TELEDYNE
OLDHAM SIMTRONICS
Everywhereyoulook™

INSTRUCTION MANUAL

700 TP SERIES

HYDROGEN SULFIDE DETECTOR SOLID STATE SENSOR

OLCT 700

OLCT 710

User Manuals in other languages are available on Website https://teledynegasandflamedetection.com

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TELEDYNE OLDHAM SIMTRONICS S.A.S.

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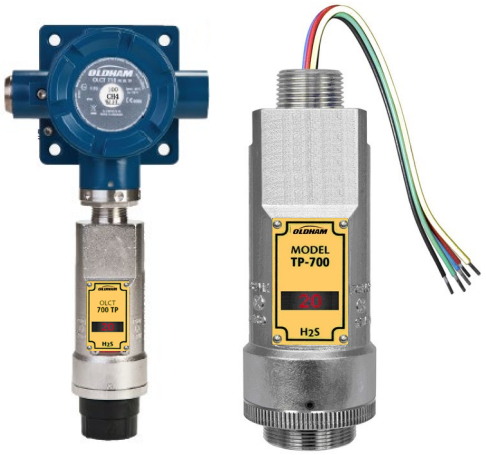
1 Introduction

1.1 Description

Teledyne Oldham Simtronics OLCT 700 TP hydrogen sulfide gas transmitters are non-intrusive "Smart" detectors designed to detect and monitor H_2S in air. Ranges of detection are 0-20ppm, 0-50ppm, 0-100ppm, and 0-200ppm. The detector features an LED display of current reading, fault and calibration status. The detector is equipped with standard analog 4-20mA and Modbus™ RS-485 outputs. A primary feature of the detector is its method of automatic calibration, which guides the user through each step via fully scripted instructions displayed on the LED display.



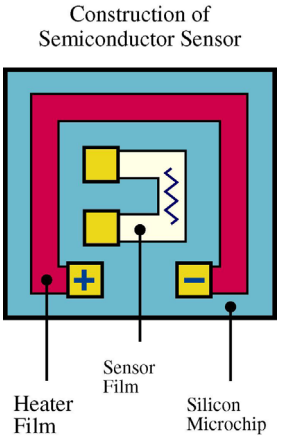
OLCT 710 OLCT 700

The microprocessor-supervised electronics are packaged in an encapsulated module and housed in an explosion proof casting, called the ITM (Intelligent Transmitter Module). The ITM includes a four character alpha/numeric LED used to display detector readings, and the detector's menu driven features when the hand-held programming magnet is used.

The OLCT 710 is made of an OLCT 700 attached to a flameproof junction that includes terminal blocks and an optional surge protection board. The complete assembly is flameproof certified « Ex d » and carries ATEX approval (see section 2.1- ATEX Operational Guidelines for Safe Use).

The OLCT 700 is flameproof certified and carries ATEX approval. The OLCT 700 shall be attached to an increased safety certified junction box when used in an ATEX zone (see section 2.1- ATEX Operational Guidelines for Safe Use).

1.1.1 Solid State H2S Sensor Technology



The sensor technology is a patented solid-state mixed metal oxide semiconductor. The sensor consists of two thin films, a temperature sensitive heater film, and a hydrogen sulfide sensitive sensor film. Both films are deposited on a silicon microchip by vacuum deposition. The heater film elevates the operating temperature of the sensor film to a level where a good sensitivity and response to hydrogen sulfide is achieved. The sensor film is a proprietary mixed metal oxide that shows an extremely stable and dynamic response to hydrogen sulfide gas.

Range of sensitivity is from parts per billion to percent by volume. The rugged sensor is capable of maintaining its operating characteristics for periods of up to 7-10 years in most industrial environments and as such, is supported by a 5-year warranty.

1.1.2 Principle of Operation

Method of detection is by diffusion/adsorption. Air and H_2S diffuse through a sintered stainless steel filter (flame arrestor) and contact the heated surface of the metal oxide sensor film. As hydrogen sulfide gas molecules react with oxygen ions on the film, there is a decrease in electrical resistance proportional to the gas concentration. The heater film elevates the temperature of the sensor film creating convection and promoting a quick response to changing gas concentrations. Electronically, the heater film is used to maintain a constant temperature of the sensor film enhancing stability and repeatability. The sensor response is reversible and results in continuous monitoring of ambient air conditions.

1.2 Modular Mechanical Design

The OLCT 700 TP Detector Assembly is completely modular and is made up of four parts (See Figure below):

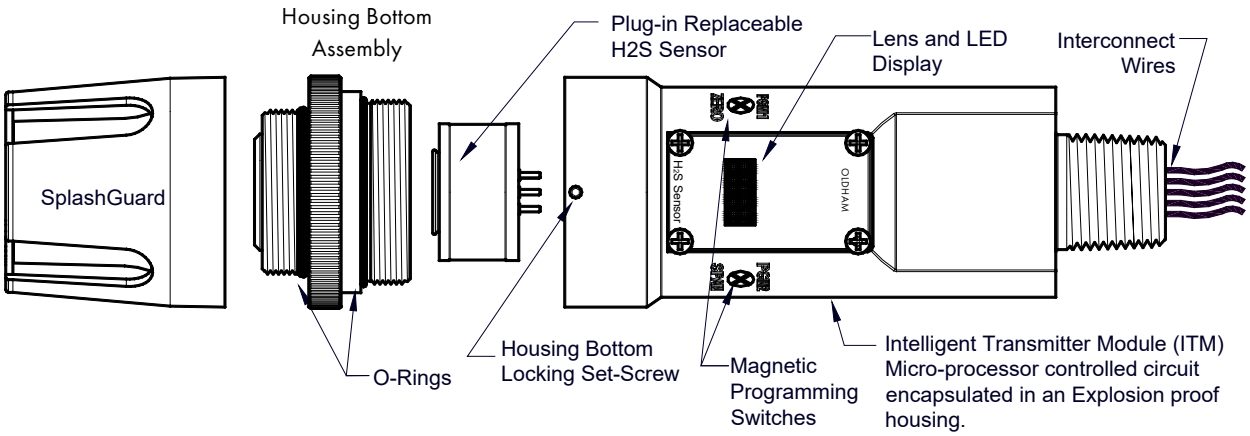


Figure 1: Detector Assembly Breakaway

1) Intelligent Transmitter Module (ITM). The Intelligent Transmitter Module (ITM) is a fully encapsulated microprocessor-based package that accepts a plug-in field replaceable H2S sensor. Circuit functions include LED display, magnetic programming switches, a linear 4-20mA DC output, and a Modbus™ RS-485 output. Magnetic program switches allow non-intrusive operator interface
2) Field Replaceable Plug-in H_2S Gas Sensor
3) Housing Bottom Assembly (contains the Housing Bottom, Flame Arrestor, Retaining Ring, and rubber O-Ring's)
4) Splash Guard

NOTE: All metal components are constructed from electro polished 316 Stainless Steel in order to maximize corrosion resistance in harsh environments.

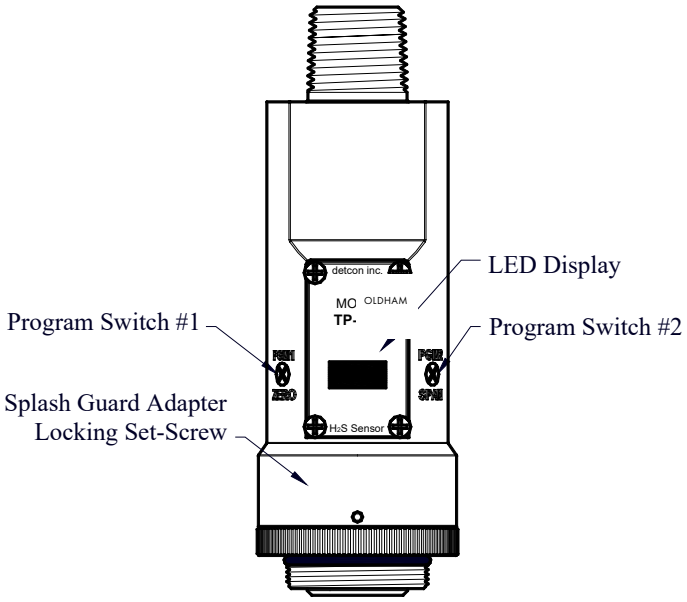


Figure 2: OLCT 700 Assembly Front View

OLCT 710 is made of an OLCT 700 attached to a flameproof certified junction box for terminal connections.

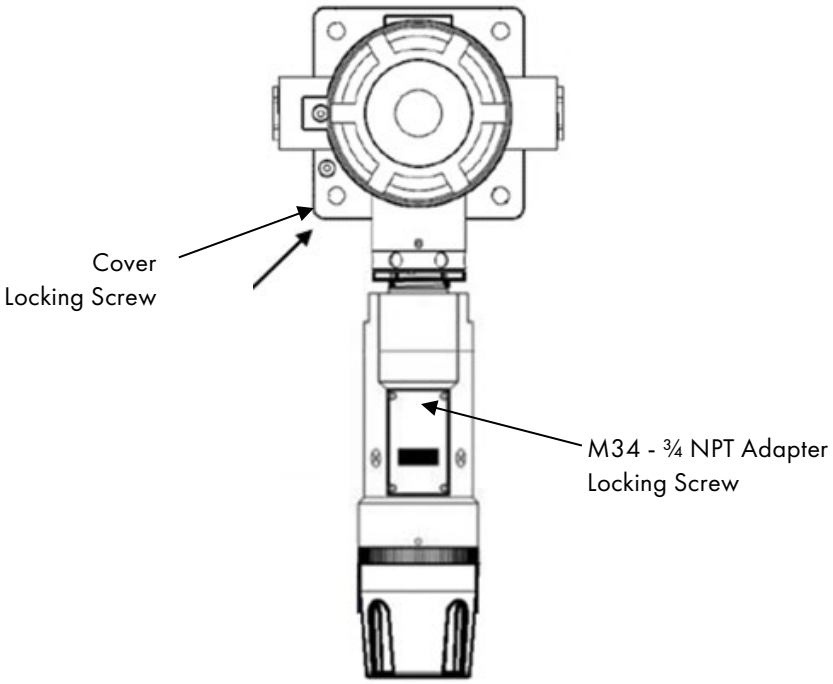


Figure 3: 'OLCT 710 Front View

1.3 Plug-in Replaceable Sensor

The Teledyne Oldham Simtronics solid-state H_2S gas sensor is a field proven, plug-in replaceable type sensor with over-sized gold-plated connections that eliminate corrosion problems. It can be accessed and replaced in the field very easily by releasing the locking screw and unthreading the housing bottom. The Teledyne Oldham Simtronics solid state H_2S sensor has an infinite shelf life and is supported by a 5 year, industry-leading warranty.

Figure 4: OLCT 700/710 TP Plug-in Sensor Cell

2 Installation

2.1 ATEX Operational Guidelines for Safe Use

OLCT 700/710 conforms to the requirements of European Directive ATEX 2014/34/EU relating to explosive Gas atmospheres.

The information given in the following sections should be respected and taken into account by the manager of the site where the equipment is installed. As far as the aim of improving the health and safety of workers who are exposed to the risks of explosive atmospheres is concerned, refer to European Directive ATEX 1999/92/CE.

1) Install detector only in areas with classifications matching with those described on the ATEX approval label. Follow all warnings listed on the label.

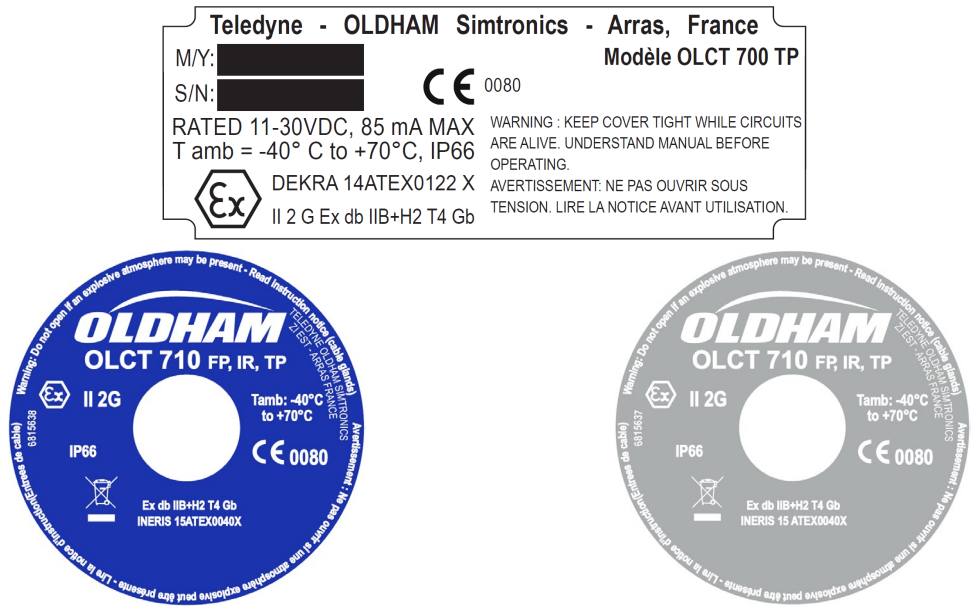


Figure 5: ATEX Approval Label

2) Cable glands shall be flameproof certified («Ex d») for use in explosive atmospheres. Ingress Protection will be greater or equal to IP66. Cable glands will be mounted according to IEC/EN 60079-14 standard, edition in force, and to additional requirements from local standards. They shall be of M20x1.5 and the engagement shall be 5 threads at least. Cables used shall have an operating temperature range equal or greater than 80 °C.

3) The threaded joints may be lubricated to maintain flameproof protection. Only non-hardening lubricants or non-corrosive agents having no volatile solvents may be used.

4) A good ground connection should be verified between the sensor's metal enclosure and the junction box. If a good ground connection is not made, the sensor can be grounded to the junction box using the sensor's external ground lug. Also verify a good ground connection between the junction box and earth ground. Installer shall use ring terminal to make connection to earth ground to be secured by screw and lock washer on sensor housing. Caution: do not loosen or twist the protective earth conductor. An earth conductor shall be mounted so that it is secured against loosening and twisting.

5) Ensure the Housing Bottom is threaded tightly to the Intelligent Transmitter Module. The locking setscrew (M3.5 x 0.6 6g6h Stainless Steel Allen set screw cup point with yield strength of greater than 40,000 PSI, typical 80,000 PSI) should then be tightened down to keep the Housing Bottom from being inadvertently removed or from becoming loose under vibration. The locking setscrew ensures that Housing Bottom is only removable by authorized personnel with the use of special tools. A M1.5 Allen Wrench is required. If screw requires replacement, only an identical screw may be used.

6) Removal of the Housing Bottom violates the Ex d protection method and hence power must be removed from the detector prior its safe removal.

7) Proper precautions should be taken during installation and maintenance to avoid the build-up of static charge on the plastic components of the detector. These include the splashguard and splashguard adapter.

8) When used in ATEX zone, OLCT 700 shall be attached to increased safety certified junction box only.

9) The sensor shall be installed on a metallic grounded structure such as the final assembly assures that sensor enclosure is bonded to ground.

10) Proper precautions shall be taken during installation, operation, maintenance and service of the product in order to avoid the build-up of static charges on the plastic splashguard.

11) The equipment manufacturer shall be contacted for information on the dimensions of the flameproof joints.

12) The screws holding down the retaining plate are special fasteners of type: stainless steel, Philips pan-head machine screws, M3 x 0,5 6g having yield strength greater than 40000 PSI.

2.2 Functional Safety (SIL 2)

Refer to safety user manual NP700TPSMEN

2.3 Detector Placement

Selection of detector location is critical to the overall safe performance of the product. Six factors play an important role in selection of detector locations:

(1) Density of the gas to be detected
(2) Most probable leak sources within the industrial process
(3) Ventilation or prevailing wind conditions
(4) Personnel exposure
(5) Maintenance access
(6) Additional Placement Considerations

Density

Placement of detectors relative to the density of the target gas is such that detectors for the detection of heavier than air gases should be located within 4 feet of grade as these heavy gases will tend to settle in low lying areas. For gases lighter than air, detector placement should be 4-8 feet above grade in open areas or in pitched areas of enclosed spaces.

Note: H_2S is heavier than air.

Leak Sources

The most probable leak sources within an industrial process include flanges, valves, and tubing connections of the sealed type where seals may either fail or wear. Other leak sources are best determined by facility engineers with experience in similar processes.

Ventilation

Normal ventilation or prevailing wind conditions can dictate efficient location of gas detectors in a manner where the migration of gas clouds is quickly detected.

Personnel Exposure

The undetected migration of gas clouds should not be allowed to approach concentrated personnel areas such as control rooms, maintenance or warehouse buildings. A more general and applicable thought toward selecting detector location is combining leak source and perimeter protection in the best possible configuration.

Maintenance Access

Consideration should be given to providing easy access for maintenance personnel. Consideration should also be given to the consequences of close proximity to contaminants that may foul the sensor prematurely.

NOTE: In all installations the gas detector should point straight down (refer to Figure 7). Improper detector orientation may result in false readings and permanent detector damage.

Additional Placement Considerations

The detector should not be positioned where it may be sprayed or coated with surface contaminating substances. Painting detector assemblies is prohibited.

Although the detector is designed to be RFI resistant, it should not be mounted in close proximity to high-powered radio transmitters or similar RFI generating equipment.

When possible mount the detector in an area void of high wind, accumulating dust, rain or splashing from hose spray, direct steam releases, and continuous vibration. If the detector cannot be mounted away from these conditions then make sure the Teledyne Oldham Simtronics Harsh Environment Splashguard accessory is used (PN DET-943-002273-000).

Do not mount in locations where temperatures will exceed the operating temperature limits of the detector. Where direct sunlight leads to exceeding the high temperature-operating limit, use a sunshade to help reduce temperature.

2.4 Sensor Contaminants and Interference

Solid State H_2S sensors may be adversely affected by exposure to certain airborne substances. Loss of sensitivity or corrosion may be gradual if such materials are present in sufficient concentrations.

The more common materials that potentially cause problems with the sensors are as follows:

- Silicone vapors such as those found in greases and lubricants
- Halide Compounds containing Chlorine, Chlorine Dioxide, Fluorine, HF, HCl, and Bromine
- Caustic and Acid liquids and concentrated vapors
- Heavy metals such as tetraethyl lead

The presence of such contaminants in an area does not preclude the use of this H_2S sensor technology, although it is likely that the sensor lifetime will be shorter as a result. Use of this sensor in these environments may require more frequent calibration checks to ensure safe system performance.

Solid State H_2S sensors require O_2 in the background gas and the reading is affected by changing O_2 levels.

Interference Data

There are some gases typically found in industrial environments that can cause a cross-interference response on the sensor. See the Table below for some examples.

Table 1: Cross Interference Gases

GAS	PPM	Reading (ppm)	GAS	PPM	Reading (ppm)
Methane	25000	0	Ammonia	500	1
Ethane	5000	0	Diesel Fuel	1000	0
Hexane	5000	0	Dimethyl Sulfide	4,4	0
Propane	5000	0	Ethylene	200	0
Butane	5000	0	Freon 12	1000	0
Carbon Monoxide	800	0	Hydrogen	1000	8
Carbon Dioxide	5000	0	Methyl Mercaptan	10	5
Carbon Disulfide	14	0	Sulfur Dioxide	300	0
Methanol	500	5	Toluene	32	0
Isopropanol	500	3	Ethanol	500	5

NOTE: The Teledyne Oldham Simtronics MOS Sensor can be damaged to the point of non-functioning if the unit is left off power and in the presence normal air levels of moisture for periods exceeding 8 hours.

NOTE: Always protect the sensor with the Teledyne Oldham Simtronics Sealing Cap and a fresh desiccant packet when the detector is powered off, this will avoid permanent sensor damage and help preserve the span calibration.

2.5 Mounting Installation

- The installation should meet all the regulations currently in force for installations in explosive atmospheres, in particular the standards IEC/EN 60079-14 and IEC/EN 60079-17 (whichever editions are in force) or in accordance with other national standards.
- The equipment is allowed in ATEX zones 1 and 2 for ambient temperatures ranging from -40 °C to + 70 °C. Understand that operating temperature range may be different (see technical specifications).
- The sensor shall always be in contact with ambient air. Therefore,
    - -do not cover the detector
    - -do not paint detector assemblies
    - -avoid dust accumulation

The OLCT 700/710 TP should be vertically oriented so that the detector points straight downward (see Figure below). Installation of the enclosure shall be secured with 4 x M6 screws and the appropriate plugs for the supporting material. There is an adaptor plate for ceiling installation (PN 6322420).

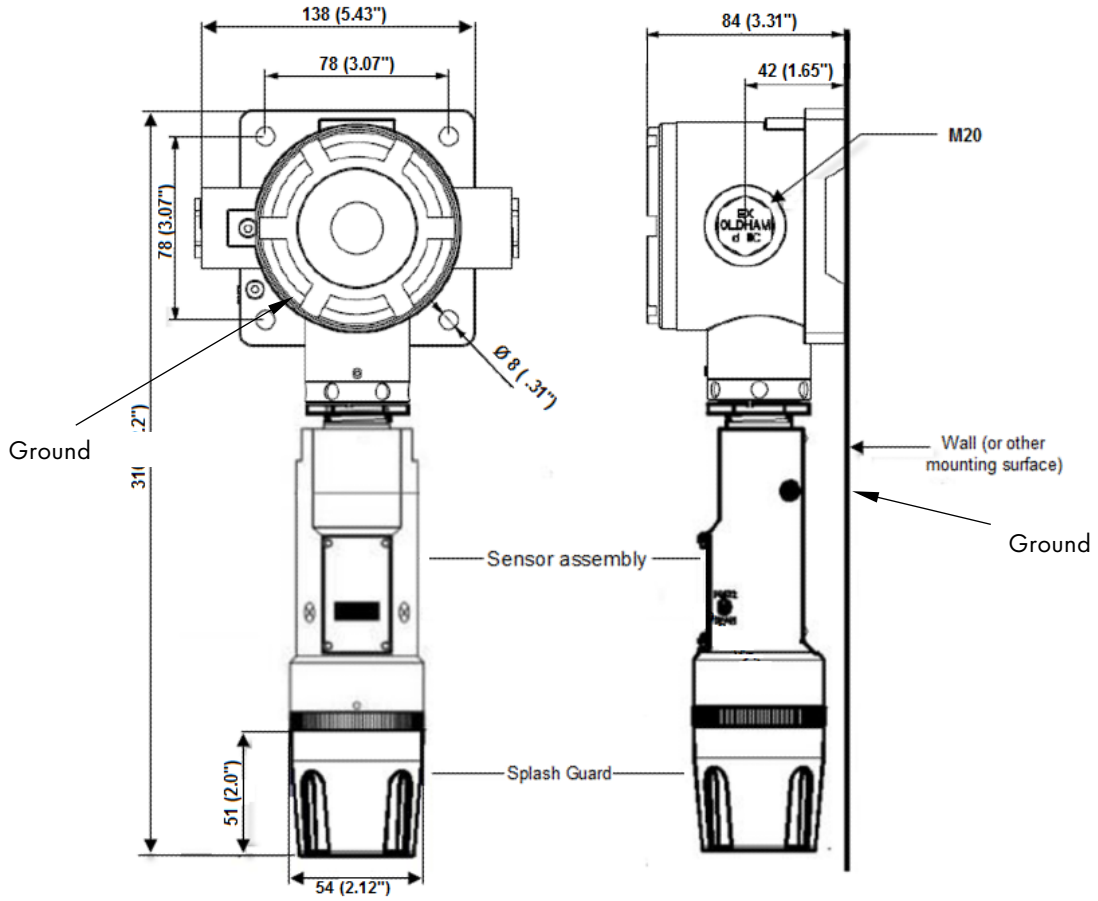


Figure 6: Outline and Mounting Dimensions

When mounting on a pole, secure the Junction Box to a suitable mounting plate and attach the mounting plate to the pole using U-Bolts (Pole-Mounting brackets for Teledyne Oldham Simtronics J-box accessories are available separately).

2.6 Electrical Installation

The installation should meet all the regulations currently in force for installations in explosive atmospheres, in particular the standards IEC/EN 60079-14 and IEC/EN 60079-17 (whichever editions are in force) or in accordance with other national standards. OLCT 700 and OLCT 710 are certified for use in ATEX zones 1 and 2, group IIB+H2, T4.

Proper electrical installation of the gas detector is critical for conformance to Electrical Codes and to avoid damage due to water leakage. Refer to Figure 7 and Figure 8 for proper electrical installation.

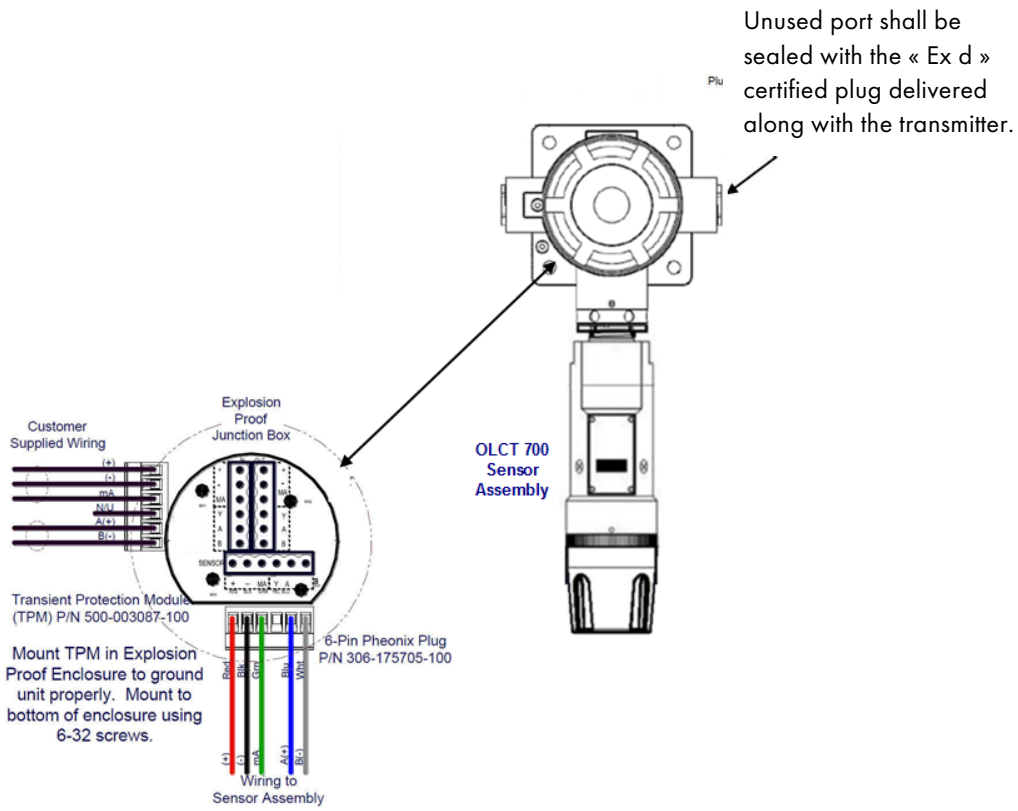


Figure 7: Typical Installation

NOTE: The Teledyne Oldham Simtronics Warranty does not cover water damage resulting from water leaking into the enclosure. However, since the electronics are 100% epoxy encapsulated, only the wire terminations could get wet. Moisture could cause abnormal operation and possibly corrosion to the terminal connections, but permanent damage to the detector would not be expected.

NOTE: Unused port should be blocked with the M20x1.5 male plug supplied by Teledyne Oldham Simtronics (ATEX and 'Ex d IIC' certified). The engagement shall be 5 threads at least.

2.7 Field Wiring

Teledyne Oldham Simtronics OLCT 700/710 TP solid-state H_2S detector assemblies require three conductor connections between power supplies and host electronic controller's 4-20mA output, and 2 conductor connections for the Modbus™ RS-485 serial interface. Wiring designations are + (24 VDC), – (0 V), mA (detector signal), and Modbus™ RS-485 A (+), and B (-). Maximum wire length between detector and 24VDC source is shown in the Table below. Maximum wire size for termination in the Teledyne Oldham Simtronics J-Box accessory is 14 gauge.

Max loop load resistance between green and black wire (analog signal output) is 500 ohms. Minimum loop load resistance between green and black wire is 100 ohms. This is considers wire diameter, wire length, max operating temperature and selected termination resistor.

Table 2: Wire Gauge vs. Distance

AWG	Wire Dia.	Cross Section	Meters/Feet	Over-Current Protection
22	0,65 mm	0,32 mm^2	700/2080	3A
20	0,8 mm	0,5 mm^2	1120/3350	5A
18	1,0 mm	0,8 mm^2	1750/5250	7A
16	1,3 mm	1,3 mm^2	2800/8400	10A
14	1,6 mm	2 mm^2	4480/13440	20A

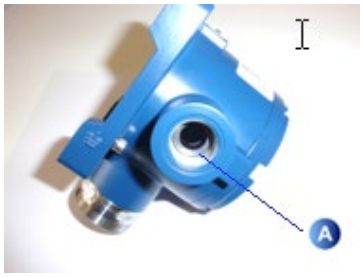
NOTE 1: Wiring table is based on stranded tinned copper wire and is designed to serve as a reference only.

NOTE 2: Shielded cable is required for installations where cable trays or conduit runs include high voltage lines or other possible sources of induced interference. Separate conduit or tray runs are highly recommended in these cases.

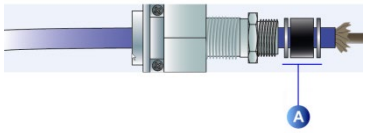
NOTE 3: The supply of power should be from an isolated source with over-current protection as stipulated in table.

2.7.1 Cable Preparation

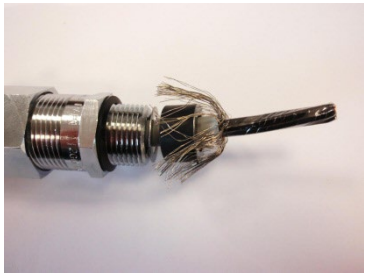
NOTE : It is essential that the instructions provided by the manufacturer of the cable gland are followed and the braid is correctly connected.



1 - Remove the rubber pot and the two metal washers (A)



2 - Arrange the cable as shown in the picture



3 – Arrange the braid as shown in the picture.
Avoid creating "pigtails"

4 - Insert the part back into the OLCT 710

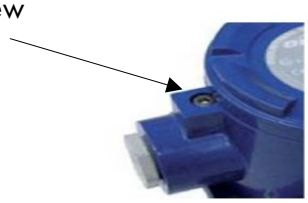
2.7.2 Terminal Connections

CAUTION: Do not apply System power to the detector until all wiring is properly terminated and openings are properly closed.

a) Remove the junction box cover. Identify the terminal blocks for customer wire connections (see Figure 8).

NOTE : To remove the cover, tighten the locking screw before unscrewing the cover

Locking screw



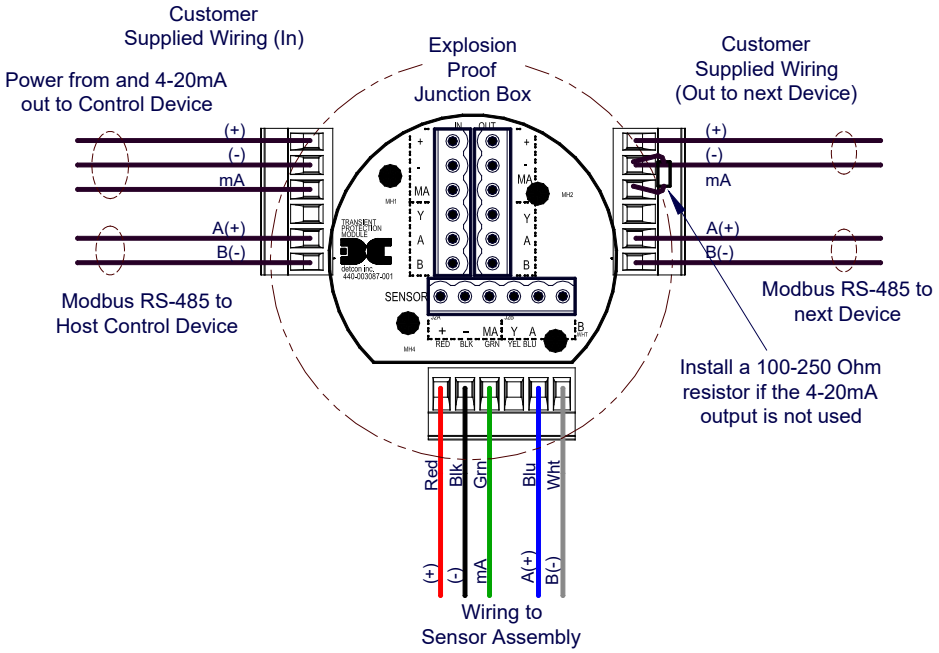


Figure 8: Detector Wire Connections

b) Observing correct polarity, terminate the 3-conductor 4-20mA field wiring (+, -, and mA) to the detector assembly wiring in accordance with the detail shown in Figure 8.

NOTE: If the 4-20mA output is not being used, the Green wire from the detector *must* be connected to the Black wire at the (-) terminal on the Transient Protection Module to ensure RS-485 communication is not disrupted by a 4-20mA Fault.

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c) If applicable, terminate the RS-485 serial wiring. Use the second plug (Out) as termination point on the customer side to facilitate a continuous RS-485 serial loop.

The RS-485 (if applicable) requires 24 gauge, two conductor, shielded, twisted pair cable between detector and host PC. General Cable Commodore part number ZO16P0022189 is recommended.

NOTE: Install a 120Ω resistor across A & B terminals on the last detector in the serial loop.

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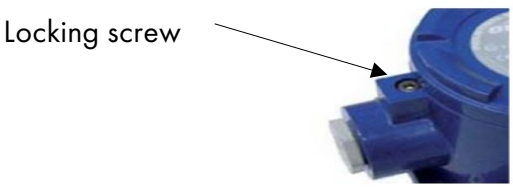
d) Screw the cover firmly and loosen the locking screw until it reaches the cover.



2.8 Initial Start Up

Upon completion of all mechanical mounting and termination of all field wiring, apply system power in the range of 11.5-30VDC (24VDC typical).

NOTE: A desiccant cap with a desiccant packet is attached to the sensor housing to avoid damage during storage and shipping. This prevents water from contacting the sensor film, and as a result helps to retain the stability of the factory span calibration.

Remove the desiccant cap about 10 minutes after applying power to the detector and install the weatherproof splashguard accessory supplied with the detector.

NOTE: Store the desiccant caps with the desiccant packets in a sealed container (i.e. zip-lock bag) for future use. It is advisable to reinstall the desiccant cap and packet during prolonged periods without power (more than 1 day is considered "prolonged"). An active desiccant packet is blue in color and turns pink when consumed (PN DET-960-240010-000).

In the absence of fault messages (flashing display), OLCT 700/710 TP display reads "0". A temporary upscale reading may occur as the detector heats up. This upscale reading will decrease to "0" ppm within 1-2 minutes of power-up, assuming there is no gas in the area of the detector.

NOTE: The 4-20mA signal is held constant at 4mA for the first two minutes after power up.

2.8.1 Initial Operational Tests

After a warm up period of 1 hour, the detector should be checked to verify sensitivity to H_2S gas.

Material Requirements

- PN DET-613-120000-700 OLCT 700/710 Splash Guard with integral Cal Port OR PN DET943-000006-132 Threaded Calibration Adapter
- PN 18108087 Span Gas; 25ppm H_2S in balance Air (10ppm for 0-20ppm range)
- PN DET-985-241100-321 In-Line Humidifying Tube

NOTE: Do not use H_2S in Nitrogen background gas mixtures. This will cause significant reading inaccuracies.

NOTE: Span gas bottles contain 0% humidity and this ultra-low humidity condition will cause inaccurate readings when used to calibrate a detector. To prevent this error, Teledyne Oldham Simtronics prescribes the use of the In-Line Humidifying Tube.

a) Connect the In-Line Humidifying Tube between the cal gas cylinder and the detector. The humidifying tube will introduce the ambient relative humidity into the Cal Gas as it passes through the tube.

b) Attach the calibration adapter to the threaded detector housing. Apply the test gas at a controlled flow rate of 0.5l/min max. Allow 1-2 minutes for the reading to stabilize. Observe that during the 1-2 minutes the OLCT 700/710 display increases to a level near that of the applied calibration gas value.

c) Remove test gas and observe that the display decreases to "0".

Initial operational tests are complete. Teledyne Oldham Simtronics H2S gas detectors are factory calibrated prior to shipment, and should not require significant adjustment on start up. However, it is recommended that a complete calibration test and adjustment be performed 16 to 24 hours after power-up. Refer to span calibration instructions in Section 0.

3 Operation

3.1 Programming Magnet Operating Instructions

The Operator Interface of the OLCT 700/710 gas detectors is accomplished via two internal magnetic switches located to either side of the LED display (see Figure 10). The two switches, labeled "PGM1" and "PGM2", allow for complete calibration and configuration, thereby eliminating the need for area de-classification or the use of hot permits.

Figure 9: Magnetic Programming Tool

The magnetic programming tool (Figure 9) is used to operate the magnetic switches. Switch action is defined as momentary contact, 3-second hold, and 10-second hold (hold times are defined as the time from the point when the arrow prompt ◄ appears). For momentary contact use, the programming magnet is briefly held over a switch location. The 3 and 10 second holds are generally used to enter calibration/program menus and save new data. The momentary contact is generally used to move between menu items and to modify set-point values. Arrows (◄ and ►) are used on the LED display to indicate when the magnetic switches are activated.

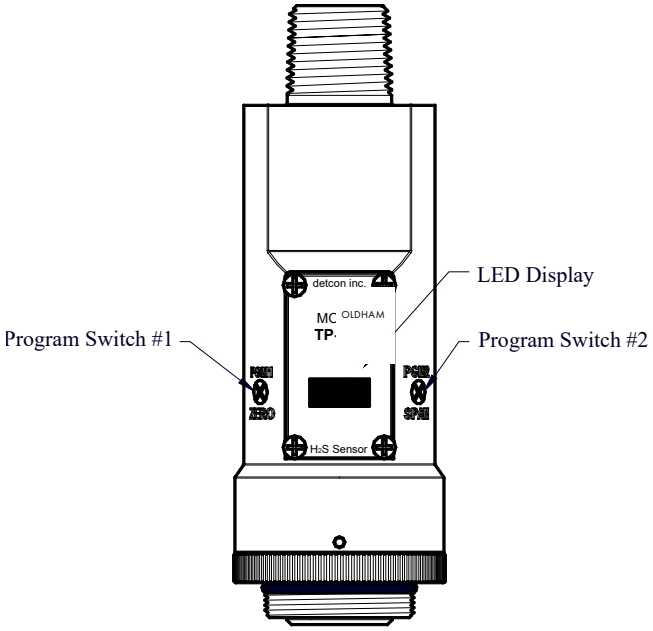


Figure 10: Magnetic Programming Switches

NOTE: While in the Program Mode, if there is no magnetic switch interaction after 4 consecutive menu scrolls, the detector will automatically revert to normal operating condition. While changing values inside menu items, **if there is no magnet activity after 3-4 seconds the detector will revert to the menu scroll** *(exception to this is with "Signal Output Check" mode).*

3.2 Operator Interface

The operating interface is menu-driven via the two magnetic (PGM1 and PGM2) program switches located under the target marks of the detector housing. The menu list consists of three major items that include sub-menus as indicated below (refer to the complete Software Flow Chart in Figure 11).

Normal Operation

- Current Reading and Fault Status

Calibration Mode

- AutoSpan

Program Mode

- View Sensor Status
  - Sensor Model Type
  - Current Software Version
  - Range of Detection
  - Serial ID address
  - AutoSpan Level
  - Days Since Last AutoSpan
  - Remaining Sensor Life
  - Sensor Heater Power
  - Sensor Heater Voltage
  - Raw Sensor Resistance
  - mA Output
  - Input Voltage Supply
  - Sensor Temperature
- Set AutoSpan Level
- Set Range
- Set Serial ID
- Set Heater Power
- Signal Output Check
- Restore Default Settings

Software Flowchart

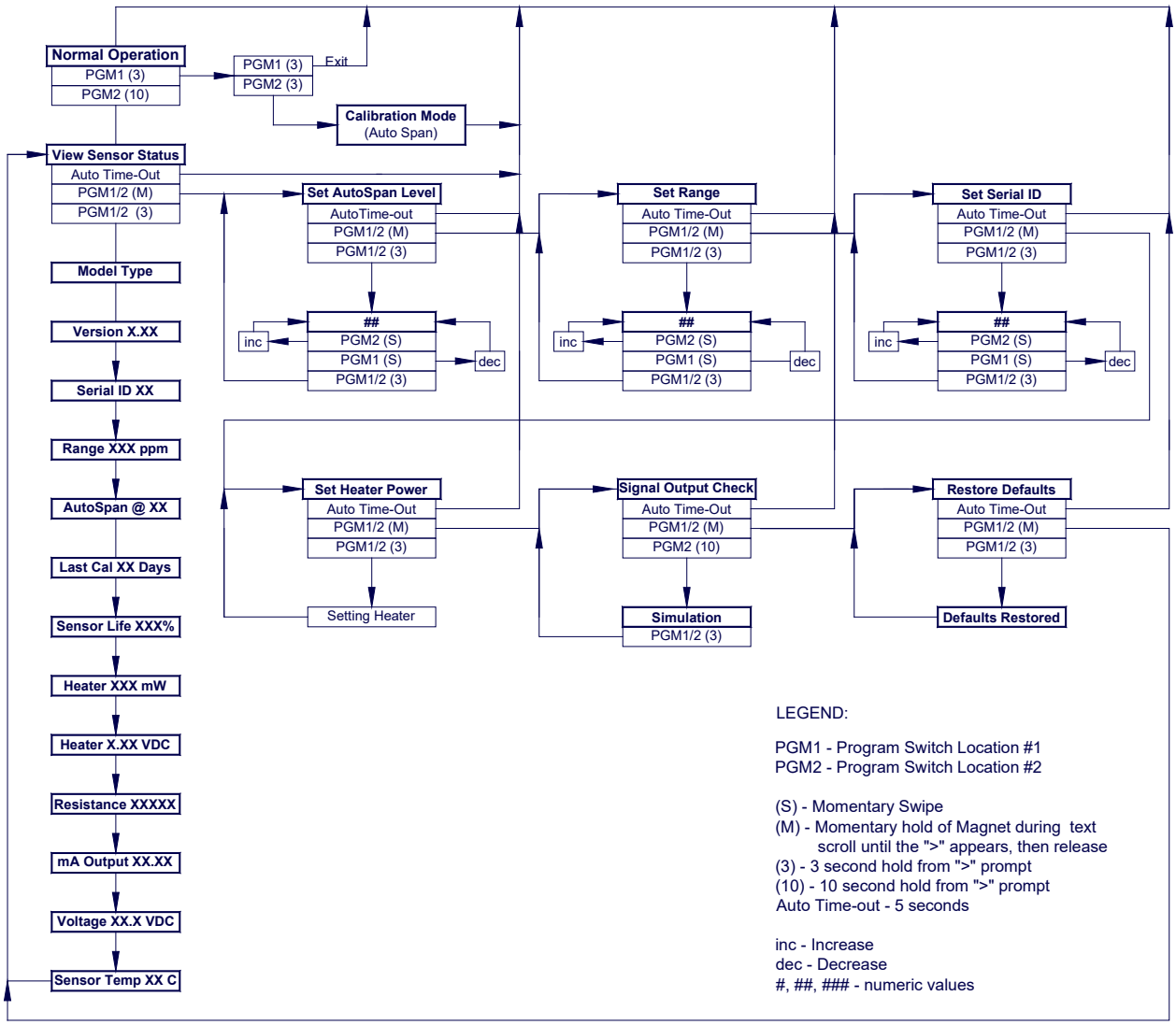


Figure 11: OLCT 700/710 TP Software Flowchart

3.3 Normal Operation

In normal operation, the OLCT 700/710 Display continuously shows the current detector reading, which will normally appear as "0". Once every minute, the LED display will flash the detector's units of measure and the gas type (i.e. ppm H_2S). If the detector is actively experiencing any diagnostic faults, a "Fault Detected" message will scroll across the display once every minute instead of the units of measure and the gas type. At any time, while the detector is in "Fault Detected" mode, PGM1 or PGM2 can be swiped to prompt the detector to display a list of the active faults.

In normal operation, the 4-20mA current output linearity corresponds with the full-scale range. The RS-485 Modbus™ serial output provides the current gas reading and complete fault status on a continuous basis when polled by the master device.

3.4 Calibration Mode (AutoSpan)

Calibration Mode allows for sensor span calibration. Span calibration should be performed on a routine basis (quarterly minimum) to ensure reliable performance. If a sensor has been exposed to any de-sensitizing gases or to very high over-range H_2S levels, then a re-calibration should be considered. Unless otherwise specified, span adjustment is recommended at 25ppm for the 0-100 and 0-50ppm ranges (and 10ppm for 0-20ppm range).

Material Requirements:

- PN DET-327-000000-000 Programming Magnet
- PN DET-613-120000-700 OLCT 700/710 Splash Guard with integral Cal Port and Calibration Wind Guard (PN DET-943-000000-000) -OR- PN DET-943-000006-132 Threaded Calibration Adapter
- PN DET-985-241100-321 In-Line Humidifying Tube
- PN 18108087 H_2S Span Gas in air balance

NOTE 1: The span gas source must have a normal background concentration of 20.9% O2 (H_2S balanced with Air). Pure Nitrogen background mixtures are not acceptable! Significant span calibration inaccuracies will result.

NOTE 2: An H_2S gas concentration of 25ppm is strongly recommended for 0-50 and 0-100ppm ranges (10ppm span gas for 0-20ppm range). This should be supplied at a controlled flow rate of 200 to 500cc/min.

NOTE 3: Span gas bottles contain 0% humidity and this ultra-low humidity condition will cause inaccurate readings when used to calibrate a detector. To prevent this error, Teledyne Oldham Simtronics prescribes the use of a 24" flexible In-Line Humidifying Tube.

NOTE 4: The Calibration Wind Guard must be used when the Splashguard Adapter with integral Cal Port is used. Failure to use the Calibration Wind Guard may result in an inaccurate AutoSpan calibration.

AutoSpan consists of entering Calibration Mode and following the menu-displayed instructions. Follow the instructions "a" through "e" below for AutoSpan calibration.

a) Verify that the AutoSpan Level is equal to the Calibration Span Gas Concentration (refer to View Sensor Status in Section 3.5.2.). If the AutoSpan Level is not equal to the Calibration span gas concentration, adjust the AutoSpan Level as instructed in Section 3.5.3 Set AutoSpan Level.

b) From Normal Operation, enter Calibration Mode by holding the programming magnet over PGM1 for 3 seconds. Note, the "◀" prompt will show that the magnetic switch is activated during the 3 second hold period. The display will then scroll "PGM1=Exit PGM2=Span". Hold the programming magnet over PGM2 for 3 seconds to execute AutoSpan (or allow to timeout in 5 seconds if AutoSpan is not intended). The OLCT 700/710will then scroll "Apply XX ppm Gas".

NOTE: Upon entering Calibration Mode, the 4-20mA signal drops to 2mA and is held at this level until the program returns to normal operation. Modbus™ Status Register bit 14 is also set to signify when the detector is in-calibration mode.

c) Apply the span calibration test gas via the In-Line Humidifying Tube at a flow rate of 0.2-0.5l/min. As the detector signal begins to increase the display will switch to reporting "XX" reading methods as the detector shows the sensor's "as found" response to the span gas presented. If it fails to meet the minimum in-range signal change criteria within 2½ minutes, the display will report "Range Fault" twice and the OLCT 700/710 will return to normal operation, aborting the AutoSpan sequence. The detector will continue to report a "Range Fault" and will not clear the fault until a successful AutoSpan is completed.

   Assuming acceptable sensor signal change, after 3 minutes the reading will auto-adjust to the programmed AutoSpan level. During the next 30 seconds, the AutoSpan sequence checks the sensor for acceptable reading stability. If the sensor fails the stability check, the reading is re-adjusted back to the AutoSpan level and the cycle repeats until the stability check is passed. Up to three additional 30-second stability check periods are allowed before the detector reports a "Stability Fault" twice and the OLCT 700/710 will return to normal operation, aborting the AutoSpan sequence. The detector will continue to report a "Stability Fault" and will not clear the fault until a successful AutoSpan is completed.

   If the sensor passes the stability check, the OLCT 700/710 reports a series of messages:
   "**AutoSpan Complete**"
   "**Sensor Life XXX%**"
   "**Remove Span Gas**"

d) Remove the span gas and calibration adapter, or the optional gas ampoule or gas generator calibration technique components when AutoSpan cycle is complete. The OLCT 700/710 will report a live reading as it clears toward "0". When the reading clears below 5ppm, the detector will display "Span Complete" and will revert to normal operation. If the sensor fails to clear to less than 5ppm within 5 minutes, a "Clearing Fault" will be reported twice and the detector will return to normal operation, aborting the AutoSpan sequence. The OLCT 700/710 will continue to report a "Clearing Fault" and will not clear the fault until a successful AutoSpan is completed.

   AutoSpan calibration is complete.

NOTE 1: If the sensor fails the minimum signal change criteria, a **"Range Fault"** will be declared and a "Fault Detected" message will be displayed alternately with the detector's current reading. The 4-20mA output will be taken to 0mA and the "Range Fault" fault bit will be set on the Modbus™ output.

NOTE 2: If the sensor fails the stability criteria, a **"Stability Fault"** will be declared and a "Fault Detected" message will be displayed alternately with the detector's current reading. The 4-20mA output will be taken to 0mA and the "Stability Fault" fault bit will be set on the Modbus™ output.

NOTE 3: If the sensor fails the clearing time criteria, a "**Clearing Fault**" will be declared and a "Fault Detected" message will be displayed alternately with the detector's current reading. The 4-20mA output will be taken to 0mA and the "Clearing Fault" fault bit will be set on the Modbus™ output.

NOTE 4: The most common cause of "**Range Fault**" and "**Stability Fault**" is the improper storage of the unit / sensor. When the detector power is removed for any period of time, the sensor cell should be protected with a Desiccant Pack (PN DET-960-240010-000) and covered by the Dust Cap (PN DET-600-003232-000)

3.5 Program Mode

Program Mode provides a "View Sensor Status" menu to check operational and configuration parameters. Program Mode provides for adjustment of the AutoSpan Level, Sensor Range, Heater Power, and Serial ID. Additionally, Program Mode includes the diagnostic function "Signal Output Check" and "Restore Factory Defaults".

The Program Mode menu items appear in the order presented below:

View Sensor Status
Set AutoSpan Level
Set Range
Set Serial ID
Set Heater Power
Signal Output Check
Restore Default Settings

3.5.1 Navigating Program Mode

From Normal Operation, enter Program Mode by holding the magnet over PGM2 for 4 seconds (until the displays starts to scroll "View Sensor Status"). Note, the "◄ " prompt will show that the magnetic switch is activated during the 4 second hold period. The OLCT 700/710 will enter Program Mode and the display will display the first menu item "View Sensor Status". To advance to the next menu item, hold the magnet over PGM1 or PGM2 while the current menu item's text is scrolling. At the conclusion of the text scroll the arrow prompt ("◄ " for PGM2 or "►" for PGM1) will appear, immediately remove the magnet. The OLCT 700/710 will advance to the next menu item. Repeat this process until the desired menu item is displayed. Note, PGM1 moves the menu items from right to left and PGM2 moves the menu items from left to right.

To enter a menu item, hold the magnet over PGM1 or PGM2 while the menu item is scrolling. At the conclusion of the text scroll the "◄ " (or "►") prompt will appear, continue to hold the magnet over PGM1 or PGM2 for an additional 3-4 seconds to enter the selected menu item. If

there is no magnet activity while the menu item text is scrolling (typically 4 repeated text scrolls), the OLCT 700/710 will automatically revert to Normal Operation.

3.5.2 View Sensor Status

View Sensor Status displays all current configuration and operational parameters including: sensor type, software version number, detection range, AutoSpan level, days since last AutoSpan, estimated remaining sensor life, heater power, heater voltage, raw resistance, mA output, input voltage and detector ambient temperature.

From the **View Sensor Status** text scroll, hold the magnet over PGM1 or PGM2 until the "◀" prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll "Status Is"). The display will scroll the complete list of detector status parameters sequentially:

Sensor Model Type

The menu item appears as: "700 TP"

Current Software Version

The menu item appears as: "V X.XXZ"

Range of Detection

The menu item appears as: "Range XXXppm"

Serial ID address

The menu item appears as: "Serial ID XX"

AutoSpan Level

The menu item appears as: "Auto Span Level XXppm"

Days Since Last AutoSpan

The menu items appears as: "Last Cal XX days"

Remaining Sensor Life

The menu item appears as: "Sensor Life 100%"

Sensor Heater Power

The menu item appears as: "Heater XXXmW"

Sensor Heater Voltage

The menu item appears as: "Heater X.XXVDC

Raw Sensor Resistance

The menu item appears as: "Resistance XXXXX"

mA Output

The menu item appears as: "mA Output XX.XX mA"

Input Voltage Supply

The menu item appears as: "Voltage XX.X VDC"

Operating Temperature

The menu item appears as: "Temp XX C"

When the status list sequence is complete, the OLCT 700/710 will revert to the "View Sensor Status" text scroll. The user can either: 1) review list again by executing another 3-4 second hold, 2) move to another menu item by executing a momentary hold over PGM1 or PGM2, or 3) return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll "View Sensor Status" 4 times and then return to Normal Operation).

3.5.3 Set AutoSpan Level

Set AutoSpan Level is used to set the span gas concentration level that is being used to calibrate the detector. This level is adjustable from 10% to 50% of selected full-scale range. The current setting can be viewed in View Program Status.

From the **Set AutoSpan Level** text scroll, hold the magnet over PGM1 or PGM2 until the "◀" prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll "Set Level"). The display will switch to "XX" (where XX is the current gas level). Swipe the magnet momentarily over PGM2 to increase or PGM1 to decrease the AutoSpan Level until the correct level is displayed. When the correct level is achieved, hold the magnet over PGM1 or PGM2 for 3-4 seconds to accept the new value. The display will scroll "Level Saved", and revert to "Set AutoSpan Level" text scroll.

Move to another menu item by executing a momentary hold, or return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll "Set AutoSpan Level" 4 times and then return to Normal Operation).

3.5.4 Set Range

Set Range is used to change full-scale ranges. This is selectable between 0-20, 0-50, 0-100ppm, and 0-200ppm. The current range can be viewed in View Sensor Status using instruction given in Section 3.5.2 View Sensor Status.

From the "**Set Range"** text scroll, hold the programming magnet over PGM1 or PGM2 until the "◀" prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll "Set Range"). The display will then switch to "XXX" (where XXX is the current Range). Swipe the magnet momentarily over PGM2 to increase or PGM1 to decrease the range Level until the desired range is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value. The display will scroll "Range Saved", and revert to "Set Range" text scroll.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll "Set Range" 7 times and then return to Normal Operation).

NOTE: When switching between ranges, it may be necessary to readjust the AutoSpan Level.

3.5.5 Set Serial ID

Teledyne Oldham Simtronics OLCT 700/710 TP detectors can be polled serially via RS-485 Modbus™ RTU. Refer to Section 4.0 for details on using the Modbus™ output feature.

Set Serial ID is used to set the Modbus™ serial ID address. It is adjustable from 01 to 256 in hexadecimal format (01-FF hex). The current serial ID can be viewed in View Sensor Status using the instruction given in Section 3.5.2 View Sensor Status.

From the "**Set Serial ID"** text scroll, hold the programming magnet over PGM1 or PGM2 until the "◄ " prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll "Set ID"). The display will then switch to "XX" (where XX is the current ID address). Swipe the magnet momentarily over PGM2 to increase or PGM1 to decrease the hexadecimal number until the desired ID is displayed. Hold the magnet over PGM1 or PGM2 for 3-4 seconds to accept the new value. The display will scroll "ID Saved", and revert to "Set Serial ID" text scroll.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll "Set Serial ID" 5 times and then return to Normal Operation).

3.5.6 Set Heater Power

Set Heater Power is used to set the each H_2S sensor to the optimum operating temperature.

NOTE: The function is performed during factory calibration of each OLCT 700/710 TP detector assembly, and is not necessary during installation. However, it is necessary to perform in the field if the plug-in H2S sensor is replaced or if the Restore Factory Defaults function has been executed.

From the "Set Heater Power" text scroll, hold the programming magnet over PGM1 or PGM2 until the "◄ " prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll "Setting Heater"). After scrolling "Setting Heater", the detector will adjust the Heater power. The sequence should require about 2-minutes. When the cycle is complete, the OLCT 700/710 will revert to the "Set Heater Power" text scroll.

NOTE: If the OLCT 700/710 cannot adjust the heater power within 3 minutes an error message, "Can't set, Reverting to Default", will be scrolled.

The current values for heater power and heater voltage can be observed in the "View Sensor Status" menu. The target heater power setting at 25C operating temperature is 235 +/- 5mW. At the operating temperature extremes the observed heater power settings will vary according to the data below:

Temperature (in °C)	Heater Power (+/- 5 mW)
50	215
0	260
-20	275
-40	295

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll "Set Heater Power" 4 times and then return to Normal Operation).

3.5.7 Signal Output Check

Signal Output Check provides a simulated 4-20mA output and RS-485 Modbus™ output. This simulation allows the user to conveniently perform a functional system check of their entire safety system. This signal output simulation also aids the user in performing troubleshooting of signal wiring problems.

From the "Signal Output Check" text scroll, hold the magnet over PGM1 or PGM2 until the "◀" prompt appears and then hold continuously for an additional 10 seconds. Once initiated, the display will scroll "Simulation Active" until the function is stopped. During simulation mode, the 4-20mA value will be increased from 4.0mA to 20.0mA (in 1% of range increments at about a 1 second update rate) and then decreased from 20.0mA to 4.0mA. The same simulation sequence is applied to the Modbus™ output gas reading.

NOTE: Signal Output Check stays active indefinitely until the user stops the function. There is no automatic timeout for this feature.

To end simulation mode, hold magnet over PGM1 or PGM2 for 3 seconds. The display will either move to the prior menu item or move to the next menu item respectively.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds.

3.5.8 Restore Factory Defaults

Restore Factory Defaults is used to clear current user configuration and calibration data from memory and revert to factory default values. This may be required if the settings have been configured improperly and a known reference point needs to be re-established to correct the problem.

NOTE: "Restoring Factory Defaults" should only be used when absolutely necessary. All previously existing configurational inputs will have to be re-entered if this function is executed. A full 10-second magnet hold on PGM 2 is required to execute this function.

From the "Restore Defaults" text scroll, hold the programming magnet over PGM2 until the "◀" prompt appears and continue to hold 10 seconds. The display will scroll "Restoring Defaults", and then will revert to the "Restore Defaults" text scroll.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll "Restore Defaults" 4 times and then return to Normal Operation).

Following the execution of "**Restore Defaults**", the OLCT 700/710 TP will revert to its factory default settings. The default settings are:

- Serial ID = 01. The Serial ID must be set appropriately by the operator (3.5.5)

NOTE: The following must be performed in order before the detector can be placed in operation.

- Range = 100ppm. Range must be set appropriately by the operator (3.5.4)
- AutoSpan Level = 25ppm. AutoSpan level must be set appropriately by the operator (3.5.3)
- Heater Power: Heater Power settings are lost and "Set Heater Power" (3.5.6) must be performed before "AutoSpan"
- AutoSpan: AutoSpan Settings are lost and a successful "AutoSpan" must be performed before placing the Detector into operation (0)

3.6 Program Features

Teledyne Oldham Simtronics OLCT 700/710 TP H_2S gas detectors incorporate a comprehensive set of diagnostic features to achieve Fail-Safe Operation. These Operational features and Failsafe Diagnostic features are detailed below.

3.6.1 Operational Features

Over-Range

When gas greater than the full-scale range is detected, the OLCT 700/710 display will continuously flash the full-scale reading (20, 50, 100ppm, 200ppm). This designates an over-range condition. The 4-20mA signal will report a 22mA output during this time.

In-Calibration Status

When the detector is engaged in AutoSpan calibration, the 4-20mA output signal is taken to 2.0mA and the in-calibration Modbus™ Status Register bit 14 is set. This alerts the user that the OLCT 700/710 is not in an active measurement mode. This feature also allows the user to log the AutoSpan events via their master control system.

Sensor Life

Sensor Life is calculated after each AutoSpan calibration and is reported as an indicator of remaining service life. It is reported in the "View Sensor Status" menu and as a RS-485 Modbus™ register bit. Sensor Life is reported on a scale of 0-100%. When Sensor Life falls below 25%, the sensor should be replaced within a reasonable maintenance schedule.

Last AutoSpan Date

This reports the number of days that have elapsed since the last successful AutoSpan. This is reported in the View Sensor Status menu. After 180 days, an AutoSpan Fault will be declared.

3.6.2 Fault Diagnostic/Failsafe Features

Fail-Safe/Fault Supervision

OLCT 700/710 TP detectors are designed for Fail-Safe operation. If any of the diagnostic faults listed below are active, the ITM Display will scroll the message "Fault Detected" every 30 seconds during normal operation. At any time during "Fault Detected" mode, holding the programming magnet over PGM1 or PGM2 for 1 second will display the active fault(s). All active faults are reported sequentially.

Most fault conditions result in failed operation of the detector. In these cases the 4-20mA signal is dropped to the universal fault level of 0mA. These include the AutoSpan Calibration faults, Heater Fault, Sensor Fault, Processor Fault, Memory Fault, Loop Fault, and Input Voltage Fault (the 0mA fault level is not employed for a Temperature Fault, or during Calibration). For every diagnostic fault condition the associated RS-485 Modbus™ fault register will be flagged to alert the user digitally.

NOTE: Refer to the Troubleshooting Guide, Section 0, for guidance on fault conditions.

Range Fault – AutoSpan

If the sensor fails the minimum signal change criteria during AutoSpan sequence (Section 0), the "Range Fault" will be declared. A "Range Fault" will cause a "Fault Detected" message to scroll once a minute on the display and drop the 4-20mA output to 0mA. The Modbus™ fault register bit for Range Fault will be set and will not clear until the fault condition has been cleared. The OLCT 700/710 should be considered "Out-of-Service" until a successful AutoSpan calibration is performed.

Stability Fault - AutoSpan

If the sensor fails the signal stability criteria during AutoSpan sequence (Section 0), the "Stability Fault" will be declared. A "Stability Fault" will cause a "Fault Detected" message to scroll once a minute on the display and drop the mA output to 0mA. The Modbus™ fault register bit for Stability Fault will be set and will not clear until the fault condition has been cleared. The OLCT 700/710 should be considered as "Out-of-Service" until a successful AutoSpan calibration is performed.

Clearing Fault - AutoSpan

If the sensor fails the signal stability criteria during AutoSpan sequence (Section 0), the "Clearing Fault" will be declared. A "Clearing Fault" will cause a "Fault Detected" message to scroll once a minute on the display and drop the mA output to 0mA. The Modbus™ fault register bit for Clearing Fault will be set and will not clear until the fault condition has been cleared. The OLCT 700/710 should be considered as "Out-of-Service" until a successful AutoSpan calibration is performed.

Open Heater Fault

If the sensor heater should fail and become electrically open, a "Heater Fault" will be declared. A "Heater Fault" will cause a "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for Heater Fault will be set and will not clear until the fault condition has been cleared. If a Heater Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

Open Sensor Fault

If the sensor film should fail and become electrically open, a "Sensor Fault" is declared. A "Sensor Fault" will cause a "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for Sensor Fault will be set and will not clear until the fault condition has been cleared. If a Sensor Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

Processor Fault

If the OLCT 700/710 has any unrecoverable run-time errors, a "Processor Fault" is declared. A "Processor Fault" will cause a "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for Processor Fault will be set and will not clear until the fault condition has been cleared. If a Processor Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

Memory Fault

If the OLCT 700/710 has a failure in saving new data to memory, a "Memory Fault" is declared. A "Memory Fault" will cause the "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for Memory Fault will be set and will not clear until the fault condition has been cleared. If a Memory Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

4-20mA Loop Fault

If the OLCT700/710 detects a condition where the 4-20mA output loop is not functional (high loop resistance or failed circuit function) a "4-20mA Fault" is declared. A "4-20mA Fault" will cause the "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for Loop Fault will be set and will not clear until the fault condition has been cleared. If a Loop Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

NOTE: If the 4-20mA output is not being used, the Green wire from the detector *must* be connected to the Black wire at the (-) terminal on the Transient Protection Module to ensure RS-485 communication is not disrupted by a 4-20mA Fault.

Input Voltage Fault

If the OLCT 700/710 is currently receiving an input voltage that is outside of the 11.5-28VDC range, an "Input Voltage Fault" is declared. An "Input Voltage Fault" will cause the "Fault Detected" message to scroll once a minute on the display. The fault register bit for Input Voltage Fault will be set and will not clear until the fault condition has been cleared. If an Input Voltage Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

Temperature Fault

If the OLCT 700/710 is currently reporting an ambient temperature that is outside of the –40°C to +75°C range, a "Temperature Fault" is declared. A "Temperature Fault" will cause the "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for Temperature Fault will be set and will not clear until the fault condition has been cleared. If a Temperature Fault occurs, the 4-20mA signal remains operational.

AutoSpan Fault

If 180 days has elapsed since the last successful AutoSpan, an AutoSpan Fault will be generated. An "AutoSpan Fault" will cause the "Fault Detected" message to scroll once a minute on the display. The Modbus™ fault register bit for AutoSpan Reminder Fault will be set and will not clear until the fault condition has been cleared. If an AutoSpan Reminder Fault occurs, the 4-20mA signal remains operational.

Refer to the Troubleshooting Guide, Section 0, for guidance on fault conditions If you cannot fix the fault condition, email our Technical Service team at oldhamsimtronics-support@teledyne.com or call +33 (0)3 21 60 80 86.

4 RS-485 Modbus™ Protocol

OLCT 700/710 gas detectors feature Modbus™ compatible communications protocol and are addressable via the program mode. Communication is two wire, half duplex 485, 9600 baud, 8 data bits, 1 stop bit, no parity, with the detector set up as a slave device. A master controller up to 1200 meters (4000 feet) away can theoretically poll up to 256 different detectors. This number may not be realistic in harsh environments where noise and/or wiring conditions would make it impractical to place so many devices on the same pair of wires. If a multi-point system is being utilized, each detector should be set for a different address. Typical address settings are: 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B, 0C, 0D, 0E, 0F, 10, 11...etc.

Detector RS-485 ID numbers are factory default to 01. These can be changed in the field via the Operator Interface described in Section 3.5.5 Set Serial ID.

The following section explains the details of the Modbus™ protocol that the OLCT 700/710 detector supports.

Code 03 - Read Holding Registers is the only code supported by the transmitter. Each transmitter contains 6 holding registers which reflect its current status.

Table 3: Modbus™ Registers

FC	REG	Content Description	R/W	Content Definition		
				Value	Meaning	Range
03	40000	Device Type	R	8	OLCT 700/710 Detector	
03 06	40001 40001	Read Detectable Range[1,2] Write Detectable Range	R/W	100 10000	For 0-100 For 0-10000[2]	FP – Read only TP – 20, 50, 100, 200 IR – 0 to 10000
03	40002	Read Concentration[3,2]	R	1000	Bound by range. If > range, this value is in fault.	
03 06	40003 40003	Read AutoSpan Level[4,2] Write AutoSpan Level	R/W	50	Span gas at 50	FP – 5% to 95% of Range (40001) TP – 2% to 50% of Range (40001) IR – 5% to 95% of Range (40001)
03	40004	Read Sensor Life	R	85	For 85% sensor life	
03	40005	Read Fault Status Bits[5]	R	0x0001 0x0002 0x0004 0x0008 0x0010 0x0020 0x0040 0x0080 0x0100 0x0200 0x0400 0x0800 0x1000 0x2000 0x4000 0x8000	Global Fault Auto Span Fault Temperature Fault 4-20mA Fault Input Voltage Fault Memory Fault Processor Fault Clearing Fault Stability Fault Range Fault Sensor Fault Zero Fault Sensor Fault 2 <reserved> In Calibration Communication Error	
03	40006	Read Model #	R	1, 2, 3, 4, 5	DM, FP, IR, TP, PID respectively	
03	40007	Read Days Since Cal	R	29	29days	
03	40008	4-20 Current Output mA x100	R	400	4.00mA	Range
03	40009	Read Input Voltage V x100	R	2400	24.00V	

FC	REG	Content Description	R/W	Content Definition		
				Value	Meaning	Range
03	40010	Read Temperature	R	28	28 °C	
03/06	40011	Special #1	R/W		Function dependent on value of 40006 (See Special Register Table 4)	
03/06	40012	Special #2	R/W		Function dependent on value of 40006 (See Special Register Table 4)	
03	40013	Special #3	R		Function dependent on value of 40006 (See Special Register Table 4)	
03/06	40014	Special #4	R/W		Function defendant on value of 40006 (See Special Register Table 4)	
03	40015	Calibration Status	R	0x0000 0x0001 0x0002 0x0003 0x0004	Idle Zero Calibration Started Span Calibration Started Span Set Span Calibration Unsuccessful	
06	40015	Calibration Enable	W	0x0001 0x0002 0x0008 0x0009 0x000A 0x000B	Set Zero Set Span Signal simulation mode Set OLCT 700/710 FP Bridge Voltage Set OLCT 700/710 TP Heater Power Set OLCT 700/710 IR Gain	
03	40016	Read Text 1, first char in L	R		Two Char of Gas/Units String[6]	
03	40017	Read Text 2	R		Two Char of Gas/Units String[6]	
03	40018	Read Text 3	R		Two Char of Gas/Units String[6]	
03	40019	Read Text 4	R		Two Char of Gas/Units String[6]	
03	40020	Read Text 5, last char in H	R		Two Char of Gas/Units String[6]	
03	40021	Text null terminator in L	R		Two Char of Gas/Units String[6]	

[1] Integer ranges from 1 all the way to 10,000.
[2] Units are determined by "units" field in the "notation" string
[3] Gas Reading times one *(x 1)* with units in notation string for "Low Range" = 0. Gas Reading times one *(x 10)* with units in notation string for "Low Range" = 1. Gas Reading times one *(x 100)* with units in notation string for "Low Range" = 2.
[4] Span Gas must be less than or equal to Detectable Range and is usually about ½ of it.
[5] Fault status bits self-reset when fault clears
[6] Text in ASCII, in order L byte, H byte, L byte... See field descriptions of notation string.

Gas/Units String

Character #	1	2	3	4	5	6	7	8	9	10	11
Description	Units			0x20	Gas Type						0x00

Units – This field is 'PPM', 'PPB', or '_ _ %' (where ' _ ' is a space, 0x20).
0x20 – The units filed is terminated with an ASCII space (0x20)
Gas Type – This field contains the gas type of the cell. Any ASCII string is permissible
0x00 – The notation string is terminated with an ASCII null character

Table 4: Modbus™ Special Registers

REG	700/710 FP (40006 = 2)	700/710 IR (40006 = 3)	700/710 TP (40006 = 4)[1]
40011	Gas Factor (R/W) Range = 79 to 565	Gas Factor (R/W) Range = 20 to 565	Heater Power (mW) (R/W)
40012	Cal Factor (R/W) Range = 79 to 565	Active Counts	Heater Voltage (mV)
40013	Bridge Current (mA)	Reference Counts	Sensor Resistance (x100 Ω)
40014	Bridge Voltage (mV) (Read only)	Range Divisor 1,10,100, or 1000	Heater Current (mA)

[1] Only possible ranges are 20, 50, 100, 200. Modbus register 40001 will contain either 20, 50, 100, or 200, range divisor is not necessary.

5 Service and Maintenance

5.1 Calibration Frequency

Gas detectors are safety devices. TELEDYNE OLDHAM SIMTRONICS recommends the regular testing of fixed gas detection installations. This type of test consists of applying calibration gas at a sufficient concentration to trigger the pre-set alarms. It is to be understood that this test is in no way a replacement for a detector calibration. The bump tests frequency depends on the application. Upon initial installation and commissioning, close frequency tests should be performed, weekly to monthly. Test results should be recorded and reviewed to determine a suitable calibration interval; however, it must not exceed one year. The general manager should put safety procedures in place on-site. TELEDYNE OLDHAM SIMTRONICS cannot be held responsible for their enforcement.

5.2 Visual Inspection

The Detector should be inspected annually. Inspect for signs of corrosion, pitting, and water damage. During visual inspection, the Splash Guard should be inspected to insure that it is not blocked. Examine the porous 316SS flame arrestor within the detector's bottom housing for signs of physical blockage or severe corrosion. Also, inspect inside the Junction Box for signs of water accumulation or Terminal Block corrosion.

5.3 Condensation Prevention Packet

A moisture condensation packet should be installed in every explosion proof Junction Box. The moisture condensation prevention packet will prevent the internal volume of the J-Box from condensing and accumulating moisture due to day-night humidity changes. This packet should be replaced annually. Teledyne Oldham Simtronics's PN is DET-960-202200-000.

NOTE: A desiccant cap with a desiccant packet is attached to the sensor housing to avoid damage during storage and shipping. This prevents water from contacting the sensor film, and as a result helps to retain the stability of the factory span calibration.

NOTE: Store the desiccant caps with the desiccant packets in a sealed container (i.e. zip-lock bag) for future use. It is advisable to reinstall the desiccant cap and packet during prolonged periods without power (more than 1 day is considered "prolonged"). An active desiccant packet is blue in color and turns pink when consumed (PN DET-960-399800-000 Package of 10).

5.4 Replacement of Plug-in H_2S Sensor

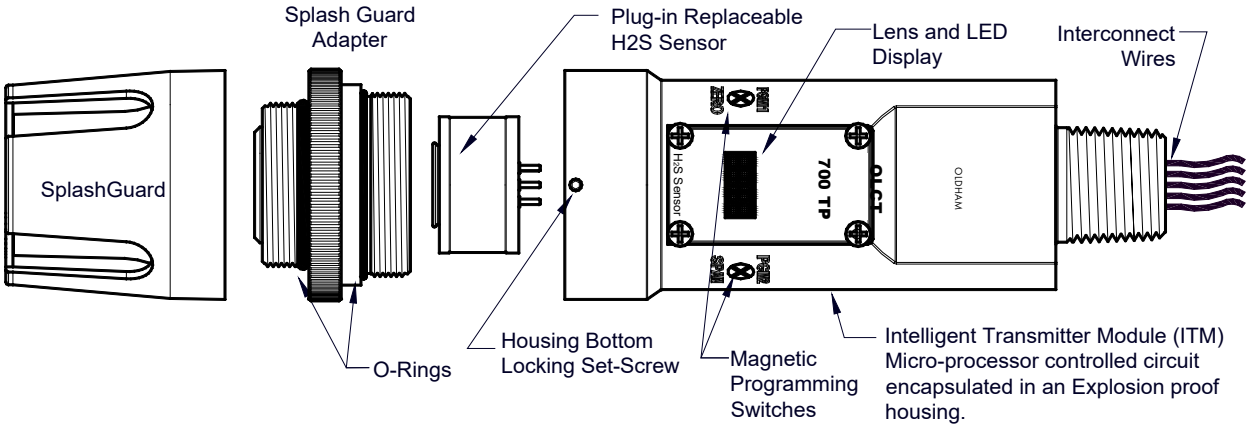


Figure 12: Detector Assembly

a) Remove power to OLCT 700/710 TP detector by lifting the + 24VDC wire in J-Box.

NOTE: It is necessary to remove power while changing the plug-in H_2S sensor in order to maintain area classification.

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b) b) Use a M1.5 Allen wrench to release the locking setscrew that locks the ITM and bottom housing together (One turn will suffice - Do not remove setscrew completely).

c) Remove splashguard. Unthread and remove the Bottom Housing from the ITM.

d) Gently pull the plug-in H_2S sensor cell out of the ITM. Orient the new plug in sensor so that it matches with the female connector pins. It may be necessary to look from below to assure alignment is correct. When properly aligned, press the sensor in firmly to make the proper connection.

e) Thread the Bottom Housing onto the ITM to a snug fit and tighten the locking setscrew using the 1/16" Allen wrench. Reinstall the splashguard.

f) Perform "Set Heater Power (Section 3.5.6 to match the new sensor with the ITM. Perform a successful AutoSpan to match the new sensor with the ITM (Section 0).

6 Troubleshooting Guide

Refer to the list of Failsafe Diagnostic features listed in Section 3.6 for additional reference in troubleshooting activities. Listed below are some typical trouble conditions and their probable cause and resolution path.

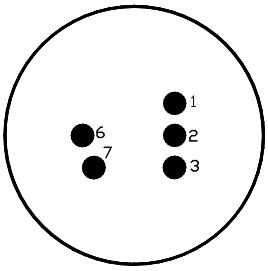

Figure 13: Sensor PCB

Open Heater

Probable Cause: Plug-in sensor has failed

- Remove plug-in H_2S sensor and verify resistance between PIN 2 and PIN 3 (Shown in Figure 13) using an ohmmeter. At room temperature, the heater film's normal reading should range between 65 and 95 ohms.
- Replace the plug-in H_2S sensor if open circuit or significantly out-of range readings are found.

Open Sensor

Probable Cause: Plug-in sensor has failed

- Remove plug-in H2S sensor cell and verify resistance between PIN 6 and PIN 7 (Shown in Figure 13) using an ohmmeter. At room temperature, the sensor film's normal reading range should be 10-100 k-ohms. For sensors with an "X" in the serial number, the normal reading range should be 75 k-ohms to 2 meg-ohms. Failure would be open circuit.
- Replace the plug-in H_2S sensor cell if an open circuit found.

AutoSpan Calibration Faults – (Range, Stability and Clearing)

To clear any AutoSpan Calibration fault, the AutoSpan process must be completed successfully (Section0).

Range Fault

Probable Causes: Failed Sensor, Cal Gas not applied or not applied at appropriate time, problems w/ cal gas and delivery, no Humidifying Tube used, failure to properly desiccant packet the sensor during extended power-off periods.

- Check Heater Power Setting (should be 235 +/- 5mW at 25ºC ambient temperature).
- Verify use of span gas Humidifying Tube.

- If using Splashguard with Integral Cal Port, must use Calibration Wind Guard or air movement can compromise span gas delivery.
- Check validity of span gas using H2S pull tube or other means (check MFG date on cal gas cylinder).
- Check for obstructions through stainless steel flame arrestor (including being wet, blocked, or corroded).
- Replace the plug-in H2S sensor.

Stability Fault

Probable Causes: Failed Sensor, empty or close to empty Cal Gas Cylinder, problems with cal gas and delivery, or no Humidifying Tube used, failure to properly desiccant packet the sensor during extended power-off periods.

- Check Heater Power Setting (should be 235 +/- 5mW at 25ºC ambient temperature).
- Verify use of span gas Humidifying Tube.
- If using Splashguard with Integral Cal Port, must use Calibration Wind Guard or air movement can compromise span gas delivery.
- Check validity of span gas using H2S pull tube or other means (check MFG date on cal gas cylinder).
- Check for obstructions through stainless steel flame arrestor (including being wet, blocked, or corroded).
- Replace the plug-in H2S sensor.

Clearing Fault

Probable Causes: Failed Sensor, Cal Gas not removed at appropriate time or problems with cal gas and delivery, presence of background H_2S, or incorrect Heater Power Setting.

- Must recover to < 5ppm in < 5 min after AutoSpan is complete.
- Use bottled air (zero air) if there is a known continuous H2S background level.
- Verify use of span gas Humidifying Tube.
- Check validity of span gas using H2S pull tube or other means (check MFG date on cal gas cylinder).
- Check for obstructions through stainless steel flame arrestor (including being wet, blocked, or corroded).
- Perform Heater Power Setting.
- Replace the plug-in H2S sensor.

Poor Calibration Repeatability

Probable Causes: Failed Sensor, use of wrong Cal Gas or problems w/ cal gas and delivery, or Interference Gases.

- Check for adequate Sensor Life.
- Check Heater Voltage Setting (should be 235±5mW at 25ºC).
- Verify use of span gas Humidifying Tube.

- Check validity of cal gas using H2S pull tube or other means (check MFG date on cal cylinder).
- Check for obstructions through stainless flame arrestor (including being wet, blocked, or corroded).
- Evaluate area for presence of any contaminating gases as listed in Section 2.4.
- Note the sensor's serial # and report repetitive problems to Teledyne Oldham Simtronics's Repair Department.
- Replace plug-in H_2S sensor.

Unstable Output/ Sudden spiking

Possible Causes: Unstable power supply, inadequate grounding, or inadequate RFI protection.

- Verify Power source is stable.
- Verify field wiring is properly shielded and grounded.
- Contact Teledyne Oldham Simtronics to optimize shielding and grounding.
- Add Teledyne Oldham Simtronics's RFI Protection Circuit accessory if problem is proven RFI induced.

Nuisance Alarms

- Check condulet for accumulated water and abnormal corrosion on terminal blocks.
- If nuisance alarms are happening at night, suspect condensation in condulet. Add or replace Teledyne Oldham Simtronics's Condensation Prevention Packet PN DET-960-202200-000.
- Investigate the presence of other target gases that are causing cross-interference signals.
- Determine if cause is RFI induced.

Processor and/or Memory Faults

- Recycle power in attempt to clear problem
- Restore Factory Defaults - This will clear the processor's memory and may correct problem.Remember to re-enter all customer settings for range and cal gas level after Restore Factory Defaults.
- If problem persists, replace the Intelligent Transmitter Module.

Unreadable Display

- If due to excessive sunlight, install a sunshade to reduce glare.

Nothing Displayed – Transmitter not Responding

- Verify condulet has no accumulated water or abnormal corrosion.
- Verify required DC power is applied to correct terminals.
- Swap with a known-good ITM to determine if ITM is faulty.

Faulty 4-20mA Output

If Detector has a normal reading with no Faults displayed, and the 4-20 mA signal output is 0mA.

- Check that wiring is properly connected at terminal blocks and through to controller inputs. The 4-20mA output loop must be closed to avoid a Loop Fault. If the 4-20mA output is not

being used the green wire from the detector must be connected to the (-) terminal on the Transient Protection Module to ensure that it does not create a 4-20mA Fault (section 2.7).
- Perform a "Signal Output Check" sequence via Section 3.5.7 and verify 4-20mA output with Current Meter.
- Swap with new ITM to determine if the ITM's 4-20mA output circuit is faulty.
- If the 4-20mA current loop is still out of tolerance, contact Teledyne Oldham Simtronics's Technical Support at oldhamsimtronics-support@teledyne.com.

No Communication - RS-485 Modbus™

If detector has a normal reading with no Faults displayed and the Modbus™ is not communicating.

- Verify that the correct (and non-duplicated) serial address is entered (per Section 0).
- Check that the wiring is properly connected at terminal blocks, and the serial loop is wired correctly.
- Perform a "Signal Output Check" per Section 3.5.7 and troubleshoot wiring.
- Consider adding a Modbus™ repeater if the distance from the nearest distribution drop is excessive.
- Swap with new ITM to determine if the ITM's serial output circuit is faulty.
- Refer to Teledyne Oldham Simtronics's "Guide to Proper Modbus™ Communications" Application Note.

Customer Support and Service Policy

Teledyne Oldham Simtronics Headquarters

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- customer service:oldhamsimtronics-customerserviceexport@teledyne.com
- technical support:oldhamsimtronics-support@teledyne.com
- repair activities:oldhamsimtronics-R2@teledyne.com

All Technical Service and Repair activities should be handled by the Teledyne Oldham Simtronics Service Department via phone, fax or email at contact information given above. RMA numbers should be obtained from the Teledyne Oldham Simtronics Service Department prior to equipment being returned. For on-line technical service, customers should have ready the model number, part number, and serial number of product(s) in question.

7 Appendix

7.1 Specifications

Sensor Type:	Continuous diffusion/adsorption type CHEMFET Solid State MOS type True plug-in replaceable type
Sensor Life:	5-10 years typical
Measuring Ranges:	0-20ppm, 0-50ppm, 0-100ppm
Accuracy/ Repeatability:	± 10% of reading or ± 2ppm (whichever is greater)
Response Time:	T50 < 30 seconds, T80 < 60 seconds
Analog Output:	Linear 4-20mA DC current (1000 ohms maximum loop load @ 24VDC) 0mA All Fault Diagnostics 2mA In-Calibration 4-20mA 0-100% full-scale 22mA Over-range condition
Serial Output:	RS-485 Modbus™ RTU 9600 BPS (9600,N,8,1 Half Duplex)
Status Indicators:	4-digit LED Display with gas concentration full-script menu prompts for AutoSpan, Set-up Options, and Fault Reporting
Faults Monitored:	Heater, Loop, Input Voltage, Sensor, Processor, Memory, Calibration
ATEX Marking:	 II 2 GEx db IIB+H_2 T4 Gb (Tamb=-40° to +70°C)
Ingress Protection:	NEMA 4X, IP66
Safety Approvals:	ATEX CE Marking SIL2 FMEDA Rating
Warranty:	Sensor – 5 year Transmitter – 2 years

Environmental Specifications

Operating Temperature:	-40°F to +158°F; -40°C to +70°C FM ISA 92.0.01 Certified from -40°C to +65°C for H_2S
Storage Temperature:	-58°F to +158°F; -50°C to +70°C
Operating Humidity:	5-100% RH (Non-condensing)
Operating Pressure Range:	Atmospheric ± 10%

Mechanical Specifications

Dimensions :	
OLCT 700	7"H x 2.2" Dia.; 178mmH x 65mm Dia.
OLCT 710	13.74"H x 5.0"W x 5.12"D; 349mmH x 127mmW x 130mmD
Weight:	2.5 lbs; 1.14 kg (OLCT 700 only) 7.4 lbs; 3.36 kg (OLCT 710 w/aluminum j-box) 16.4 lbs; 7.44 kg (OLCT 710 w/stainless steel j-box)

Electrical Specifications

Input Voltage:	11-30 VDC
Power Consumption:	Normal operation = 68mA (<1.7 watt) Maximum = 85mA (2 watts)
Inrush current:	1.0A @ 24V
RFI/EMI Protection:	Complies with EN 50270 for Type 2 device

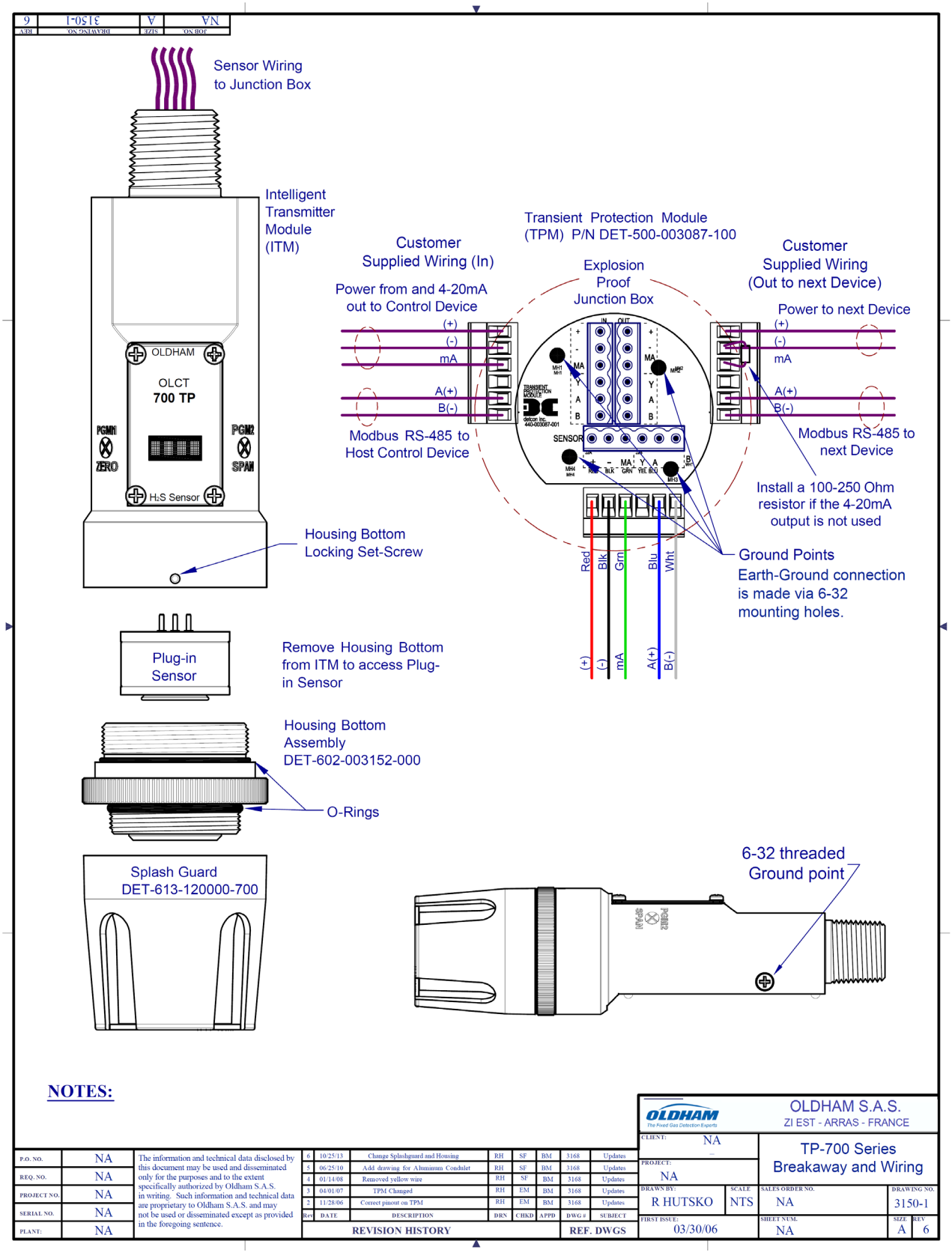
Cable Requirements:

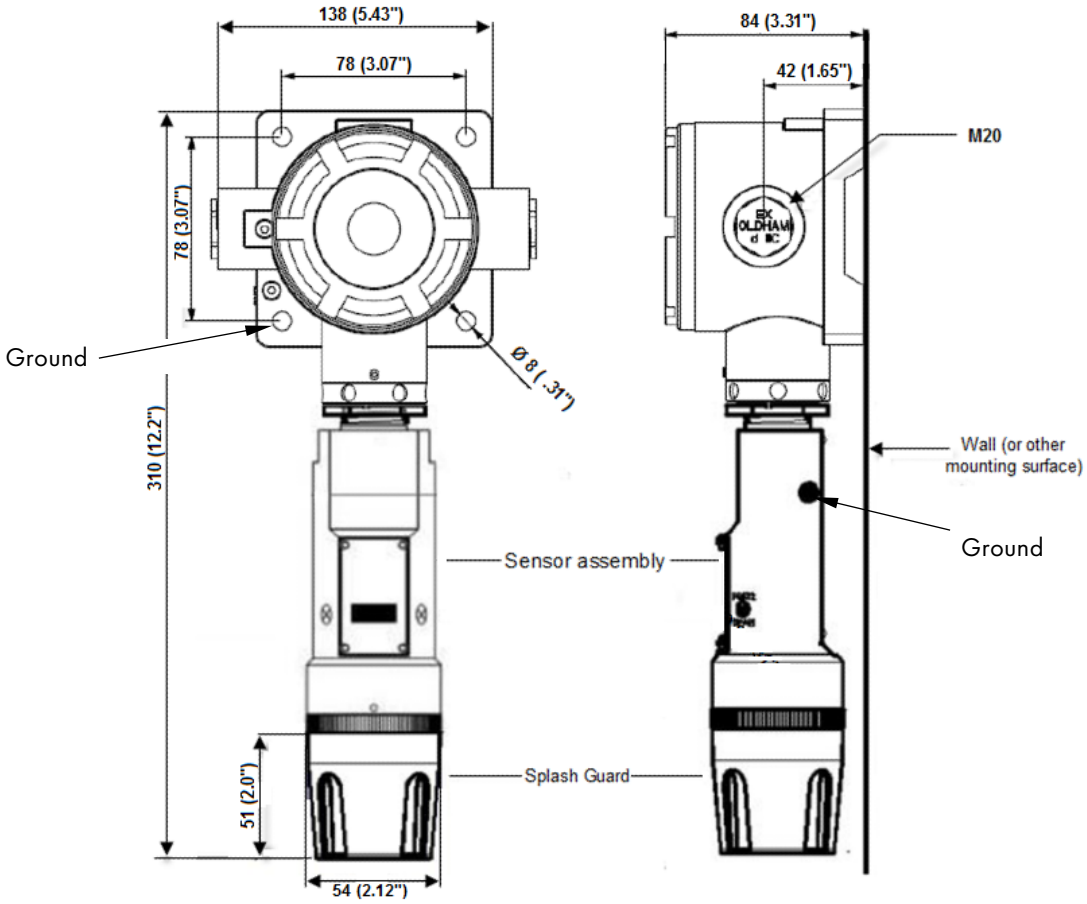
Power/Analog:	3-wire shielded câble Maximum distance is 4000 meters with 14 AWG
Serial Output:	2-wire twisted-pair shielded cable specified for RS-485 use Maximum distance is 1200 meters to last detector
I/O Protection:	Over-Voltage, Miss-wiring, EMI/RFI Immunity

7.2 Spare Parts, Detector Accessories, Calibration Equipment

Part Number	Spare Parts
DET-927-015500-100	OLCT 700/710 TP Intelligent Transmitter Module (ITM)
DET-602-003280-000	OLCT 700/710 TP Housing Bottom Assembly (includes Flame Arrestor)
DET-370-010000-700	Replacement Plug-in H_2S sensor
DET-500-003087-100	Transient Protection PCA
Detector Accessories	
DET-613-120000-700	Detector Splashguard with integral Cal-Port
DET-943-002273-000	Hazardous location dust guard
DET-327-000000-000	Programming Magnet
DET-960-202200-000	Condensation Prevention Packet (for J-Box replace annually)
DET-602-003306-0TP	Dust Cap 1.5" Thread with Desiccant Pack
DET-960-240010-000	Desiccant Protection Packet for Cell
6322420	OLCT 710 ceiling mount
Calibration Accessories	
DET-943-000000-000	Calibration Wind Guard
DET-943-000006-132	Threaded Calibration Adapter
DET-985-241100-321	In-Line Humidifying Tube
18108088	Span Gas cylinder: 10ppm H_2S in air (for 20ppm range). Contains 112 liters of gas.
18108087	Span Gas cylinder: 25ppm H_2S in air (for 50 and 100ppm ranges). Contains 112 liters of gas.
18108010	Span Gas cylinder : Zero Grade Air. Contains 112 liters of gas.
6128848	0.5l/min Fixed Flow Regulator for span gas bottle
Recommend Spare Parts for 2 Years	
DET-927-015500-100	OLCT 700/710 TP Intelligent Transmitter Module (ITM)
DET-602-003280-000	OLCT 700/710 TP Housing Bottom Assembly (includes Flame Arrestor)
DET-370-010000-700	Replacement Plug-in H_2S sensor
DET-500-003087-100	Transient Protection PCA
DET-960-202200-000	Condensation prevention packet (for J-Box replace annually)

7.3 OLCT 700710 TP Drawings





OLCT 710 TP Series Dimensional

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