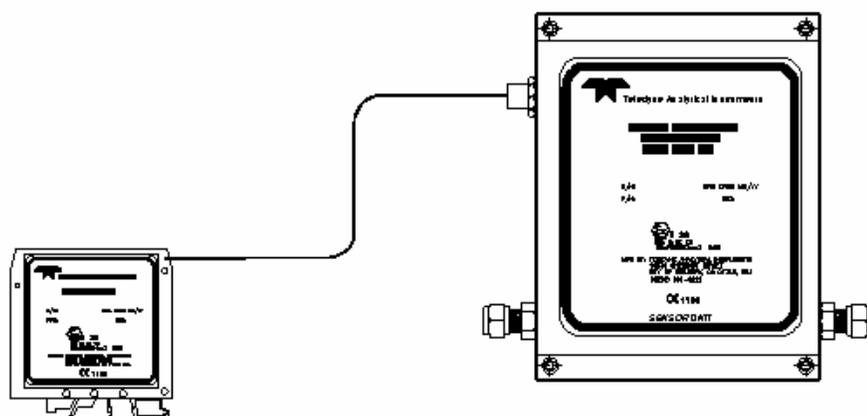




## OPERATING INSTRUCTIONS FOR

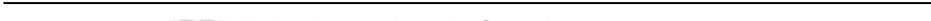
# 2000 XTC

## Thermal Conductivity Transmitter



**P/N M74838  
ECO: 04-0203  
REV 1**

	<b>DANGER</b>	
<p>Toxic gases and/or flammable liquids may be present in this monitoring system. Personal protective equipment may be required when servicing this instrument. Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected. Only authorized personnel should conduct maintenance and/or servicing.</p>		



Before conducting any maintenance or servicing, consult with authorized supervisor/manager.

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**Warranty**

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Teledyne or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

**Important Notice**

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Teledyne at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Teledyne Analytical Instruments, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

### Specific Model Information

It is not recommended that this instrument be used for analysis on any other gas or gas mixture than that specified at the time of purchase. Thermal conductivity analyzers are calibrated at the factory for a specific application using a known gas mixture that is representative of the customers' process. Using this instrument to analyze any other gas mixture may result in serious error. Consult the factory for additional information for gas analysis not specified at the time of purchase.

**Instrument Serial Number:** \_\_\_\_\_

Instrument Range: \_\_\_\_\_

Calibrated for: \_\_\_\_\_

Background Gas: \_\_\_\_\_

Zero Gas: \_\_\_\_\_

Span Gas: \_\_\_\_\_

## Safety Messages

---

Your safety and the safety of others is very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:



**GENERAL WARNING/CAUTION:** Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily injury and/or damage the instrument.



**CAUTION: HOT SURFACE WARNING:** This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.



**WARNING: ELECTRICAL SHOCK HAZARD:** Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.



No  
Symbol

*Technician Symbol:* All operations marked with this symbol are to be performed by qualified maintenance personnel only.

*NOTE:* Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

**CAUTION:**



**THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.**

**IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.**

This manual provides information designed to guide you through the installation, calibration operation and maintenance of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from Teledyne at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: [www.teledyne-ai.com](http://www.teledyne-ai.com).

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## Thermal Conductivity Transmitter

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**DANGER  
COMBUSTIBLE GAS USAGE  
WARNING**



**This instrument is approved as an intrinsically safe gas analyzer for usage in a category (ib) Group IIC hazardous area. This approval applies only to the equipment specified and installed in accordance with the information contained within this manual. It is the customer's responsibility to ensure safety, especially when combustible gases are being analyzed since the potential of gas leaks always exists.**

**The customer should ensure that the principles of operating of this equipment are well understood by the user and that the instrument as well as any approved support equipment is properly installed. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the certification and safety of this instrument.**

**Since the use of this instrument is beyond the control of Teledyne, no responsibility by Teledyne, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.**

## Introduction

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### 1.1 Overview

The Teledyne Analytical Instruments 2000 XTC Thermal Conductivity Transmitter is an instrument designed to analyze the gas concentration of a binary gas mixture. This manual covers the CENELEC/ATEX approved model 2000 XTC Thermal Conductivity Transmitter. These units are rated as intrinsically safe and may be used in Class I, Group A, B, C, D, Div. 1 (North America) and EEx ib IIC T3 (IEC/Europe) hazardous environments.

### 1.2 Typical Applications

The 2000 XTC Thermal Conductivity Transmitter is versatile. It is capable of measuring the gas concentration of a species in a binary or pseudo-binary mixture of gases over a concentration range. The specific species and gas mixture as well as the analysis range employed is fixed at the factory for your specific application. Typical applications for this transmitter include:

- Determining the gas concentration of a binary gas, for instance, Ar or N<sub>2</sub> in air
- Analyzing the methane (CH<sub>4</sub>) concentration in natural gas (80-100% CH<sub>4</sub>) sample
- Analysis of H<sub>2</sub> in various backgrounds
- CO<sub>2</sub> safety monitoring
- Specific gas mixer and process control applications
- Semiconductor manufacturing
- Petrochemical process control
- Quality assurance

Typical instrument ranges for this instrument include:

- H<sub>2</sub> in N<sub>2</sub> (or air)  
0-5%, 0-8%, 0-10%, 0-20%, 0-100%

- He in N<sub>2</sub> (or air)  
0-5%, 0-8% 0-10%, 0-30%, 0-100%
- Natural Gas in Methane  
0-20%, 0-50%, 0-100%
- Nitrogen (or air) in CO<sub>2</sub>  
0-10%, 0-20%, 0-50%, 0-100%

### 1.3 Main Features of the Transmitter

The 2000 XTC Thermal Conductivity Transmitter is sophisticated yet simple to use. It provides a 4-20 mA output signal proportional to the concentration of one component of a gas mixture. The signal is based on the difference between the thermal conductivity of the sampled gas compared to calibration points. The main features of the analyzer include:

- Integral isolated safety barrier classified as intrinsically safe for hazardous area use.
- Nema 4X, IEC 60529 and IP 66 rated sensor housing
- ATEX approved for EEx ib IIC T3 (Europe)
- 4-20 mA signal output proportional to the concentration of one of the gases in the mixture.
- Long-lifetime solid state thermal conductivity sensor
- Temperature controlled cell block provides excellent zero and span stability over a wide temperature range
- Versatile analog signal processing IC.
- Easy installation

### 1.4 Operator Interface

The user does not interact with the transmitter directly. The standard 2000 XTC Thermal Conductivity Transmitter provides a 4-20 mA output signal proportional to the concentration of the gas being analyzed. This signal can be used to drive devices such as displays, concentration alarms, user-supplied devices, or it can be monitored using a chart recorder.

Figure 1-1 shows the 2000 XTC Thermal Conductivity Transmitter. The instrument is comprised of two modules: the transmitter unit and the galvanic isolator unit. The transmitter is located at the sample point (which can be a hazardous area) and is where the sample gas input is converted into an electrical output signal.

The galvanic isolator module contains the 24V power supply, the power isolation safety barrier and signal output connection. This module is used to provide safe power to the transmitter eliminating the danger of ignition by sparks or heating due to excessive power.

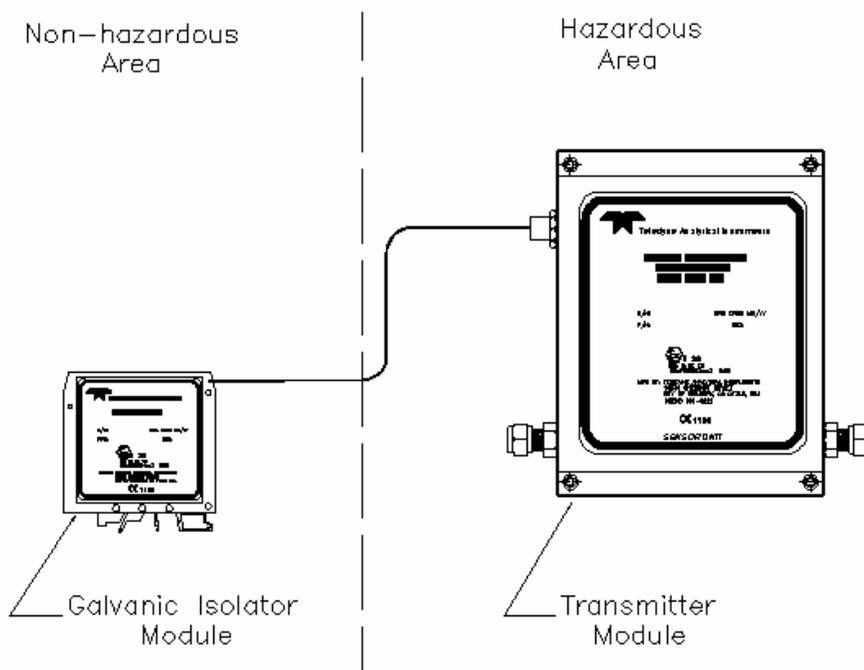


Figure 1-1: XTC-Transmitter Modules



## Operational Theory

---

### 2.1 Introduction

The 2000 XTC is comprised of two subsystems:

1. The thermal conductivity sensor and transmitter
2. Galvanic isolator and power supply

The system directs a sample gas into the transmitter. Internally, the sample is passed to the sensor and heated without contaminating or altering the sample in any way. The thermal conductivity sensor is a solid-state device that translates the amount of gas present in the sample into a change in resistance (expressed in ohms). The electronic signal processing and control circuits provide a linear output signal compensated for ambient temperature fluctuations over a wide range. Increased stability is achieved using integral heaters that control the temperature of the sensor cell.

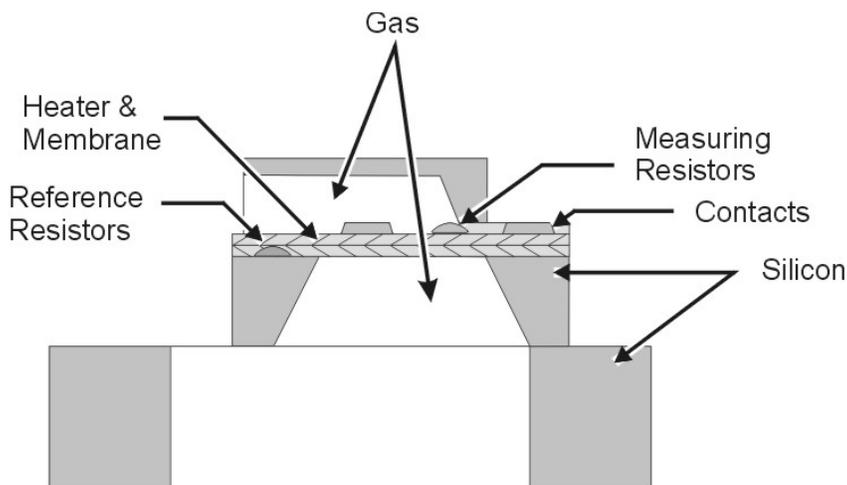
### 2.2 The Thermal Conductivity Sensor

The Thermal Conductivity Transmitter is designed to measure the concentration of a component in a binary stream of gas. It can be used to determine the concentration of a sample stream containing a composite mixture of impurities by comparing the difference in thermal conductivity of the sample stream with calibrated reference points.

Thermal conductivity measurements are non-specific by nature. The thermal conductivity of a gas mixture depends on the conductivities of the individual components of the mixture and their relative concentration. The transmitter is calibrated at the factory to be linear over the range and mixture of interest specified by the customer at the time of purchase. In order to accurately detect and quantify a component in a sample stream, the sample must be composed of the particular component and background gas specified at the time of purchase. The transmitter can be used with other binary gas mixtures, but the output signal may or may not be linear across the sensor output range. Consult the factory for additional information regarding the use of this

instrument for analyzing other gas mixtures. Generally, the user must be able to calibrate the instrument with a gas containing the host gas and a known concentration of the impurity or gas to be analyzed. At a minimum, a zero gas and a mixture containing approximately 70-100% of the species to be analyzed on the range of interest should be provided in order to properly calibrate this instrument.

Figure 2-1 shows a cross section of the sensor used in the 2000 XTC. A resistor is mounted on a heated membrane to which the sample gas is exposed. This resistor is used to both heat and measure the temperature of the membrane. A second resistor is fabricated directly on the silicon and is used to compensate for changes in the ambient temperature. Depending on the sample gas density, exposing the sensor to the gas will either increase the membrane temperature or decrease or the measuring resistor temperature. Implementing each of the two resistors in the analog signal conditioning stages enables the null point of the circuit to be directly related to the thermal conductivity of the sample gas.



*Figure 2-1: Thermal Conductivity Sensor*

During calibration, the analog signal is balanced for the zero gas at one end of the measurement range, and span gas at the other end. The resulting electrical signal is fed to a microprocessor which linearizes the output based on data programmed at the factory. An E-to-I converter produces an isolated 4–20 mA DC current output spanning the analysis range.

Control circuitry precisely regulates the temperature of the measuring cell. These additional controlled heaters are installed to heat the sample gas and compensate for ambient temperature fluctuations, enhancing the stability and accuracy of the measuring process. The heater temperature is adjustable using a set-screw adjustment potentiometer inside the transmitter unit.

Control of the sample and supporting gases is not provided in the basic design. TAI offers a variety of supporting gas control panels as companion accessories to the analyzer to fill this need. In any case, means must be provided for controlling the flow rates of sample and calibration gas through the analyzer. A control manifold will be required for the introduction of zero and span gas, as well as sample gas, into the sample path. Appropriate pressure reducing regulators will have to be installed at all gas supply sources; for those customers wishing to incorporate their own sample controls, a recommended system piping drawing is shown in Figure 2.2 and a reference drawing is included among the drawings at the rear of the manual.

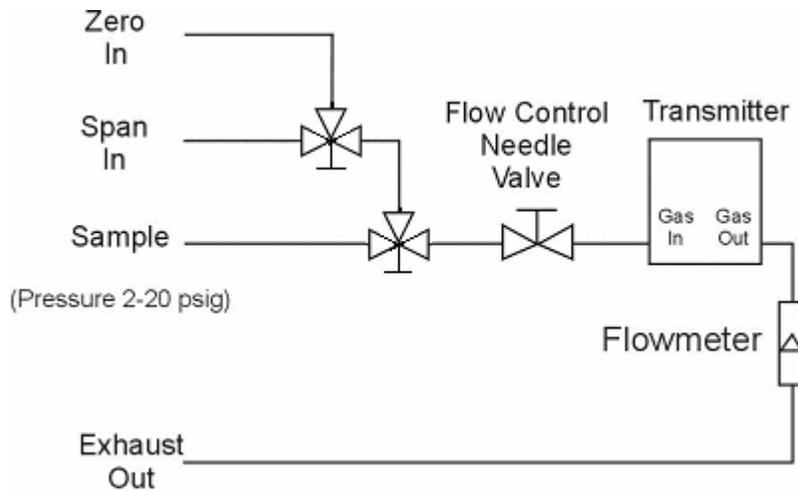
## 2.3 Sample System

A suitable external sample system must be provided by the customer. The external sample system delivers calibration or sample gas to the transmitter at suitable pressure and flow rate. Internally, the 2000 XTC uses a brass cell block with stainless steel tubing and connectors.

**CAUTION:** **IT IS THE RESPONSIBILITY OF THE END-USER TO ENSURE THAT THE GASES USED IN THIS INSTRUMENT ARE COMPATIBLE WITH THE MATERIALS USED IN THE SAMPLE SYSTEM. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY AS WELL AS DAMAGE TO THE INSTRUMENT.**



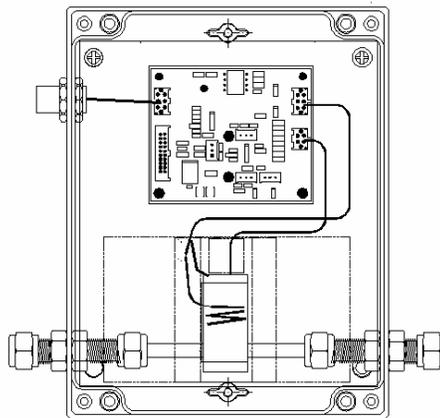
The external sample system should be capable of supplying clean, particulate-free and moisture-free sample gas to the transmitter. The sample gas must be regulated between 2-20 psig. A flow control device such as a flow meter with a needle valve should be incorporated to maintain gas flow within 0.4-2 SCFH. It is convenient to install valves in the sample system to allow switching between sample and calibration gas. Figure 2-2 is a typical sample system for delivering sample and calibration gases to the transmitter. It uses two (2) 3-way valves to deliver either sample or calibration (zero or span) gas to the transmitter.



*Figure 2-2: Recommended External Sample System*

The sample path within the transmitter is a straight-through path. Gas encounters no dead space. This minimizes residual gas pockets that can interfere with accurate analysis.

Stainless steel 1/4" tube fittings are installed (6mm are available) for connecting the external sample system to the transmitter. For metric system installations, 6 mm adapters can be supplied if needed. The sample gas path through the transmitter is shown in Figure 2-3.



*Figure 2-3: Internal Piping*

## 2.4 Electronics and Signal Processing

For safety reasons, the electronics and signal processing section are located remotely from the transmitter module. A galvanic isolator is employed to limit the current that can be passed through the interconnect cable to levels that are incapable of providing an ignition source. The galvanic isolator also provides an optically-isolated 4-20 mA output signal reconstructed from the 0-4 mA output signal sent from the transmitter. All electronics in the transmitter are contained on a single PC board accessible by removing the front cover. The transmitter is powered from two (2) separate 15VDC lines from the galvanic isolator module. The galvanic isolator incorporates a 24VDC power supply.

The processing electronics for the sensor are located inside the transmitter case in addition to the sample cell heaters and E-to-I converter. The control circuitry for the sample cell heaters, the 24 VDC power supply, and electronics used to condition the output signal are located in the galvanic isolator case. Figure 2-4 is a block diagram of the instrument electronics.

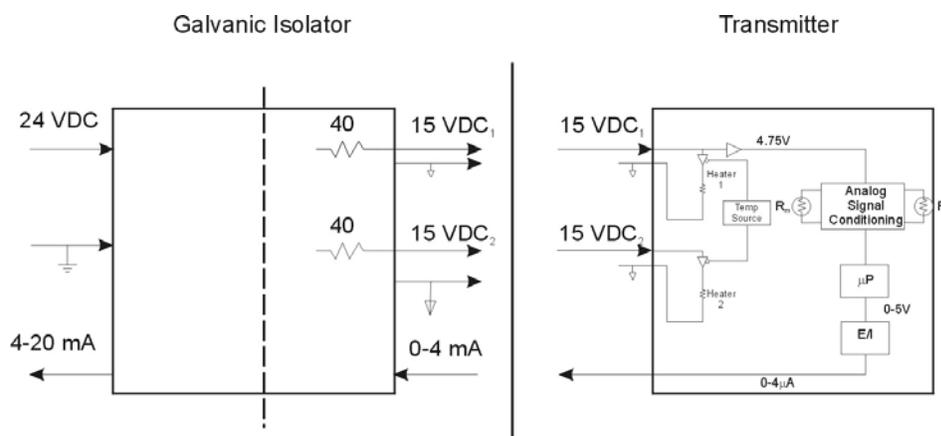


Figure 2-4: Block Diagram of 2000 XTC

### 2.4.1 Transmitter

The differences in thermal conductivities of the sample gas provide a small but detectable change in temperature of the resistive sensor

membrane. The amount of voltage needed to offset the analog output (i.e. to null the circuit when the resistance changes due to temperature effects) is measured and applied. A preprogrammed microcontroller with EPROM uses the offset voltage from the analog stages to generate a linearized output voltage signal, which is then converted to a 0-4 mA current. This signal is fed back to the galvanic isolator for conversion to a standard 4-20 mA current, to be used as interface with the user's readout device or alarm circuit. The linearized output is based on calibrations performed and adjustments made at the factory for the specific application at hand.

Certain factors outside of the gas concentrations bear on the accuracy of the thermal conductivity sensor. The major contributor involves temperature deviations or transients from a baseline temperature. For this reason, a pair of controlled heaters is used to fix the operating temperature of the sample cell. The control circuitry is capable of maintaining a temperature setting from 18°C to 67°C within the operating range of the instrument (0 to 50°C). Electronics for the temperature control are housed in the transmitter module. Power is supplied to the heaters by pins 2-3 for heater #1 and 1-4 for heater #2 on the 5-wire interconnection cable.

#### **2.4.2 Galvanic Isolator**

The purpose of the safety barrier is to limit power to and from the transmitter to levels that are incapable of generating enough energy to cause ignition in a flammable or explosive gas mixture. The galvanic isolator accepts a 24 volt DC input and provides two separate and isolated 15 volt DC power outputs, plus receiving a 0-4mA current input from the transmitter. Both power outputs are mutually isolated and comply with the CENELEC requirement intrinsically safe to 60V. The output from the isolator supplies power to the two (2) heaters in the transmitter. Additionally, it supplies power to the sensor and PC board for the compensation circuitry within the transmitter.

Each output side of the galvanic isolator is protected with a series 200mA fuse. A pair of zener diodes limits the open circuit voltage to below 18V and short circuit current to 503mA or less. Power fluctuations are reduced at the input side of the 24V input transformer using a crowbar network of diodes.

The 24 VDC input is fed to the primary side of an input transformer. The input circuit is fused via a 400 mA fuse and incorporates a diode protection circuit in case of accidental reverse polarity connection.

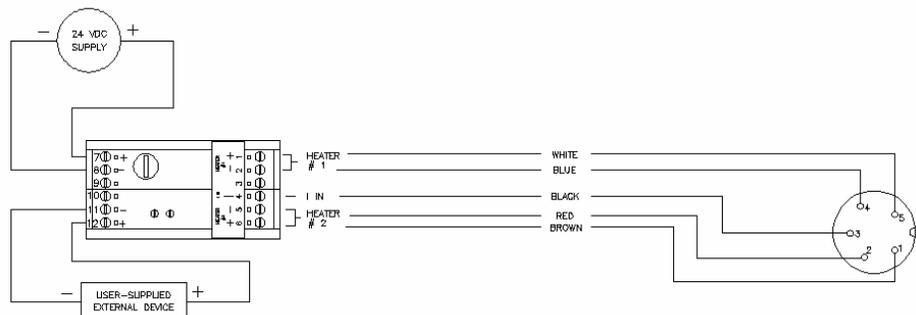
The signal output is also fused, with a 50 mA fuse protecting the 4-20 mA output terminal. This terminal is also isolated using a high linearity optocoupler with its own power-limiting circuitry.

Schematic diagrams for both the transmitter and galvanic isolator are included in the drawing section of the Appendix.

### 2.5 Connection Cable

The interconnection between the safety barrier and transmitter modules is accomplished with a 5-wire cable supplied as part of the instrument. The transmitter end of the cable is fitted with an ATEX approved 5-wire connector which can only be inserted in one orientation. The other end of the connector is wired directly to the rear of the galvanic isolator module. The wiring diagram for the galvanic isolator is shown in Figure 2-5.

The 5-wire interface cable delivers power to the two heaters and the electronics board. It also carries the 0-4 mA output signal from the transmitter back to the galvanic isolator unit. Figure 2-5 shows the pin configuration for this cable. The interface unit and the transmitter module can be separated up to 30.5 meters (100 feet).



*Figure 2-5: Model 2000 XTC External Wiring Diagram*

## Installation

---

For Intrinsically Safe (IS) installation, special considerations are required. The 2000 XTC Thermal Conductivity Transmitter has been designed to be Intrinsically Safe using an integral galvanic isolator module that limits power to and from the transmitter in a hazardous location. When properly installed, this design utilizes redundant safety features to prevent the transmitter from becoming an ignition source in the event of a circuit failure. There are various regulations and specifications relating to intrinsically safe instrumentation and the user should consult with the proper certifying agency prior to installation. Using the integral galvanic isolator reduces the possibility of fires or explosion stemming from power circuitry associated with the transmitter in hazardous locations by limiting the energy available for ignition. This instrument must be installed properly and all cables, wires, connectors and solenoid valves (if equipped) must be approved by the proper certifying agency. The configuration and associated approval of this unit is based on the user's application as specified at the time of purchase. Consult the spare parts list in this manual or the factory for approved replacement parts for this instrument.

Installation of the 2000 XTC Thermal Conductivity Transmitter includes:

- Unpacking
- Mounting
- Gas connections
- Electrical connections
- Calibration

### 3.1 Unpacking the Transmitter

The transmitter is shipped with all the materials needed to install and prepare the system for operation. Carefully unpack the transmitter and inspect it for damage. Immediately report any damage to the shipping agent.



### 3.2 Mounting the Transmitter

The Model 2000 XTC Transmitter is intended for indoor use only.

The transmitter module is designed for operation in a hazardous location. It should be mounted in an area close to the sample take-off point. Refer to Figure 3-1 for mounting information and dimensions. The calibration and temperature control adjustment potentiometers are located under the top cover of the transmitter. This should be taken into consideration when determining mounting location. Also make sure there is adequate room to make the sample system connections. Once a suitable location has been determined, flush-mount the transmitter using the holes provided in the case.

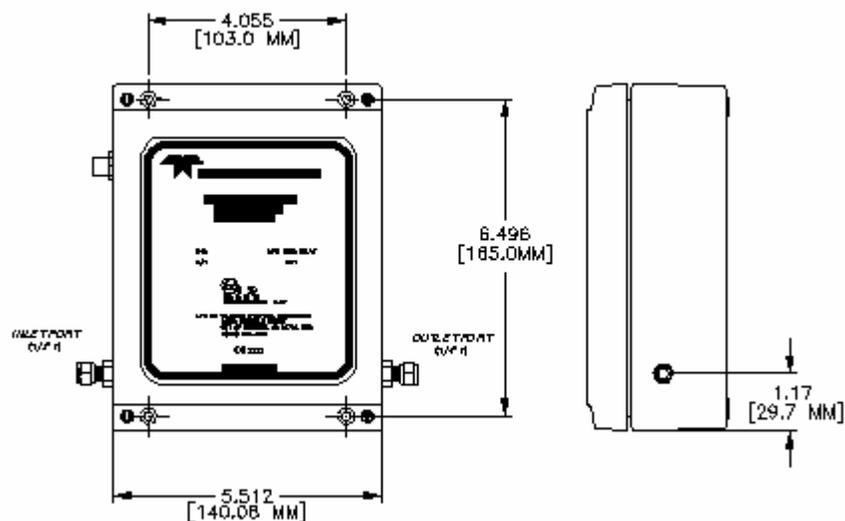


Figure 3-1: Mounting Dimensions for Sensor Unit

### 3.3 Mounting the Interface Unit

The galvanic isolator module or interface unit must be located indoors in a general-purpose location. It can safely be located up to 30.5 meters from the transmitter. This module can either be DIN rail mounted or panel mounted. The dimensions for this module are shown in Figure 3-2.

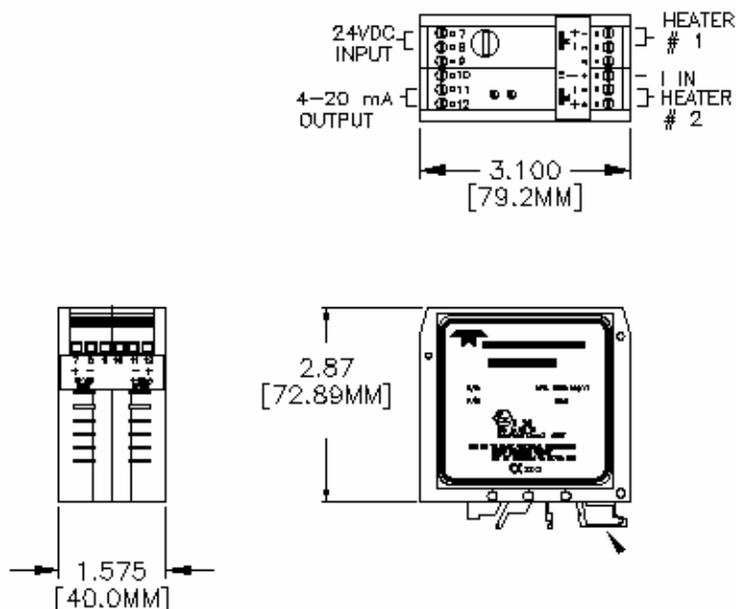


Figure 3-2: Mounting Dimensions for Interface Unit

Once the transmitter and galvanic isolator are securely mounted, connect the interface cable to the transmitter. If the cable is not attached to the safety barrier, connect the wires to the unit as described in Section 3-5. The transmitter end of the cable is fitted with a 5-pin connector. Secure the cable to the mating connector on the transmitter.

### 3.4 Gas Connections

The unit is manufactured with 1/4-inch stainless steel tube fittings for the inlet and outlet gas connections. Refer to Figure 2.2 in Section 2.3 for a recommended sample system.

1. Insert the tube into the tube fitting, and finger-tighten the nut until the tubing in the fitting cannot be rotated freely by hand. (This may require an additional 1/8 turn beyond finger-tight.)
2. Hold the fitting body steady with a backup wrench, and with another wrench rotate the nut another 1-1/4 turns.

*Note: Do not crimp or bend the tubing when attaching to the transmitter.*

**CAUTION:**  **THIS INSTRUMENT IS DESIGNED TO HANDLE HAZARDOUS GASES. WHENEVER A FITTING IS OPENED, USE A NEW FERRULE AND CONE TO SECURE A GAS TIGHT SEAL. EACH FITTING MUST BE LEAK CHECKED WHENEVER A CONNECTION HAS BEEN OPENED OR DISTURBED IN ANY MANNER.**

The inlet gas pressure should be regulated between 2-20 psig. A flow control device should be installed before the “sample in” port in order to keep the gas flow between 0.4 and 2 SCFH.

If greater flow is required for improved response time (over 20 SCFH), install a bypass in the sampling system upstream of the analyzer input.

Exhaust connections must be consistent with the hazard level of the constituent gases. Check local, state, and federal laws, to ensure the exhaust stream vents to an appropriately controlled area if required. The exhaust should be vented to atmospheric pressure or returned to the process line. Use care not to create backpressure in the vent line.

### 3.5 Electrical Connections

The Thermal Conductivity Transmitter requires three electrical connections:

- 24 VDC power input
- Signal output (4-20 mA current output)
- Interconnection cable

Power and output signal connections are made to the galvanic isolator module according to the interconnection diagram C-74837 included at the back of this manual. See also Figure 3-3.

#### 24VDC Power Connection

The 24VDC power supply can deliver a maximum of 10.8 watts to power the heaters and drive the electronics in both the galvanic isolator and the transmitter modules. Connect the positive lead from the 24 VDC source to terminal 7 and the negative lead to terminal 8 on the galvanic isolator module as shown in Figure 3-3.

### 4-20 mA Output Signal

The output signal from the instrument is available to the user as a 4-20 mA current. It has a maximum impedance of 700 Ohms. Typically, this output is used to display concentration using a digital meter or chart recorder or to trigger an alarm circuit. Referring again to Figure 3-3, connect the positive lead to terminal 12 and the negative lead to terminal 11 on the galvanic isolator module.

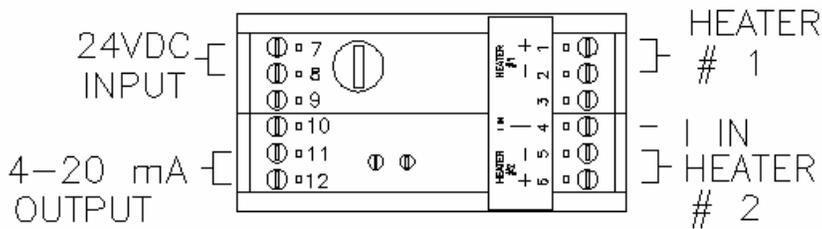


Figure 3-3: Power and Output Connections to Galvanic Isolator Module

### Interface Cable

The interconnection cable is a 5-wire cable which delivers power to the heaters and drives the electronics in the transmitter module. It also passes a 0-4 mA linearized signal back from the sensor circuit to the galvanic isolator module for output processing. To connect the cable, insert the 5-pin connector end of the cable to the mating connector on the transmitter. Connect the other end to the galvanic isolator according to the diagram in Figure 3-4.

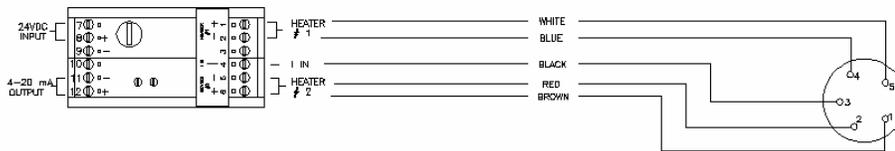


Figure 3-4: Cable Connection to Galvanic Isolator Module

**CAUTION:**



**THIS INSTRUMENT MEETS OR EXCEEDS THE REQUIREMENTS FOR CENELEC APPROVAL AS AN INTRINSICALLY SAFE APPARATUS. IN ORDER TO MAINTAIN COMPLIANCE AND TO ENSURE THE CONTINUED SAFE OPERATION OF THIS**

**INSTRUMENT USE ONLY AN APPROVED INTERCONNECTION CABLE. SEE THE SPARE PARTS LIST IN THE APPENDIX OF THIS MANUAL FOR AN APPROVED FACTORY REPLACEMENT CABLE.**

For intrinsically safe installation, use only the cable supplied by the factory. Run length should not exceed 30.5 meters (100 ft).

### 3.6 Calibration

*Note: Calibration frequency of the 2000XTC is highly dependent on gas application. The recommended frequency is once per month, although specific applications may be able to go longer without required calibration. Perform calibration procedure as required for your application, or contact the manufacturer for more information.*

Once the modules have been properly installed and wiring is secure, check the following before calibrating the transmitter:

- Make sure that suitable sources of zero and span gas are connected to the transmitter either via a switching manifold or separately (zero followed by span gas). See section 2.3.
- Check the integrity and accuracy of the gas connections. Make sure there are no leaks.
- Verify that the modules have been properly installed and wiring is secure.
- Check that inlet sample pressure and flow rate is within the accepted range (see section 3.3).

Calibration involves setting the zero level followed by setting the span of the instrument. Zero and span potentiometers are located under the cover of the transmitter on the PC board as shown in Figure 3-5.

The following calibration procedures assume that suitable calibration gas connections have been made and that a read-out device capable of interpreting a 4-20 mA current is attached to the output terminals of the galvanic isolator module (see Section 3-5).

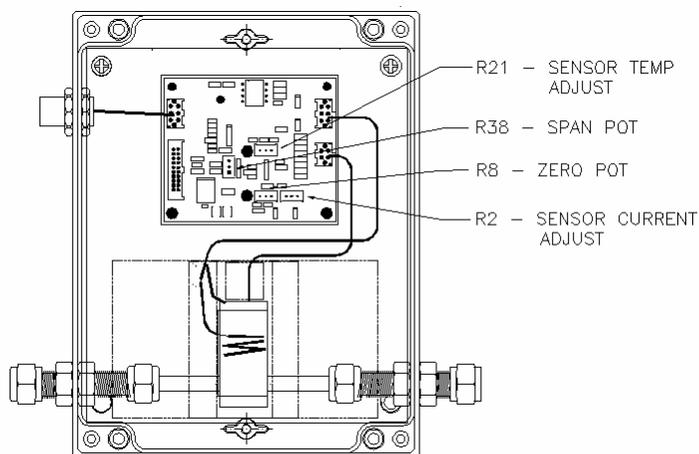


Figure 3-5: Temperature and Calibration Adjustment Location

### 3.6.1 Adjusting Cell Block Temperature

*Note: A separate heater inside the transmitter case controls the transmitter cell block temperature. It has been adjusted at the factory for optimum performance based on your application. Depending on the location of the transmitter and your process application, it may be necessary to adjust the temperature of the internal heaters. If temperature adjustment is necessary proceed with the following steps, if not, skip this section and proceed with Zero Calibration. Remove the 4 screws securing the transmitter cover and lift off the top cover.*

To adjust the internal temperature of the transmitter:

1. Allow span gas to flow into the transmitter. Set the flow rate of the zero gas to between 0.4 and 2 SCFH. As the span gas is flowing through the instrument, check the output for a stable reading.
2. If the output is varying over time, increase the temperature of the internal heater. Using a small flat blade screwdriver, turn the adjustment screw (R21) clockwise to increase the heater temperature or counterclockwise to reduce the internal temperature. The heater set temperature can be measured on the board at U1 pin 12 (see Table 3.1). Allow 15 minutes for

stabilization of the heater before continuing with the calibration.

3. If the output is still fluctuating after 15 minutes, continue making small adjustments to the temperature until the output signal stabilizes.

Table 3-1: Concentration from Output Current

Heater Temperature (°C)	Voltage at U1 pin 12 (V)
20°	2.04 V
25°	2.25 V
30°	2.45 V
35°	2.62 V
40°	2.78 V
45°	2.92 V
50°	3.04 V
55°	3.15 V
60°	3.24 V
65°	3.32 V

### 3.6.2 Zero Calibration

Zero calibration requires the use of a prepared gas known to be free of the gas species to be analyzed. If possible, the calibration gas should be the background gas used in your application.

*Note: This instrument was assembled and calibrated at the factory using a specific background gas determined at the time of purchase to be representative of the customer's application. Specific data has been pre-programmed into the transmitter that is used by the system to linearize the output signal generated by the sensor. If a different gas is used, the resulting output signal may not be linear with concentration. You also may experience difficulty in*

*zeroing this instrument when using a gas different than the gas specified at the time of purchase.*

To zero calibrate this instrument:

1. Connect a read-out device to the 4-20 mA output signal terminals on the galvanic isolator module according to Section 3-5.
2. If the transmitter cover has not been removed, unscrew the 4 cover screws and remove the top cover.
3. Allow zero gas to pass into the transmitter. The pressure should be regulated between 2-20 psig and the flow set between 0.4 –2 SCFH.

*Note: It may be necessary to purge the sample line and transmitter with zero gas for several minutes before obtaining a stable zero reading.*

4. The output should read the zero gas value or 4 mA. If not, adjust the zero potentiometer (R8) on the PC board using a thin blade screwdriver until the reading is the zero gas value or 4 mA.
5. It may be necessary to recalibrate the zero after span calibration.

### **3.6.3 Span Calibration**

Span calibration requires the use of a prepared gas mixture containing a known concentration of the gas species to be analyzed in a background gas. An acceptable span gas concentration is 70-100% of the anticipated analysis range.

*Note: This instrument was assembled and calibrated at the factory using a specific gas mixture determined at the time of purchase to be representative of the customer's application. Specific data has been pre-programmed into the transmitter that is used by the system to linearize the output signal generated by the sensor. If a different gas is used, the resulting output signal may not be linear with concentration. You also may experience difficulty in span calibrating this instrument when using a gas different than the gas specified at the time of purchase.*



To span calibrate this instrument:

1. Connect a read-out device to the 4-20 mA output signal terminals on the galvanic isolator module according to Section 3-5.
2. If the transmitter cover has not been removed, unscrew the 4 cover screws and remove the top cover.
3. Allow span gas to flow through the transmitter. After a few moments, the output device should respond to the known concentration of gas in the span gas mixture.
4. If the read-out device indicates a value different than the known concentration, adjust the span potentiometer (R38) as shown in Figure 3-5 until the readout is correct. If using a mA current read-out device, refer to Table 3-1 to determine concentration from the output current.
5. If the zero calibration must be changed after initial span calibration, recalibrate the span.

*Table 3-2: Concentration from Output Current*

Current Output (mA)	Concentration				
	0-1% Full Scale	0-10% Full Scale	0-50% Full Scale	90-100% Full Scale	0-100% Full Scale
4	0	0	0	90	0
5.6	0.1	1	5	91	10
7.2	0.2	2	10	92	20
8.8	0.3	3	15	93	30
10.4	0.4	4	20	94	40
12.0	0.5	5	25	95	50
13.6	0.6	6	30	96	60
15.2	0.7	7	35	97	70
16.8	0.8	8	40	98	80
18.4	0.9	9	45	99	90
20	1.0	10	50	100	100

## Maintenance

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### 4.1 Routine Maintenance

Aside from normal cleaning and checking for leaks at the gas connections, routine maintenance is limited to recalibration. For calibration procedures, refer to Section 3.6. On occasion, it may be necessary to replace a blown fuse. This is covered in section 4.2.

**WARNING: SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.**



The overall design of the instrument is intended to facilitate servicing and troubleshooting, should that ever be necessary. The sensor itself is a solid-state unit with no serviceable parts. The cell is enclosed in an insulated compartment that is readily accessible after removing the transmitter cover. There are three (3) PC boards handling the electronics: one in the transmitter module and two in the galvanic isolator module. Both boards are easily accessible after removing the respective front covers.

### 4.2 Troubleshooting

The following table offers guidelines for diagnosing and correcting common problems associated with the 2000 XTC Thermal Conductivity Transmitter.

*Table 4-1 Troubleshooting*

Symptom	Cause	Remedy
The unit will not power up.	Power not connected or a wire has pulled loose.	A) Make sure 24VDC power is connected and turned on. B) Check input power wiring at rear of galvanic isolator module.

Symptom	Cause	Remedy
	Blown fuse on input power circuit.	Check fuse and replace if necessary with 400 mA fuse. See Section 4.3.
No output signal	<p>Blown fuse</p> <p>Cable disconnected or broken</p> <p>Problem with external read-out device</p>	<p>A) Check fuse on signal output circuit. Replace if necessary with 50 mA fuse. See Section 4.3.</p> <p>B) Check fuse on output power circuit. Replace if necessary with 200mA fuse. See Section 4.3.</p> <p>Check power cable in transmitter module. See Figure 4.1.</p> <p>Check external signal read-out device connection.</p>
Erratic output signal	<p>Instrument out of calibration or improperly calibrated</p> <p>Temperature instability inside transmitter case</p> <p>Loose cable connection</p> <p>Damaged sensor</p>	<p>A) Recalibrate instrument with known calibration gases.</p> <p>B) Use appropriate calibration gas</p> <p>A) Adjust heater temperature and recalibrate. See Section 3.6.1.</p> <p>A) Check interconnection cable.</p> <p>B) Check heater cable. See Figure 4.1.</p> <p>C) Check sensor cable. See Figure 4.1.</p> <p>A) Replace sensor. Contact factory.</p>

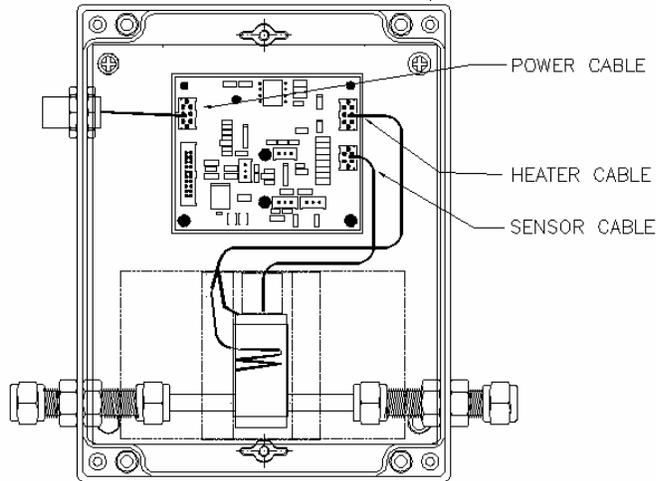


Figure 4-1: Cable Identification in Transmitter

### 4.3 Fuse Replacement

There are four fuses installed in the galvanic isolator module for circuit protection. The main fuse (F1) is accessible after removing the fuse holder cover. All other fuses require separating the 2 galvanic isolator modules. See Figure 4-2 for fuse identification. Table 4-1 lists the fuse rating, TAI part number, and the applicable circuit it serves to protect.

Table 4-2: Fuses

Fuse	Circuit	Fuse Rating	TAI P/N
F1	24 VDC Main Power	400 mA Fast-Acting 5x20	F1668
F2 & F3	Heater Circuit / Transmitter Power	160 mA Fast-Acting 5x20	F1697
F4	Output Signal	50 mA Fast-Acting 5x20	F1670

To replace the main power fuse (F1):

- Disconnect power to the instrument
- Use a flat blade screwdriver to remove the fuse holder cover. Push in with the screwdriver and turn counterclockwise.
- Pull out the blown fuse and replace with an exact replacement according to Table 4-2.
- Replace cover and power up instrument.

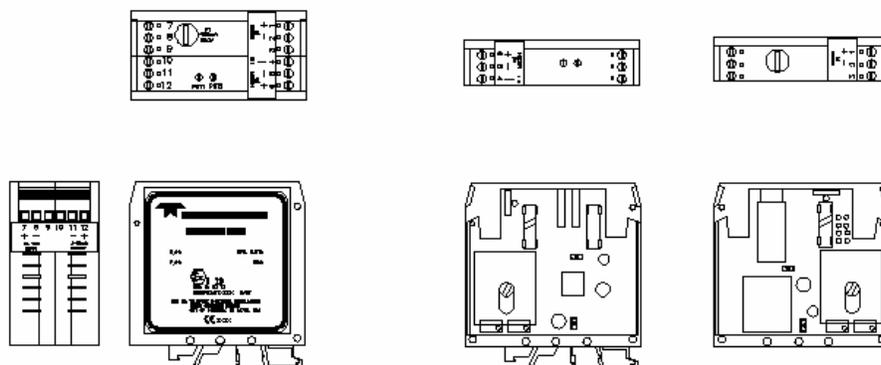


Figure 4-2 Fuse Location

To remove the other fuses:

- Disconnect power to the instrument.
- Remove the interface unit from the mounting rail or enclosure
- The two galvanic isolators snap together. Separate the two by gently pulling the top section while holding the bottom section.
- Gently pry out the blown fuse and replace with an exact replacement according to Table 4-2.
- Reassemble the isolator modules and reinsert the assembly into its housing or mounting rail.

## Appendix

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### Specifications

**System:** Dual module: transmitter and galvanic isolator

**Enclosure:** Galvanic isolator: plastic DIN mountable case

Transmitter: aluminum case, panel mountable, Nema 4X, IEC 60529 and IP 66 rated

**Classification:** ATEX EEx ib IIC T3 (Europe)

**Power Requirements:** 24VDC, 10.8 watt max power consumption (8 watts normal)

**Ranges:** Specific application determined by user. See Section 1.2 for example ranges.

**Sensor:** Thermal conductivity sensor (Microsens MTCS 2201)

**Accuracy:**  $\pm 2\%$  of full scale at constant temperature and pressure,  $\pm 5\%$  over 0–50°C range.

**Response Time:** 10-90% of signal level in less than 30 seconds

**Operating Temperature:** 0–50°C

**Signal Output:** 4–20 mA DC linear

**Max Load Impedance:** 700 Ohms

**Sample System:** Brass cell block with stainless steel tubing and 1/4 inch connectors

**Pressure:** 2-3 psig min inlet pressure



**Flow Rate** 0.4-2.0 SCFH

**Internal Heater:** 2—1.5W heaters

**Temp Control:** Factory set to  $20 \pm 2^\circ\text{C}$   
User settable

**Calibration Controls:** Zero, span and temperature control

**Fuses:** Input power circuit: 400 mA  
Output Signal Circuit: 50 mA  
Heater Circuit: (2) 160 mA

**Mounting (transmitter):** Wall-mount (see section 3.2)

**Mounting (interface unit):** DIN-rail mounting (see section 3.3)

## Recommended Spare Parts List

Qty.	Part Number	Description
1	U2	Bulkhead compression fitting, 1/4" tube
1	C74627	Galvanic isolator board #1
1	C74632	Galvanic isolator board #2
1	C73750	T/C Transmitter Board
1	A74933	T/C Sensor Assembly
1	B74934	Cable assembly, interconnect
4	F1668	Fuse, Fast-acting 5mm x 20mm, 400 mA
4	F1697	Fuse, Fast-acting 5mm x 20mm, 160 mA
4	F1670	Fuse, Fast-acting 5mm x 20mm, 50 mA
2	R2157	1/4" to 6mm tubing adapter SS

A minimum charge is applicable to spare parts orders.

*Note: Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.*

Orders should be sent to:

### **TELEDYNE Analytical Instruments**

16830 Chestnut Street  
City of Industry, CA 91749-1580

Phone (626) 934-1500, Fax (626) 961-2538

Web: [www.teledyne-ai.com](http://www.teledyne-ai.com)  
or your local representative.

## Reference Drawings

C74836	Outline Diagram
C74837	Interconnection Diagram
C74838	Final Assembly Drawing
B74934	Cable Assembly, Interconnect

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