 single-channel electronic pressure regulators
- 2 NC contacts, 2 NO contacts

Notice:
The carrier gas defined for the delivered state must be used.
Changing the carrier gas could destroy the thermal conductivity detectors.

> 99.999 % (5.0)
< 0.1 μm
Degree of separation 99.99 % for 0.1 μm particles
500 ... 700 kPa
600 kPa (g) recommended

Important:
A continuous carrier gas supply is required for error-free operation (frequent carrier gas failure has a negative effect on the life cycle of the detectors and the device-internal pressure regulator). In addition, an external two-layer pressure regulator for the carrier gas pressure is strongly recommended.

• Gas purity (minimum requirement)
• Solid components
• Required filtration
• Consumption
• Inlet pressure

Sample and injection
- Sample streams: 3
- Calibration sample streams: 1
- Phase: Gaseous
- Permissible sample pressure: 10 ... 60 kPa above atmospheric pressure
- NOTICE: Sample must not contain ethine (acetylene).
- Sample flow: 20 ... 100 ml/min
- Max. sample temperature: 120 °C
- Solid components: < 0.1 μm
- Required filtration
- Material with which the sample comes into contact
- Injection: "Valveless" live injection
- Controller: With multifunctional diaphragm valve
- Injection volume adjustable using switching times: From 2 ... 50 μl

Detectors, calibration and performance data
- Detector type: TCD, max. 8 sensors
- Cell volume: 0.02 μl
- Calibration: Manual or automatic, single level
- Repeatability for calorific value and density: ≤ 0.01 % (for natural gas)
- Accuracy for calorific value and density: ≤ 0.1 % (for natural gas)
- Linear range: Typically ≥ 10^6
- Cycle time: Application-dependent
- Ambient temperature influence: Negligible
- Mean Time to Repair/MTBF: < 1 hour / 3 years (without consumables)

Electronics: Communication and analytical controller (CAC)
- Microprocessor: Intel 586 architecture
- Flash EPROM: 128 MB
- Dynamic RAM: 64 MB
- Operating system: Windows CE 5.0
- Software: Preinstalled; Modifications or upgrades for operation PC downloadable via network or locally

Electronics: Realtime signal processor (RSP)
- Microprocessor: Motorola 68376, 20 MHz
- Flash EPROM: 1 MB
- Static RAM: 1 MB
- Operating system: Forth
- Software: Preinstalled; Modifications or upgrades downloadable via internal service interface

Interfaces
- Communication: 1 x Ethernet 10BaseT/TCP/IP
- Control system coupling: 1 x Modbus RS 485/RS 232 RTU/ASCII

Inputs/outputs: Basic equipment
- Digital outputs (relay contact 0.4 A/24 V DC): 4, 3 x samples, 1 x calibration
- Digital inputs (24 V to optocoupler): 4, for 1 = sample flow; 2 = time synchronization; 3 = revision (results have no effect on average values); 4 = calibration

Status indicator
- LEDs for:
  - Supply voltage
  - Software Heartbeat
  - Ready
  - Maintenance request alert
  - Fault
  - Sample flow
- LCD for:
  - Sample stream: S1, S2, S3, S4
  - Sample components: e.g. CO2, propane, etc.
  - Measured value of sample as numeric value

Recommended operator panel
- Personal computer: Desktop or laptop
- Processor: At least Pentium III
- Clock: ≥ 800 MHz
- Interfaces: 1 x Ethernet
- Operating system: Windows XP, Windows 7
- Software: CV Control version 1.30.0.0 and higher

Instrument air
- Not required

• Gas purity (minimum requirement)
• Solid components
• Required filtration
• Consumption
• Inlet pressure

Notice:
The carrier gas defined for the delivered state must be used.
Changing the carrier gas could destroy the thermal conductivity detectors.

> 99.999 % (5.0)
< 0.1 μm
Degree of separation 99.99 % for 0.1 μm particles
500 ... 700 kPa
600 kPa (g) recommended

Important:
A continuous carrier gas supply is required for error-free operation (frequent carrier gas failure has a negative effect on the life cycle of the detectors and the device-internal pressure regulator). In addition, an external two-layer pressure regulator for the carrier gas pressure is strongly recommended.

Material with which the sample comes into contact
Injection: "Valveless" live injection
 Controller: With multifunctional diaphragm valve
 Injection volume adjustable using switching times: From 2 ... 50 μl

Sample streams: 3
Calibration sample streams: 1
Phase: Gaseous
Permissible sample pressure: 10 ... 60 kPa above atmospheric pressure
NOTICE: Sample must not contain ethine (acetylene).
Sample flow: 20 ... 100 ml/min
Max. sample temperature: 120 °C
Solid components: < 0.1 μm
Required filtration
Material with which the sample comes into contact
Injection: "Valveless" live injection
Controller: With multifunctional diaphragm valve
Injection volume adjustable using switching times: From 2 ... 50 μl

Detectors, calibration and performance data
Detector type: TCD, max. 8 sensors
Cell volume: 0.02 μl
Calibration: Manual or automatic, single level
Repeatability for calorific value and density: ≤ 0.01 % (for natural gas)
Accuracy for calorific value and density: ≤ 0.1 % (for natural gas)
Linear range: Typically ≥ 10^6
Cycle time: Application-dependent
Ambient temperature influence: Negligible
Mean Time to Repair/MTBF: < 1 hour / 3 years (without consumables)

Electronics: Communication and analytical controller (CAC)
Microprocessor: Intel 586 architecture
Flash EPROM: 128 MB
Dynamic RAM: 64 MB
Operating system: Windows CE 5.0
Software: Preinstalled; Modifications or upgrades for operation PC downloadable via network or locally

Electronics: Realtime signal processor (RSP)
Microprocessor: Motorola 68376, 20 MHz
Flash EPROM: 1 MB
Static RAM: 1 MB
Operating system: Forth
Software: Preinstalled; Modifications or upgrades downloadable via internal service interface

Interfaces
Communication: 1 x Ethernet 10BaseT/TCP/IP
Control system coupling: 1 x Modbus RS 485/RS 232 RTU/ASCII

Inputs/outputs: Basic equipment
Digital outputs (relay contact 0.4 A/24 V DC): 4, 3 x samples, 1 x calibration
Digital inputs (24 V to optocoupler): 4, for 1 = sample flow; 2 = time synchronization; 3 = revision (results have no effect on average values); 4 = calibration

Status indicator
LEDs for:
- Supply voltage
- Software Heartbeat
- Ready
- Maintenance request alert
- Fault
- Sample flow

LCD for:
- Sample stream: S1, S2, S3, S4
- Sample components: e.g. CO2, propane, etc.
- Measured value of sample as numeric value

Recommended operator panel
Personal computer: Desktop or laptop
Processor: At least Pentium III
Clock: ≥ 800 MHz
Interfaces: 1 x Ethernet
Operating system: Windows XP, Windows 7
Software: CV Control version 1.30.0.0 and higher

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Notes on 7KQ3105-.. 

Support bracket

For easy mounting, incl. support for 8 gas connections consisting of:
- Mounting part: Dimensions 380 x 110 mm (W x H)
- Bracket for gas connection: Dimensions 146 x 110 mm (D x H), bracket on right side, mounted at right angle

Sample flow switchover

The chromatograph enables automatic selection and switchover of 3 sample flows and 1 calibration flow. The DO signal from the gas chromatograph requires an external relay for the solenoid valve. The sample preparation system can be ordered separately.

Ambient temperatures

Particularly in warmer zones, weather protection is necessary to protect the SITRANS CV against direct solar radiation. The chromatograph is designed as standard for temperatures from -20 to +55 °C. A version in a thermostatically-controlled casing is also available as an option for temperatures outside these limits.

Communication

SITRANS CV has a serial interface (RS 485/RS 232) for MODBUS communication (RTU/ASCII). Modbus mapping can be flexibly used (see manual for more information).

The operator input is by means of another separate interface via Ethernet (TCP/IP).

Other serial and analog (4 to 20 mA) interfaces are optionally possible using an external solution package (see Article No. 7KQ2160).

Documentation

The documentation includes a SITRANS CV Manual and CVControl Operating Manual in English and German. The documents can be found on the enclosed CD.

Safety manuals in all EU languages are also available on the CD.

CVControl operating software

The operating software (language: English or Russian) is included in the scope of supply. Windows XP or Windows 7 must be installed on the computer in order to install this software.

Application

A general system check is made of the basic unit and the integrated application module. The module and basic unit are described in the manual. In addition to the standard configuration, additional country-specific and user-specific sub-configurations are available. The performance record ex works contains the analysis check, including a repeatability record (4h test).

The chromatograph is preconfigured; In addition, three CD-ROMS are enclosed:
- SITRANS CV Software (including manuals and CVControl Operating Instructions)
- Country-specific sub-setups
- Parameter backup

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Process Gas Chromatographs
SITRANS CV

Article No. Pos. 8_0: Applications – Standard calorific value analysis

This application comprises the standard calorific value analysis. The chromatograph’s measurement method is set at the factory, using a synthetic natural gas mixture. The performance parameters specified in Table 5 and the criteria explained in the subsequent text apply to the individual components in Table 1 and their physical variables.

The calculation of the calorimetric variables is possible according to the following standards: ISO 6976-95, GOST, AGA 8, where the former is present. The reference states for the combustion and for the gas volume that must be specified for calculation purposes are preset to the standard state (Tb=25 °C, Tn = 0 °C) and can be easily changed to other reference states during commissioning using the operating software (Tb= operating temperature, Tn= standard temperature).

The CVControl software provides the energy units BTU/ft³, KWh/m³ and MJ/m³.

Article No. Pos. 8_1: Applications – extended calorific value analysis with oxygen

This position includes the extended calorific value analysis of the components and possible working ranges from Table 1. Oxygen is measured in addition to the listed components (see Table 2).

A carrier gas dry filter (Article No. filter set A5E00400116) on the mounting bracket of the SITRANS CV or enclosed separately is used as standard for this measurement.

The remarks concerning oxygen and CO in footnote 1 of Table 1 are no longer applicable to this position. The information concerning calculation and performance parameters are identical to Pos. 8_0.

Important:

For correct operation of SITRANS CV in accordance with Pos. 8_0 and 8_1, all measured components must be present in the calibration gas. The calibration gases listed in the table "Recommended calibration gases for Pos. 8_0 and 8_1" are recommended (also see Table 6):

<table>
<thead>
<tr>
<th>Component</th>
<th>Pos. 8_0 (mol%)</th>
<th>Pos. 8_1 (mol%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>4</td>
<td>0.05</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Methane</td>
<td>88.9</td>
<td>88.4</td>
</tr>
<tr>
<td>Ethane</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Propane</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>n-Butane</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>n-Butane</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Neopentane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Neopentane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>n-Pentane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>n-Hexane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table 7: Recommended calibration gases for Pos. 8_0 and 8_1

A summary of the various country-specific setups, i.e. standard settings including measured components and calibration gases, can be found on the parameter backup CD in the "Readme.pdf" document.

Article No. Pos. 8_2: Applications – Calorific analysis with biomethane

This position contains the analysis of the components and working ranges of the biomethane listed in Table 3. Based on the measured concentrations of the components, the quality parameters – such as heating values – are determined in accordance with the international standards ISO, GOST and AGA analogously to positions 8_0 and 8_1.

Article No. Position 8_3: Applications – Calorific value analysis with backflush summation

This position includes the analysis of the components listed in Table 4, in which case the components starting from C6, including the isomers, are regarded as the sum peak. This variant is especially well suited for natural gases with very low content of higher hydrocarbons, especially C6+.

However, this backflush summation can also be used to effectively analyze natural gas with typical C6+ fractions. The components up to and including C6+ can be analyzed within the possible concentration ranges according to Table 4.

A01 – SITRANS CV for calorific value analysis Pos. 8_0, 8_1, 8_2 and 8_3 – Russian configuration

This position includes the possibility for ordering SITRANS CV with a Russian Ex certificate.

IMPORTANT: This Russian version results in a change in the nomenclature from SITRANS CV to MicroSAM.

The following also applies to Pos. 8_3:

The limits listed in GOST Standard 31371.1.7-2008 are checked during the inspection and supplied with the device documentation.

B02- SITRANS CV with extended measuring range in combination with Pos. 8_0

This position permits separate measurement of the group isomers of the higher hydrocarbons C6 to C7(+) and C6 to C9 (+). In accordance with the designation C7(+) and C9 (+), a detailed measurement is carried out up to and including n-C9.

Important:

Testing and certification of the SITRANS CV is carried out using the standard calorific value analysis in accordance with Pos. 8_0. If Pos. D02 or D03 has been selected, this does not include repetition of the proof of repeatability (4 h test) of the unit during the factory acceptance.

The following calibration gases are essential for operation of the SITRANS CV including these extended measuring ranges:

<table>
<thead>
<tr>
<th>Required components</th>
<th>Calibration gas for C6 and C7(+) measurement (mol%)</th>
<th>Calibration gas for C6 and C9(+) measurement (mol%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Methane</td>
<td>89.00</td>
<td>89.00</td>
</tr>
<tr>
<td>Ethane</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Propane</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Isobutane</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>n-Butane</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Neopentane</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Isopentane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>n-Pentane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>n-Hexane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>n-Nonane</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table 8: Components and concentrations of the calibration gases for the extended measuring ranges

Further information regarding startup of SITRANS CV including C7(+) and C9(+) measurement can be found in the manual and in the enclosed document CD (country-specific nomenclature "Readme.pdf" file).
Table 8: Scope of test during factory acceptance

SITRANS CV is a standard product. Only in this manner is it possible to guarantee short delivery times and attractive prices. All performance records required retroactively require higher overhead. However, will be happy to come to an agreement regarding implementation.

D02 - Acceptance and customer information - Factory acceptance, each additional day

Only in conjunction with D01 or D02

EOx - Repeatability test

Proof of repeatability over a period of 4 h is included as standard. Longer repeatability records for the unit can be ordered by means of the supplementary item EOx.

EO1 to E03 - Repeatability test, 8 h - 24 h – 48 h

Only in conjunction with D02

Linearity tests can be carried out in the factory on request. The standard calibration gases required for this (Table 10: "Recommended calibration gases for linearity test during acceptance") are provided free of charge. If the customer specifies other calibration gases with different compositions or higher uncertainty requirements, they must provide these gases for acceptance purposes. As an option, Siemens can procure these special calibration gases (subject to a charge).

On request, proof of the complete functionality of the SITRANS CV is possible within the certified temperature and ambient conditions.

### Table 10: Recommended calibration gases for linearity test during acceptance

<table>
<thead>
<tr>
<th>Component</th>
<th>Gas #1 (Mol.%)</th>
<th>Gas #2 (Mol.%)</th>
<th>Gas #3 (Mol.%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>Residual (approx. 75)</td>
<td>Residual (approx. 85)</td>
<td>Residual (approx. 96.5)</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>15.5</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>0.5</td>
<td>2</td>
<td>0.1</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Ethane</td>
<td>8</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>Propane</td>
<td>0.5</td>
<td>2</td>
<td>0.15</td>
</tr>
<tr>
<td>i-butane</td>
<td>0.15</td>
<td>0.5</td>
<td>0.03</td>
</tr>
<tr>
<td>n-butane</td>
<td>0.15</td>
<td>0.5</td>
<td>0.03</td>
</tr>
<tr>
<td>Neopentane</td>
<td>0.08</td>
<td>0.3</td>
<td>0.03</td>
</tr>
<tr>
<td>i-pentane</td>
<td>0.08</td>
<td>0.3</td>
<td>0.03</td>
</tr>
<tr>
<td>n-pentane</td>
<td>0.08</td>
<td>0.3</td>
<td>0.03</td>
</tr>
<tr>
<td>Hexane</td>
<td>0.05</td>
<td>0.1</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Table 11: Uncertainties of calibration gases

Notes on 7QK2160-...

Analog and serial data transmission

SITRANS CV does not provide internal analog outputs. These properties can be provided by the SIMATIC Extension Unit. This uses the Modbus output of the chromatograph in order to generate up to 8 active analog outputs (standard, more analog outputs on request).

Modbus multiplexers are available in addition, and allow up to 2 Modbus masters to be connected to the SITRANS CV. The distance from the SITRANS CV should not be more than 1,200 m. In the case of an installation without enclosure (without explosion protection), we deliver the components for generation of analog outputs mounted on a rail, otherwise in the Ex d enclosure.

Pos. 08_0 – 5 – Analog values via external unit

This position includes:
- Mounting rail
- Power supply
- SIMATIC S 7-300 and SIMATIC S7, Micro Memory Card 3.3 V NFLASH, 64 KB
- Analog output module with terminating connector
- Protocol converter

Pos. 09_ A – C: Modbus multiplexer

(only applicable together with 0-4)

The Modbus signal can be routed using the Modbus multiplexer and connected to two Modbus masters. B specifies supply of the components without CE certificate.

Pos. 10_ A - B: Enclosure

This position includes the option for installation of the SIMATIC extension unit in the hazardous area (Zone 1 and Zone 2). A protective casing Ex d with standard cable glands including the modules required for the analog outputs and the Modbus multiplexer (if applicable) are provided for this purpose.
Process Gas Chromatographs
SITRANS CV

Dimensional drawings

SITRANS CV, dimensions in mm