

GE Sensing

Applications

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

Metals Industry

- H₂ in N₂: atmosphere in metal heat-treating furnaces

Electric Power Industry

- H₂ in cooling systems for generators

Petroleum Industry

- H₂ in hydrocarbon streams

Chemical Industry

- H₂ in ammonia synthesis gas
- H₂ in methanol synthesis gas
- H₂ in chlorine plants

Methane Industry

- CO₂ in methane
- N₂ in methane

Landfill/Biogas Industry

- CO₂ in biogas
- CH₄ in biogas

Gas Production Industry

- Purity monitoring of argon, hydrogen, nitrogen and helium

Food Industry

- CO₂ 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

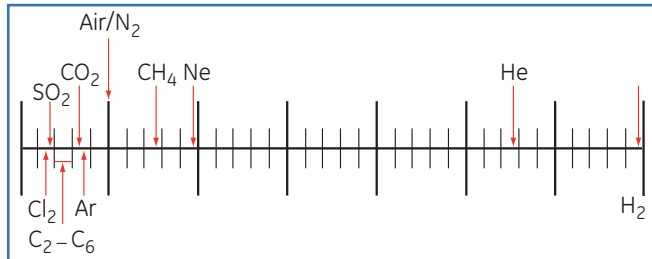
Panometrics Thermal Conductivity Binary Gas Transmitter

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 ₂ H ₂	0.777	0.900
Air	N ₂ /O ₂	1.000	1.000
Argon	Ar	0.677	0.665
n-Butane	C ₄ H ₁₀	0.552	0.744
Carbon Dioxide	CO ₂	0.603	0.704
Chlorine	Cl ₂	0.232	0.340
Ethylene Alcohol	C ₂ H ₅ OH ₄	0.590	0.644
Ethylene	C ₂ H ₄	0.720	0.980
Ethylene Oxide	C ₂ H ₄ O	0.469	0.620
Freon-11	CCl ₃ F	0.286	0.368
Helium	He	5.97	5.53
n-Heptane	C ₇ H ₁₆	0.399	0.582
n-Hexane	C ₆ H ₁₄	0.508	0.662
Hydrogen	H ₂	6.968	6.803
Methane	CH ₄	1.25	1.45
Methyl Chloride	CH ₃ Cl	0.377	0.5300
Neon	Ne	1.90	1.84
n-Pentane	C ₅ H ₁₂	0.535	0.702
Sulfur Dioxide	SO ₂	0.350	0.381
Water Vapor	H ₂ 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[®] 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 CO₂) 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)

- H₂ in N₂ or CO₂
- He in N₂ or air
- CO₂ in N₂ or air
- SO₂ in air
- H₂/CO₂/air for hydrogen-cooled generators

Required Sample Flow Rate

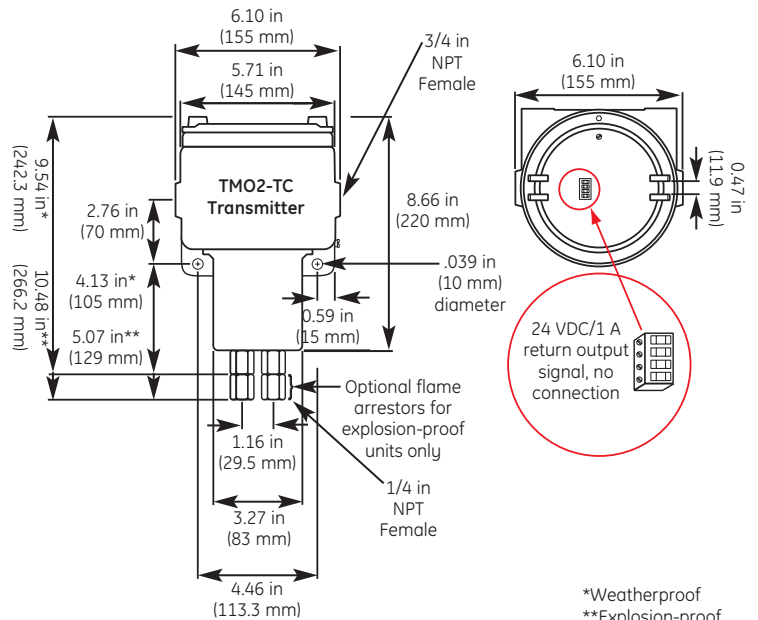
0.1 to 4.0 SCFH (50 to 2000 cc/min), 0.5 SCFH (250 cc/min) nominal

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.

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 H₂ in N₂
- 2 CO₂ in N₂ (minimum range 0% to 20% CO₂)
- 3 CO₂ in air (minimum range 0% to 20% CO₂)
- 4 He in N₂
- 5 He in air
- 6 Calibration for H₂-cooled generators, H₂/CO₂/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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