Appendix U: Monitoring Equipment Specifics

1. INNOVA 1412 Photoacoustic Field Gas-Monitor

Product Data

1412 Photoacoustic Field Gas-Monitor

USES:
- Indoor Air Quality measurements
- Ventilation measurements using tracer-gas
- Occupational Health and Safety measurements – of possible production or accumulation of toxic/carcinogenic substances in working areas
- Monitoring of anaesthetic agents in hospitals
- Emission monitoring of greenhouse gases from agricultural production
- Emission monitoring of exhaust from chemical processes

FEATURES:
- Selectively measures a wide range of gases/vapours
- Linear response over a wide dynamic range
- High stability (low drift) makes calibration only necessary 1-2 times a year
- Extremely reliable due to self-testing procedures
- User-friendly procedures for calibrating the monitor, presenting and analyzing measurement data via the PC user-interface
- Accurate – compensates for temperature and pressure fluctuations, water-vapour interference and interference from other known gases
- Extremely low-volume flushing possible
- Operates immediately – no warm-up time necessary
- Presents measurement data via connected PC both in tabular and graphic formats – up to 5 gas concentration and water vapour graphs displayed, simultaneously

Introduction

The 1412 Photoacoustic Field Gas-Monitor is a highly accurate, reliable and stable quantitative gas monitoring system. It uses a measurement system based on the photoacoustic infra-red detection method, and is capable of measuring almost any gas that absorbs infra-red light.

Gas selectivity is achieved through the use of optical filters. By installing up to 5 of these filters in the 1412, it can measure the concentration of up to 5 component gases and water vapour in any air sample. Although the detection limit is gas-dependent, it is typically in the ppb region. The accuracy of these measurements is ensured by the 1412's ability to compensate for temperature and pressure fluctuations, water-vapour interference and interference from other gases known to be present. Reliability of measurement results can be ensured by regular self-tests, which the 1412 performs. By the nature of this measurement system, it requires no consumables and very little regular maintenance, for example for most applications recalibration is only necessary 1-2 times a year.

The monitoring system is easily operated through either of the two user interfaces: the front panel with its push-buttons and display providing short explanatory texts, or the PC Software, with its graphical interface. Both interfaces enable the monitor to be set-up, a measurement sequence started and the resulting concentration values of the specified gases viewed while monitoring.

The monitor is equipped with 2 standard interfaces: IEEE-488 and RS-232. These enable the monitor to be integrated into automated process systems. The 1412 has a built-in pump system that allows samples to be drawn from up to 50 m away.

Selectivity

The gas selectivity of the 1412 is determined by the optical filters installed in its filter wheel.

Because water is nearly always present in ambient air and absorbs infra-red light at most wavelengths, it contributes to the total acoustic signal in the analysis cell. Therefore, the monitor is permanently
A Quality Assurance Project Plan for Monitoring Gaseous and Particulate Matter Emissions from Broiler Housing

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Measurement Cycle
1. The pump draws air from the sampling point through an air filter to flush out the "old" air in the measurement system and replace it with a "new" air sample. The pressure sensor is used to check that the pump sequence is completed successfully and to measure the actual pressure.

2. The "new" air sample is hermetically sealed in the anhydride cell by closing the inlet and outlet valves.

3. Light from a mobile laser is reflected off a mirror, passed through a mechanical chopper, which pulsates it, and then through one of the optical filters in the filter wheel.

4. The gas being monitored, causing the temperature of the gas to increase selectively absorbs the light transmitted by the optical filter. Because the light pulsating, the gas temperature increases and decreases, causing an equivalent increase and decrease in the presence of the gas (an acoustic signal) in the closed cell.

5. Two microphones mounted in the cell will measure this acoustic signal, which is directly proportional to the concentration of the measured gas present in the cell.

6. The filter wheel turns so that light is transmitted through the next optical filter, and the new signal is measured. The number of times this is repeated is dependent upon the number of gases being measured.

7. The response time is below approx. 13 sec. for one gas or water vapour, or approx. 40 sec. if 3 gases and water vapour are measured.

Calibration
After the relevant optical filters are installed, the monitor must be calibrated. This is achieved through easy-to-use menu-driven instructions. With its high stability, calibration of the 1412 is seldom necessary more than once a year.

Calibration is performed using either the PC Software or directly from the front panel.

Operation
The 1412 monitoring system is easy to operate using either the PC Software or the frontpanel push-keys (which can be locked and accessed at 3 levels using passwords). The monitor can be operated as both an on-line and off-line instrument. Using these user-interfaces with their logical division of information, everything that needs to be defined is achieved prior to starting the monitoring task.

Setting-up the Monitor
The Set-up option enables all the parameters necessary to complete the monitoring task to be defined.

Within this option, the Sample Integration Times (S.I.T.) is set enabling measurement results to be weighted - sensitivity against speed.

Starting Measurements
Once the set-up parameters have been defined, measurements can be started either immediately or later using a delayed start time. Once started, the monitoring task then continues until it is stopped either manually or using a defined stop time.

Alarms
When measuring, two Alarm trigger levels, which provide high alarm limit 1 and 2 for each measured gas, can be defined. These can also be linked to audible alarms.

Measurement Results
On-line Measurements
Using one or more of the monitor's standard interfaces, measurement results are transferred directly to a PC or control console. Here they can be displayed on screen as real-time values in tables and graphs (see Fig. 1) or integrated into the process system.

In the PC Software, the graphs can be set up to display only the desired gases, defined concentration ranges and results from statistical analysis.

Also, when using the PC Software, all measurement data is stored in user-defined databases, in a MS-Access format.

Off-line Measurements
Gas measurement result data is displayed on the 1412's screen (Display Memory) as soon as it is available, and is constantly updated. During a task, the 1412 performs running statistical analysis of the measured gas concentrations, calculating a variety of values for each monitored gas.

The data in Display Memory can be copied to the Background Memory, which is a non-volatile storage area. Data stored in Background Memory can be recalled to Display Memory. From this memory, data can, if necessary, be uploaded to the PC Software and printed out in a list form on any standard text printer via the 1412's IEEE and RS-232 interfaces.
Reliability
Executive selftest check: software, data integrity, and the 1412's components, to ensure that they function properly. If a fault is found, it is reported in the measurement results, so that the integrity of the results can be ensured.

If the power-supply fails, the 1412 will automatically start-up again when power is restored. Measurement data stored in the monitor's memory is not affected.

Maintenance
The only maintenance tasks necessary are calibration and changing the air-filter. Both tasks are easily performed, and the frequency for changing the air-filter depends on the individual applications.

Remote Control Options
Innova AirTech Instruments offers two additional application software programs, the 7300 Application Software and the 7620 Application Software.

Using 7300, a computer can remotely control a 1412 together with one 1309 Multipoint Sampler for sequentially monitoring air-samples from up to 12 locations.

Using the 7620, a computer can control a 1412 together with up to two 1309 Multipoint Sampler and Doser units. This enables up to 12 locations to be dosed with a trace-gas and air-samples to be drawn from each location for analysis by the 1412. The software uses the resultant measurements to calculate the air-change or ventilation efficiency of each location.

Ordering Information

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<th>Optional Accessories</th>
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</tr>
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<td>Temperature</td>
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<td>QA 0966</td>
<td>27 optical filters</td>
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</table>

Innova AirTech Instruments A/S reserves the right to change specifications and accessories without notice.
Specifications 1412

MEASUREMENT TECHNIQUE:
Photometric infrared spectroscopy.

Your local INNOVA representative will assist in the selection of suitable optical fibers. Details are provided in the Gas Detection Limits chart.

RESPONSE TIME:
Dependent on the Sample Integration Time (S.I.T.) and the flushing time defined. The fastest response time for one gas is 13s and for 5 gases and water vapor 40s. Please see the examples below.

MEASUREMENT SPECIFICATIONS:

<table>
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<tr>
<th>Monitor Set-up</th>
<th>Response Times</th>
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<tbody>
<tr>
<td>S.I.T. “Normal” (5s)</td>
<td>One gas = 25s</td>
</tr>
<tr>
<td></td>
<td>5 gases + water = 75s</td>
</tr>
<tr>
<td>S.I.T. “Fast” (1s)</td>
<td>One gas = 15s</td>
</tr>
<tr>
<td></td>
<td>5 gases + water = 45s</td>
</tr>
</tbody>
</table>

Detection Limits: Gas-dependent, but typically in the ppb region. Using the Gas Detection Limits chart, the detection limit for a selected sample integration time (S.I.T.) can be calculated.

Dynamic Range: Typically 4 orders of magnitude (c.e. 10,000 times the detection limit at S.I.T.).

Using two span concentrations it can be expanded to 5 orders of magnitude.

Zero Drift: Typically ± Detection limit ± 2% per month.

Accuracy: ± 5% of detection limit ± 2%.

Repeatability: ± 1% of measured value.

Range Drift: ± 2% of measured value ± 3% per month.

Effect of temperature: ± 1% of measured value ± 3% per month.

Effect of humidity: ± 0.1% of measured value ± 3% per month.

Reference conditions:
- Measured at 20°C, 1033 mbar, and relative humidity (RH) 60%.
- Measured at 1013 mbar, and RH 60%.
- Measured at 20°C and RH 60%.
- Measured at 45°C S.I.T.

Interference:
The 1412 automatically compensates for temperature and pressure fluctuations in its analysis cell, and can compensate for water vapor in the air sample. If an optical filter is installed to measure a known substance the 1412 can compensate for the interference.

Acoustic Sensitivity: Not influenced by external sound.

Vibration Sensitivity: Vibration stronger than 20Hz can affect the detection limit.

INTERNAL DATA STORAGE CAPACITY:
Dependent on the number of gases being measured. Sufficient for a 12-day monitoring task, monitoring 5 gases and water vapor every twenty minutes.

GENERAL:
Pumping Rate: 30mL/min (flushing sampling tube) and 50mL/min (flushing measurement chamber).

Power Requirements: 100-240VAC, 50-60Hz.

Power Consumption: 120VA.

Air Volume per sample:

<table>
<thead>
<tr>
<th>Flushing Settings</th>
<th>Volume of Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto: Tube Length: 1m</td>
<td>140 cm³/sample</td>
</tr>
<tr>
<td>Fixed Time: Chamber 3, Tube 1</td>
<td>100 cm³/sample</td>
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</table>

Alarm Relay Socket: for connection to one or two alarm relays (internal/external). Alarms levels for each gas are user-defined. Max. 25VDC, max. 300mA.

Battery Life: 3V lithium battery, lifetime 5 years. This protects data stored in memory, and power the internal clock.

COMPLIANCE WITH STANDARDS:

UL-Mark indicates compliance with UL Standards.

Safety:
EN/IEC 60101-1: Safety requirements for electrical equipment for measurement, control and laboratory use.
UL 2014:1: Safety requirements for electrical equipment for laboratory use.
CAMS 264-1: Safety requirements for equipment for measurement, control and laboratory use.

EMC:
EN 50081-1: Emission and immunity requirements for electrical apparatus for the detection and measurement of combustible gases, toxic gases, and oxygen.
EN 50081-2: Emission requirements for electromagnetic interference.
EN 50082-3: Immunity requirements for electromagnetic field.

Temperature:
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<th>SPECIFICATION</th>
<th>CONDITION</th>
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<tr>
<td>Humidity</td>
<td>IEC 86-2-30: 90% RH (non-condensing at 50°C).</td>
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</table>

Dimensions:
Height: 175 mm (6.9 in).
Width: 395 mm (15.6 in).
Depth: 330 mm (13.0 in).
Weight: 9 kg (19.8 lbs.).

COMMUNICATION:
The monitor has 2 interfaces: IEEE 488 and RS-232. These are used for data exchange and remote control of the 1412. The PC software communicates using the RS-232 interface.

PC SOFTWARE REQUIREMENTS:
Hardware:
A Pentium (166MHz) processor or better.
Max. 64MB of RAM (depending on Op Syst.).
Max. 64MB of space available on the hard disk. One EIDE IDE port.
Software:
Windows 95, 2000 (min. SP4), NT 4.0 (min. SP4).

WARNING:
The 1412 must not be placed in areas with flammable gases or dust and is not appropriate for explosive atmospheres. Also, monitoring of certain aggressive gases, or very high concentrations of water vapor, could damage the 1412. Ask your local INNOVA representative for further information.
2. Optical Filters for INNOVA 1412

The optical filters

INNOVA optical filters display different characteristics while sharing a basic design. Each filter comprises three separate infra-red elements: a narrow-band pass element, a short-wave pass element, and a wide-band pass element. The narrow-band pass element has very specific transmission characteristics. These are further defined by the short-wave pass and wide-band pass elements, which prevent transmission of light at other wavelengths, as a result of INNOVA optical filters having low leakage characteristics.

The narrow-band pass filter determines the centre wavelength and bandwidth of the optical filter, and thus which gases can be detected. The range of optical filters span the entire “fingerprint” region (700 to 1350 cm⁻¹) plus the region between 2000 and 3000 cm⁻¹. See Fig. 1 and Table 3. The “gap” in the infra-red spectrum between 1350 cm⁻¹ and 2000 cm⁻¹ is due to strong water absorption. This region is only suitable for monitoring water vapour.

In Table 3 the specification for the 26 optical filters can be studied. The bandwidth is given as a percentage of the filter centre wavelength. The bandwidth of c.g. UA0987 thus becomes 3.4 µm x 6.0% = 0.204 µm.

Fig. 1 and Table 3 contain 4 special filters:
- SD0527 is the standard filter for measurement of water vapour. The detection limit for this filter is 50 ppm.
- EB6010 is a high sensitive filter for measurement of water vapour. The detection limit for this filter is 0.1 ppm. Main application is measurement of humidity in pure gases.
- EB6009 is a high sensitive filter for measurement of Carbon dioxide. The detection limit for this filter is 4 ppb. Main application is measurement of Carbon dioxide in pure gases.
- EB6008 is a dedicated filter for measurement of mustard gas. The detection limit for this filter is 0.1 ppm.

Choosing a filter

Immunity to interfering species is perhaps the most important consideration in any gas detection programme. Careful consideration of potential interference is therefore essential. Depending on the concentration and type of interfering gases and on the measurement range required, different filters may be selected in different applications in order to measure the same gas.

Table 3. Filter specifications:

<table>
<thead>
<tr>
<th>Filter Number</th>
<th>Filter Centre</th>
<th>Bandwidth</th>
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<tbody>
<tr>
<td></td>
<td>mm</td>
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<td>UA0982</td>
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Dimensions: Diameter: 31.00 mm Height: 5.15 mm
Operating temperature: -20°C to +70°C
Relative humidity: 0% to 95% RH
Storage temperature: -25°C to +70°C

All INNOVA optical filters comply with MIL-SC-48497A requirements.
Converting Concentration Units

The detection limits listed on this wall chart are given in "parts per million" by volume (ppm) at 20°C and 1 atmosphere of pressure. These values can be converted into the concentration unit "mg/m" by using equation (1) given in the box below.

For a gas at 20°C and 1 atmosphere of pressure:
Concentration (mg/m³) = Concentration (ppm) \times \text{Molec. Weight (g/mol)} \times 1\text{mol}

(1)

To Convert ppm to mg/m³ (at 20°C and 1 atm.): 

Reading from the chart - the detection limit at 20°C and 1 atmosphere pressure of Toluene is 0.5 ppm using the UA0974. The molecular weight of Toluene is 92.14 g/mol. Using equation (1) shown in the box above, the detection limit can be calculated in mg/m³:

Detection Limit = 0.5 \times 92.14 \times 1.92 \text{ mg/m³} 

24.04

To Convert Measured Gas Concentrations from mg/m³ to ppm (at T °C and P atm.)

Equation (1) can only be used to convert concentration units of a gas measured at a pressure of 1 atmosphere and at a temperature of 20°C. If the gas is at a pressure of P atmospheres and its temperature is T Kelvin, then the conversion equation becomes:

Concentration (ppm) = \frac{\text{Concentration (mg/m³) \times \text{Molec. Weight (g/mol)}}}{\text{Molec. Weight (g/mol)}}

Where: Molec. Weight = molecular weight of the substance (g/mol). Can be found in the Detection Limit Chart.

Molar Volume = \text{volume occupied by one mole of an ideal gas at a specified temperature and pressure. Table 2 lists the molar volume of a gas at various temperatures and 1 atmosphere of pressure. Its value at a temperature of T K and a pressure of P atmosphere can be calculated from the following equation:}

Molar Volume = \frac{RT}{P}

Where: T = temperature of the gas in K

R = Gas Constant

= 8.3154 \times 10^\text{3} \text{ litre atm. K}^{-1} \text{ mole}^{-1}

P = pressure of the gas in atmospheres

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>-20</th>
<th>-15</th>
<th>-10</th>
<th>-5</th>
<th>0</th>
<th>+5</th>
<th>+10</th>
<th>+15</th>
<th>+20</th>
<th>+25</th>
<th>+30</th>
<th>+35</th>
<th>+40</th>
<th>+45</th>
<th>+50</th>
</tr>
</thead>
</table>

Table 2: Molar Volume of an Ideal Gas at 1 Atmosphere of Pressure at Different Temperatures

Calculation of Detection limits for different SIT settings

To calculate the detection limit at Sample Integration Times other than 5 seconds the following equation must be used:

Detection limit = Detection limit in chart \times DLF

The factor DLF can be read in Table 1.

Example:

Reading from the chart - the detection limit for Sulphur hexafluoride (SF₆) using the optical fiber UA0988 is 0.006 ppm. Calculating the detection limit using SIT (Sample Integration Time) of 0.5 second and 50 seconds gives the following result:

Detection limit SF₆ (SIT of 0.5) = 0.006 ppm \times 3.2 = 0.019 ppm

Detection limit SF₆ (SIT of 50) = 0.006 ppm \times 0.3 = 0.002 ppm
3. California Analytical Digital to Analog Module for INNOVA

CALIFORNIA ANALYTICAL
INSTRUMENTS INC.

Operating instructions for the Model CAI WB 1318 digital to analog module.

The CAIWB 1318 analog module works in conjunction with the INNOVA Model 1312 or 1302 Photo Acoustic Multi gas Analyzers. Model 1312 has five sample channels and a sixth humidity channel. The data from these six channels are available in the ASCII serial data. The analog module converts the ASCII format into the analog current or voltage. All the channels are individually isolated. The analog outputs are available either as current or as voltage. The current range is 4 to 20 ma and the voltage is 0 to 10 V.

INPUT / OUTPUT
The input to the 1318 is connected at the DB - 9 pin RS-232 connector. The various outputs can be accessed at the DB - 25 pin connector. Details of the pin identification and the corresponding channel are:

<table>
<thead>
<tr>
<th>Channel number</th>
<th>Filter</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>6 (H₂O)</td>
<td>W</td>
<td>24</td>
<td>11</td>
</tr>
</tbody>
</table>

This arrangement can also be found by referring to Figure 1.

COMMUNICATION BETWEEN 1312 and CAIWB 1318 ANALOG MODULE

TYPE OF CABLES REQUIRED:
To input the data you must use the null modem cable (CAI -750 ) provided with the 1312. There will be no communication between the 1312 and the analog module if ordinary passthrough RS 232 cables are used.
COMMUNICATION PARAMETERS:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud rate</td>
<td>9600</td>
</tr>
<tr>
<td>Stop bits</td>
<td>2</td>
</tr>
<tr>
<td>Data bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>NONE</td>
</tr>
<tr>
<td>Hard wire mode</td>
<td>Three wire</td>
</tr>
<tr>
<td>Hand-shake</td>
<td>X - ON / X - OFF</td>
</tr>
</tbody>
</table>

A PARTIAL RESET must be made on 1312 whenever the communication parameters are changed.

TURN OFF THE POWER TO THE 1312 WHENEVER THE COMMUNICATION CABLES ARE EITHER CONNECTED OR DISCONNECTED.

If the 1312 is used to communicate with the computer change the communication parameters to:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud rate</td>
<td>9600</td>
</tr>
<tr>
<td>Stop bits</td>
<td>1</td>
</tr>
<tr>
<td>Data bits</td>
<td>7</td>
</tr>
<tr>
<td>Parity</td>
<td>Even</td>
</tr>
<tr>
<td>Hard wire</td>
<td>Switched line</td>
</tr>
<tr>
<td>Hand-shake</td>
<td>Hard wired</td>
</tr>
</tbody>
</table>

TESTING:

Turn the power on. Push the “F” button. A menu appears. Select the desired channel by pressing the appropriate channel number. The current range is set by pushing 7 or 8 or 9 for the 4, 12, 20 ma. The current may be measured with a multi-meter in the ma mode.

SETTING UP THE RANGES:

Input data range can be programmed by setting the highest value expected for each of the first five channels. The sixth channel is fixed with a range of – 60°C to +60°C. Dew point. – 60°C equals the minimum output. These settings are done at the factory before shipping.
CHANGING THE RANGES:

Turn the power off. Hold the "F" button down for 5 seconds while turning the power back on. When released a secret menu appears displaying the current settings for all the five or requested programmable channels. To change the range, follow the menu on the screen. For example to change the previously set value on channel 1 press 1 on the keypad. Enter the new range by sequentially pressing digits followed by B for plus (+) and A for minus (-) to enter the exponent. If the entry is correct accept it by pressing "F". If not press C and start over. Press C after making the desired changes for the channels 1 to 5. By way of illustration 100E-03 is 0.100, this corresponds to 20 ma at 0.1 ppm., 12 ma at 50 E-03 or 0.05 ppm and about 4 ma for 1E-02 or smaller.

Pressing any key during the operation, the monitoring will cease and a maintenance menu will appear. The operator can select any or all the five channels and set the output to 4, 12 or 20 ma. Exiting the maintenance menu will return the analog module to normal operating mode.

OUTPUTS:

All the outputs are expressed in ma as set from 4 to 20 ma. If the readout from 1312 is zero or a negative number then the output current will appear as zero. If the humidity is set in degrees dew point Celsius, below zero the output current will appear as zero ma. However, if the ppm units for moisture are selected then the current output will be ma at temperatures below zero degrees.
4. Volgen America Switching Power Supply

**100 WATT, Universal Input**

*Fully Enclosed Switching Power Supply*

<table>
<thead>
<tr>
<th>FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>POWER FACTOR CORRECTED</em></td>
</tr>
<tr>
<td><em>UNIVERSAL INPUT (AC85-264V)</em></td>
</tr>
<tr>
<td><em>BUILT-IN OVERVOLTAGE PROTECTION</em></td>
</tr>
<tr>
<td><em>OVERCURRENT PROTECTION</em></td>
</tr>
<tr>
<td><em>LIGHTWEIGHT CONSTRUCTION</em></td>
</tr>
<tr>
<td><em>METAL CHASSIS WITH COVER</em></td>
</tr>
<tr>
<td><em>COMPACT LOW-PROFILE PACKAGE</em></td>
</tr>
<tr>
<td><em>3 YEAR WARRANTY</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAFETIES/EMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCC-B</td>
</tr>
<tr>
<td>UL</td>
</tr>
<tr>
<td>EN 55022-B</td>
</tr>
<tr>
<td>VCCI-II</td>
</tr>
</tbody>
</table>

### ELECTRICAL SPECIFICATIONS

All specifications are typical at nominal input, full load.

#### INPUT SPECIFICATIONS

- Input Voltage: AC 85V-264V
- DC 110V-340V
- Input Frequency: 47-63 Hz
- Input Current: 0.66~1.3A Typ
- Inrush Current (100/230VAC cold start): 15~25A
- Power Factor: 0.99

#### OUTPUT SPECIFICATIONS

- Output Voltage: See Chart
- Output Adjustment: ±10%
- Efficiency: 79~87%
- Over-Voltage Protection: 115 - 150% Manual Reset
- Over-Current Protections: Automatic Recovery (105% min)
- Ripple and Noise: 100 mVp-p max.
- Hold-Up Time: 50 ms
- Line/Load Regulation: See Chart
- Rise Time: 800-1600 ms
- Leakage Current (100/230VAC): 0.75 mA

### GENERAL SPECIFICATIONS

- MTBF: >140,000 Hours
- Isolation Voltage:
  - Primary to Secondary: 3000 VAC
  - Primary to Case: 1500 VAC
  - Secondary to Case: 500 VAC
- Isolation Resistance: 100-Mohms min.

### ENVIRONMENTAL SPECIFICATIONS

- Operating Temperatures: 0°-60°C
- Cooling: Convection
- Temperature Coefficient: 0.02%/°C
- Humidity: 20 - 85% Rh (Non-condensing)
- Storage Temperature: -20°-85°C
- Shock Vibration: Shock: 20G (3 directions each 3 times)
- Vibration: 10~55Hz

### PHYSICAL SPECIFICATIONS

- Metal Enclosed, Terminal Block
### Table 1: Product Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Output Voltage</th>
<th>Output Current</th>
<th>Line Regulation</th>
<th>Load Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPN100-6SS</td>
<td>5V</td>
<td>30.0 A</td>
<td>79%</td>
<td>81%</td>
</tr>
<tr>
<td>SPN100-12S</td>
<td>12V</td>
<td>8.6 A</td>
<td>83%</td>
<td>83%</td>
</tr>
<tr>
<td>SPN100-15S</td>
<td>15V</td>
<td>7.0 A</td>
<td>83%</td>
<td>88%</td>
</tr>
<tr>
<td>SPN100-24S</td>
<td>24V</td>
<td>4.4 A</td>
<td>83%</td>
<td>85%</td>
</tr>
<tr>
<td>SPN100-48S</td>
<td>48 V</td>
<td>2.2 A</td>
<td>84%</td>
<td>87%</td>
</tr>
</tbody>
</table>

**NOTE:**

All specifications typical and nominal/full load and 25°C unless otherwise noted.
Avoid sustained operation in overload or dead short conditions.
Specifications subject to changes without notice.

---

*No. 6-32 mounting holes standard
*Dimensions in mm
*Terminal block or "pin" type connector available
5. Thomas Diaphragm Pump, Model 107CAB18

**DIAPHRAGM**

Pumps and Compressors

107 Series

**MODELS:**
Standard models available.
107CAB18, 107CCD18, 107CEF18, 107CGH18
107CDC20

Other models based on availability and minimum purchase.

**FEATURES (AC & DC):**
- Oil-less operation
- Permanently lubricated bearings
- Closed housing and motor vents (107CDC/C only)
- Stainless valves
- Die cast aluminum head, valve plate and diaphragm hold down plate with dichromate conversion treatment
- Balanced for smooth, low vibration operation
- Long-life diaphragm
- Field service capability
- UL® recognized motor and thermal protector (115 Volt, AC only)
- Inlet filter
- CE approval on all standard 220-240/60Hz models
  (Consult factory for non-standard models)

Consult factory for custom applications
6. Setra Differential Pressure Transducer

Setra Systems 264 pressure transducers sense differential or gauge (static) pressure and convert this pressure difference to a proportional electrical output for either unidirectional or bidirectional pressure ranges. The 264 Series is offered with a high level analog 0 to 5 VDC or 4 to 20 mA output.

Used in Building Energy Management Systems, these transducers are capable of measuring pressures and flows with the accuracy necessary for proper building pressurization and air flow control.

The 264 Series transducers are available for air pressure ranges as low as 0.1 in. W.C. full scale to 100 in. W.C. full scale. Static standard accuracy is ±0.5% full scale in normal ambient temperature environments, but higher accuracies are available. The units are temperature compensated to ±0.003% FSL/F thermal error over the temperature range of 0°F to +150°F.

The Model 264 utilizes an improved stainless steel micro-forged sensor. The tensioned stainless steel diaphragm and insulated stainless steel electrode, positioned close to the diaphragm, form a variable capacitor. Positive pressure moves the diaphragm toward the electrode, increasing the capacitance. A decrease in pressure moves the diaphragm away from the electrode, decreasing the capacitance. The change in capacitance is detected and converted to a linear DC electrical signal by Setra's unique electronic circuit.

The tensioned sensor allows up to 10 PSI overpressure (in either direction) with no damage to the unit. In addition, the parts that make up the sensor are thermally matched coefficients, which promote improved temperature performance and excellent long term stability.

NOTE: Setra quality standards based on ANSI 376.1. The calibration of this product is NIST traceable.
U.S. Patent nos. 4,650,915; 4,611,114; 4,424,993; 4,193,905; 4,014,400. Other Patent Pending.

Visit Setra Online: http://www.setra.com

139 Swanson Rd., Boxborough, MA 01719/Telephone: 978-263-1400/Fax: 978-264-0292
A Quality Assurance Project Plan for Monitoring Gaseous and Particulate Matter Emissions from Broiler Housing

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Model 264 Specifications

Environmental Data
- Temperature: Operating: 30°F to 80°F
- Storage: -40°F to 125°F
- *Operating temperature limits of certain electronics may be determined by manufacturer.

Physical Description
- Case: Hi-Abrasion Glass Filled Polyester
- Mounting: Four screw holes on removable zinc-plated steel base (designed for 2-1/4" snap track)
- Electrical Connection: Screw Terminal Strip
- Pressure Fittings: 3/16" O.D. barbed brass pressure fitting for 1/4" push-on tubing
- Zero and Span Adjustments: Accessible on top of case
- Weight (approx.): 10 ounces

Pressure Media
- Typically air or similar non-conducting gases.
- Specifications subject to change without notice.

Electrical Data (Voltage)
- Circuit: 3-Wire (Open Exc, Out)
- Excitation: 9 to 30 VDC
- Output: 0 to 5 VDC
- Bidirectional output at zero pressure: 2.5 VDC
- Output Impedance: 500 ohms
- *Bidirectional output 500 ohms design, spec to order 900 ohms for higher gain.
- **Excitation range per model: 5000 to 30000 for Model 264A (usually for industrial applications).

Electrical Data (Current)
- Circuit: 2-Wire
- Output: 4 to 20 mA
- Bidirectional output at zero pressure: 12 mA
- External Load: 0 to 500 ohms
- Minimum supply voltage (VDC) = 9 + 0.02 x (Resistance of exciter plus line)
- Maximum supply voltage (VDC) = 30 + 0.084 x (Resistance of exciter plus line).
- *Excitation range with 5000 ohms: 120 mA (4 to 20 mA).
- **Excitation range with 30000 ohms: 500 mA (4 to 20 mA).

Outline Drawings

Code T1 Electrical Termination Dimensions

Optional 1/2" Conduit Electrical Enclosure Dimensions

ORDERING INFORMATION

Code all blocks in table.

Example: Part No. 26412R5WDDT1T/C for a 264 Transducer: 0 to 2.5 in WC range, 4 to 20 mA, Terminal Strip Electrical Connection, and ±1% Accuracy.

<table>
<thead>
<tr>
<th>Model 264</th>
<th>264</th>
<th>1</th>
<th>264</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential</td>
<td>Ranges</td>
<td>Bidirectional</td>
<td>Output</td>
</tr>
<tr>
<td>0R1W0 = 0 to 0.1 in WC</td>
<td>0R8W0 = 0.05 in WC</td>
<td>0T1W0 = 4-20 mA</td>
<td>T1 = Terminal Strip</td>
</tr>
<tr>
<td>0R2W0 = 0 to 0.25 in WC</td>
<td>0R9W0 = ±0.1 in WC</td>
<td>0T2W0 = 0 to 5 VDC</td>
<td></td>
</tr>
<tr>
<td>0R3W0 = 0 to 0.5 in WC</td>
<td>0R10W0 = ±0.25 in WC</td>
<td>0T3W0 = 20</td>
<td></td>
</tr>
<tr>
<td>0R4W0 = 0 to 1 in WC</td>
<td>0R5W0 = ±0.5 in WC</td>
<td>0T4W0 = 50</td>
<td></td>
</tr>
<tr>
<td>0R6W0 = 0 to 2.5 in WC</td>
<td>0R6W0 = ±1 in WC</td>
<td>0T5W0 = 100</td>
<td></td>
</tr>
<tr>
<td>0R7W0 = 0 to 5 in WC</td>
<td>1R5W0 = ±1.5 in WC</td>
<td>0T6W0 = 200</td>
<td></td>
</tr>
<tr>
<td>0R8W0 = 0 to 10 in WC</td>
<td>2R5W0 = ±2.5 in WC</td>
<td>0T7W0 = 500</td>
<td></td>
</tr>
<tr>
<td>0R9W0 = 0 to 25 in WC</td>
<td>3R5W0 = ±5 in WC</td>
<td>0T8W0 = 1000</td>
<td></td>
</tr>
<tr>
<td>0R10W0 = 0 to 50 in WC</td>
<td>4R5W0 = ±10 in WC</td>
<td>0T9W0 = 2000</td>
<td></td>
</tr>
<tr>
<td>0R11W0 = 0 to 100 in WC</td>
<td>5R5W0 = ±25 in WC</td>
<td>0T10W0 = 5000</td>
<td></td>
</tr>
<tr>
<td>0R12W0 = 0 to 200 in WC</td>
<td>6R5W0 = ±50 in WC</td>
<td>0T11W0 = 10000</td>
<td></td>
</tr>
<tr>
<td>0R13W0 = 0 to 500 in WC</td>
<td>7R5W0 = ±100 in WC</td>
<td>0T12W0 = 20000</td>
<td></td>
</tr>
<tr>
<td>0R14W0 = 0 to 1000 in WC</td>
<td>8R5W0 = ±200 in WC</td>
<td>0T13W0 = 50000</td>
<td></td>
</tr>
<tr>
<td>0R15W0 = 0 to 2000 in WC</td>
<td>9R5W0 = ±500 in WC</td>
<td>0T14W0 = 100000</td>
<td></td>
</tr>
<tr>
<td>0R16W0 = 0 to 5000 in WC</td>
<td>10R5W0 = ±1000 in WC</td>
<td>0T15W0 = 200000</td>
<td></td>
</tr>
<tr>
<td>0R17W0 = 0 to 10000 in WC</td>
<td>11R5W0 = ±2000 in WC</td>
<td>0T16W0 = 500000</td>
<td></td>
</tr>
<tr>
<td>0R18W0 = 0 to 20000 in WC</td>
<td>12R5W0 = ±5000 in WC</td>
<td>0T17W0 = 1000000</td>
<td></td>
</tr>
<tr>
<td>0R19W0 = 0 to 50000 in WC</td>
<td>13R5W0 = ±10000 in WC</td>
<td>0T18W0 = 2000000</td>
<td></td>
</tr>
<tr>
<td>0R20W0 = 0 to 100000 in WC</td>
<td>14R5W0 = ±20000 in WC</td>
<td>0T19W0 = 5000000</td>
<td></td>
</tr>
<tr>
<td>0R21W0 = 0 to 200000 in WC</td>
<td>15R5W0 = ±50000 in WC</td>
<td>0T20W0 = 10000000</td>
<td></td>
</tr>
</tbody>
</table>

Please contact factory for versions not shown.
7. Vaisala Humidity and Temperature Sensor

Vaisala HUMICAP® Humidity and Temperature Transmitters HMW61/71 are protected against dust and sprayed water.

The wall mount Vaisala HUMICAP® Humidity and Temperature Transmitters HMW61 and HMW71 are designed for monitoring relative humidity and temperature in demanding environments.

**Withstands dust and sprayed water**
The transmitters are protected against dust and sprayed water, meeting the IP65 (NEMA 4) requirements. All the materials used have been chosen for excellent corrosion resistance. In addition, the transmitters incorporate Vaisala HUMICAP® Sensor, which is insensitive to dust and most chemicals.

All of these features make the HMW61/71 transmitters especially suitable for humid and wet environments, e.g. greenhouses, livestock farms, indoor swimming pools and other wash down areas.

<table>
<thead>
<tr>
<th>Features/Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Full 0...100 %RH measurement</td>
</tr>
<tr>
<td>• Accuracy up to ±2 %RH</td>
</tr>
<tr>
<td>• True two-wire transmitter with a 4...20 mA loop powered output (HMW61)</td>
</tr>
<tr>
<td>• Three-wire transmitter with a selectable signal output of 0...1 V, 0...5 V or 0...10 V (HMW71)</td>
</tr>
<tr>
<td>• Optional temperature measurement</td>
</tr>
<tr>
<td>• Electronic, on-site, one-point calibration</td>
</tr>
<tr>
<td>• Vaisala HUMICAP® Sensor for excellent accuracy and long-term stability, negligible hysteresis and resistance to dust and most chemicals.</td>
</tr>
<tr>
<td>• Temperature compensated</td>
</tr>
<tr>
<td>• IP65 (NEMA 4) housing</td>
</tr>
<tr>
<td>• NIST traceable (certificate included)</td>
</tr>
</tbody>
</table>

**Measures both humidity and temperature**
The HMW61/71 transmitters are available as relative humidity only (U), and as relative humidity and temperature (Y).

**Fast, on-site calibration**
The accuracy of the transmitters is simple to check using either the Vaisala HUMICAP® Hand-Held Humidity and Temperature Meter HM70 or the Vaisala HUMICAP® Humidity Indicator HM41. The calibration can be done in seconds with a single potentiometer without disturbing operation, resulting in savings in both maintenance time and costs. Customized calibration and maintenance contracts for HMW61/71 are available on request.
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Technical Data

Relative humidity

Measurement range: 0 to 100 %RH
Accuracy at +20 °C (+68 °F): ±2 %RH (0 to 90 %RH)
±3 %RH (90 to 100 %RH)

Temperature dependence

ARH

-10 0 10 20 30 40 50 60 70 80 90 100
-10 -5 0 5 10 15 20
Response time (90%) at +20 °C (+68 °F) in still air: 15 seconds (with membrane filter)
Humidity sensor: HUMICAP® 180

Temperature (Y model only)

Measurement range: -20...+60 °C (-4...+140 °F)
Accuracy: Optional temperature scale available on request.

Lineararity: better than 0.1 °C (0.18 °F)
Temperature sensor: Pt1000 EEC 751 class B

General HMW61/U/Y

Supply voltage: 10...35 VDC (IL = 0 ohms)
20...35 VDC (IL = 500 ohms)

Output signal: Output signal corresponds to 0...100 %RH and +20...+80 °C (+4...+176 °F)

General HMW71/U/Y

Supply voltage range depends on the selected output signal. When an AC supply is used, an isolated source is recommended.

DC: 0...1 V: 10...35 V: 14...35 V: 19...35 V: Output signal corresponds to 0...100 %RH and +20...+80 °C (+4...+176 °F)

Factory setting: 0...1 V. Other outputs selectable by jumper connections. An output change causes an error which is less than 0.5 %RH without recalibration.

Power consumption: @ 24 VAC
HMW71U: 10 mA typical
HMW71Y: 12 mA typical

HUMIDITY

HMW70 hand-held humidity and temperature meter or HM41 humidity indicator


Wiring

HMW61 wiring diagram

HMW71 wiring diagram

Dimensions

Dimension in mm (inches)

Vaisala Product Catalog 2005
Ref. 8210095en rev. A

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8. Fluorotherm FEP Tubing

![Fluorotherm FEP Tubing Image]

**TYPICAL PROPERTIES OF FLUOROPOLYMERS**

<table>
<thead>
<tr>
<th>Property</th>
<th>Method No.</th>
<th>Units</th>
<th>PTFE</th>
<th>FEP</th>
<th>PFA</th>
<th>ETFE</th>
<th>ECTFE</th>
<th>PCTFE</th>
<th>PVDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>D792</td>
<td></td>
<td>2.17</td>
<td>2.15</td>
<td>2.15</td>
<td>1.74</td>
<td>1.7</td>
<td>1.7</td>
<td>1.78</td>
</tr>
<tr>
<td>Melting Point</td>
<td>D2236 deg F</td>
<td>621</td>
<td>518</td>
<td>581</td>
<td>527</td>
<td>464</td>
<td>410</td>
<td>352</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>D638 psi</td>
<td>2,900</td>
<td>4,350</td>
<td>4,570</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>7,830</td>
<td></td>
</tr>
<tr>
<td>Yield Strength</td>
<td>D638 psi</td>
<td>1,450</td>
<td>1,740</td>
<td>2,250</td>
<td>3,480</td>
<td>4,500</td>
<td>5,800</td>
<td>6,670</td>
<td></td>
</tr>
<tr>
<td>Elongation</td>
<td>%</td>
<td>200-500</td>
<td>250-350</td>
<td>300</td>
<td>200-500</td>
<td>200-300</td>
<td>80-250</td>
<td>20-150</td>
<td></td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>D638 ksi</td>
<td>87</td>
<td>72.5</td>
<td>101.5</td>
<td>217.5</td>
<td>240</td>
<td>218</td>
<td>348</td>
<td></td>
</tr>
<tr>
<td>Flex Modulus</td>
<td>D790 ksi</td>
<td>98</td>
<td>101.5</td>
<td>95</td>
<td>203</td>
<td>261</td>
<td>-</td>
<td>333.5</td>
<td></td>
</tr>
<tr>
<td>Izod Impact</td>
<td>D256 ft-lbs/in</td>
<td>3.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2-4</td>
<td></td>
</tr>
<tr>
<td>Hardness</td>
<td>D2240 Shore D</td>
<td>60</td>
<td>57</td>
<td>62</td>
<td>75</td>
<td>75</td>
<td>90</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>HDT, @ 66 psi</td>
<td>D648 deg F</td>
<td>250</td>
<td>158</td>
<td>164</td>
<td>219</td>
<td>240</td>
<td>248</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>HDT, @ 264 psi</td>
<td>D648 deg F</td>
<td>122</td>
<td>129</td>
<td>118</td>
<td>160</td>
<td>169</td>
<td>-</td>
<td>239</td>
<td></td>
</tr>
</tbody>
</table>

All mechanical strength properties given at room temperature only. These properties decrease significantly with rise in temperature, at a different rate for different materials.

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Halar® © Ausimont/Aldrich Chemicals Trademark for ECTFE resin
Kynar® © Akzochem Trademark and Kynar® © Ausimont Trademark for PVDF resin

**PTFE VERSUS FEP - PROPERTY COMPARISON**

1. Chemical Structure: PTFE - homopolymer, FEP - copolymer
2. Continuous Use Temperature: PTFE - 500 deg F, FEP - 399 deg F
3. Melt Temperature: PTFE - Does not melt, softens at 625 deg F, FEP - 500 deg F
4. PTFE, being a homopolymer, has the best thermal and best chemical resistance compared to copolymers.
5. Tensile Strength at 23 deg C: PTFE - 2500 psi - 3553 psi* (see reference below) FEP 100 - 3335

In general PTFE has a tensile strength 15% to 20% lower than FEP; however, this difference may narrow at higher operating temperatures due to the higher sensitivity of FEP to increase in temperature.

6. See Fluorotherm brochure PB-7-93, for additional information on PTFE.


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Telephone
Toll Free USA and Canada Only: 1-877-777-2629
973-575-0760
973-276-1931
FAX
973-575-0431
Postal address
22 P Commerce Road, Fairfield, NJ 07004-2204, USA
Electronic mail: sales@fluorotherm.com
Customer Support: sales@fluorotherm.com

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9. API UV Fluorescence Non-Methane Hydrocarbon Analyzer

Table 2-1: Model 101E Basic Unit Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Specification Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min/Max Range (Physical Analog Output)</td>
<td>In 1 ppb increments from 50 ppb to 20,000 ppb, independent ranges or auto ranging</td>
</tr>
<tr>
<td>Measurement Units</td>
<td>ppb, ppm, µg/m³, mg/m³ (user selectable)</td>
</tr>
<tr>
<td>Zero Noise¹</td>
<td>0.2 ppb RMS</td>
</tr>
<tr>
<td>Span Noise¹</td>
<td>0.2 ppb RMS</td>
</tr>
<tr>
<td>Lower Detectable Limit²</td>
<td>0.4 ppb RMS</td>
</tr>
<tr>
<td>Zero Drift (24 hours)</td>
<td>&lt;0.5 ppb</td>
</tr>
<tr>
<td>Zero Drift (7 days)</td>
<td>1 ppb</td>
</tr>
<tr>
<td>Span Drift (7 Days)</td>
<td>&lt;0.5% FS</td>
</tr>
<tr>
<td>Linearity</td>
<td>1% of full scale</td>
</tr>
<tr>
<td>Precision</td>
<td>0.5% of reading¹</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>&lt; 0.1% per ºC</td>
</tr>
<tr>
<td>Voltage Coefficient</td>
<td>&lt; 0.05% per V</td>
</tr>
<tr>
<td>Rise/Fall Time¹</td>
<td>95% in &lt;100 sec</td>
</tr>
<tr>
<td>Sample Flow Rate</td>
<td>650 cc/min. ±10%</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>5 – 40°C</td>
</tr>
<tr>
<td>Humidity Range</td>
<td>0 - 95% RH, non-condensing</td>
</tr>
<tr>
<td>Dimensions H x W x D</td>
<td>7” x 17” x 23.5” (178 mm x 432 mm x 597 mm)</td>
</tr>
<tr>
<td>Weight, Analyzer (Basic Configuration)</td>
<td>45 lbs (20.5 kg) w/internal pump</td>
</tr>
<tr>
<td>AC Power Rating</td>
<td>100 V, 50/60 Hz (1.7 A / 2.3 A surge); 115 V, 60 Hz (1.3 A / 3.0 A surge); 220 – 240 V, 50/60 Hz (0.75 A / 1.0 A surge)</td>
</tr>
<tr>
<td>Environmental</td>
<td>Installation category (over-voltage category) II; Pollution degree 2</td>
</tr>
<tr>
<td>Analog Outputs</td>
<td>Three (3) Outputs</td>
</tr>
<tr>
<td>Analog Output Ranges</td>
<td>100 mA, 1 V, 5 V, 10 V, 2-20 or 4-20 mA isolated current loop. All Ranges with 5% Under/Over Range</td>
</tr>
<tr>
<td>Analog Output Resolution</td>
<td>1 part in 4096 of selected full-scale voltage</td>
</tr>
<tr>
<td>Status Outputs</td>
<td>8 Status outputs from opto-isolators</td>
</tr>
<tr>
<td>Control Inputs</td>
<td>6 Control Inputs, 3 defined, 3 spare</td>
</tr>
<tr>
<td>Serial I/O</td>
<td>One (1) RS-232; One (1) RS-485 (2 connectors in parallel)</td>
</tr>
<tr>
<td>Baud Rate: 300 – 115200: Optional Ethernet Interface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IEC 61010-1:90 + A1:92 + A2:95,</td>
</tr>
</tbody>
</table>

¹ As defined by the USEPA.
² Defined as twice the zero noise level by the USEPA.
10. Tapered Element Oscillating Microbalance (TEOM)

**Series 1400a**

**TEOM® Automated Ambient Particulate Monitor**

- **Features**
  - Continuous *True Mass* Measurement with Unmatched Short-Term (Hourly) Precision and Resolution
  - PM-10, PM-2.5, PM-1, TSP Inlets
  - Active Volumetric Flow Control Using Advanced Mass Flow Controllers
  - No Radioactive Components
  - Audit and Calibration Using NIST-Traceable Mass and Flow Standards
  - USEPA PM-10 (EQPM-1090-079) and PM-2.5, Worldwide Approvals

**Series 8500 FDMS® System**

- Measures *Total Atmospheric Aerosol Mass Concentration*
- Accounts for Non-volatile and Volatile PM Components with Innovative Self-Referencing Methodology

**Series 8100 Aethalometer™ Module**

- Continuous Black Carbon (BC) Analyzer for the TEOM Monitor

[Images and graphs related to TEOM and other monitoring equipment.]
FEATURES SHEET

TEOM® SERIES 1400A AMBIENT PARTICULATE MONITOR

The Series 1400a monitor has the following features:

- Incorporates Thermo's "AB" technology for enhanced measurement stability—ideal for mobile installations. Alternate configurations for specialized applications: Sample Equilibration System (SES) and Series 8500 Filter Dynamics Measurement System (FDMS™ Unit).

- Filter-based direct mass monitoring using Thermo's patented TEOM® technology that never requires mass recalibration. The instrumentation contains no radioactive components. Industry-leading 2 year warranty.

- The only continuous dust monitor with USEPA approval (EQPM-1090-079) that complies with the California ARB 1-hour acceptance criteria for mass concentration precision. TEOM instrumentation has German EPA approval for TSP and PM-10 measurements.

- Unsurpassed mass and time resolution (mass transducer minimum detection limit of 0.01 µg). Precision of ±5.0 µg/m³ for 10-minute averaged data and ±1.5 µg/m³ for 1-hour averages.

- Activol™ flow control system maintains a constant volumetric flow at the flow rate specified by the user by incorporating ambient pressure and temperature sensors.

- NIST-traceable audit/calibration of mass determination and flow rate.

- Available with a choice of sample inlets for PM-10, PM-2.5, PM-1 or TSP measurements.

- Sample filters can be analyzed after exposure for heavy metals with laboratory techniques such as AA or ICAP.

- Flexible viewing and entry of instrument parameters made possible by a menu-driven user interface. Keypads are available in English, Spanish and German.

- Internal data logging of up to 40 weeks with one variable stored every hour. Each record may contain up to eight user-selectable variables.

- Three real-time analog outputs (0-1, 0-2, 0-5 or 0-10 VDC), and two user-defined contact closures alarm circuits.

- Two levels of password protection—low and high lock. These can be used to restrict access to instrument functions.

- Advanced RS-232 support. This allows users to retrieve real-time and stored information and change instrument parameters, both remotely and at the sampling location.

- Seven built-in averaged analog inputs (scalable as ±2 or ±10 VDC) with user-defined conversions to engineering units. The averaging time is equal to the user-defined data storage interval. Averaged values may be logged internally.

- Analog inputs from a wind vane/anemometer are used to compute averaged wind speed, and vector-averaged velocity and direction.

- Built-in support for the optional ACCU™ system. The ACCU system is an intelligent sampler that offers the user great flexibility in the sampling of particulate and/or gases through filter cartridges or gas collection tubes.

TEOM® is a registered trademark of Thermo Electron Corporation. Activol™ and ACCU™ are trademarks of Thermo.
11. VIG Industries Hydrocarbon Analyzer

**Heated Methane / NonMethane / Total Hydrocarbon Analyzer (NMHC) Model-200**

The VIG Industries, Inc. Model-200 is a microprocessor based, oven heated methane / nonmethane / total hydrocarbon gas analyzer designed for high accuracy, sensitivity and stability. The Model-200 uses two independent flame ionization detectors (FIDs), one to measure total hydrocarbons and the second coupled with a GC Column for the separation of the methane and nonmethane components. A sample is fed to the analyzer via an internal heated pump to the first FID for a real time total hydrocarbon reading. A portion of the sample is trapped and pushed through a column to separate the methane component and then to the second FID. Any remaining sample in the column is back flushed through the column to obtain the nonmethane component. All components that come in contact with the sample through analysis are maintained in a temperature-controlled oven to prevent condensation, and to provide repeatable, reliable performance in the analysis of a wide variety of hydrocarbon concentrations in gaseous mixtures or in ambient air.

**Features**
- Easy to use software
- Automatic start-up/ignition
- Heated sample pump heads
- Two stage sample filter with exchangeable sintered stainless steel elements
- Teflon isolated detectors (FIDs)
- Automatic fuel shut-off system
- Automatic flame-out indicators
- Adjustable alarm and oven settings
- Precision 1% of full scale
- 19" rack/bench mount

**Options**
- 4-20mA output - no extra charge
- Zero and calibration solenoids with software
- RS-232 interface
- Internal combustion air supply

**Related Available Equipment**
- Zero air generator (Reduces bottles)
- Hydrogen generator (Reduces bottles)
- Heated sample lines and controllers
- Strip chart recorders and data loggers
- NEMA rated enclosures

**Applications**
- **Compliance Monitoring** - U.S. E.P.A. Method 18 and Method 25A
- **Process Monitoring** - Continuous monitoring and alarm or control of process gas streams utilizing organic solvents, crude oil, and other chemicals containing hydrocarbons.
- **Efficiency Monitoring** - Monitoring effluent of volatile organic compound (VOC) reduction equipment for environmental compliance, efficiency control of incinerators (Thermal or catalytic), scrubbers, carbon absorbers, and other abatement equipment, monitoring of catalytic converters, combustion and diesel engine efficiency.
- **Safety Monitoring** - Lower explosive limit (LEL) monitoring and/or control of ovens/dryers, fugitive emissions monitoring, personnel work area monitoring, leak detection of process equipment or solvent storage areas.
- **Stack Monitoring**

VIG INDUSTRIES, INC.
4051 E. La Palma Ave. Anaheim, CA 92807 • Toll Free (800) 862-7844 • Phone (714) 632-8200 • Fax (714) 632-8201 • http://www.vigindustries.com
### Standard Specifications

**Measuring Method** - 2 Oven Heated, Flame Ionization Detectors (FIDs)

**Separation Method** - GC Column

**Measurement Range/Standard Ranges** -
- 4 Ranges per amplifier, 2 amplifiers per analyzer, 1 amplifier for total and 1 amplifier for methane and nonmethane
- 0-100, 0-1000, 0-10000, 0-100000 ppm (Lower detection limit 0.01 ppm) or
- 0-100, 0-1000, 0-10000, 0-100000 ppm (Lower detection limit 0.1 ppm)
- Other ranges available upon request

**Zero & Span Noise** - Less than 0.2% of full scale

**Zero & Span Drift** - +/- 1% full scale per 24 hours

**Linearity** - Within 1% of full scale through all ranges

**Repeatability** - Within 1% of full scale through all ranges

**Stability** - Within 1% of full scale through all ranges

**Oxygen Syneresis** - Within 1% of full scale within selected range

**Response Time**
- Total - Within 5 seconds to 90% of final reading (Continuous real time reading)
- Methane - Approximately 40 seconds, updated every 3 minutes
- Nonmethane - Approximately 70 seconds, updated every 3 minutes

**Ambient Temperature** - From 50°F to 120°F

**Flow Rate** - 4 Liters/Minute (Standard) or 10 Liters/Minute (Upon request)

**Physical Dimensions** - 19" Wide Front Panel, 16.75" Wide Chassis, 24" Deep Chassis, 27" Deep with fittings and handles, 9" High

**Weight** - 55 lbs to 65 lbs depending on options

**Oven operating temperature** - 275°F (Adjustable from 200°F to 300°F)

**Safety** - Flame-Out indicator lamp, flame-out alarm contacts on back panel.

**Fuel shut-off, calibration and zero solenoid shut-off**

**Voltage Outputs** - One of the following voltage outputs
- 0-10VDC (Standard), 0-1VDC or 0-5VDC (Optional - no extra charge)

**Current Outputs** - 4-20mA, Sourcing (Optional - no extra charge)

**Flame-Out Alarms** - Normally open, low current relay contacts (Close on alarm, latching)

**Concentration Alarms** - Normally open, low current relay contacts (Close on alarm, latching)

**Ignition** - Automatic (Can be set to manual by operator from front panel)

**Glow Plugs** - Main and spare glow plugs installed (Selectably by switch on back panel)

**Warm-up Time**
- Usable in approximately 45 minutes
- Stable in approximately 2 hours

**Display** - Graphic, backlit, 240W x 64H pixels, high contrast, wide viewing angle

### Operation Requirements

**Fuel** - UHP Hydrogen @ 18psi incoming pressure

**Combustion Air** - Oil/Water/Hydrocarbon free instrument air @ 18psi incoming pressure

**Zero Calibration Gas** - UHP zero grade air or nitrogen @ 9psi incoming pressure

**Span Calibration Gas** - Known concentration of operator selected hydrocarbons balanced in either air or nitrogen @ 9psi incoming pressure (VIG recommends using a mixture of methane and propane balanced in air to save calibration time)

**Carrier Gas** - UHP nitrogen @ 30psi incoming pressure

**Compressed Air** - Oil/Water free air @ 50psi incoming pressure for column switching valve

**Power Requirements** - 115VAC @ 60Hz or 720Watts or optional 220VAC @ 50Hz

---

**Warranty**

All instruments sold by VIG Industries, Inc. are warranted for a period of one (1) year from date of purchase against defects in materials and workmanship. The seller warrants that the product supplied conforms to the specifications assigned therein. There is no other warranty either expressed or implied. Seller liability is limited specifically to the cost or assigned value of the items sold. Service contracts are available after the warranty expires.
12. Rotem RSC-2 Poultry Scale System

For Broilers, Breeders, Pullets and Turkeys. Special program that weighs males and females separately, providing separate data on the same platform.

The RSC-2 is a stand-alone live bird scale center. It assures continuous accurate daily data collection of average bird weight, number of weighings, daily weight gain, standard deviation, CV and uniformity.

The RSC-2 can handle up to two bird scale platform placed on the litter in the same or different houses. It is very simple to use. Rotem’s unique user-friendly Scale Center uses easy to understand menu.

The sophisticated software can accurately weigh the birds even if more than one bird is stepping on the platform at the same time.

You can link an unlimited number of Rotem bird scale centers to a nationwide communication network, controlled by one central PC via modem, using Rotem’s advanced communication program for Windows.

The platforms are made of a high quality stainless steel and are completely sealed to prevent any damage to the excellent load cells installed inside. Rotem uses high quality cables to ensure long life in the harsh litter environment.

**Features:**
- Up to two bird scales.
- 5 digit display.
- Up to 500 days data collection.
- User friendly 3 key programming.
- Weight displayed in Kg. or Lb.
- 115 / 230 VAC operation.
- Local or remote modern PC communication.
- Unerasable memory.
- Power surge protection.
- Water and dust resistant enclosure.
- Simple installation.

[Rotem RSC-2 Poultry Scale System image]
13. Barometric Pressure Sensor

WE100 Barometric Pressure Sensor

Description

Global Water's highly accurate Barometric Pressure Sensor covers a pressure range from 800 to 1100 mb. The barometric pressure indicator is fully temperature compensated within an operating range of -40° to 85° C. The sensor is mounted on 25' of marine grade cable, with lengths up to 500' available upon request. The sensor output is 4-20 mA with a two wire configuration.

Specifications

- Output: 4-20 mA
- Range: 800-1100 mb
- Accuracy: ±1% of full scale
- Linearity/Hysteresis: ± 0.1%
- Operating Voltage: 10-36 VDC
- Current Draw: Same as sensor output
- Warm Up Time: 3 seconds maximum
- Operating Temp: -40° to +56°C
- Sensor Size: 3"x2"x1"
- Weight: 0.13 lb

Price List

- WE100 Barometric Pressure Sensor $375
- WQEXC Extra Cable
  - Cable length is measured from end of cable to bottom of sensor.
  - After 25', up to 500' $1.10/ft

Global Water
The Leader in Water Instrumentation

In the U.S., call toll free at 1-800-876-1172
International: 916-538-3429
Fax: 916-538-0270
Email: globalw@globalw.com

Visit our online catalog at:
www.globalw.com
Our Address:
11350 Amalgam Way
Gold River, CA 95670