

Gas Type

Line Size

Flow Rate

Velocity

Pressure

Temperature

# THERMAL DISPERSION

LEVEL / FLOW / INTERFACE

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LEVEL / FLOW / INTERFACE

TG1/TG2  
TA2  
TD1/TD2



## THERMATEL® THERMAL DISPERSION

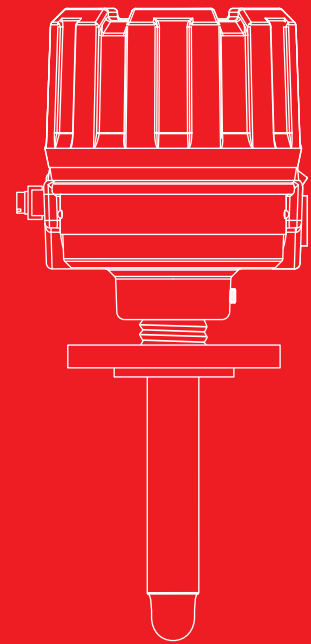
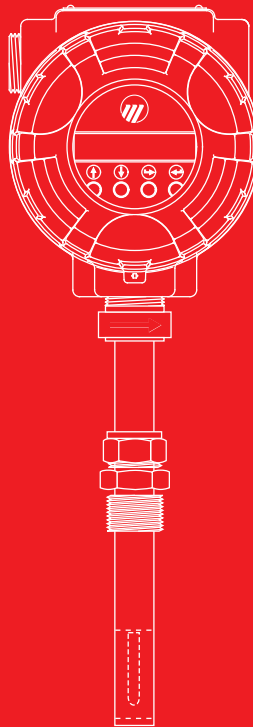
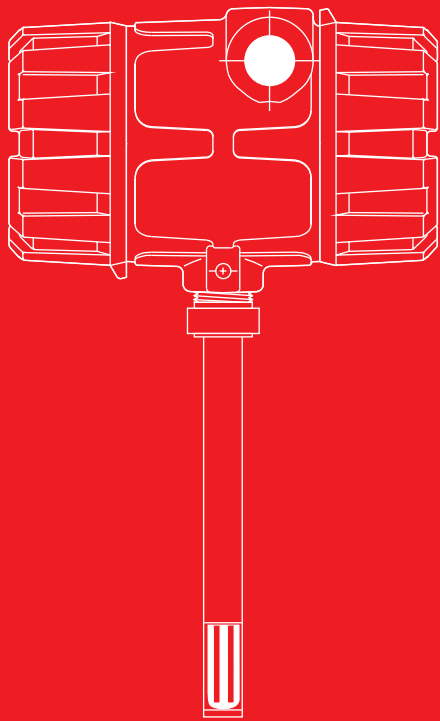


# Magnetrol®

Worldwide Level and Flow Solutions™

**The Total Spectrum of Solutions** ▶

Magnetrol® products employ many technologies to meet the challenges of level and flow control. Thermatel® switches and transmitters utilize the principles of thermal dispersion for accurate and reliable level, flow, and interface control.



**MAGNETROL®**  
THERMAL DISPERSION PRODUCTS



**M**agnetrol® International—a world leader in level and flow control technology—designs, manufactures, markets, and services level and flow instrumentation worldwide.

MAGNETROL product groups are based upon these technologies:

- Air Sonar
- Buoyancy
- Contact Ultrasound
- Guided Wave Radar
- Pulse Burst Radar
- RF Capacitance
- Thermal Dispersion
- Vibration
- Visual Indicators

The industries we serve include:

- Petroleum Production
- Petroleum Refining
- Power
- Petrochemical
- Chemical
- Water & Wastewater
- Pulp & Paper
- Food & Beverage
- Pharmaceutical

## THERMATEL THERMAL DISPERSION

### C O N T E N T S

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- Thermatel® Sensors 10
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- Thermatel® RPA Hot Tap Assembly 11

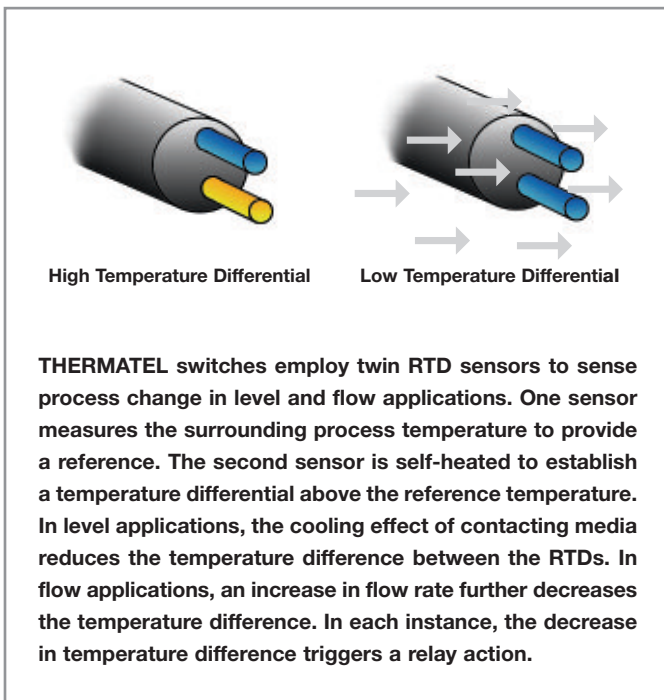
# An Introduction To Thermatel® Technology & Products

**T**hermatel® products utilize thermal dispersion technology for unsurpassed accuracy and reliability in monitoring gas flow, liquid flow, liquid level, and interface. A market-proven technology, thermal dispersion has been in use by process industries for measurement and control purposes since the early 1960s.

## Product Scope

The THERMATEL product line has been structured to provide customers with a complete range of options in thermal dispersion technology. Each THERMATEL product is engineered and manufactured to provide the highest reliability in even the most demanding process environments.

THERMATEL products range from single-point switches to the powerful TA2 Thermal Mass Flow Transmitter. The TA2 powerful microprocessor-based electronics make these units the premier thermal dispersion mass flow meters in the industry. They are easy to set up, configure, and provide high levels of accuracy, repeatability, and diagnostics.



## Applications Range

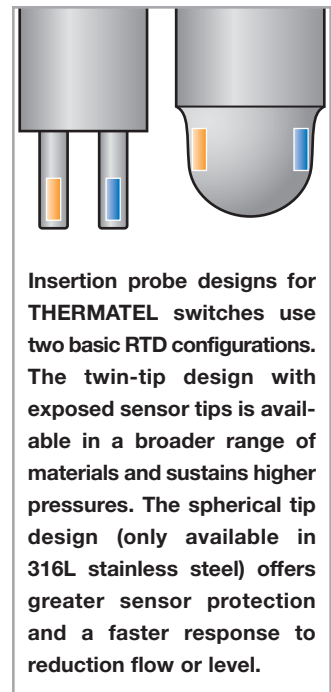
THERMATEL products are in service worldwide in many of the most demanding applications. As a flow switch THERMATEL is used for gas and liquid applications for both flow and no/low flow detection. Typical applications involve pump protection, cooling air/water, relief valve monitoring, exhaust flows and lubrication systems. THERMATEL products provide outstanding low flow sensitivity with high rangeability.

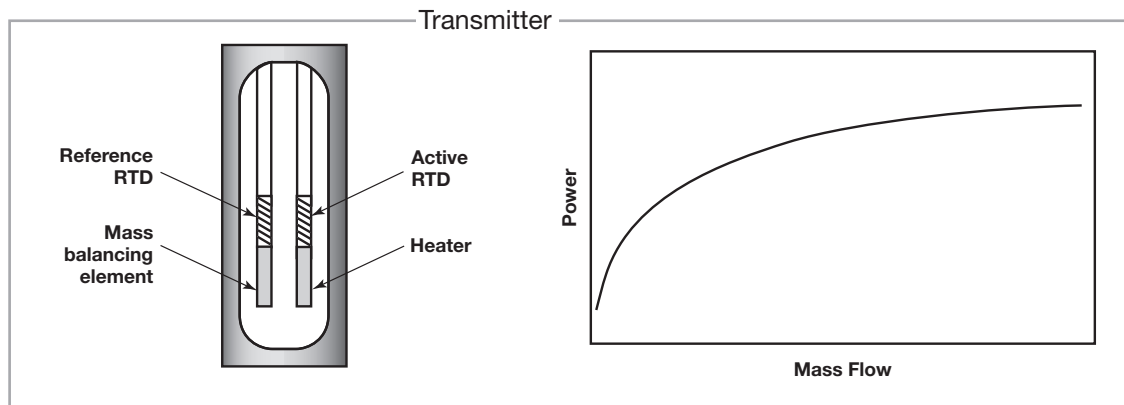
THERMATEL level switches provide outstanding performance with liquids and slurries in a wide variety of demanding applications including interface, high viscosity, turbulence, high temperatures, and presence of foam.

For mass flow measurement of air and gases, the THERMATEL TA2 Thermal Mass Flow Transmitter is without peer. The easy to use instrument is installed in numerous flow measurement applications including combustion air flow, compressed air/gas and aeration air flow measurement. Other common applications include natural gas, digester/bio gas, flare lines, hydrogen, oxygen, and many other gas flow measurement applications.

## Principle of Operation: Switches

Flow and level detection is accomplished when THERMATEL sensing elements detect changes in the heat transfer characteristics of the process media. As a flow switch, THERMATEL switches will rapidly detect changes in liquid or gas flow rate by detecting heat transfer, which increases at higher flow rates. Level detection is accomplished by sensing changes in the thermal conductivity of media. THERMATEL switches can also be calibrated to sense difference in heat transfer at the interface between two dissimilar media, such as oil/water, or water/foam.





THERMATEL switches rely on two miniature sensing elements to detect heat transfer. Resistance Temperature Detectors (RTDs) establish a thermal relationship that establishes the basis for flow and level detection. One RTD measures the temperature of the surrounding media which serves as the instrument's reference temperature. The second RTD is heated to establish a temperature differential above the reference temperature. In flow sensing applications, the heated RTD cools with increasing flow. In level sensing applications, the RTD cools in the presence of media. In each case, cooling the heated RTD decreases the differential temperature between the two RTDs. This decrease is then converted into a relay actuation which performs an alarm function.

### Principle of Operation: Flow Meter

Thermal dispersion technology provides a mass flow measurement of air or gas. This is accomplished by precisely measuring the cooling effect as the mass (molecular) flow passes the heated sensor. The sensor consists of two elements: the reference which measures the temperature of the gas and a second element which is heated at a variable power. This maintains the desired temperature difference between the two sensors.

The illustration on the top of this page shows the amount of power required to maintain a constant temperature difference between the two sensors. Under low mass flow conditions, there is minimal cooling and little power is required. As the mass flow increases, more power is required. This provides excellent low flow sensitivity and high turndown capabilities.

Each instrument is factory calibrated and configured for the specific application. If necessary, the TA2 can be reconfigured in the field for different conditions.

### Strengths + and Cautions -

- + Direct mass flow measurement—does not require pressure or temperature compensation which is required by other technologies.
- + THERMATEL offers excellent low flow sensitivity: gas velocities from 25 ft/min (0.13 m/s) to over 50,000 ft/min (255 m/s).
- + THERMATEL products are easy to install and can be “hot tapped.”
- An alternative flow meter technology should be considered where condensed moisture is continuously present.

Refer to MAGNETROL bulletin 54-621 for further technical information on Thermal Dispersion Mass Flow.



# THERMATEL TA2 Thermal Mass Flow Transmitter

## Mass Flow Measurement of Air and Gas

**General Description:** The MAGNETROL TA2 Thermal Dispersion Mass Flow Transmitter provides direct mass flow measurement of air and gases. The powerful micro-processor-based electronics provide an instrument that is easy to configure to the application, yet provides flexibility and ease of use. Advanced temperature compensation provides high performance over the entire operating range of the instrument. Installed cost of this instrument is very competitive with other gas mass flow measurement technologies.

- Technology Features:**
- ▶ Direct mass flow measurement in SCFM, SCFH, MMSCFD, Nm<sup>3</sup>/h, lb/hr, kg/hr
  - ▶ Excellent low flow sensitivity
  - ▶ High turndown ratios
  - ▶ Ease of installation
  - ▶ Low pressure drop

**Applications:** Typical applications include combustion air-flow measurement, compressed air, natural gas flow, flare lines, digester/bio gas, and other process gas flow measurement.



In The **MAGNETROL Product Calibration Lab**, THERMATEL products are calibrated and tested to meet customer specifications. Calibrations traceable to NIST.



**Model TA2  
Mass Flow Transmitter**



**Model TA2  
Mass Flow Transmitter**



**Model TA2  
with Flow Body**

# THERMATEL TA2

## Product Features:

- ▶ Accepts all typical input powers in same unit
- ▶ Second mA output for temperature output or second flow range optional
- ▶ Pulse output optional
- ▶ Integral or remote electronics
- ▶ Rotatable housing to permit viewing the display from any position
- ▶ Pre-calibrated and configured for the user's application. Ready to install.
- ▶ Flow totalization
- ▶ Stainless steel and Hastelloy probes with wide selection of process connections
- ▶ All explosion proof housing with FM, FMC, and ATEX hazardous area approval
- ▶ Insertion probes and flow body designs
- ▶ Ability to replace probe/circuit boards in field
- ▶ On-site calibration verification procedure
- ▶ PACTware™ for configuration, diagnostics, and trending
- ▶ SIL 1 with SFF value of 88.4%
- ▶ NIST traceable calibration
- ▶ Optional hot tap assembly
- ▶ HART®, AMS communication
- ▶ Ability to replace probe in field
- ▶ 4-button keypad for data entry
- ▶ Two gas calibrations available



## APPROVALS



## SPECIFICATIONS

<b>Supply Voltage</b>	11.6 to 30 VDC 100 to 264 VAC
<b>Power Consumption</b>	7 VA typical
<b>Flow Range Maximum</b>	10–50,000 SFPM (0.05–250 Nm/s) air reference to standard conditions Higher ranges and other gases available
<b>Accuracy Flow</b>	±1% of reading +0.5% of calibrated full scale
<b>Accuracy Temperature</b>	±2° F (1° C)
<b>Repeatability</b>	±0.5% of reading
<b>Turn Down</b>	100:1 typical (depending on calibrated flow range)
<b>Ambient Temperature</b>	-40° to +176° F (-40° to +80° C); display not readable below -22° F (-30° C)
<b>Process Temperature</b>	-50° to +400° F (-45° to +200° C)
<b>Pressure Rating</b>	1500 psig (103 bar) maximum
<b>Analog Output Signal</b>	
	<b>Active:</b> 4–20 mA (isolated) maximum 1000 Ω loop resistance
	<b>Passive:</b> 4–20 mA (isolated) loop resistance dependent on power supply
<b>HART</b>	Optional

# THERMATEL TD1 & TD2 Switches

## Flow / Level / Interface Detection

**General Description:** The TD1/TD2 THERMATEL switch is extremely versatile providing flow/level/interface detection in a single unit. Both liquid and gas flow detection is obtainable. The TD1 is available with 24 VDC power with the TD2 available in either an AC or DC version. The TD2 also provides LED indication through an optional glass window, mA output for diagnostics or repeatable flow/level indication, optional hermetically sealed relay, time delay adjustment, and remote electronics. Continuous diagnostics on both units provides assurance that the switch is operating properly.

- Features:**
- ▶ Continuous diagnostics
  - ▶ Temperature compensation
  - ▶ No moving parts
  - ▶ Narrow hysteresis
  - ▶ Operating temperatures to +850° F (+450° C)
  - ▶ Integral or remote electronics
  - ▶ 8-amp DPDT relay with optional hermetically sealed relay
  - ▶ Low flow sensing capabilities
  - ▶ Probes available in 316 stainless steel, Hastelloy® C, and Monel®
  - ▶ Wide selection of sensors – see page 10
  - ▶ NACE construction available
  - ▶ Hygienic design available

- Applications:**
- Flow:** Pump protection, relief valve monitoring, low flow/high flow indication, cooling air/water, exhaust flow, analyzer lines, lubrication systems
- Level:** High level/low level/interface detection, high viscosity liquids, slurries, high pressure, high temperature, air/foam and foam/liquid detection, corrosive environments



### APPROVALS



### SPECIFICATIONS

<b>Input Power</b>	<b>TD1:</b> 19.2 to 28.8 VDC
	<b>TD2:</b> 100 to 264 VAC, 50–60 Hz or 19.2 to 28.8 VDC
<b>Power Consumption</b>	<b>TD1:</b> 3.5 watts at 24 VDC, 4.5 watts at 30 VDC
	<b>TD2:</b> 4 watts at 24 VDC, 4.5 watts at 30 VDC, 5 watts at 100 to 264 VAC
<b>Power to Probe</b>	Less than 1 watt
<b>Electronics</b>	<b>TD1:</b> Integral
	<b>TD2:</b> Integral or remote
<b>Relay</b>	8-amp DPDT — TD2 has optional hermetically sealed relay
<b>Set Point Range</b>	<b>Water:</b> 0.01 to 5 fps (0.003 to 1.5 m/s)
	<b>Air:</b> 0.1 to 500 sfps (0.3 to 150 nm/s)
<b>Process Temperature</b>	-100° to +850° F (-73° to +454° C)
<b>Process Pressure</b>	Probe dependent — to 6000 psig (414 bar)



# THERMATEL TG1 Switch

## Two-Wire Intrinsically Safe Flow / Level / Interface Detection

**General Description:** The MAGNETROL TG1/TG2 switch is the industry's only two-wire, intrinsically-safe thermal dispersion switch. The switch consists of a probe and preamplifier with remote DIN rail electronics. Barriers in the DIN rail enclosure provide a two-wire, intrinsically-safe circuit to the probe/preamplifier.

**Product Operation:** The preamplifier converts the temperature difference to a pulse signal which is super-imposed on the two wires providing power to the sensor. The DIN rail electronics provide operation control including set point adjustment, LED indication of flow/level, relay, fail-safe adjustment, and time delay. A non-linear mA output signal is available for diagnostics and repeatable flow/level indication.

- Features:**
- ▶ DIN rail mounted electronics with built-in barrier provide a two-wire intrinsically-safe circuit to the probe/preamplifier
  - ▶ Versatile switch for flow and level
  - ▶ Set point adjustment at remote electronics
  - ▶ Up to 1,650 feet (500 meters) cable length
  - ▶ LED indication provides monitoring of actual flow/level
  - ▶ mA output signal will provide repeatable indication plus can be used for diagnostics
  - ▶ Uses all THERMATEL probes including low flow body and high-temperature sensor

- Applications:**
- Flow:** Liquid or gas flow, pump protection, cooling air/water, relief valves, flow/no flow
  - Level:** Hi/Low level, high viscosity media, high solids content, aeration/foaming, hygienic applications, interface detection, high-temperature applications



### APPROVALS



### SPECIFICATIONS

<b>Supply Voltage</b>	24 VDC
<b>Relay</b>	2-amp, SPDT relay
<b>Signal</b>	mA output, non-linear
<b>Fail-safe</b>	Switch selectable
<b>LED Indication</b>	
<b>4 Green:</b>	Flow/Level is normal
<b>1 Yellow:</b>	Flow/Level is near set point
<b>1 Red:</b>	Alarm condition (TG1 only)
<b>Set-Point</b>	Adjustable via potentiometer

<b>Operating Temperature</b>	
<b>Sensor:</b>	-100° to +850° F (-70° to +450° C)
<b>Flow Range Insertion Probes</b>	
<b>Water:</b>	0.01 – 5 fps (0.003 to 1.5 m/s)
<b>Air:</b>	0.1 – 500 fps (150 m/s)

# THERMATEL Switch Sensors

**Twin-Tip Sensors** are mounted at the end of each tip. **Spherical Sensors** are bonded directly to the wall of the tip for greater sensitivity and sensor protection.

Probe pressure and temperature ratings are dependent upon process connection; maximum pressure and temperature ratings are shown below.

## Twin-Tip Sensor

<b>General Use:</b>	General purpose and corrosive resistant applications
<b>Material Options:</b>	316 stainless steel, Hastelloy C-276, or Monel
<b>Process Connections:</b>	NPT threads, G threads, ANSI flanges, EN/DIN flanges
<b>Max Temperature:</b>	+400° F (+200° C)
<b>Max Pressure:</b>	3,000 psig (207 bar) – 1850 psi (127 bar) extended length
<b>Insertion Lengths:</b>	2 to 130 inches (50 to 3,300 mm)



## Spherical-Tip Sensor

<b>General Use:</b>	General purpose service and high-viscosity applications
<b>Material:</b>	316 stainless steel
<b>Process Connections:</b>	NPT threads, G threads, ANSI flanges, EN/DIN flanges, hygienic
<b>Max Temperature:</b>	+400° F (+200° C)
<b>Max Pressure:</b>	600 psi (40 bar)
<b>Insertion Lengths:</b>	2 to 130 inches (50 to 3,300 mm)



## High-Temperature Sensor

<b>General Use:</b>	For high-temperature process environments
<b>Material:</b>	316 stainless steel; Hastelloy C-276
<b>Process Connections:</b>	NPT threads, G threads, ANSI flanges, EN/DIN flanges
<b>Max Temperature:</b>	+850° F (+454° C)
<b>Max Pressure:</b>	6,000 psi (413 bar)
<b>Insertion Lengths:</b>	2 to 36 inches (50 to 900 mm)



## Low Flow Body Sensor



<b>General Use:</b>	Low flow detection; suitable for chemical feed pumps, additive flow, pump seals, process analyzers
<b>Material:</b>	316 stainless steel
<b>Flow Rate:</b>	0.055 to 3 gallons/hour (0.02 to 11.5 liters/hr.)
<b>Process Connections:</b>	¼" and ½" NPT, and G threads
<b>Max Temperature:</b>	+400° F (+200° C)
<b>Max Pressure:</b>	5,800 psi (400 bar)

## Mini Sensor

<b>General Use:</b>	Probes specifically designed to fit into a ½", ¾", or 1" Tee
<b>Material:</b>	316 stainless steel
<b>Max Temperature:</b>	+400° F (+200° C)
<b>Max Pressure:</b>	3,000 psig (207 bar) – 1850 psi (127 bar) extended length
<b>Insertion Length:</b>	1 to 130 inches (25 to 3300 mm)



# THERMATEL 052-7201 Switch

## Flow Switch for Naval Applications

### General Description:

The THERMATEL "Navy Switch" is a special version of the THERMATEL switch. It is used by the United States Navy for use on board Naval ships for flow detection in sprinkler systems.

### Features:

- ▲ Meets MIL-S-901D: Grade A shock requirements
- ▲ Meets MIL-STD-167-1: Vibration requirements
- ▲ Unit comes with Tee for use with MIL-T-16420 CUNI tubing (For tubing sizes: 1.25", 1.50", 2.00", 2.50", 3.00" or 4.00")
- ▲ 120 VAC power
- ▲ 10 amp DPDT relay
- ▲ Calibrated for sprinkler systems to detect flow of 10 GPM with 10-second delay time



# THERMATEL RPA Hot Tap Assembly

## Allows probe installation or removal without process shut-down

### General Description:

When used with THERMATEL insertion probes, the Retractable Probe Assembly (RPA) permits the probe to be installed or removed from the vessel or pipe while the process remains in operation. Once installed, it is not necessary to drain or depressurize a tank or shut down the operation in order to install or remove a THERMATEL instrument.

### Features:

- ▲ Standard 316 stainless steel gland construction
- ▲ Carbon steel or stainless steel process connections
- ▲ Flange and ball valve available as an option
- ▲ 1½" NPT or flange connection
- ▲ Teflon® compression rings

### Capabilities:

- ▲ Temperatures to +400° F (+200° C)
- ▲ Standard pressure to 50 psi (3.4 bar) (80 psi (5.5 bar) for TA2)
- ▲ High-pressure design option to Class 300 pound service



**THERMATEL Hot Tap Assemblies:**  
Standard Design (Left) and  
High Pressure Design (Right).



# Magnetrol®

**Worldwide Level and Flow Solutions™**

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