CEM400
Online Gas Analyser

Specialist Of UV Spectroscopy

4-20 mA output module
(Included with one gas)
Isolated 4-20 mA output
Active output, Max load 500 Ohm
Relay module
Contact rating: 2A/220V
It is based on UV spectroscopy that brings a higher sensitivity than infra-red and gives the possibility to measure several gases simultaneously.

A high selectivity is achieved by a fast Fourier transform (FFT) on the absorbance spectrum for all the gases having a periodic structure like NH3, SO2, NO and some others.

All the internal gas circuit is heated at 190°C to admit directly hot and humid combustion gases.

the CEM400 stand in a watertight wall mounted enclosure.

This model may include a heated sampling pump as an option.
Several gases can be measured simultaneously thanks to the UV spectroscopy method by using different wavelengths and algorithms. For gases with a periodic absorption spectrum such as NH₃, SO₂, NO, CS₂, formaldehyde or acetylene, an algorithm based on FFT (Fast Fourier Transform) guarantees a very good selectivity of measurement. The solid-state design due to the UV spectroscopy gives a high reliability of the measuring system with quite no maintenance.

- The UV lamp is a xenon flash lamp with a high lifetime and without thermal effect that may generate measurement drift.
- The gas flow cell has two quartz windows to transmit the UV light through the measured gas. The standard path length of the flow cell is 240 mm.
- The spectrograph is based on a concave grating to minimize the optical parts and the spectrum is read on a 254 or 512 pixels diode array.
- A zero is done automatically on zero air or nitrogen with an adjustable period (if possible every 2 or 4 hours but once per day remains acceptable).
- The absorbance spectrum is calculated from the reference spectrum acquired during the zero step.

\[ [C] = K \log \frac{I_{\text{ref}}}{I_{\text{gas}}} \]

where 
- \( [C] \) : Concentration of the sample
- \( K \) : Absorption coefficient at a specific wavelength for a specific gas
- \( I_{\text{ref}} \) : Light intensity on the zero air
- \( I_{\text{gas}} \) : Light intensity on the sample

No Interference with CO, CO₂ and CH₄

The major emission gases like CO, CO₂, and CH₄ have no UV absorption, therefore they don’t interfere with the measured gases.

H₂O has a weak absorption in the UV range but at different wavelengths than combustion gases like NH₃, NO, NO₂ or SO₂. Consequently, H₂O, with an usual concentration between 5% and 20%, is not disturbing the measurements.

Heated Version

The analyser is provided with an heating system for the gas circuit. The heating temperature can be adjusted up to 190°C. The high temperature evaporates any deposits on the windows.

Multi-Gas Configuration

Several gases can be measured in a same analyser if the sample gas composition is compatible with the selected algorithms and wavelengths. The analyser gives high measurement selectivity thanks to the recognition of the specific UV absorption spectrum of gases by using proprietary algorithms.
The design has been specially oriented for low maintenance and high reliability on the measurements.

The UV xenon lamp is specified for a lifetime of $10^9$ flashes. Therefore, the lifetime is about 1 year with continuous measurements or 10 years with one measurement per minute. This reduces considerably the maintenance and the risk of wrong measurement due to aged lamps or its replacement.

The colour touch screen and intuitive interface available in 8 different languages (Chinese, English, French, German, Italian, Portuguese, Spanish, Turkish) makes very easy to test or configure the analyser.

Many test functions allows to test and troubleshoot each element of the analysers (light signal, pumps, solenoid valves, etc...) to setup quickly a maintenance diagnostic.

For process that requires fast measurement like motor bench application, the analyser is able to measure the sample concentration within 200 milliseconds thanks to an ultra fast electronics design based on high speed DSP (Digital Signal Processor). However, usual measurements on emission gases are performed within 5 seconds. A special auto averaging algorithm can be activated to improves the stability without affecting the response time.

Three gas connections are available on the rear panel of the analyser:
- Inlet for the sample
- Zero air or nitrogen
- Outlet for sample or zero

Inlet and zero are connected on a 3 ways electric valve. When the automatic zero is activated, the solenoid valve switches the flow cell on zero air. A pressure sensor takes the pressure of measured gas to compensate it and to give a flow indication.

All the gas circuit is in a heated compartment controlled within +/- 0.5 °C at an adjustable temperature between 60°C and 190°C.

An optional pump may be included before the gas flow cell in order to pump the sample as well as the zero gas that may be ambient air for most of the applications.

An internal measurement of temperature and pressure of the sample is performed. A ratio related to the ideal gas law is applied on the measured value to compensate the effects of temperature and pressure.

Recorded data and diagnostic files for each parameter can be downloaded to memory stick thanks to a USB port.

This allows to collect easily these files on site without using a computer. The files are in text format and can be directly imported to Excel® for graphic charts.
The design has been specially oriented for low maintenance and high reliability on the measurements. The UV xenon lamp is specified for a lifetime of 10^9 flashes. Therefore, the lifetime is about 1 year with continuous measurements or 10 years with one measurement per minute. This reduces considerably the maintenance and the risk of wrong measurement due to aged lamps or its replacement.

**User-Friendly Interface**

For processes that require fast measurement like motor bench applications, the analyser is able to measure the sample concentration within 200 milliseconds thanks to an ultra-fast electronics design based on high-speed DSP (Digital Signal Processor). However, usual measurements on emission gases are performed within 5 seconds. A special auto-averaging algorithm can be activated to improve stability without affecting the response time.

An internal measurement of temperature and pressure of the sample is performed. A ratio related to the ideal gas law is applied on the measured value to compensate the effects of temperature and pressure.

### Parameters Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range* (ppm)</th>
<th>Range* (mg/m3)</th>
<th>Typical Repeatability</th>
<th>Detection Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH3 Ammonia</td>
<td>0-10 ppm</td>
<td>0 - 7 mg/m3</td>
<td>0.05 ppm at 10 ppm</td>
<td>0.1 ppm</td>
</tr>
<tr>
<td></td>
<td>0-100 ppm</td>
<td>0 - 70 mg/m3</td>
<td>0.1 ppm at 100 ppm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-1000 ppm</td>
<td>0 - 700 mg/m3</td>
<td>0.5 ppm at 1000 ppm</td>
<td></td>
</tr>
<tr>
<td>NO Nitrogen Oxide</td>
<td>0-2000 ppm</td>
<td>0 - 2500 mg/m3</td>
<td>1 ppm at 1000 ppm</td>
<td>3 ppm</td>
</tr>
<tr>
<td>SO2 Sulfur Dioxide</td>
<td>0-1000 ppm</td>
<td>0 - 3000 mg/m3</td>
<td>2 ppm at 1000 ppm</td>
<td>0.5 ppm</td>
</tr>
<tr>
<td>H2S Hydrogen Sulfide</td>
<td>0-500 ppm</td>
<td>0 - 750 mg/m3</td>
<td>0.5 ppm at 500 ppm</td>
<td>0.5 ppm</td>
</tr>
<tr>
<td>NO2 Nitrogen Dioxide</td>
<td>0-2000 ppm</td>
<td>0 - 4000 mg/m3</td>
<td></td>
<td>10 ppm</td>
</tr>
<tr>
<td>CS2 Carbon Disulfide</td>
<td>0-100 ppm</td>
<td>0 - 300 mg/m3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6H6 Benzene</td>
<td>0-100 ppm</td>
<td>0 - 300 mg/m3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7H8 Toluene</td>
<td>0-30 ppm</td>
<td>0 - 100 mg/m3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C8H10 Xylene</td>
<td>0-30 ppm</td>
<td>0 - 150 mg/m3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCL3 Nitrogen Trichloride</td>
<td>0-100 ppm</td>
<td>0 - 500 mg/m3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Higher range available on request
## CEM400 General Specifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data storage</td>
<td>5000 measurements for all parameters</td>
</tr>
<tr>
<td>Interfaces</td>
<td>Interface RS232 (MODBUS, AK and http / html5 protocol)</td>
</tr>
<tr>
<td></td>
<td>USB Port (for memory stick)</td>
</tr>
<tr>
<td></td>
<td>External WIFI interface IEEE 802.11 b (option)</td>
</tr>
<tr>
<td></td>
<td>External Ethernet 10 Base-T interface IEEE 802.3 (option)</td>
</tr>
<tr>
<td>Signals</td>
<td>1 to 8 analog outputs 4-20 mA opto-isolated (option)</td>
</tr>
<tr>
<td></td>
<td>1 to 4 relay contacts programmable (option)</td>
</tr>
<tr>
<td>Display</td>
<td>LCD colour screen (TFT) with LED backlight 320x240 pixels</td>
</tr>
<tr>
<td>Power supply</td>
<td>90-264 VAC / 1000 VA / 50-60Hz</td>
</tr>
<tr>
<td>Operatings limits</td>
<td>0 to 40 °C, less than 90% as relative humidity</td>
</tr>
<tr>
<td>CE standards</td>
<td>Electromagnetic compatibility and safety</td>
</tr>
<tr>
<td></td>
<td>EN 61010-1, IEC 61010-1 / EN 61326, IEC 61326</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Wall mounting enclosure (IP65), Coated steel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>410 x 571 x 255 mm (H x W x D)</td>
</tr>
<tr>
<td>Weight</td>
<td>27 kg</td>
</tr>
<tr>
<td>Sampling gas</td>
<td>Pressure : 0 – 2 Bar Absolute (0 – 2000 hPa Absolute)</td>
</tr>
<tr>
<td></td>
<td>Flow : 0.1 to 10 l/min</td>
</tr>
<tr>
<td></td>
<td>Temperature : ambiant to 400 °C</td>
</tr>
<tr>
<td></td>
<td>Fittings : Swagelok, stainless steel 316 for tube OD ¼” (6.4 mm)</td>
</tr>
<tr>
<td>Zero gas</td>
<td>Pressure : 0 – 2 Bar Absolute (0 – 2000 hPa Absolute)</td>
</tr>
<tr>
<td></td>
<td>Flow : 0.1 to 10 l/min</td>
</tr>
<tr>
<td></td>
<td>Fittings : Swagelok, stainless steel 316 for tube OD ¼” (6.4 mm)</td>
</tr>
</tbody>
</table>
### Basic unit with heated gas circuit

**CEM400**

- **Basic unit (one gas included)**
  - Minimum response time: 1 seconds
  - Recommended flow for sample and zero air: 0.5 to 5 litres/min
  - Fittings: Swagelok stainless steel 316 for tube OD ¼” (6.35 mm)
  - Color graphic display 320x240 pixels with touch screen
  - Built-in data logger, memory 5000 measurements
  - 12 sockets for input and output modules (not included, refer to options)
  - RS232 included (Sub-D 9 ways female connector) with 2 meters cable for PC
  - RS485 included for communication with MODBUS protocol
  - USB Port included for USB key connection
  - Power supply 90–260 VAC 47–63 Hz with power cord 2 meters
  - Enclosure IP65/Nema4X (580x450x255mm / 27kg)
  - Mounting lugs for wall
  - Sampling pump no included
  - Heated version at 190 °C (adjustable)
  - For use on wet combustion gas

### Internal pump

**PUMP400**

- **Internal membrane pump with heated head**
  - Built-in inside the enclosure
  - Flow about 6 l/min
  - Heated version at 190 °C

### Additional gas measurement

**Additional gas**

- 4-20 mA isolated output included

**NH3**

- **Ammonia**
  - Range: 0 – 10 ppm NH₃ (or 0 – 7 mg/m³ NH₃ at 20°C)
  - Range: 0 – 100 ppm NH₃ (or 0 – 70 mg/m³ NH₃ at 20°C)
  - Range: 0 – 1000 ppm NH₃ (or 0 – 700 mg/m³ NH₃ at 20°C)

**H₂S**

- **Hydrogen sulphide**
  - Range: 0 – 500 ppm H₂S (or 0 – 750 mg/m³ H₂S at 20°C)
  - Measurement possible until 1000 ppm H₂S (or 0 – 1500 mg/m³ H₂S at 20°C)

**NO**

- **Nitric oxide**
  - Range: 0 – 2000 ppm NO (or 0 – 2500 mg/m³ NO at 20°C)
  - Measurement possible until 5000 ppm NO (or 6000 mg/m³ NO at 20°C)

**NO₂**

- **Nitrogen dioxide**
  - Range: 0 – 2000 ppm NO₂ (or 0 – 4000 mg/m³ NO₂ at 20°C)
  - Measurement possible until 15,000 ppm NO₂ (or 25,000 mg/m³ NO₂ at 20°C)

**SO₂**

- **Sulfur dioxide**
  - Range: 0 – 500 ppm SO₂ (or 0 – 1500 mg/m³ SO₂ at 20°C)
  - Measurement possible until 1000 ppm SO₂ (or 2500 mg/m³ SO₂ at 20°C)

**C₆H₆**

- **Benzene**
  - Range: 0 – 100 ppm C₆H₆ (or 0 – 300 mg/m³ C₆H₆ at 20°C)
  - Measurement possible until 200 ppm C₆H₆ (or 600 mg/m³ C₆H₆ at 20°C)

**C₇H₈**

- **Toluene**
  - Range: 0 – 30 ppm C₇H₈ (or 0 – 100 mg/m³ C₇H₈ at 20°C)
  - Measurement possible until 60 ppm C₇H₈ (or 200 mg/m³ C₇H₈ at 20°C)

**C₈H₁₀**

- **Xylene**
  - Range: 0 – 30 ppm C₈H₁₀ (or 0 – 150 mg/m³ C₈H₁₀ at 20°C)
  - Measurement possible until 60 ppm C₈H₁₀ (or 250 mg/m³ C₈H₁₀ at 20°C)

**CS₂**

- **Carbone disulfide**
  - Range: 0 – 1000 ppm CS₂ (or 0 – 3000 mg/m³ CS₂ at 20°C)
  - Measurement possible until 10,000 ppm CS₂ (or 30,000 mg/m³ CS₂ at 20°C)

**C₂H₂**

- **Acetylene**
  - Range: 0 – 5000 ppm C₂H₂ (or 0 – 5000 mg/m³ C₂H₂ at 20°C)
  - Measurement possible until 10,000 ppm C₂H₂ (or 10,000 mg/m³ C₂H₂ at 20°C)
## CEM400 Parts references

### Input modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI4-20</td>
<td><strong>4-20 mA input module</strong>&lt;br&gt;Isolated 4-20 mA input&lt;br&gt;Impedance: 100 Ohm</td>
</tr>
<tr>
<td>MIL</td>
<td><strong>Double logical inputs module</strong>&lt;br&gt;Input no 1: external pulse command for measurement&lt;br&gt;Input no 2: measurements inhibition&lt;br&gt;Isolated 0 – 24 V DC inputs&lt;br&gt;Impedance: &gt;10 Kohm</td>
</tr>
</tbody>
</table>

### Output modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO4-20</td>
<td><strong>4-20 mA output module</strong>&lt;br&gt;(Included with one gas)&lt;br&gt;Isolated 4-20 mA output&lt;br&gt;Active output, Max load 500 Ohm</td>
</tr>
<tr>
<td>MRELAY</td>
<td><strong>Relay module</strong>&lt;br&gt;Contact rating: 2A/220V</td>
</tr>
</tbody>
</table>

### Communications

<table>
<thead>
<tr>
<th>Interface</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIFI400</td>
<td><strong>Wifi Interface</strong>&lt;br&gt;Connection to wireless WIFI network&lt;br&gt;300m nominal range (open space)&lt;br&gt;Secured data transfer (WEP keys)</td>
</tr>
<tr>
<td>ETHER400</td>
<td><strong>Ethernet Interface</strong>&lt;br&gt;Ethernet 10 base-T (IEEE 802.3)</td>
</tr>
<tr>
<td>MT1133</td>
<td><strong>Phone modem</strong>&lt;br&gt;Industrial modem 33,6 Kb/s V34+&lt;br&gt;DIN rail Mounting&lt;br&gt;Power supply 12V from the analyser</td>
</tr>
<tr>
<td>GSM</td>
<td><strong>GSM modem</strong>&lt;br&gt;Dual band (EGSM 900/1800 MHz)&lt;br&gt;Integral SIM card reader&lt;br&gt;R &amp; TTE approved</td>
</tr>
</tbody>
</table>

### Recommended consumables for 2 years:

- **L-XEN-1**: xenon lamp with trigger (x2)
- **MKIT-SPL- G-1**: Pump kit with membrane (x2) only if sampling pump

---

The manufacturer reserves the right to modify and/or change any specifications, dimensions, design or drawing at any time without prior notice.

---

**TETHYS Instruments**<br>57, Chemin du vieux Chêne, 38240 MEYLAN -France-<br>Tel : +33 4 76 41 86 39 - Fax : +33 4 76 41 92 27<br>Mail : sales@tethys-instruments.com<br>Web : www.tethys-instruments.com