

# GE Sensing

## Applications

A thermal conductivity gas transmitter for use in the following industries and applications:

### Metals Industry

- H<sub>2</sub> in N<sub>2</sub>: atmosphere in metal heat-treating furnaces

### Electric Power Industry

- H<sub>2</sub> in cooling systems for generators

### Petroleum Industry

- H<sub>2</sub> in hydrocarbon streams

### Chemical Industry

- H<sub>2</sub> in ammonia synthesis gas
- H<sub>2</sub> in methanol synthesis gas
- H<sub>2</sub> in chlorine plants

### Methane Industry

- CO<sub>2</sub> in methane
- N<sub>2</sub> in methane

### Landfill/Biogas Industry

- CO<sub>2</sub> in biogas
- CH<sub>4</sub> in biogas

### Gas Production Industry

- Purity monitoring of argon, hydrogen, nitrogen and helium

### Food Industry

- CO<sub>2</sub> in fermentation processes

## Features

- Ultrastable glass-coated thermistors
- Single or dual gas push-button calibration
- Explosion-proof/flameproof design; ATEX, FM and CSA certified for Class I, Division 1 and zone 1 hazardous locations
- Sealed air reference for most applications
- Optional Hastelloy® materials for corrosive gases
- Quick response

# TM02-TC

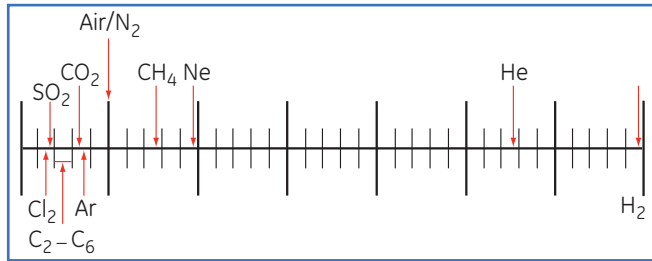
## Panometrics Thermal Conductivity Binary Gas Transmitter

TM02-TC is a Panometrics product. Panometrics has joined other GE high-technology sensing businesses under a new name—GE Industrial, Sensing.



# GE Sensing

The TMO2-TC is a compact, rugged, online transmitter that provides simple and reliable gas composition analysis of binary gas mixtures. It is ideal for analysis of hydrogen, carbon dioxide, methane and helium in ranges from 0 to 100 percent.



Relative thermal conductivities of common gases at 212°F (100°C)

Gas	Chemical Formula	32°F (0°C)	212°F (100°C)
Acetylene	C <sub>2</sub> H <sub>2</sub>	0.777	0.900
Air	N <sub>2</sub> /O <sub>2</sub>	1.000	1.000
Argon	Ar	0.677	0.665
n-Butane	C <sub>4</sub> H <sub>10</sub>	0.552	0.744
Carbon Dioxide	CO <sub>2</sub>	0.603	0.704
Chlorine	Cl <sub>2</sub>	0.232	0.340
Ethylene Alcohol	C <sub>2</sub> H <sub>5</sub> OH <sub>4</sub>	0.590	0.644
Ethylene	C <sub>2</sub> H <sub>4</sub>	0.720	0.980
Ethylene Oxide	C <sub>2</sub> H <sub>4</sub> O	0.469	0.620
Freon-11	CCl <sub>3</sub> F	0.286	0.368
Helium	He	5.97	5.53
n-Heptane	C <sub>7</sub> H <sub>16</sub>	0.399	0.582
n-Hexane	C <sub>6</sub> H <sub>14</sub>	0.508	0.662
Hydrogen	H <sub>2</sub>	6.968	6.803
Methane	CH <sub>4</sub>	1.25	1.45
Methyl Chloride	CH <sub>3</sub> Cl	0.377	0.5300
Neon	Ne	1.90	1.84
n-Pentane	C <sub>5</sub> H <sub>12</sub>	0.535	0.702
Sulfur Dioxide	SO <sub>2</sub>	0.350	0.381
Water Vapor	H <sub>2</sub> O	0.755	0.771

## Applications

The TMO2-TC can be used in a wide variety of industrial applications where it is necessary to measure the concentration of one component of a binary gas mixture. It can also be used in pseudo-binary gas mixtures where the ratio of concentrations of the background gas components remains constant and in gaseous mixtures where the thermal conductivity of the gas of interest is significantly different from that of the background gas.

## Theory of Operation

The TMO2-TC measures the concentration of a gas in binary or pseudo-binary gas mixtures by measuring the thermal conductivity of the sample gas and comparing it to the thermal conductivity of a selected reference gas.

Two ultrastable, precision glass-coated thermistors are used—one in contact with the sample gas and the other in contact with the reference gas (such as air in a sealed chamber). The thermistors are mounted so that they are in close proximity to the stainless steel (or Hastelloy<sup>®</sup> alloy) walls of the sample chamber. The entire transmitter is temperature controlled, and the thermistors are heated to an elevated temperature in a constant-current Wheatstone bridge. The thermistors lose heat to the walls of the sample chamber at a rate that is proportional to the thermal conductivity of the gas surrounding them. Thus, each thermistor will reach a different equilibrium temperature. The temperature difference between the two thermistors is detected in the Wheatstone bridge, and the resulting bridge voltage is amplified and converted to a linear 4 to 20 mA output proportional to the concentration of one of the constituents of the binary gas mixture.

The TMO2-TC transmitter has polarity inverse jumpers that permit the measurement of gases (such as CO<sub>2</sub>) with relative thermal conductivity less than air or nitrogen.

## TMO2-TC Transmitter

The TMO2-TC transmitter is self contained, consisting of the thermal conductivity sensor and associated electronics. It requires 24 VDC power and provides a 4 to 20 mA output signal proportional to the thermal conductivity of the sample gas and to the concentration of one of the gases in the binary mixture.

The transmitter is available in a standard two-port (sealed reference gas) version or optional four-port (flowing reference gas) version. The two-port configuration is used for zero-based ranges with air or nitrogen at atmospheric pressure as the balance or background gas. It utilizes air with desiccant in a factory-sealed chamber as the reference gas. The four-port configuration is used for zero-suppressed ranges and some other special applications.

# TMO2-TC Specifications

## Performance

### Accuracy

±2% of span

### Linearity

±2% of span (for most ranges)

### Repeatability

±0.5% of span

### Zero Stability

±0.5% of span per week

### Span Stability

±0.5% of span per week

### Response Time

20 seconds for 90% of step change

### Measurement Ranges (Typical)

- 0% to 2%
- 0% to 5%
- 0% to 10%
- 0% to 25%
- 0% to 50%
- 0% to 100%
- 50% to 100%
- 80% to 100%
- 90% to 100%

### Measurement Gases (Typical)

- H<sub>2</sub> in N<sub>2</sub> or CO<sub>2</sub>
- He in N<sub>2</sub> or air
- CO<sub>2</sub> in N<sub>2</sub> or air
- SO<sub>2</sub> in air
- H<sub>2</sub>/CO<sub>2</sub>/air for hydrogen-cooled generators

### Required Sample Flow Rate

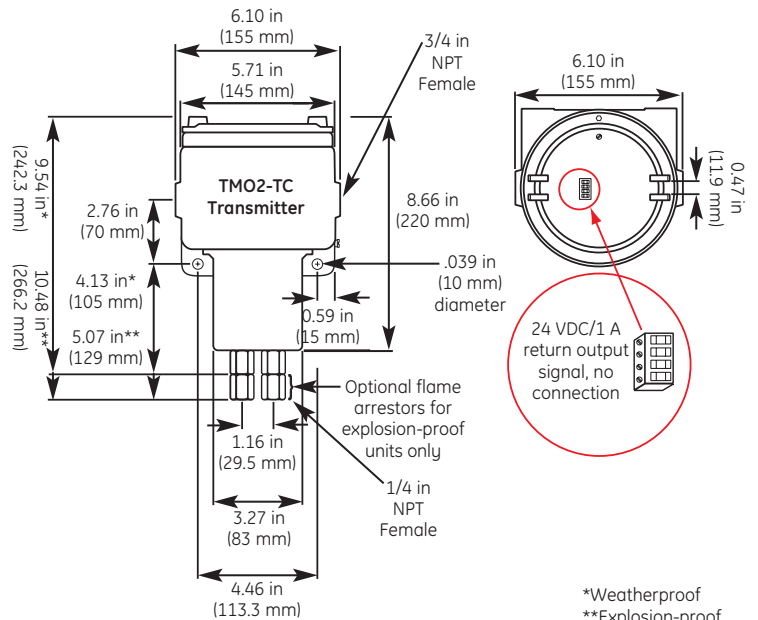
0.1 to 4.0 SCFH (50 to 2000 cc/min), 0.5 SCFH (250 cc/min) nominal

### Sample Flow Rate Effect

Less than 0.5% of span for flow range of 0.1 to 4.0 SCFH (50 to 2,000 cc/min)

### Required Reference Flow Rate

0.01 to 4.0 SCFH (5 to 2000 cc/min), 0.5 SCFH (250 cc/min) nominal



TMO2-TC thermal conductivity transmitter dimensions.

\*Weatherproof  
\*\*Explosion-proof

## Warm-Up Time

30 minutes

## Functional

### Analog Output(s)

4 to 20 mA, 600 Ω maximum

### Power

24 VDC ±4 VDC, 1 A maximum

### Cable

- Standard: 10 ft (3 m), three-wire
- Optional: Lengths up to 4000 ft (1200 m)

### Operating Temperature

- Standard: 131°F (55°C)
- Optional: 149°F (65°C)

## Physical

### Wetted Sensor Materials

- Standard: 316 stainless steel, glass and Viton® O-rings
- Optional: Hastelloy C276, titanium and Chemraz® O-rings

# TMO2-TC Specifications

## Dimensions

- Weatherproof unit (h x diameter): 9.53 in x 5.71 in (242 mm x 145 mm)
- Explosion-proof/flameproof unit (h x diameter): 10.47 in x 5.71 in (266 mm x 145 mm)

## Weight

9.5 lb (4.3 kg)

## Environmental Certification

- Weatherproof: Type 4X/IP66
- Explosion-proof: FM/CSA Class I, Division 1, Groups A,B,C&D
- Flameproof:
  - Ex II 2 GD EEx d IIC T6 or T5
  - ISseP02ATEX022
  - Ex d II C T6 IP66 Class I, Zone 1
  - SAA AUS Ex 3139X

## European Compliance

Complies with EMC Directive 89/336/EEC and PED 97/23/EC for DN<25

## Order Information

Record selected option in blank indicated at bottom of form.

### TMO2D-TC Thermal Conductivity Transmitter

#### Measuring Cell Package

- 3 Weatherproof, four-port, flowing reference gas, CPVC cell
- 4 Explosion-proof, four-port, flowing reference gas, CPVC cell
- 5 Weatherproof, two-port, sealed reference gas, FEP-coated
- 6 Explosion-proof, two-port, sealed reference gas, FEP-coated aluminum cell
- W No enclosure, two-port, sealed reference gas, FEP-coated aluminum cell (spare)
- Y No enclosure, four-port, flowing reference gas, CPVC cell (spare)

#### Output

- 2 4 to 20 mA

#### Maximum Ambient Temperature

- 1 131°F (55°C)
- 2 149°F (65°C)

#### Materials

- 1 316 stainless steel
- 2 Hastelloy C276

TMO2D —    2 —    —    Use this number to order product

*For explosion-proof/flameproof packages, select temperature as follows: 131°F (55°C) for EEx d IIC T6 or 149°F (65°C) for EEx d IIC T5. For weatherproof packages, select temperature as follows: 149°F (65°C)*

### TMO2D-TC Calibration Specifications

#### Cell Range

- |             |               |               |
|-------------|---------------|---------------|
| 1 0% to 2%  | 6 0% to 50%   | C 50% to 100% |
| 2 0% to 5%  | 7 0% to 100%  | S Special     |
| 3 0% to 10% | A 90% to 100% |               |
| 4 0% to 25% | B 80% to 100% |               |

#### Calibration Gases

- 1 H<sub>2</sub> in N<sub>2</sub>
- 2 CO<sub>2</sub> in N<sub>2</sub> (minimum range 0% to 20% CO<sub>2</sub>)
- 3 CO<sub>2</sub> in air (minimum range 0% to 20% CO<sub>2</sub>)
- 4 He in N<sub>2</sub>
- 5 He in air
- 6 Calibration for H<sub>2</sub>-cooled generators, H<sub>2</sub>/CO<sub>2</sub>/air
- S Other, please specify

TC-CAL —    —    Use this number to specify transmitter calibration

*Binary or pseudo-binary gas composition must total 100%*



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920-042B

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Instructions: Please fill out the fields in        color. Any field with a        lock is a required field.

Today's Date:        **GE Sensing XMTC/TMO2-TC Analyzer Application Data Sheet**

**Contact Information**

<b>Name:</b>		<b>Phone:</b>	
<b>Company:</b>		<b>Fax:</b>	
<b>Address:</b>		<b>E-mail:</b>	
<b>Installation Address:</b>		<b>Delivery Want</b>	
<b>Measurement Points</b>			
<b>Account Manager/Sales rep (if known)</b>			

**Process Data**

<b>Process/Application:</b>			
<b>Physical State of material:</b>	<input type="checkbox"/> Gas	(confirm gas)	
<b>Complete Chemical Composition:</b>	<b>Component Name</b>	<b>Chemical Formula</b>	<b>Volume Percent</b>
Gas A*	Oxygen	O2	Nominal: % +/- %
Gas B			Nominal: % +/- %
Gas C**			Nominal: % +/- %
Gas D**			Nominal: % +/- %
Gas E			Nominal: % +/- %
Other**			Nominal: % +/- %
		<b>Total***</b>	100%

\* Gas A is the measurement gas, i.e., the gas to be measured      \*\*\* Gas composition must total 100%

\*\*\* The TMO2-TC and XMTC are binary gas analyzers. For more than two gases, consult the factory for "pseudo-binary" applicability. Attach additional pages if more space is needed.

<b>Pressure at sample points:</b>	Units	Minimum	Maximum	Nominal
<b>Temperature at sample points:</b>	Units	Minimum	Maximum	Nominal
<b>Sample Outlet:</b>	<input type="checkbox"/> Vent to atmosphere		<input type="checkbox"/> Return to process	
If sample will be returned to process, pressure at sample return point:				
	Units	Minimum	Maximum	Nominal
Temperature at sample return point:				
	Units	Minimum	Maximum	Nominal

**Measurement Parameters**

<b>Measurement gas (e.g., hydrogen, H2):</b>			
<b>Analyzer range (e.g. 0-25%):</b>		% O2	
<b>Utilities available at transmitter:</b>	<input type="checkbox"/> Air, pressure	psig	<input type="checkbox"/> N2, pressure
	<input type="checkbox"/> Water, pressure	psig	<input type="checkbox"/> Temperature
	<input type="checkbox"/> 1.2-A, 24-VDC power	<input type="checkbox"/> Available	<input type="checkbox"/> Not available
<b>Output units:</b>	Standard 4 to 20 mA (isolated)		
<b>Area classification:</b>	<input type="checkbox"/> Nonhazardous	<input type="checkbox"/> Hazardous	
<b>If hazardous:</b>	Class	Division	Groups
<b>Ambient pressure:</b>	Units	Minimum	Maximum
<b>Ambient temperature:</b>	Units	Minimum	Maximum

**Electronics/Display Package**

<b>Digital display:</b>	<input type="checkbox"/> Local	<input type="checkbox"/> Remote	<input type="checkbox"/> Not required
<b>Type:</b>	<input type="checkbox"/> Weatherproof	<input type="checkbox"/> Explosionproof	<input type="checkbox"/> Rack
	<input type="checkbox"/> Bench	<input type="checkbox"/> Panel	
<b>Automatic calibration:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required	
<b>RS232 port</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required	
<b>Alarm relays:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required	
<b>Output units:</b>	<input type="checkbox"/> Single 4 to 20 mA (isolated)	<input type="checkbox"/> Dual 4 to 20 mA (isolated)	
<b>Power available:</b>	<input type="checkbox"/> VAC	<input type="checkbox"/> Hz	<input type="checkbox"/> Other
<b>Area classification:</b>	<input type="checkbox"/> Nonhazardous	<input type="checkbox"/> Hazardous	
<b>If hazardous:</b>	Class	Division	Groups
<b>Distance between display(s) &amp; transmitter(s):</b>	<input type="checkbox"/> ft	<input type="checkbox"/> m	Choose one
<b>Tagging:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required	
<b>Drawings:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required	
<b>SS compression fitting</b>	Parker / Swagelok / Other		

**Additional Measurements**

<b>Oxygen:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required
<b>Moisture:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required
<b>Flow:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required
<b>Energy flow rate:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required
<b>Flue gas analysis:</b>	<input type="checkbox"/> Not required	<input type="checkbox"/> Required

Combustible gas:	<input type="checkbox"/>	Not required	<input type="checkbox"/>	Required	
Wobbe index:	<input type="checkbox"/>	Not required	<input type="checkbox"/>	Required	
CARI:	<input type="checkbox"/>	Not required	<input type="checkbox"/>	Required	
Calorific value:	<input type="checkbox"/>	Not required	<input type="checkbox"/>	Required	
Carbon potential:	<input type="checkbox"/>	Not required	<input type="checkbox"/>	Required	
Special Requirements:					
Please attach a brief description or sketch of the process					