



**GENERAL MONITORS**

# **SAFETY MANUAL**

## **TS4000 Intelligent Sensor for Toxic Gas Applications**



The information and technical data disclosed in this document may be used and disseminated only for the purposes and to the extent specifically authorized in writing by General Monitors.

**Safety Manual**

**04-09**

General Monitors reserves the right to change published specifications and designs without prior notice.

**Part No.  
Revision**

**MANTSSAFETY  
A/04-09**

This manual describes the safety related information for the installation, operation, configuration, and maintenance of the TS4000 Toxic Gas Detector.

For complete information regarding performance, installation, operation, maintenance, and specifications of the TS4000, please refer to the associated product instruction manual.

General Monitors' mission is to benefit society by providing safety solutions through industry-leading products, services, and systems that save lives and protect capital resources from the dangers of hazardous flames, gases, and vapors.

The safety product you have purchased should be handled carefully, and installed and maintained in accordance with the TS4000 product instruction manual. Remember, this product is for your safety.



**WARNING:** TOXIC, COMBUSTIBLE, AND FLAMMABLE GASES AND VAPORS ARE VERY DANGEROUS. USE EXTREME CAUTION WHEN THESE HAZARDS ARE PRESENT.

## INTRODUCTION

### General Description

The General Monitors Model TS4000 Toxic Gas Detector monitors a variety of toxic gases in parts per million (ppm) ranges and provides a 4-20 mA analog signal proportional to gas concentration and an optional relay output. Optional Warn and Alarm relays can be programmed to trip when gas concentrations reach a percentage of the sensor range. All detectors are regarded as Type B field devices per IEC 61508.

The safety function of the TS4000 detector does not include:

- RS-485 Modbus communication

Modbus communication is typically used for field device setup, diagnostics, and troubleshooting. Carefully observe requirements for interfacing in hazardous locations. Modbus communication is a non-interfering function and does not interrupt the safety critical function of the detector.

## INSTALLATION

---

**NOTE:** Power should remain disconnected until all other wiring connections are made.

---

For complete information on the installation of the TS4000 Toxic Gas Detector refer to the product instruction manual.

### Location Considerations

There are no standard rules for detector placement since the optimum sensor location is unique for each application. Before installing the TS4000, check the conditions at the installation site to make this determination. The following guidelines can assist in determining the best possible placement of the TS4000:

- Locate the TS4000 near potential gas leak sources and away from excessive heat, light, wind, dust, water, vibration, shock, and radio frequency interference (RFI).
- Ensure the installation location has sufficient space to accommodate the Base Unit, Interface Module, electrochemical cell, and all necessary cabling.
- Mount the TS4000 with the electrochemical cell pointing down and in an easily accessible location for reading of the LED display and calibration checks.



**WARNING:** Operation above or below temperature limits may cause unstable readings, resulting in false alarms or sensor failures. For Environmental Specifications, refer to the instruction manual.

---

**NOTE:** Frequent inspection, cleaning, and sensitivity checking is suggested for detectors mounted in dirty environments.

---

No special or additional detector mounting, wiring, power, or tool requirements exist beyond the standard installation practices documented in the TS4000 product instruction manual.



**WARNING:** Under NO circumstances should equipment be connected or disconnected when under power. This is contrary to hazardous area regulations and may also lead to serious damage to the equipment. Equipment damaged in this manner is not covered under warranty.



**WARNING:** Connect the TS4000 TB1-8 connector to the power supply DC Ground (COM) first, before connecting other devices. The DC Ground (COM) should also be disconnected last. The power supply must remain OFF until all cabling is completed. For detailed instructions, refer to the instruction manual for the power supply.

## OPERATION AND MAINTENANCE

For complete operation, configuration, and maintenance information for the TS4000 Toxic Gas Detector refer to the product instruction manual.

---

**NOTE:** The sensor should be powered for a minimum of one hour prior to calibration.

---

The TS4000 is an intelligent sensor performing internal diagnostics on critical faults every second and responds with 0 mA at the Analog Output upon detection of a fault.

Refer to the Troubleshooting Section in the TS4000 instruction manual in the event of a fault condition. In addition, spare parts should be on-hand to maintain the four hour repair time. Refer to the Spare Parts Section of the instruction manual for more information.

Once correctly installed, the TS4000 requires little or no maintenance other than periodic calibration checks to ensure system integrity. It is important that the TS4000 not be painted, as it will prevent reading the LEL measurements on the Base Unit display and will also prevent the diffusion of gas into the sensor in the Interface Module.

General Monitors recommends that the TS4000 be calibrated one hour after start-up and also 24 hours later. Calibrations should be checked at least every 90 days, to ensure system integrity. The user should not expect problems with sensor life or stability. Frequent calibrations will ensure optimum product performance. More frequent calibration checks are recommended for environments where mud and/or other unintended contaminants may collect on the sensor or there is a presence of other extreme conditions. General Monitors recommends that a calibration schedule be established and followed. A log should also be kept showing calibration dates and sensor replacement dates.

## SPECIFICATIONS

Table 1 and Table 2 list specifications for the TS4000. For a complete list of specifications refer to the TS4000 instruction manual.

<b>TS4000</b>	
Instruction Manual P/N	MANTS4000
Operating Temperature Ranges*	
for all gases other than NH <sub>3</sub> , H <sub>2</sub> S:	-4°F to +122°F (-20°C to +50°C)
for H <sub>2</sub> S:	-40°F to +122°F (-40°C to +50°C)
for NH <sub>3</sub> :	-40°F to +104°F (-40°C to +40°C)
Humidity Range:	15% to 95% RH, non-condensing
Input Power:	
Absolute min:	20 VDC
Nominal:	24 VDC
Absolute max:	36 VDC

**Table 1 – Environmental/Electrical Specifications**

\* Temperature ranges are driven by electrochemical cell specifications.

<b>Mode</b>	<b>TS4000</b>
Fault	<1 mA
Start Up	1.5 mA
Calibration	1.5 mA
Detection Range	4-20 mA
Over range	20.1 – 22 mA

**Table 2 – Analog Output Specifications\***

\* 600 ohm maximum load.

## CERTIFICATIONS AND FAILURE RATE DATA

The TS4000 has gone through rigorous reliability and functional safety assessments, which have resulted in the gas detector being certified to IEC 61508 Parts 1, 2, and 3, by FM Approvals. The reliability assessment is a failure rate prediction that assumes an average temperature of 40°C and an environmental factor equivalent to Ground Fixed. It is assumed that the TS4000 will be installed in a Safety Instrumented System (SIS) operating in a Low Demand environment per IEC 61508. Table 3 lists the (Safety Integrity Level (SIL) parameters for the TS4000.

Field Device	TS4000 Analog Output	TS4000 Relay Output
FM Certificate	3034949-TS4000	3034949-TS4000
Product Life (Years)*	19	16
$\lambda_{DD}$ (Fails per hour)	1.93E-6	1.82E-6
$\lambda_{DU}$ (Fails per hour)	9.48E-8	2.43E-7
Safe Failure Fraction (SFF)	>98%	96%
Safety Integrity Level (SIL)**	2	2
Diagnostic Test Interval	1 second (critical faults)	
Response Time	(see TS4000 product instruction manual for Response Time for various gases)	
Average Probability of Failure on Demand $PFD_{avg1001}$ ***	1.12E-4	2.73E-4

**Table 3 – SIL Parameters for TS4000**

\* Typical electrochemical cell sensor life is 2 to 3 years under normal conditions.

\*\* Hardware Fault Tolerance (HFT) = 0.

\*\*\*  $PFD_{avg1001}$  assumes a 4 hour repair time and 90 day proof test interval.

### Agency Approvals

The TS4000 has the following approvals:

- ATEX
- CSA
- Approved for Russia
- IEC 61508 per FM Approvals