TROLEX

TX6383 FLAMMABLE GAS SENSOR/ TRANSMITTER

USER MANUAL

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1 PRINCIPAL OPERATING FEATURES

Stationary gas sensors for the detection of a wide range of flammable gases.

Suitable for use in SIL 1 and SIL 2 applications, in accordance with any conditions or restrictions

Poison resistant CATALYTIC COMBUSTION sensors.

Pre-calibrated plug-in gas sensing module with a standardised output signal for convenient replacement and servicing.

Calibration available for a wide range of flammable gases.

LCD readout of gas concentration with OVERRANGE indication.

Convenient push button calibration of ZERO and SPAN.

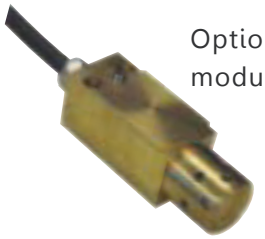
Signal fix during calibration to prevent false alarms.

Output signal versions:- 4 to 20 mA 0.4 to 2 V 5 to 15 Hz.

Stainless steel reinforced polycarbonate housing.

Intrinsically safe for use in Group I and Group II hazardous areas.

Special versions with weatherproof plug and socket connections in place of cable glands.



Optional format with remote mounted gas sensing module in robust metal housing.

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2 APPLICATION

Fixed gas monitoring for point-source hazards and perimeter protection in arduous duty and exposed locations.
Safety protection for toxic gas risk occurring in hazardous areas and general industrial applications.

- Petrochemical processing.
- Mining and tunnelling.
- Offshore platforms.
- Manufacturing and process plants.
- Storage areas and warehousing.
- Water management and sewage treatment.
- Power generation.
- Gas storage and distribution.
- Marine and shipping applications.
- Telecommunications.

A choice of output signals for direct interfacing with most standard industrial monitoring systems.

A range of primary instrumentation and monitoring modules is available from Trolex to which the sensors can be directly connected to provide a flexible choice of display and control functions.

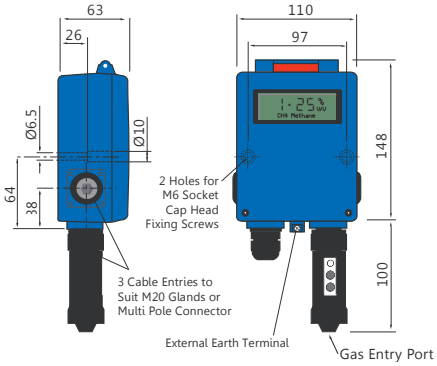
TRIP AMPLIFIER
for use with
analogue output sensors.

CONFIGURABLE SENSOR CONTROLLER
for monitoring up to
8 analogue output sensors.

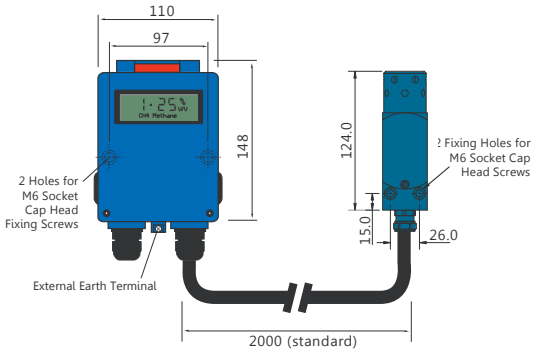
COMMANDER DISTRIBUTED I/O SYSTEM
for large scale general plant monitoring systems
and the mining and tunnelling industries.

3 DIMENSIONS

3.1 TX6383 Flammable Gas Sensor/Transmitter



3.2 TX6383.84 Flammable Gas Sensor/Transmitter with Remote Gas Sensing Module



ALL DIMENSIONS IN MM

4 TECHNICAL DETAILS

4.1 Specification

Operating Temp. Limits:	–10 to +40°C (Ambient temp. range for explosion protection: -20 to + 40°C)
Storage Temperature:	–25 to +60°C
Ambient Pressure Limits:	1000 mbar ± 200 mbar absolute
Humidity:	95% RH non-condensing
Protection Classification:	Dust and waterproof to IP66. Gas inlet port to IP54
Housing Material:	Reinforced polymer - proof against electrostatic discharge
Nett Weight:	450 g
Cable Entries:	M20 x 1.5
Electrical Connections:	4 mm Barrier/clamp terminals
Information Display:	Graphic LCD
Impact Limits:	20 joules (Housing)

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GAS SENSING MODULE

Plug-in gas sensing module with signal conditioning. Precalibrated and standardised output signal.

Measuring Range:	0 to 5% v/v CH_4. Calibrated for Methane Alternative sensing ranges available to specification
Linearity:	±1% 0 to 60% FULL SCALE ±5% from 60% up to 100% FULL SCALE
Maximum Drift @ 25°C:	±0.25% v/v per month
Response Time t(90):	<30 seconds response time is tested by flowing test gas using the calibration kit referred to in section 9 maintenance
Sensing Element Life:	>5 years in clean atmosphere
Warm Up Time:	<5 mins in air or 1% v/v CH_4.
Stabilisation Time:	>15 minutes
Calibration:	Digitally controlled ZERO and SPAN. Pushbutton setting
Signal Fix:	The transmitted output signal of the sensor is FIXED at 00.0 during calibration to prevent false alarms from being initiated
Overrange:	If the measured gas concentration exceeds the calibration range of the sensor: The STATUS indicator will flash The display value will be CLAMPED The transmitted output signal will be CLAMPED
Pellistor Protection:	The supply to the gas sensing element will be switched off to prevent oxidisation damage occurring if the gas concentration exceeds safe limits. The sensor will attempt to switch back on at 5 minute intervals until the gas concentration has reduced to a safe level

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4 TECHNICAL DETAILS continued

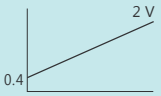
4.1 Specification (cont.)

The table shows the response variation of the gas sensing module on exposure to a range of gases and vapours at the same %LEL concentration. The figures are experimentally derived and expressed relative to the methane signal (=100).

Gas/Vapour:	Relative Sensitivity	Gas/Vapour	Relative Sensitivity
Methane	100	Carbon Monoxide	130
Propane	70	Hydrogen	120
n-Butane	70	Ammonia	155
n-Pentane	60	Cyclohexane	55
n-Hexane	60	Ethylene	90
Acettylene	85		

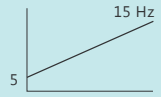
TX6383.01 GROUP I APPLICATIONS (12 V dc)

Output:	0.4 to 2 V dc
Min Load	10 k ohms
Supply	6.5 to 16.5 V dc
Max Current	80 mA



Output:	4 to 20 mA
Max Load @ 12 V	140 ohms
Supply	6.5 to 16.5 V dc
Max Current	24 mA

Output:	5 to 15 Hz
Max Load	Opto isolated 2 mA max
Supply	6.5 to 16.5 V dc
Max Current	80 mA



TX6383.02 GROUP II APPLICATIONS (24 V dc)

When used in conjunction with safety barriers. (Section 6)

Refer to Section 6

Output:	4 to 20 mA
Max Load @ 24 V	240 ohms
Supply	Minimum 6.5 V at the sensor supply terminals (3 and 4)
Max Current	100 mA

TX6383.03 GENERAL PURPOSE APPLICATIONS (24 V dc)

NOT SUITABLE FOR USE IN CLASSIFIED HAZARDOUS AREAS.

Output:	4 to 20 mA
Max Load @ 24 V	240 ohms
Supply	6.5 to 30 V dc
Nominal Current	100 mA

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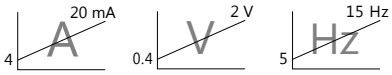
5 INSTALLATION

5.1 Conformity Check

(Refer to Test Certificate provided with the sensor).



Does the output signal of the sensor concur with the input requirement of the monitoring equipment being used?

12 V dc **24 V dc**

Is the correct supply voltage available for the sensor?

Is the type of gas and its anticipated maximum level of concentration, within the operating parameters of the sensor?

Is the temperature variation range, at the installation, within the stated temperature range of the sensor?

GENERAL PURPOSE | GROUP I | GROUP II

Is the hazardous area classification correct?

If the hazard is Group II – are the correct safety barriers fitted?

STANDARD OPTIONS AVAILABLE

TX6383.01	**FLAMMABLE GAS SENSOR/ TRANSMITTER**	**GROUP I**
TX6383.02	**FLAMMABLE GAS SENSOR/ TRANSMITTER**	**GROUP II**
TX6383.03	**FLAMMABLE GAS SENSOR/ TRANSMITTER**	**GENERAL PURPOSE**

TX6383.84.01	**FLAMMABLE GAS SENSOR/ TRANSMITTER with Remote Gas Sensing Module**	**GROUP I**
TX6383.84.02	**FLAMMABLE GAS SENSOR/ TRANSMITTER with Remote Gas Sensing Module**	**GROUP II**
TX6383.84.03	**FLAMMABLE GAS SENSOR/ TRANSMITTER with Remote Gas Sensing Module**	**GENERAL PURPOSE**

TYPE OF GAS Refer to Section 4.2

OUTPUT SIGNAL	0.4 to 2 V	(11)
	4 to 20 mA	(12)
	5 to 15 Hz output	(13)

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5 INSTALLATION continued

5.2 Location

It is recommended that user refer to EN/IEC 60079-29-2 for useful information on the selection, installation, use and maintenance of gas detectors for potentially explosive atmospheres.

Each installation needs to be considered in its own right, with reference to safety authorities and in compliance with mandatory local safety regulations.
The sensor must be operated in accordance with the Installation and Operating Data to maintain safety, reliability and to preserve Intrinsic Safety integrity where applicable.

It is important that sensors are located in positions determined in consultation with those who have specialised knowledge of the plant or installation and of the principles of gas dispersion. Reference should also be made to those responsible for the engineering layout and topology of the plant as they will be most familiar with the nature of the potential dangers and the most likely sources of gas release.

It is also important to recognise that the characteristics of the gas source can be influenced by many factors; including the relative density or buoyancy of the gas, the pressure at the point of release, the ambient temperature and the ventilation of the site.

Sensor coverage cannot be simply expressed in terms of 'number per unit area'. Sensors need to be sited where they are capable of monitoring those parts of a plant where gas may accumulate or when a source of gas release is expected to occur. This way the earliest possible warning of a gas release can be given to initiate shutdown functions, alarm functions or safe evacuation of the premises.

5.3 System Integrity

If a gas monitoring system should fail for any reason, it is important that the system is capable of immediately alerting operational staff to this fact.
The sensor will indicate a system failure or mechanical defect and this information can be utilised to initiate a warning alarm. It is good practice to provide emergency facilities to protect against the loss of the mains power supply.
Standby batteries can be incorporated with automatic changeover facilities, so guaranteeing continued operation of the gas sensing system even in the event of a plant breakdown as a result of a power supply failure.
Certainly, in critical plants, duplication or triplication of sensors is recommended.

The Trolex TX9042 or TX9044 Programmable Sensor Controller can be programmed to operate with sensors in the multiple voting mode.

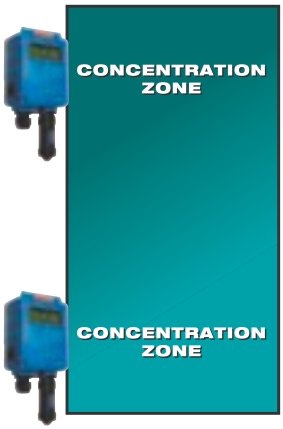
5.4 Sensor Management

A very important part of an efficient gas monitoring system is the training of plant personnel in operation and maintenance of the sensors and the complete monitoring system. Training facilities can be provided by qualified Trolex application engineers.

Once a sensor installation is complete, the sensor locations and types should be formally recorded and a planned test and maintenance procedure instituted.

5 INSTALLATION continued

5.5 Relative Density



The relative density or buoyancy of the gas or vapour with respect to air is a very important consideration. This determines its propensity to rise or fall when released into the atmosphere.

Gases or vapours with a buoyancy less than air will tend to rise from the source of release.

Conversely, gases or vapours heavier than air will tend to fall and accumulate in concentrations for long periods of time.

This is a particular problem in pits, trenches, machine rooms, etc. Normal air movements in and around such gas concentrations will have the inevitable effect of producing zones of highly flammable mixtures.

This knowledge of the characteristics of the gas assists when positioning the gas sensor.

The behaviour of the gas accumulation will also be affected by the velocity and location of the gas release and by ambient air movement caused by ventilation systems or draughts.

Pockets of gas can be trapped in trenches or ceiling cavities, all of which adds to the unpredictability of critical gas concentrations.

Hydrogen	LIGHTER THAN AIR
Town Gas	
Methane	
Ammonia	
Acetylene	
Carbon Monoxide	
Ethylene	
Methyl alcohol	HEAVIER THAN AIR
Propane	
Ethanol	
Acetone	
Butane	
Pentane	
Benzene	
Hexane	
Ethylacetate	
Toluene	
Petrol	
O-Xylene	
Octane	

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5 INSTALLATION continued

5.6 Hazardous Areas

Do not disassemble the sensor whilst in the hazardous area or use a sensor that has a damaged housing in the hazardous area.

5.7 Evacuation

If a dangerous level of gas concentration is detected by the instrument, leave the area immediately.

5.8 Operating Limits of Catalytic Combustion Sensors

Catalytic combustion gas sensors POSITIVELY detect the presence of any flammable gas. They rely upon the presence of oxygen in the atmosphere and should only be used for gas concentration up to the Lower Explosive Limit (LEL).

After this point, the output becomes non linear and may erroneously indicate that the gas concentration is below the LEL. they should not be used in oxygen enriched or deficient atmospheres.

5.9 Discrimination

Catalytic combustion sensors can detect a wide range of flammable gases but they cannot discriminate between individual gases. They will respond to most or all of the flammable components present in the atmosphere without distinguishing between them. (See section 4.1 for relative sensitivities)

5.10 Contamination

The response of catalytic combustion gas sensors can be affected by air borne contaminants which will reduce the sensitivity. Substances such as silicones, tetraethyl lead, sulphur compounds and phosphate esters can cause permanent degradation (poisoning). Halogenated carbons may also cause temporary inhibition.

5.11 Interference

If the atmosphere to be monitored contains a gas that dilutes or displaces the air, this may reduce the response of catalytic sensors. Similarly, steam laden atmospheres and condensation can reduce the sensitivity.

Air velocity may have a minor effect on the accuracy of the gas sensor.

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5 INSTALLATION continued

5.12 High Concentrations of Flammable Gas

Exposure of low concentration catalytic combustion sensors to concentrations of flammable gas greater than the LEL can affect the sensitivity and zero stability of catalytic elements and the calibration should be checked after such an exposure.

CHECK POINT

If the gas concentration does exceed 100% LEL, the supply voltage to the catalytic combustion sensing element will be automatically switched off to prevent damage to the element.

The sensor output signal will be CLAMPED, the display will indicate OVERRANGE and the STATUS indicator will FLASH.

Refer to Sections 7, 8.5 & 8.6

5.13 Toxicity

Be aware that most flammable gases and vapours are also toxic at low concentrations of LEL.

5.14 New Installations

Flammable gas sensors based on pellistor technology require regular zero and span check and adjustment operations to ensure that they remain accurate.

Refer to Section 8

The pellistor device ages during its lifetime and its baseline and sensitivity characteristics will change. These operations are normally performed three weekly.

The pellistors baseline tends to drift throughout it's lifetime. In the early stages of the lifetime, the baseline tends to move at a relatively fast rate. This movement slows down with age.

The pellistor fitted to the TX6383 will have a baseline change equivalent of upto ±2.5%LEL (0.11% v/v) in its first month of usage, then a further ±1.5% LEL (0.066% v/v) in the second month.

For newly installed equipment, end users should consider performing a zero offset adjustment and span check adjustment every two weeks for the first two months. This will ensure that the offset movement is kept below ±2% LEL (0.088% v/v) during the 'settling in' period.

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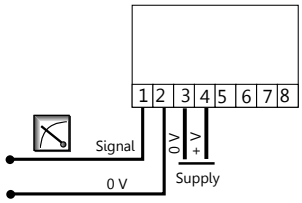
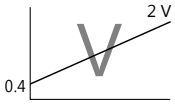
6 CONNECTIONS



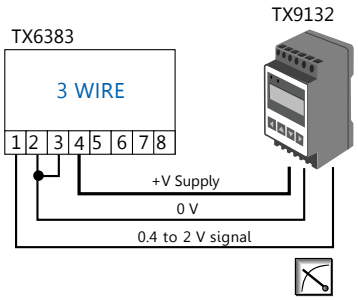
OUTPUT SIGNAL OPTIONS

TX6383 FLAMMABLE GAS SENSOR/ TRANSMITTER

6.1 0.4 to 2 V Output Signal

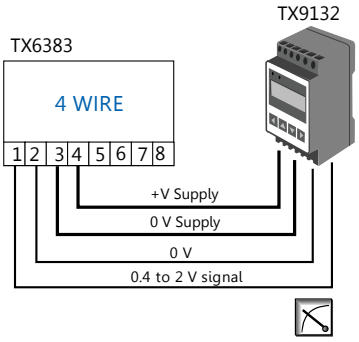


A low impedance two-wire voltage output signal requiring a separate power supply to the sensor.
This can be derived from a TX9132 Trip Amplifier or TX9042 Programmable Sensor Controller, when one of those is used as the monitoring instrument.



This connection configuration works well up to about 10 m distance between the sensor and the monitoring equipment.

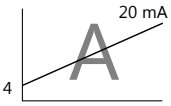
Both the signal and the power supply to the sensor are being carried in the common 0 V conductor so at some point – influenced by the length of the cable and the resistance of the cable cores – the current flowing in the 0 V conductor will impose an unacceptable voltage error onto the signal.



This effect can be reduced on long distance connections by increasing the size of the cable cores, or even better, running a separate 0 V conductor to power the sensor enabling operating distances up to 1000 m.

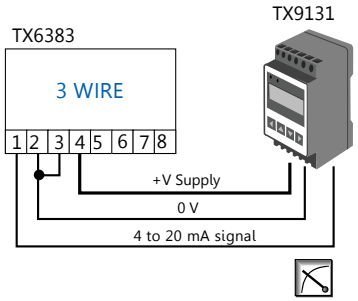
APPLICATION	GROUP I HAZARDOUS AREAS

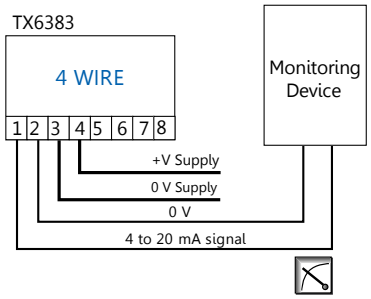
6.2 4 to 20 mA Output Signal



The sensor may be connected the 3 or 4 wire connection mode.

The power supply for the sensor may be sourced from the monitoring equipment (eg. TX9131 Trip Amplifier or a TX9042 Programmable Sensor Controller) or from a separate power supply.

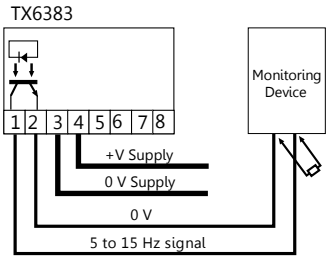




APPLICATION	GROUP I HAZARDOUS AREAS GROUP II HAZARDOUS AREAS GENERAL PURPOSE

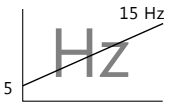
6 CONNECTIONS continued

6.3 5 to 15 Hz Output Signal



A pull up resistor may be required at the monitoring device.

A square wave, frequency variable output that is proportional to the measured value. The output device is an open collector NPN transistor.



Output:	5 to 15 Hz (zero = 5 Hz) (span = 15 Hz)
Maximum Voltage:	15.4 V
Maximum Current:	2 mA
Minimum Pulse Rise Time:	5 V/ms

APPLICATION	GROUP I HAZARDOUS AREAS

6.4 Using Gas Sensors in Hazardous Areas

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6.4.1 GROUP I HAZARDOUS AREAS (MINING)

TX6383.01 FLAMMABLE GAS SENSOR/ TRANSMITTER

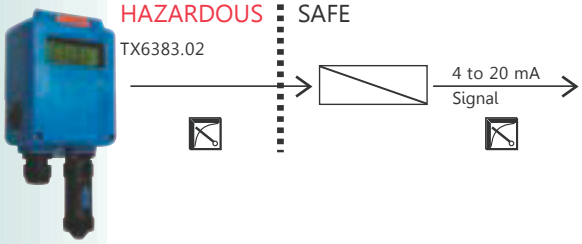
All options of the TX6383.01sensor (0.4 to 2 V, 4 to 20 mA and 5 to 15 Hz) are certified Intrinsically Safe for use in Group I hazardous areas (Mining) when used with approved equipment eg. TX9131 Trip Amplifier or a TX9042 Programmable Sensor Controller.

THE COMPLETE SYSTEM, BOTH SENSOR AND MONITORING DEVICE, CAN BE MOUNTED IN THE HAZARDOUS AREA.

The interconnecting cable between the sensor and the monitoring device must have steel wire armoured protection or a braided earth screen. The cross sectional area of the conductors must be a minimum of 1 mm^2.

6.4.2 GROUP II HAZARDOUS AREAS (24 V dc)

TX6383.02 TOXIC GAS SENSOR/ TRANSMITTER



This version of the sensor (4 to 20 mA) is certified Intrinsically Safe for use in industrial hazardous areas, when used in conjunction with safety barriers.

THE SAFETY BARRIERS ARE MOUNTED IN THE SAFE AREA, ONLY THE SENSOR IS MOUNTED IN THE HAZARDOUS AREA.

The system may be used with either zener safety barriers or isolation safety barriers.

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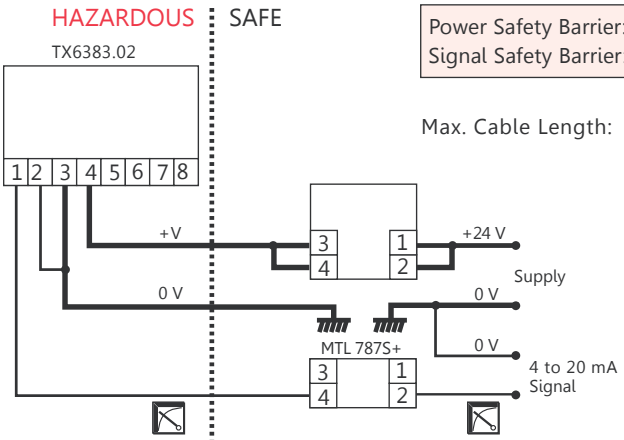
6 CONNECTIONS continued

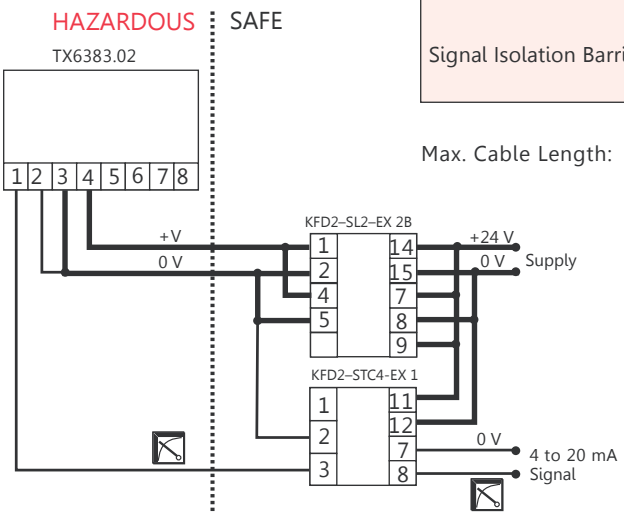
Group II sensor connections using zener safety barriers.



Power Safety Barrier:	MTL779+
Signal Safety Barrier:	MTL787S+

Max. Cable Length: 1 km using 1.5 mm² cable conductors.

Group II sensor connections using isolation safety barriers.



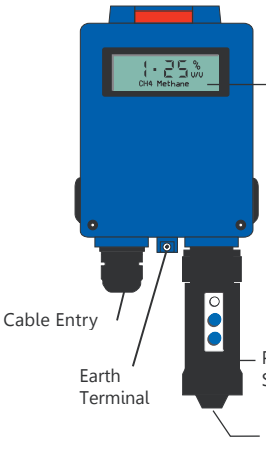
Power Isolation Barrier:	Pepperl & Fuchs KFD2–SL2–EX 2B
Signal Isolation Barrier:	Pepperl & Fuchs KFD2–STC4-EX 1

Max. Cable Length: 1 km using 1.5 mm² cable conductors.

If you require any help with the use and connection of hazardous area equipment please contact the Trolex Technical Department.

7 CONTROLS AND INDICATORS

TX6383 FLAMMABLE GAS SENSOR/



Calibration STATUS indicator

SPAN calibrate pushbutton

ZERO calibrate pushbutton

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TX6383.84 FLAMMABLE GAS SENSOR/ TRANSMITTER REMOTE GAS SENSING MODULE.

This version uses the same pre-calibrated gas sensing module as the TX6383. The module is fitted into a robust metal housing which can be mounted at a remote location where space is constricted or the operating conditions are extremely harsh.

Connections:	2 m, flexible cable in a flexible armoured conduit (other lengths available to specification. Max 10 m).
Protection Classification:	Dust and waterproof to IP66. Gas inlet port to IP54.
Housing Material:	Brass or Stainless steel.
Maximum Cable Length:	Extendible up to 500 m using 1.5 mm² cable conductors. (General Purpose only)

CHECK POINT

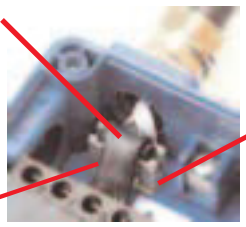
DISCONNECTING THE REMOTE GAS SENSING MODULE

The connecting cable between the remote gas sensing module and the Transmitter is normally supplied connected at both ends.

The cable can be disconnected via a plug and socket connector inside the Transmitter housing for servicing or transportation.

IMPORTANT!
The Ribbon Cable Assembly must lie flat against the inside rear of the enclosure & must be connected to the feedthrough in the orientation shown.

Double line indicates red marker on ribbon cable.



View showing orientation of ribbon cable. (All other parts removed for clarity).

Secure connector to inside of the enclosure with a double sided adhesive foam pad. (Trim off any excess before fitting).

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8 CALIBRATION

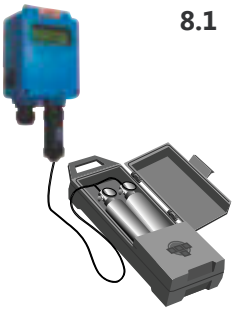
The gas sensing module will gradually change its response characteristics, by a small amount, during normal use. The output signal is standardised so the module can be quickly changed when necessary.

Service replacement modules can be supplied by our Product Support Department.

Alternatively the gas sensing module may be re-calibrated when required, using a Trolex TX6520.32 Gas Test Kit equipped with both Air and Test Gas canisters.

Maximum time interval between calibrations should be three weeks.

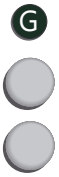
For newly installed equipment, end users should perform a zero offset adjustment and a span check/adjustment every two weeks for the first two months



8.1 Prepare to Calibrate

The sensor should be powered for a minimum of 15 minutes prior to commencing calibration, to allow the sensor to stabilise.

Connect the application tube of the gas test kit to the inlet aperture of the gas sensing module.



The indicator will be GREEN denoting the NORMAL operating condition.

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8 CALIBRATION continued

8.2 Prepare to Calibrate

Press BOTH pushbuttons on the gas sensing module for about 5 seconds. Then release.

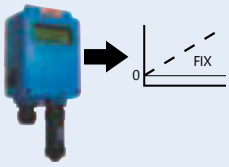
The indicator will be RED denoting that the module is now setup ready for:

Calibrate ZERO
OR
Calibrate

Refer to Section 8.3
Refer to Section 8.4

ALSO

When the Gas Sensing Module is setup into the CALIBRATE MODE it will instruct the transmitted output signal of the sensor to be FIXED at ZERO SCALE. This will prevent the possibility of false alarm signals being activated in the monitoring equipment during the calibration process.



The display will continue to show the measured value of gas concentration during the calibration process.

The gas sensing module will automatically return to the normal measuring mode if the pushbuttons are operated within 60 seconds.

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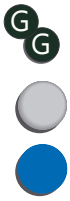
8 CALIBRATION continued

8.3 Calibrate ZERO

Apply purge air, at a flow rate of 0.2 to 1 l/min, for 20 seconds to clear all remnants of gas.

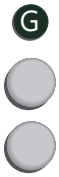


Press CALIBRATE ZERO until the indicator is flashing GREEN (about 3 seconds).

CHECK POINT

The CALIBRATE ZERO will NOT function if any level of gas concentration is detected by the sensing element – The indicator will NOT flash GREEN.

Release and the indicator will briefly show RED to denote ZERO setup.



The Gas Sensing Module will immediately return to the NORMAL measuring mode.

Switch off the purge air supply.

ALSO

The Gas Sensing Module will automatically return to the NORMAL measuring mode if NO pushbuttons are operated within 60 seconds.

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8 CALIBRATION continued

8.4 Calibrate SPAN

Apply test gas, at a flow rate of 0.2 to 1 l/min, until the display value stabilises.

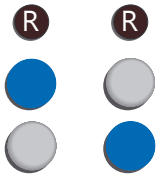
ALSO The Gas Sensing Module will automatically return to the NORMAL measuring mode if NO pushbuttons are operated within 50 seconds.

Press CALIBRATE SPAN until the indicator is flashing YELLOW (3 times).

CAUTION DO NOT PRESS CALIBRATE SPAN UNTIL THE DISPLAYED VALUE HAS FULLY STABILISED.

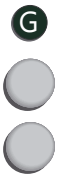
CHECK POINT The CALIBRATE SPAN will NOT function if the level of gas concentration detected by the sensing element is less than about 25% FULL SCALE.
The indicator will NOT flash YELLOW.

Release and the indicator will show RED to denote READY.



Press and hold the calibration pushbuttons to SCROLL the display value UP/DOWN until it concurs with the value of gas concentration marked on the test gas canister.

Switch off the test gas supply.



5 seconds after SCROLLING has ceased the gas sensing module will automatically return to the NORMAL measuring mode.

Re-apply the test gas for a few seconds to verify the response of the sensor.

ALSO The Gas Sensing Module will automatically return to the NORMAL measuring mode if NO pushbuttons are operated within 60 seconds.

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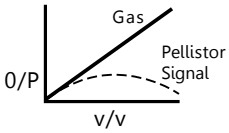
8 CALIBRATION continued

8.5 Over Range Indication

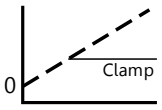


Erroneous readings will be given by a pellistor gas sensing element if it is exposed to gas concentrations that exceed its normal working range of 0 to 5% v/v CH_4.

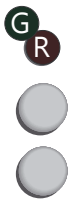
The increase in gas concentration displaces the oxygen in the atmosphere so the pellistor becomes progressively less effective, to the point where its output signal actually starts to *decrease* as the gas concentration continues to *increase*.

When OVER RANGE is detected, four conditions will be initiated:

The display will indicate OVER RANGE to prevent ambiguous readings.



The transmitted output signal will be CLAMPED at FULL SCALE to prevent an ambiguous output signal from being transmitted.



The STATUS indicator will FLASH alternate RED and GREEN.

The pellistor in the gas sensing module will be switched into a PROTECT state to prevent oxidisation damage.

Refer to Section 8.6

RESET

Briefly interrupt the power supply to the sensor to RESET the OVER RANGE condition.

This will only be effective when the gas concentration has receded and the pellistor in the gas sensing module has reset itself from the PROTECT state.

Refer to Section 8.6

8.6 Pellistor Protection

Catalytic combustion sensors can be damaged if exposed to excess concentrations of gas for long periods

If the OVER RANGE condition is initiated the gas sensing module will be switched into the PROTECT state to prevent oxidisation damage.

The status indicator will flash RED/GREEN to indicate that the pellistor is the PROTECT state.

The gas sensing module will reset itself to NORMAL operation after 5 minutes if the gas has cleared. It will continue to attempt to reset itself at 5 minute intervals until the gas has cleared.

It will now be necessary to RESET the OVER RANGE condition.

Refer to Section 8.5

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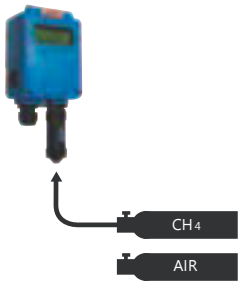
9 MAINTENANCE



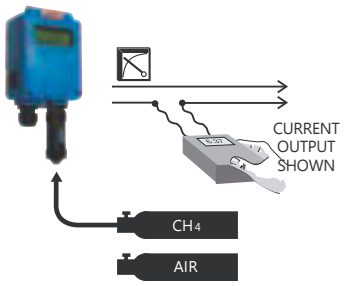
It is good safety practice to carry out regular preventative maintenance to confirm correct operation. The periodicity for preventative maintenance should be in line with best practice for the industry where the gas sensor is being used and take into consideration local operating conditions.

9.1 Output Signal

Check the response of the sensor at pre-determined intervals by injecting a test gas using a Trolex TX6520.32 Gas Test Kit.

Compare the value of the display with the value marked on the test gas canister.

9.2 Proof Test.



Calibrate the TX6383 using the instructions in Section 8.

Insert an approved test meter into the signal line.

Inject a test gas using a Trolex TX6520.32 Gas Test Kit.

Compare the value on the test meter display with the measured line value.

If the value on the test meter does not match the value on the display:

Recalibrate and then carry out the proof test again

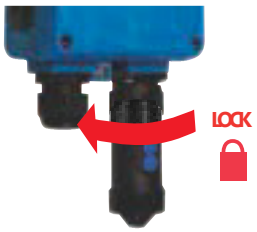
OR

Refer to Section 8

change the gas sensing module, calibrate and then carry out the proof test.

Refer to Section 9.2

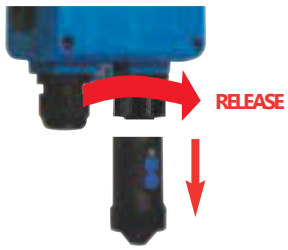
9.3 Gas Sensing Modules



The gas sensing modules should be changed at regular intervals to ensure accuracy of response.

The response of the Pellistor sensor will gradually shift due to normal device decay. The average life is about 5 years, influenced mostly by the operating environment and the mean level of exposure to flammable gas during its lifetime.
The shifting response of the cell should be checked at regular intervals particularly on new installations.

Refer to Section 5.14



The modules are conveniently replaceable giving a pre-calibrated standardised output signal. They can be changed in seconds.

Service replacement modules can be supplied by our Product Support Department on a regular basis.

Simply insert the new module into the instrument and return the original for checking and calibration.

CHECK POINT

The sensor will transmit an alarm signal if a replacement gas sensing module is not fitted within 15 seconds.

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9 MAINTENANCE continued

9.4 Annual Safety Check

The main transmitter itself will not normally require maintenance or calibration but it is advisable to return it to the Trolex Product Support Department for an annual safety check.

9.5 Damaged Sensors

A Sensor that has been dropped or damaged in any way should be taken out of service immediately for inspection, repair and re-calibration.

9.6 Water and Dust ingress (IP)

IP ratings do not imply that the equipment will detect gas, during and after exposure to those conditions.

If it is suspected that the gas inlet port has been exposed to water in conditions that exceed IPx4, the sensor should be dried and the response of the sensor checked

9.7 Record Keeping

Institute a regular calibration and maintenance procedure and keep a record.

Incorrect use of the Sensor or inadequate maintenance may not necessarily be self evident in the Sensor and consequently it must be regularly checked and maintained.

9.8 Remove Gas Sensing Modules (TX6383.84)

Insert a bar into one of the radial holes in the gas inlet bush (take care not to damage the internal filter) and unscrew the gas inlet bush.

Remove the filter from the gas inlet bush. Clean or replace the filter as necessary. Fit a new or cleaned filter to the gas inlet bush.

Using a spanner, remove the sensor retaining nut from the remote housing. Remove the gas sensing module from the remote housing. Fit a new gas sensing module to the remote housing, refit the sensor retaining nut and tighten.

Refit the gas inlet bush and tighten using a bar inserted into one of the radial holes, taking care not to damage the filter.

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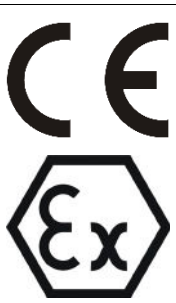
9 MAINTENANCE continued

9.9 Maintenance and Calibration Log

ORDER REF **TX6383**	DATE SUPPLIED
SERIAL No.	USER
GAS TYPE	LOCATION

DATE	SCHEDULED	FAILURE	RE-CALIBRATE	CHANGE GAS SENSING MODULE	RETURN TO MANUFACTURER	COMMENTS

Certification and Conformity

	ATEX (European Union) certification for use in underground mines (Group I) and surface industry (Group II). Complies with ATEX Directive 2014/34/EU.

ANZEx	ANZEx certification for use in underground mines (Group I) and surface industry (Group II) in Australia (including Queensland) and New Zealand.

	EAC certification for use in underground mines (Group I) and surface industry (Group II) in Eurasian Customs Union (including Russia).

Product Code:	Ex Certificate Number:	Ex Certification Code:
TX6383.01.xx.xxx.xx.01(.xx…) TX6383.84.01.xx.xxx.xx.01(.xx…)	Sira 01ATEX2299	I M1 Ex ia I Ma Ta = -20°C to +40°C
TX6383.02.xx.xxx.xx.02(.xx…) TX6383.84.02.xx.xxx.xx.02(.xx…)	Sira 01ATEX2300	II 2G Ex ia d IIB T4 Gb Ta = -20°C to +40°C
TX6383.01.xx.xxx.xx.10(.xx…) TX6383.84.01.xx.xxx.xx.10(.xx…)	ANZEx 12.3021X	Ex ia I Ta = -20°C to +60°C
TX6383.02.xx.xxx.xx.11(.xx…) TX6383.84.02.xx.xxx.xx.11(.xx…)		Ex ia d IIB T4 Ta = -20°C to +60°C
TX6383.01.xx.xxx.xx.14(.xx…) TX6383.84.01.xx.xxx.xx.14(.xx…)	RU C-GB.AA87.B.01400/24	PO Ex ia da I Ma Ta = -20°C to +40°C
TX6383.02.xx.xxx.xx.15(.xx…) TX6383.84.02.xx.xxx.xx.15(.xx…)		1Ex ia db IIB+H2 T4 Gb Ta = -20°C to +40°C

Intrinsic safety parameters

The following intrinsic safety parameters shall be taken into account during installation of the product variants certified under **Sira 01ATEX2299 (ATEX Group I)**:

	T4/T3 (power) (See note 1)		
Ui	16.5 V		
Ci	0 (See note 3)		
Li	0		
	T1/T2 (sensor output signal)		
	4-20 mA 4-wire	**0.4-2 V**	**5-15 Hz**
Ui	16.5 V	16.5 V	16.5 V
Ii	200 mA	200 mA	
Pi	0.271 W	0.271 W	
Ci			0
Li			0
Uo	16.5 V (See note 2)	5.88 V	0
Io (peak)	322 mA	24 mA	
Io (continuous)	213 mA		
Po	1.328 W	35 mW	
Co	9.7 µF	9.7 µF	
Lo/Ro	≤ 40 µH/Ω	≤ 40 µH/Ω	

Note 1: The TX6383 may be connected to supplies derived from a single power source or from two separate power sources. Where two separate power sources are used, the power and signal supplies should be regarded as separate intrinsically safe circuits.

Note 2: The quoted Uo, Io(peak) and Po parameters are worst-case values based on a Ui value of 16.5 V. Uo has the same value as Ui, so, if a Ui value of less than 16.5 V is used, the same lower value may be used for Uo. Io(peak) and Po are also reduced. Terminals T4 and T1 are connected via a minimum resistance of 51.3 Ω. Terminal T4 has a Uo value of zero on account of blocking diodes.

Note 3: There is no terminal capacitance at the supply voltage but, for system assessment purposes, the installer should note that there is a terminal capacitance of 7.0 µF at 5.88 V with one countable fault.

The following intrinsic safety parameters shall be taken into account during installation of the product variants certified under **Sira 01ATEX2300 (ATEX Group II)**:

	T4/T3 (power) and T1/T2 (sensor output signal) (See note 1)
Ui	28V
Ii	299 mA
Pi	1.41 W
Rsource	≥ 139 Ω
Ci	12 nF (See note 4)
Li	0
	T1/T2 (sensor output signal) (See note 2)
Uo	28 V
Io	171 mA
Po	1.194 W
Co	237 nF (See note 3)
Lo	200 µH (See note 3)

Note 1: The TX6383 may be connected to supplies derived from a single power source or from two separate power sources. Where two separate power sources are used, the combined current and power shall not exceed the stated values and they shall be referenced to the same zero volts.

Note 2: The quoted Uo, Io and Po parameters are worst-case values based on a Ui value of 28 V. Uo has the same value as Ui, so, if a Ui value of less than 28 V is used, the same lower value may be used for Uo. Io(peak) and Po are also reduced. Terminals T4 and T1 are connected via a minimum resistance of 25 Ω. Terminal T4 has a Uo value of zero on account of blocking diodes.

Note 3: For system assessment purposes, it should be noted that terminals T1 and T4 are connected via a minimum resistance of 25 Ω. Thus, calculations of the external capacitance and inductance connected to terminals T1/T2 should take account of capacitance and inductance connected to terminals T4 and T3.

Note 4: In addition to the terminal capacitance at the supply voltage, for system assessment purposes, the installer should note that there is a terminal capacitance of 7.0 µF at 5.88 V.

The following intrinsic safety parameters shall be taken into account during installation of the product variants certified under **ANZEx 12.3021X (ANZEx Group I)**:

	T4/T3 (power) (See note 1)		
Ui	16.5 V		
Ci	0 µF (See note 3)		
Li	0 mH		
	T1/T2 (sensor output signal)		
	4-20 mA 4-wire	**0.4-2 V**	**5-15 Hz**
Ui	16.5 V	16.5 V	16.5 V
Ii	200 mA	200 mA	Not critical
Pi	0.271 W	0.271 W	Not critical
Ci	0 µF	0 µF	0 µF
Li	0 mH	0 mH	0 mH
Uo	16.5 V (See note 2)	5.88 V	0 V
Io (peak)	322 mA	24 mA	0 mA
Io (continuous)	213 mA	-	
Po	1.33 W	35 mW	0 mW
Co	9.7 µF	9.7 µF	-
Lo/Ro	≤ 40 µH/Ω	≤ 40 µH/Ω	-

Note 1: The TX6383 may be connected to supplies derived from a single power source or from two separate power sources. Where two separate power sources are used, the power and signal supplies should be regarded as separate intrinsically safe circuits unless the combination of the sources has been assessed as non-incendive.

Note 2: The quoted Uo, Io(peak) and Po parameters are worst-case values based on a Ui value of 16.5 V. Uo has the same value as Ui, so, if a Ui value of less than 16.5 V is used, the same lower value may be used for Uo. Io(peak) and Po are also reduced.

Note 3: There is no terminal capacitance at the supply voltage but, for system assessment purposes, the installer should note that there is a terminal capacitance of 5.5 F at 5.88 V with one countable fault.

The following intrinsic safety parameters shall be taken into account during installation of the product variants certified under **ANZEx 12.3021X (ANZEx Group II)**:

	T4/T3 (power) and T1/T2 (sensor output signal) (See note 1)
Ui	28V
Ii	200 mA
Pi	1.41 W
Rsource	≥ 139 Ω
Ci	6.5 nF (See note 4)
Li	0
	T1/T2 (sensor output signal) (See note 2)
Uo	28 V
Io	171 mA
Po	1.194 W
Co	237 nF (See note 3)
Lo	200 µH (See note 3)

Note 1: The TX6383 may be connected to supplies derived from a single power source or from two separate power sources. Where two separate power supplies are used, they shall be unipolar positive power supplies referenced to the same zero volt, and the combined current and power shall not exceed the stated values.

Note 2: The quoted Uo, Io and Po parameters are worst-case values based on a Ui value of 28 V. Uo has the same value as Ui, so, if a Ui value of less than 28 V is used, the same lower value may be used for Uo. Io(peak) and Po are also reduced.

Note 3: For system assessment purposes, it should be noted that terminals T1 and T4 are connected via a minimum resistance of 25 Ω. Thus, calculations of the external capacitance and inductance connected to terminals T1/T2 should take account of capacitance and inductance connected to terminals T4 and T3.

Note 4: In addition to the terminal capacitance at the supply voltage, for system assessment purposes, the installer should note that there is a terminal capacitance of 5.5 µF at 5.88 V.

For intrinsic safety parameters and conditions of safe use associated with certificate **RU C-GB.AA87.B.01400/24 (EAC Group I and Group II)**, please refer to the relevant sections on the certificate itself. The certificate may be obtained from Trolex website www.trolex.com or directly from Trolex Ltd.

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11 FUNCTIONAL SAFETY

11.1 Overview of Safety Integrity Level

The following instructions are applicable when the TX6383 Flammable Gas Sensor/Transmitter is used as an element in a safety instrumented function that is specified to achieve a Safety Integrity Level (SIL), eg. SIL 1, 2, etc.

The reliability of the TX6383 Flammable Gas Sensor/Transmitter has been independently assessed in accordance with IEC 61508 for use in SIL applications. The compliance with IEC 61508 includes hardware reliability (probabilistic type failures) and measures to address systematic type failures.

The information that follows forms the 'Safety Manual' required by IEC 61508-2 and is intended to allow correct product selection, system integration, installation, operation and maintenance to enable the SIL specified for the safety instrumented function to be achieved and maintained, as far as the TX6383 Flammable Gas Sensor/Transmitter is concerned.

The actual SIL will depend on many system considerations that are outside the scope of the TX6383 Flammable Gas Sensor/Transmitter and will rely on personnel who are competent in the functional safety aspects of the various lifecycle activities mentioned above.

11.2 SIL Suitability

The versions and configurations of the TX6383 Flammable Gas Sensor/Transmitter identified in Table 1 in Section 11.3 below and are suitable for use in gas detection safety functions that have a specified Safety Integrity Level (SIL) in accordance with IEC 61508 or IEC 61511 up to and including:

SIL 2 - when used in a 'Low Demand' safety function [1]

SIL 1 - when used in a 'High Demand' safety function [1]

The functional safety data in Tables 1 and 2 in Section 11.3 must be taken into account by integrators and end-users, including compliance with the restrictions in use (Section 11.4) and all other provisions and conditions in this manual.

System integrators and end users responsible for other lifecycle phases (system specification, integration, installation, commissioning, operation, maintenance, etc) need to perform assessments on the complete scope of their activities to ensure a target SIL for the safety function is and continues to be met.

[1] Low Demand and High Demand modes of operation are defined in IEC 61508-4, 3.5.16

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11 FUNCTIONAL SAFETY continued

11.3 Summary of the Verified Functional Safety Data

The product, configuration and safety manual that have been assessed are shown in Table 1.

Product Information	Details
Product identification	TX6383.01.12/TX6383.84.01.12/TX6383.02.12/TX6383.84.02.12 - Flammable Gas Detector
Product specification	See Section 4 of this manual
Product configuration	4 to 20 mA output Sensor type: CH_4
System configuration	2/3-wire loop, or 4-wire powered connection; power supply and load as specification (noting Group I certified equipment requirements)
Element safety function	To produce a 4 to 20 mA output that correlates with 0 to 5% v/v concentration range of methane
Safety Manual	See Section 11 of this manual

Table 1 Basic Element Information

The hardware failure data for the TX6383 element safety function based on an extensive analysis of field failure data with a 90% single sided confidence limit is shown in Table 2.

Parameter	Value
Dangerous undiagnosed failure rate (λ_{DU})	3.5E-07
Dangerous diagnosed failure rate (λ_{DD})	4.8E-06
Safe failure rate (λ_s)	N/R [1]
Safe failure fraction (SFF)	N/R [1]
Element type	Type B
Hardware fault tolerance (internal architecture)	0
Diagnostic coverage (DC)	96%
Diagnostic test interval	N/A [2]
Probability of Failure on Demand (PFD_{AVG}) [1 year proof test; 24hr MTTR]	1.6E-03
Probability of Failure on Demand (PFD_{AVG}) [3mth proof test; 24hr MTTR]	5.0E-04
Probability of dangerous Failure per Hour (PFH)	3.5E-07

Table 2 Hardware Failure Data

[1] Not required by Route 2_H

[2] This parameter is determined by the controller being used

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11.4 Conditions or Restrictions for use in SIL Applications

The sections of this Installation and Operating Data manual shall be strictly complied with to ensure validity of the failure data and systematic safety integrity. The following additional restrictions and conditions apply when the unit is used in SIL applications:

1. The host controller must monitor the TX6383 Flammable Gas Sensor/Transmitter output at an appropriate frequency for the application (safety time) and initiate a safe action (eg. process shutdown, evacuation, etc) or be repaired within the MTTR assumed in the PFD calculations shown in the table above if an out-of-range (low) output signal is indicated.

2. If the MTTR or the proof test interval (T_1) is different from those assumed in this manual, then the PFD_{AVG} should be re-calculated and the SIL capability re-verified accordingly (refer to the Safety Manual in Section 11.5 below.

3. The display is for indication only and is not part of the safety function.

4. The environmental limits are restricted to:
   - - 20 to +40°C
   - relative humidity <95%

5. IEC 61508-2, 7.4.4.3.1c limits use to SIL 1 in high or continuous mode of operation when used in a non-redundant configuration.

6. The unit must be calibrated at commissioning and at 3 month intervals during operation and the sensor head replaced as indicated by the calibration check.

11.5 Proof Testing

Periodic proof tests of the element safety function must be performed to identify any dormant dangerous failures, particularly when used in 'low demand' safety functions - refer to Section 9.2 of this manual, for the proof test procedure. (Note that calibration alone does not operate the 4 to 20 mA signal). Faults identified by this test must be repaired within the MTTR and the unit returned to full working order.

A suitable proof test interval (T_1) should be used in order to achieve the required average probability of failure on demand (PFD_{AVG}). A nominal interval of 8,760 hrs (1 year) and Mean Time to Repair (MTTR) of 24 hours has been used in the derivation of PFD_{AVG} for illustration purposes. If different values are used, the PFD_{AVG} for a non-redundant arrangement (ie. where the safety function relies on a single element) can be re-calculated as follows:

$$PFD_{AVG} = (\lambda_{DU} + \lambda_{DD})\, t_{CE}$$

Where t_{CE} (the channel equivalent down time) = $(\lambda_{DU}/\lambda_D)(T_1/2 + MTTR) + (\lambda_{DD}/\lambda_D)\, MTTR$

For redundant arrangements refer to IEC 61508-6 for the equations.

CHECK POINT

Those responsible for specifying proof testing of safety functions should refer to IEC 61508-6:2010 clause B.3.2.5 for considerations of the effect of non-perfect proof tests.

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11.6 System Configuration Drawing

The illustration below shows how the TX6383 is to be used with other system elements.

CHECK POINT

If a controller other than the TX9042 is used then the out of range (fault indication) signal from the TX6383 must be detected and acted upon to assert a system fault.

DISCLAIMER

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All pertinent state, regional, and local safety regulations must be observed when installing and using this instrument. For reasons of safety and to help ensure compliance with documented system data, only Trolex or its affiliates should perform repairs to components.

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