TELEDYNE DETCON

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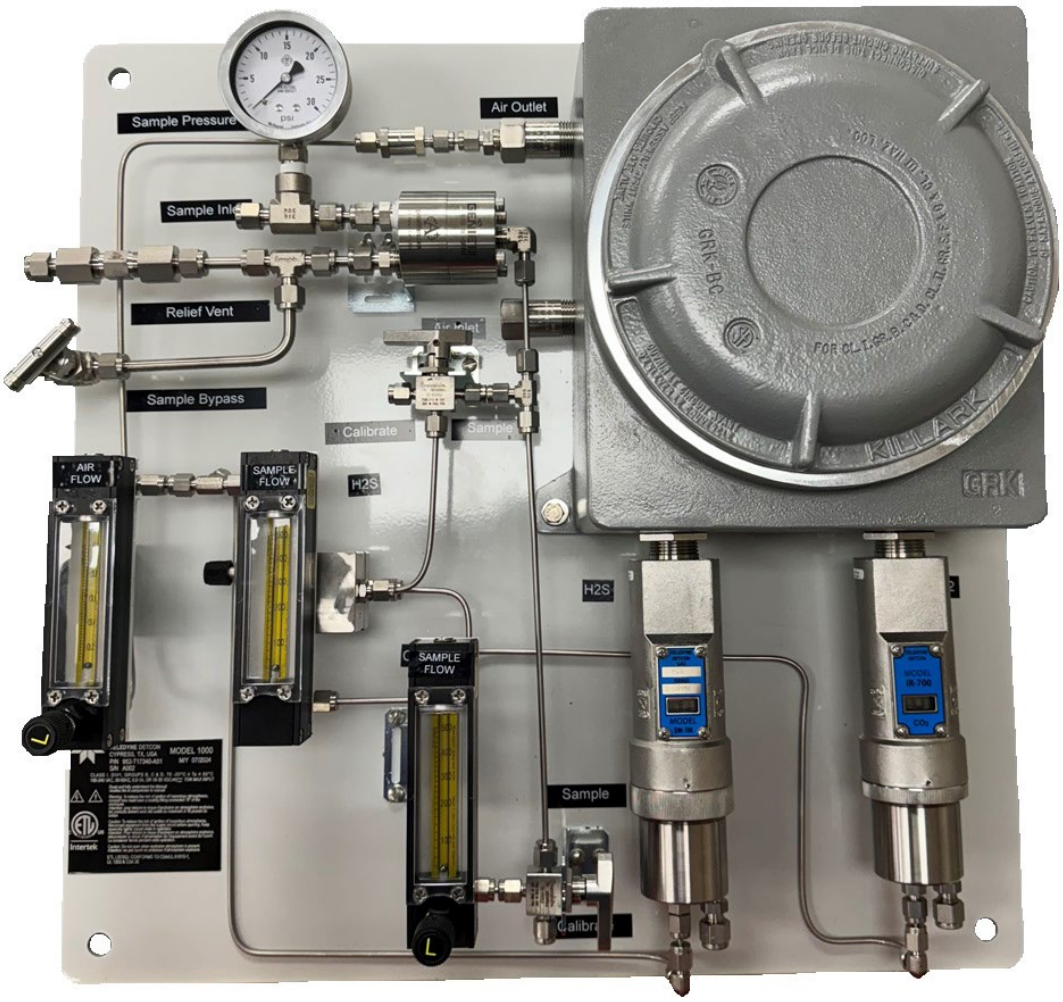
User Guide

MODEL 1000

H_2S/CO_2 Process Analyzer



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1. About this Guide

This manual provides information designed to guide you through the installation, calibration, and operation of your new Model 1000 H_2S E-Chem/CO_2 Process Analyzer (also referred to as "the Analyzer"). This document is the Operating Manual for the Analyzer. Please read this manual and keep it available.

Manuals do get misplaced. Additional hard-copy manuals can be obtained from the Company, and soft-copies of some manuals can be obtained on-line. Please refer to Section 8: Customer Support and Service Policy.

WARNING: ALL INDIVIDUALS WHO, HAVE OR WILL HAVE, RESPONSIBILITY FOR USING, MAINTAINING, OR SERVICING THIS PRODUCT, MUST READ THIS ENTIRE MANUAL CAREFULLY. FAILURE TO USE THIS EQUIPMENT PROPERLY COULD RESULT IN SERIOUS INJURY OR DEATH.

1.1 Guide Conventions

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

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

WARNING: THIS ICON AND TEXT INDICATE A POTENTIALLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR INJURY.

Caution: This icon and text indicate an action or situation, which, if not avoided, could result in injury or damage to the equipment.

NOTE: This icon and text designates information of special note to the operator.

Caution: Risk of Electrical Shock

2. Introduction

The Model 1000 Series H_2S/CO_2 Process Analyzer (also referred to as "the Analyzer") is a 110/220VAC or 24VDC powered analyzer that provides a select gas sample mixture to on-board DM-700 H_2S and IR-700 CO_2 gas sensor assemblies. The ranges of analysis are determined at time of order. This product is **NOT** to be used as a safety device.

The device is designed for indoor use. When located outdoors, the Analyzer package should be appropriately covered from direct exposure to the elements by a NEMA 4 rated enclosure.

The electronics enclosure on the upper right side of the unit houses a 24 VDC power supply, a 24V DC-DC Converter, a terminal PCB labeled for all input and output field wiring, an air dilution pump, an activated carbon scrubber and a flow fault alarm.

The Analyzer requires a constant, liquid-free 8-12 psig sample, which is provided by the customer.

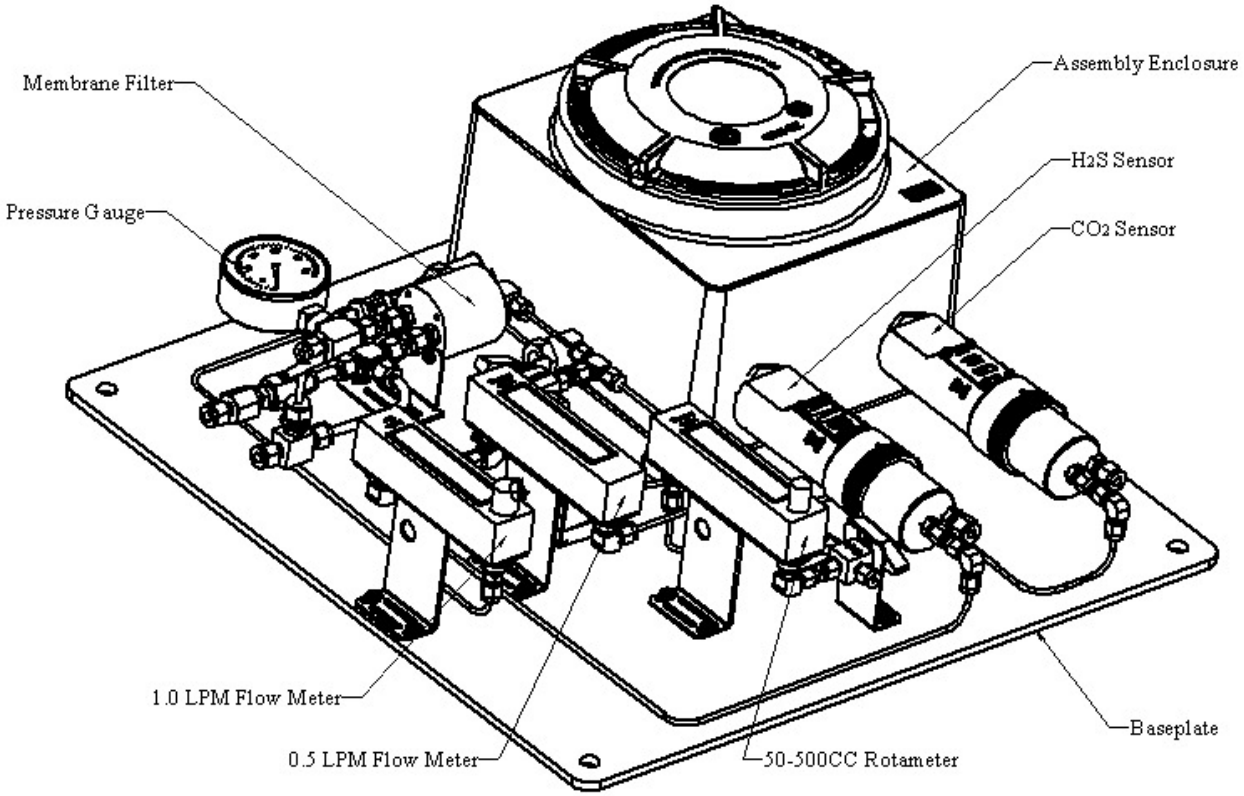

Figure 1 Major Components

The on-board gas sample conditioning system includes a stainless-steel pressure gauge (0-30 psig), and a Genie membrane filter to provide the analyzer with absolute condensate liquid protection. On the bypass port of the Genie membrane filter, a 15-psig over-pressure relief valve and flow control valve are also provided. The flow control valve can be used as a sample bypass and liquid exhaust vent. A 2-part air and one-part sample mixture is maintained and delivered to the Model DM-700 H_2S for analysis. The IR-700 CO_2 gas sensor measures the sample directly. The H_2S sample flow is maintained by a constant-flow Mass Flow controller and an associated rotameter, while airflow is maintained by a control valve rotameter. The sample for the CO_2 sensor is set by a control valve rotameter. Three-way valves are provided for manually switching between sample monitoring and span calibrations.

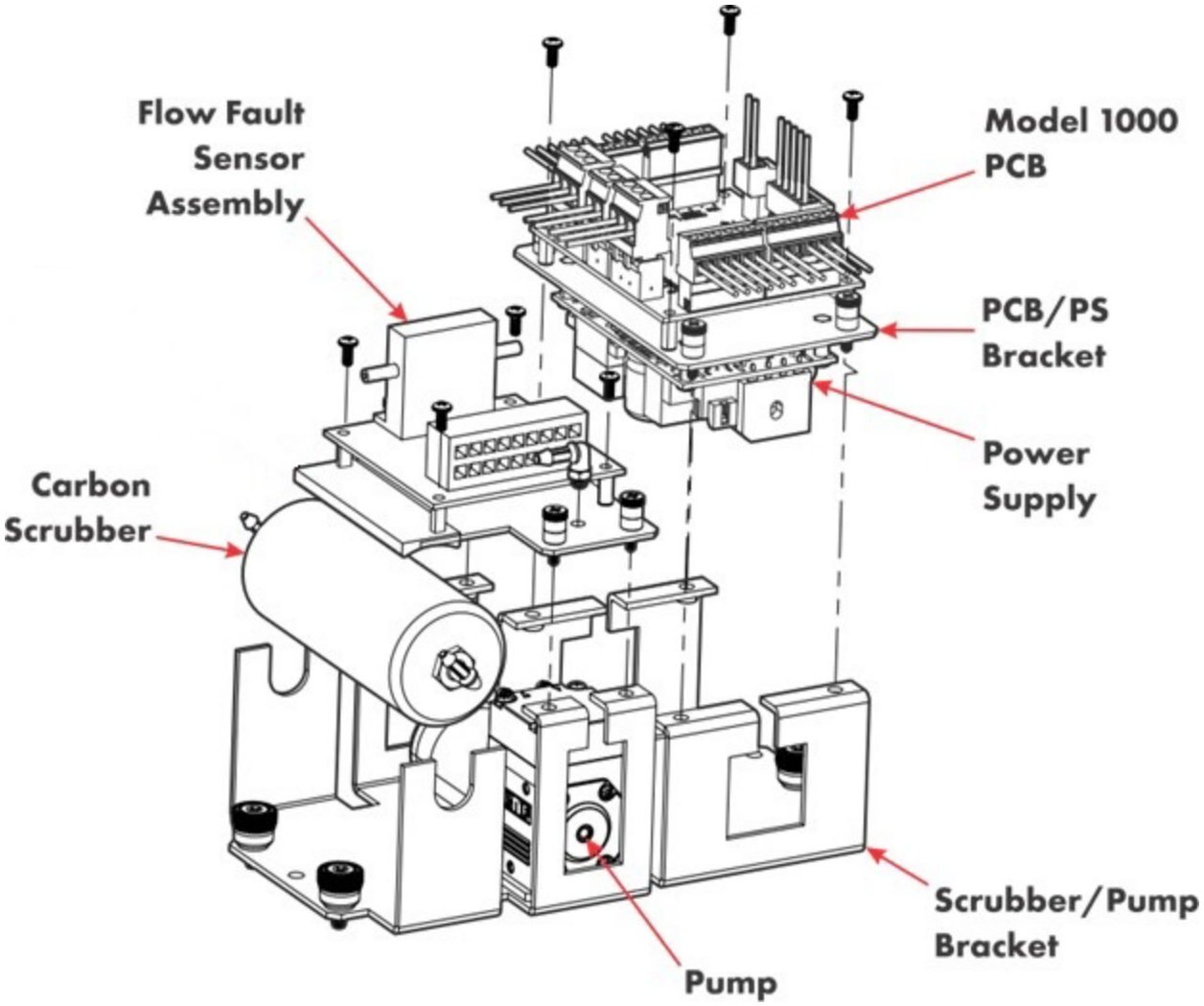

Figure 2 Inner Assembly Components

2.1 Enclosure

The pump, activated carbon scrubber, flow fault assembly, 24 VDC power supply, termination PCB for the power, relay contacts, 4-20mA output, and RS485 signal are located inside the enclosure on the upper right of the unit. The flow sensor must be properly maintained to ensure safe functioning of the device. – See Section 7: Maintenance.

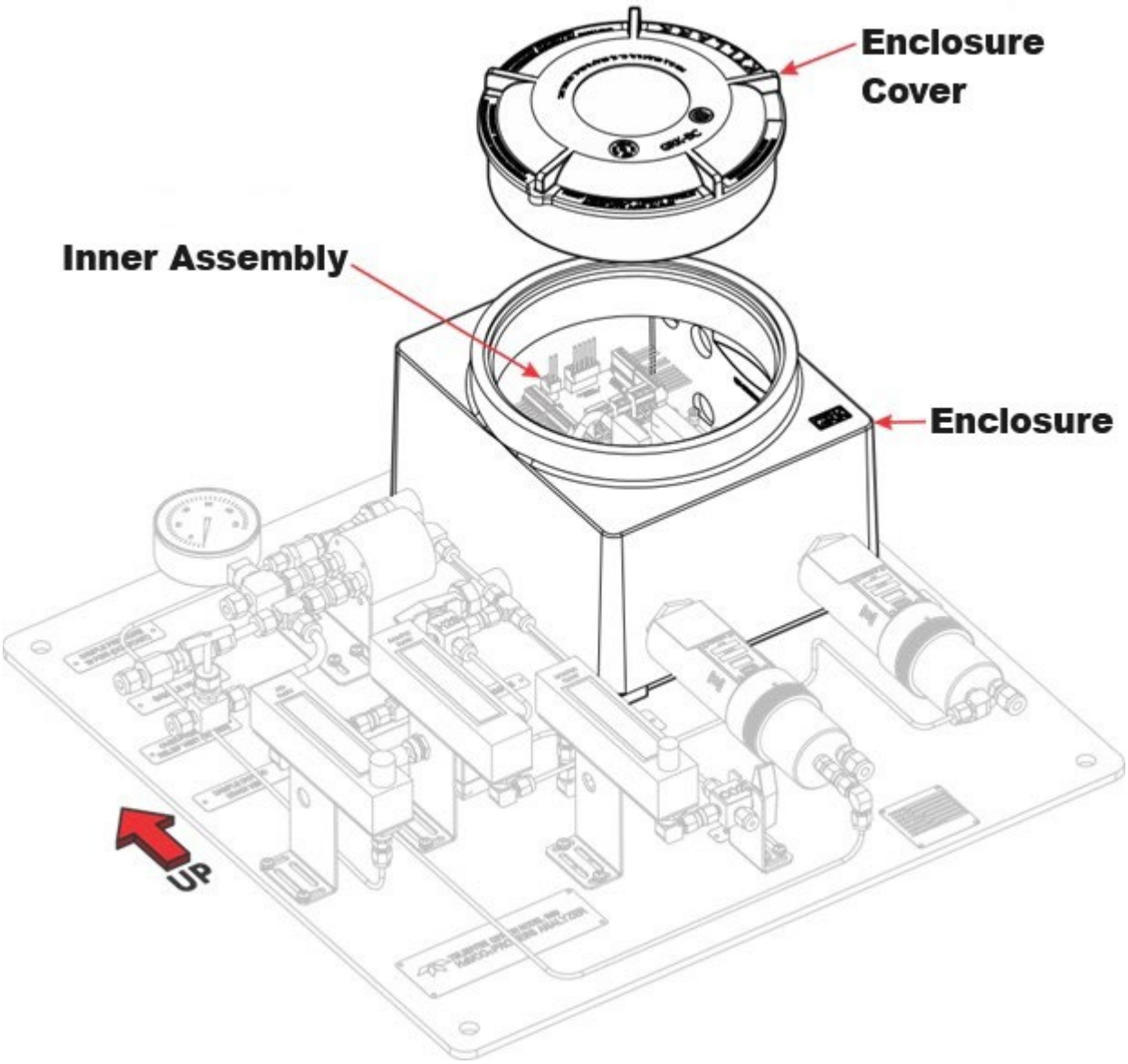

Figure 3 Enclosure with Inner Assembly

2.2 700-Series Sensor

The Model DM-700 and IR-700-CO_2 gas sensors are non-intrusive "smart" sensors designed to detect toxic gases in air. Each sensor features an LED display of current reading, fault, and calibration status. 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 features a four-character alpha/numeric LED used to display sensor readings and the sensor's menu-drive features when the hand-held programming magnet is used.

The sensors are provided with standard analog 4-20mA and ModBus™ RS-485 outputs which are routed to the Model 1000 Analyzer PCB.

The Model DM-700 and IR-700 Sensor Assemblies are completely modular and made up of the following parts:

- Intelligent Transmitter Module (ITM)
- Intelligent Plug-In Sensor (PN varies by range and model)
- Splash Guard Adapter

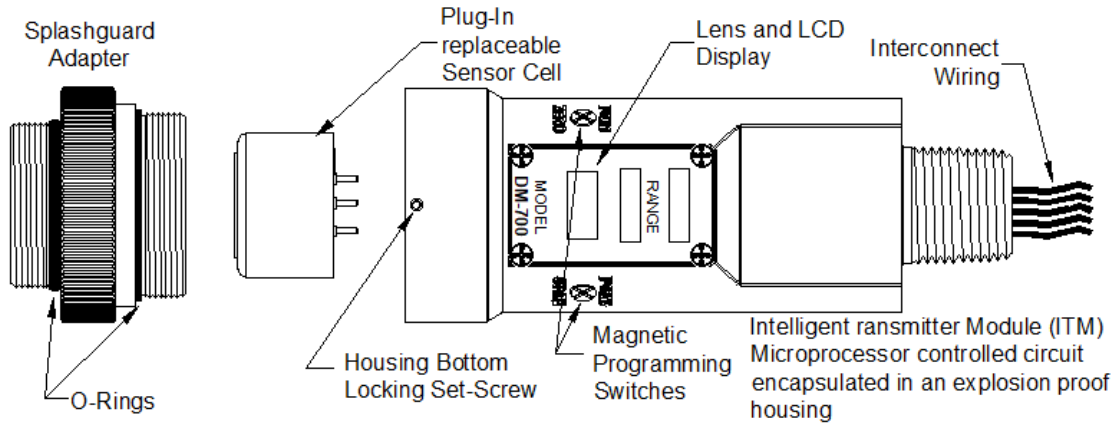

Figure 4 Sensor Assembly Breakaway

Plug-In Cells

The Model DM-700 Sensor works with an intelligent Plug-In electrochemical cell for the detection of hydrogen sulfide (H_2S), while the Model IR-700 works with an intelligent Plug-In Infrared (IR) cell for the detection of carbon dioxide (CO_2) The plug-in cells are field-replaceable components. The intelligent design provides automatic recognition of gas type, units, full-scale range, and calibration data when a new plug-in cell is installed. See Section 7 for maintenance and replacement instructions. See Appendix for sensor specifications.

3. Installation

3.1 Guidelines for Safe Use in Hazardous Locations

Read and fully understand the Manual
Veuillez lire et comprendre le manuel

1. **Warning:** To reduce the risk of ignition of hazardous atmospheres, conduit runs must have a sealing fitting connected within 18" of the enclosure.

   Attention: pour réduire le risque d'explosion en atmosphère explosive, les conduits doivent avoir été scellé au maximum à 18 pouces du boitier

2. **Caution:** To reduce the risk of ignition of hazardous atmospheres, disconnect equipment from the supply circuit before opening. Keep assembly tightly closed while in operation.

   Attention: Pour réduire le risque d'explosion en atmosphère explosive, déconnecter le circuit d'alimentation de l'équipement avant de l'ouvrir. Le conserver fermé pendant cette opération.

3. **Caution:** Do not open when explosive atmosphere is present

   Attention: ne pas ouvrir en présence d'atmosphère explosive

4. All entries into the enclosure that are not factory sealed are to be fitted with explosion proof plugs, explosion proof cable glands when required, or other explosion proof blanking elements by the end user.

5. For safe electrical supply to the Model 1000 a 3-Amp breaker must be installed. This breaker will also function as a disconnect and must be adequately labelled and easily accessible.

6. To achieve proper grounding a 16awg minimum solid or stranded CSA/UL certified cable shall be connected directly to the dedicated ground screw located in the explosion proof enclosure. The ground conductor shall be green with a yellow stripe for easy identification and terminated with a closed loop ring connector that is appropriately sized for the wire and ground screw.

7. Modification to, or Repair of, flameproof joints is not allowed by the end user.

Additional Guidelines for Safe Use in All Locations

WARNING: RISK OF INJURY THROUGH INCORRECT LIFTING AND CARRYING THE DEVICE. INJURIES CAN OCCUR DUE TO THE WEIGHT AND PROTRUDING PARTS WHEN THE DEVICE TIPS OVER OR DROPS.

- DO NOT USE PROTRUDING PARTS TO CARRY THE DEVICE
- CONSIDER THE DEVICE WEIGHT (60LBS) BEFORE LIFTING
- OBSERVE APPLICABLE REGULATIONS FOR PROTECTIVE CLOTHING
- CALL IN FURTHER PERSONNEL IF ASSISTANCE IS REQUIRED
- BEFORE TRANSPORTING, ENSURE OBSTACLES THAT COULD CAUSE FALLS OR COLLISIONS ARE CLEARED AWAY
- SECURE THE DEVICE DURING TRANSPORT
- DO NOT APPLY FORCE OR STRAIN THE EXTERNAL CABLES OR GAS CONNECTIONS

NOTE: This unit **MUST** be installed by trained, qualified and competent personnel. The installation **MUST** comply with local, state, and national regulations, as well as safety practices for this type of equipment. Only parts provided by the original manufacturer should be used with this device.

3.2 Mounting

Securely mount the Model 1000 analyzer panel. Refer to Figure 5: Unit Dimensions. Specific applications may require a protective NEMA 4X enclosure. Based on the unit's dimensions, a Saginaw P/N SCE-24H2410LP or similar (customer provided) enclosure will fit properly. Unit must be mounted vertically with the pressure gauge at the top.

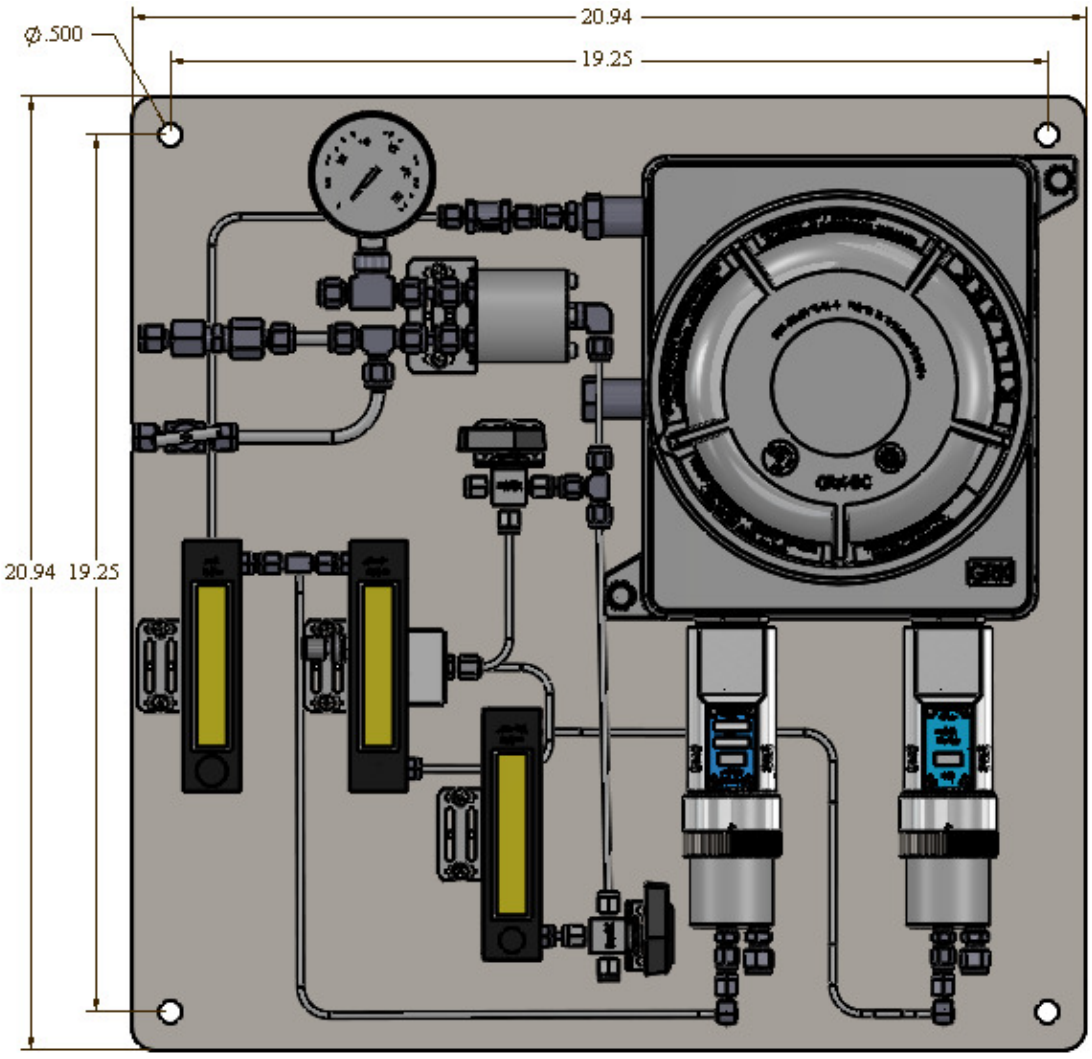

Figure 5 Unit Dimensions

3.3 Gas Connections and Sampling System

1. Install a length of tubing from the desired sample point to the sample inlet port as shown in Figure 6: Port Identification. Sample draw tubing should be 316 stainless-steel of ¼" O.D.

NOTE: A constant pressure of 10±2 psig should be provided to the analyzer for proper operation. If pressure is 2 psig above 10 psig it will automatically be vented by the over-pressure relief vent - this must be vented to a safe area. In applications where line pressure varies significantly, two-stage pressure regulation is recommended to hold the constant pressure. Ideally, the pressure drop from the source to 10 psig for analyzer should be taken as close to the pipeline as possible. This speeds up response time to actual gas concentration changes. An insertion probe membrane device is advisable to use for pipeline sources with high levels of condensates, mist, and contamination.

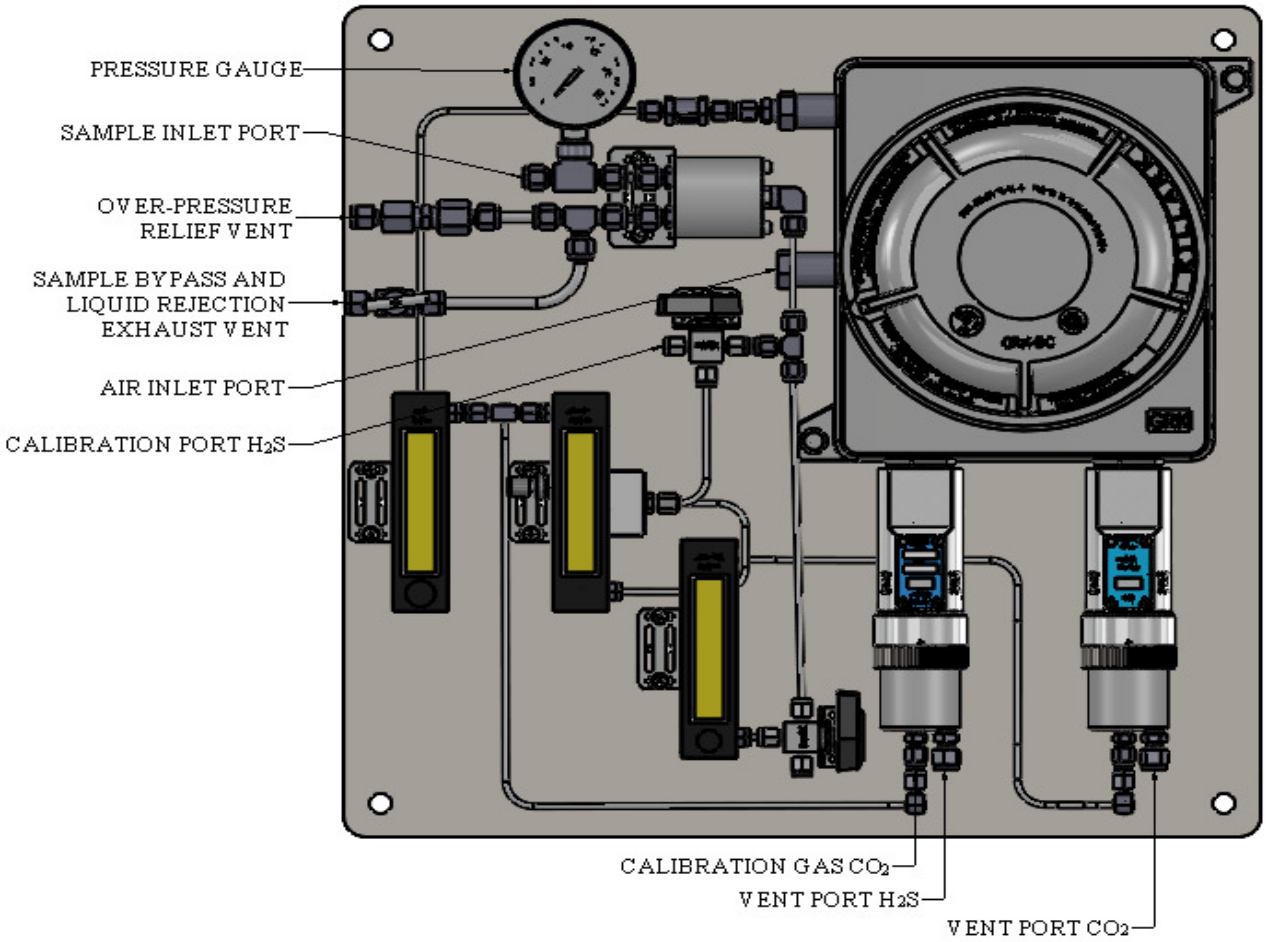

Figure 6 Port Identification

2. Whenever possible, the Sample Bypass flow control valve of the Genie membrane filter should be used to minimize the sample lag time between the sample tap and the analyzer location. It can also be used as a means to exhaust condensed liquids in the sample line away from the Genie filter and prevent a loss of flow condition. Set a flow of 100-200cc/min. and vent to a safe non-hazardous area using ¼ O.D. tubing.
3. Connect to the Over-pressure Relief valve and vent to a safe non-hazardous area. The pressure relief valve is set during assembly to open at 15-20psig. For convenience, the sample bypass and over-pressure relief can be vented together.
4. Install a length of ¼" OD stainless steel tubing from the vent port to an area deemed safe for venting. The sensor vent ports can be tied together but should be separately vented from the over-pressure relief vent and the sample by-pass vent.
5. The Air Inlet Port should remain open and unobstructed. In some cases, the user may opt to operate on instrument air instead of ambient air provided to the pump. In this case, the instrument air must be regulated to a constant pressure of 5psig. The instrument air (because it is extremely dry) must be passed through a humidifying tube. (Contact Teledyne Detcon for details.)

NOTE: Stainless steel vent tubing is recommended. If alternative tubing is used, routine inspection is required to ensure no damage has taken place.

3.4 Electrical Connections

NOTE: All wiring must be installed by a certified electrical technician. Ensure power is removed before servicing or disconnecting.

1. For AC powered units, connect 100-240 VAC to the terminal block labeled "MAINS INPUT" (P1) inside the enclosure. Connect the ground wire directly to the enclosure in the lower right corner using the green screw provided with a closed loop terminal. For DC powered units, connect 18-36VDC to the terminal connector board labeled "DC INPUT" (P2) (refer to Figure 7). Use 16GA CSA Approved UL listed 300V 90°C wire. 3-amp breaker must be installed between the instrument and customer power source.
2. The 4-20mA and/or RS-485 signal outputs should be wired from the terminal PCB and then out the right side of the electronics enclosure (refer to Figure 7). The 4-20mA and RS-485 connections are equipped with switches so that the connections can be terminated when the outputs are not needed. Switches S1 and S2 should be in the ON position ONLY when there is NO 4-20mA connection. Switch S3 should be in the ON position ONLY when the Model 1000 is the last device on the RS-485 line. Refer to the IR-700/DM-700 manuals for additional communication information.
3. Contacts for a low pump flow fault alarm are located on the main PCB (P7). They provide a form "C" relay contact (common, normally open, and normally closed) rated 1 amp at 30 VDC/0.24 amp at 125 VAC.

NOTE: A conduit seal must be installed per the manufacture's recommendations within 18" of the explosion-proof electrical enclosure, in compliance with 60079-0.

NOTE: Install 3 Amp breaker (customer provided) prior to providing power to the unit. The type of breaker must be rated for the location where it resides. The breaker will function as a power disconnect for the analyzer. Breaker must be easily accessible and must be adequately labelled as the disconnect for the equipment.

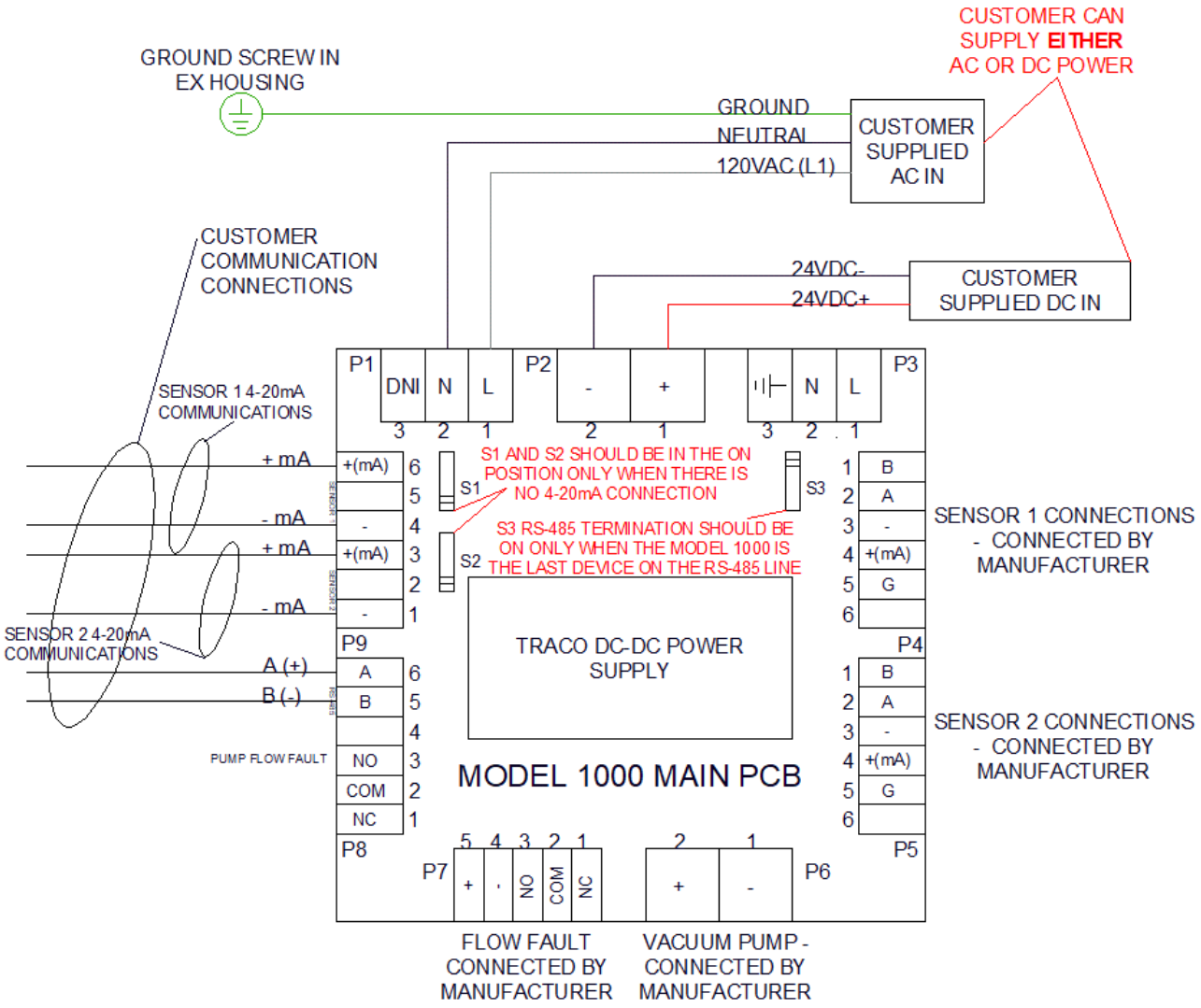

Figure 7 Customer Installation Wiring Connections

4. Start-Up

CAUTION: Do not apply power to the Analyzer in a hazardous area unless the junction box cover is tight and all electrical seals have been installed.

Upon completion of all tubing connections and field wiring the Analyzer is ready for startup. Note that after power is applied, varying readings may occur during sensor warm up. While 24 hours is recommended, allow at least 1 hour for the sensors to stabilize. With sample gas and airflow properly set, apply system power and observe the following normal conditions:

- DM-700 "Fault" LED is off;
- IR-700 "Fault" LED is off;
- a reading close to the anticipated CO_2 and H_2S level should be indicated upon conclusion of a 1-hour warm-up cycle.

NOTE: All alarms will be disabled for 2 minutes after power up. In the event of power failure, the alarm disable period will begin again once power has been restored.

1. Set the sample pressure to 10psig and verify the proper set point at the pressure gauge.
2. Set the airflow through the sample rotameter (CO_2). Adjust the rotameter flow valve to 250cc/min and in alignment with the "→" mark on the rotameter.

NOTE: When sampling sample methane (typical natural gas) the rotameter will show a sample flow of 200 cc/min, but this is actually equivalent to 250 cc/min of nitrogen (because there is a 20% gas density effect of methane on the rotameter.) Another example, a displayed methane flow of 80 cc/min is actually 100 cc/min, when accounting for the density effect. The table below shows the appropriate settings to manage this density effect.

Table 1 H_2S Flow Rate and Cal Gas

DM-700 Range (ppm)	Sample Flow (cc/min)	Air Flow (cc/min)	Span Gas Flow (cc/min)	H_2S Cal Gas (ppm)
0-10	200 Labeled "S→"	500	250 Labeled "C→"	10
0-20	200 Labeled "S→"	500	250 Labeled "C→"	10
0-25	200 Labeled "S→"	500	250 Labeled "C→"	10
0-50	200 Labeled "S→"	500	250 Labeled "C→"	10 or 25
0-100	200 Labeled "S→"	500	250 Labeled "C→"	25 or 50
0-150	200 Labeled "S→"	500	250 Labeled "C→"	25 or 50
0-500	80 Labeled "S→"	1000	100 Labeled "C→"	100

Adjust the sample mass flow controller valve per table above to meet the designated sample flow target mark labeled as "S→". Note: The "C→" indicator on the rotameter is typically used for calibration, which is described later in Section 5Sensor Operation. NOTE: A displayed methane (typical natural gas) sample flow of 200cc/min. is actually equal to 250cc/min. of nitrogen when accounting for the 20% gas density effect on the rotameter. A displayed methane flow of 80cc/min. is actually 100cc/min. when accounting for the density effect.

3. Set the airflow rotameter per the value in the table(s) above.
4. Proceed with sensor calibration. as described in section 5.4.

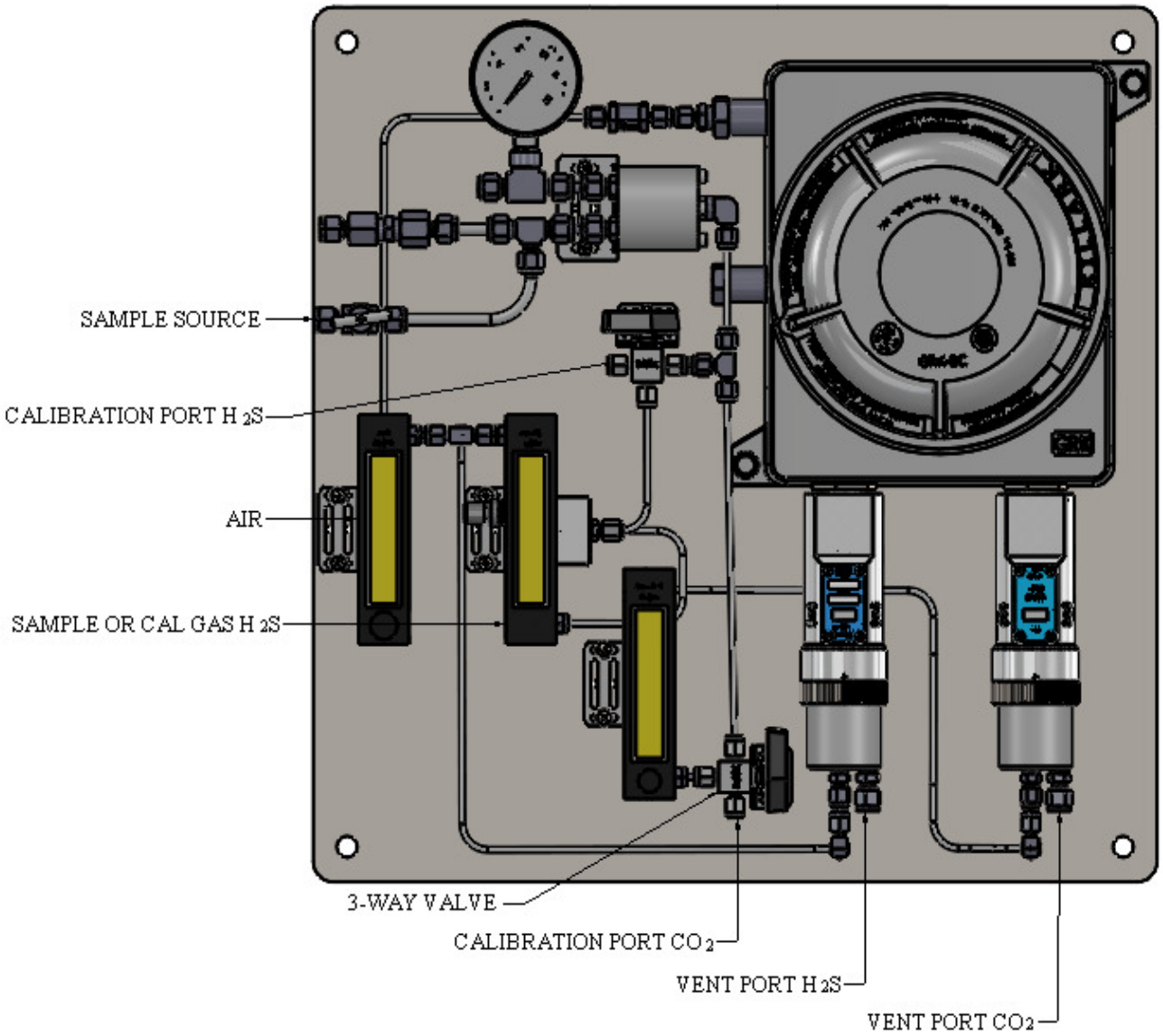

Figure 8 Rotameter and Gas Connections

5. Sensor Operation

5.1 Magnetic Interface

The Operator Interface of the Model 700 Series gas sensors used in the Analyzer is via magnetic switches located on either side of the LED display (Figure 10 Magnetic Programming Switches). The two switches, labeled "PGM1" and "PGM2" allow for calibration and configuration of the individual sensor, 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 Magnetic Programming Tool) 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. For 3-second hold, the programming magnet is held in place over the switch location for three seconds. For 10-second hold, the programming magnet is held in place over the switch location for 10 seconds. 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. The location of "PGM1" and "PGM2" are shown i Figure 10.

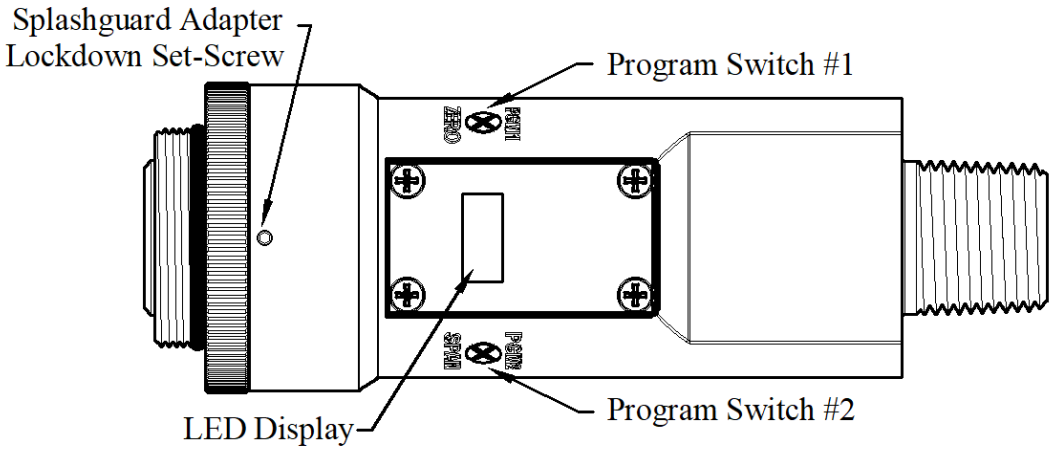

Figure 10 Magnetic Programming Switches

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

5.2 Operator Interface

The operating interface is menu-driven via the two magnetic program switches. The menu list has three modes that include sub-menus, as indicated below. Refer also to the complete Software Flow Chart in Figure 11 and Figure 12.

- **Normal Operation**
- **Calibration Mode**
  - AutoZero
  - AutoSpan
- **Program Mode**
  - View Sensor Status
  - Set AutoSpan Level
  - Set Serial ID
  - Set Range
  - Signal Output Check
  - Restore Default Settings

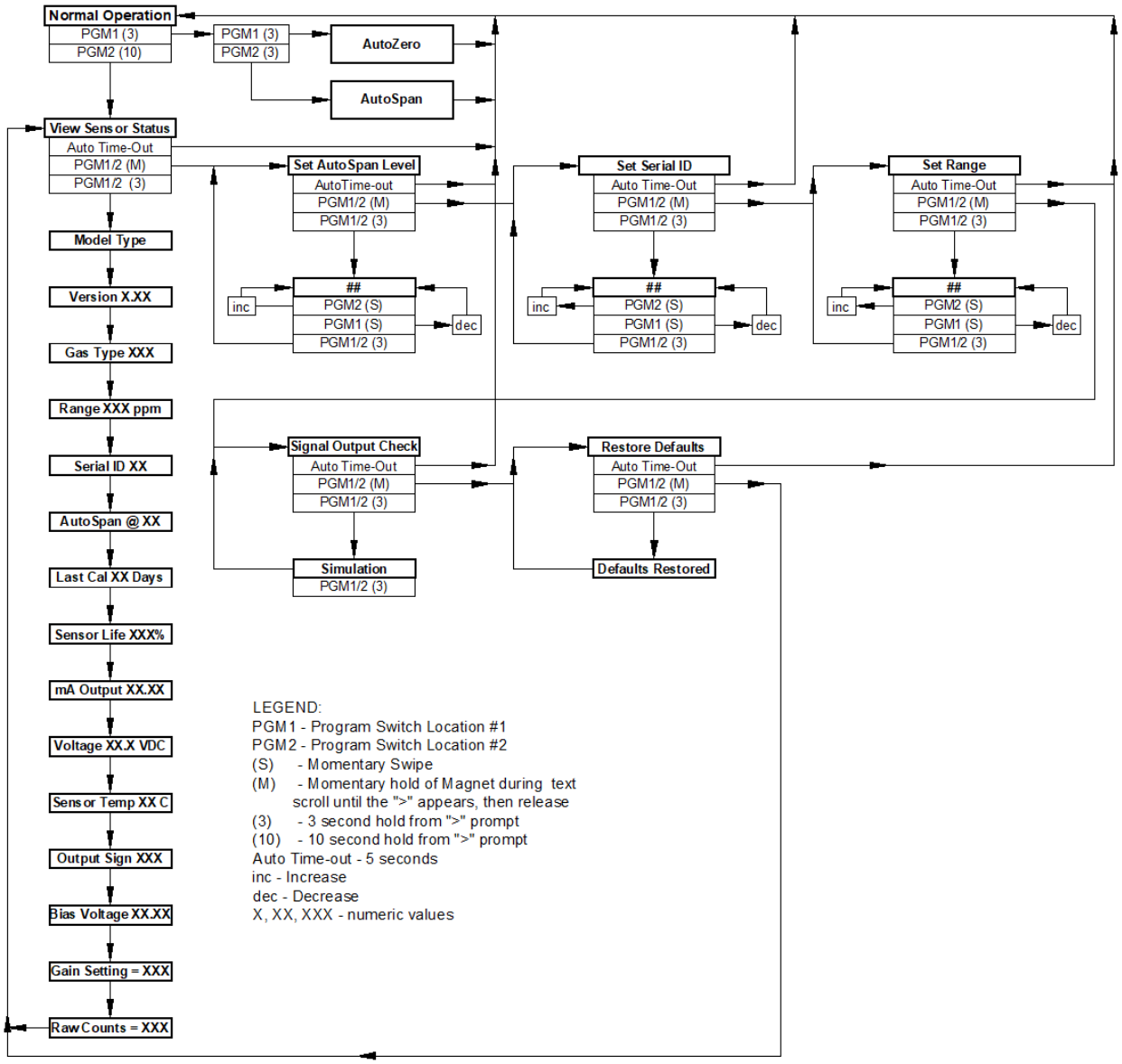

Figure 11 DM-700 Software Flowchart

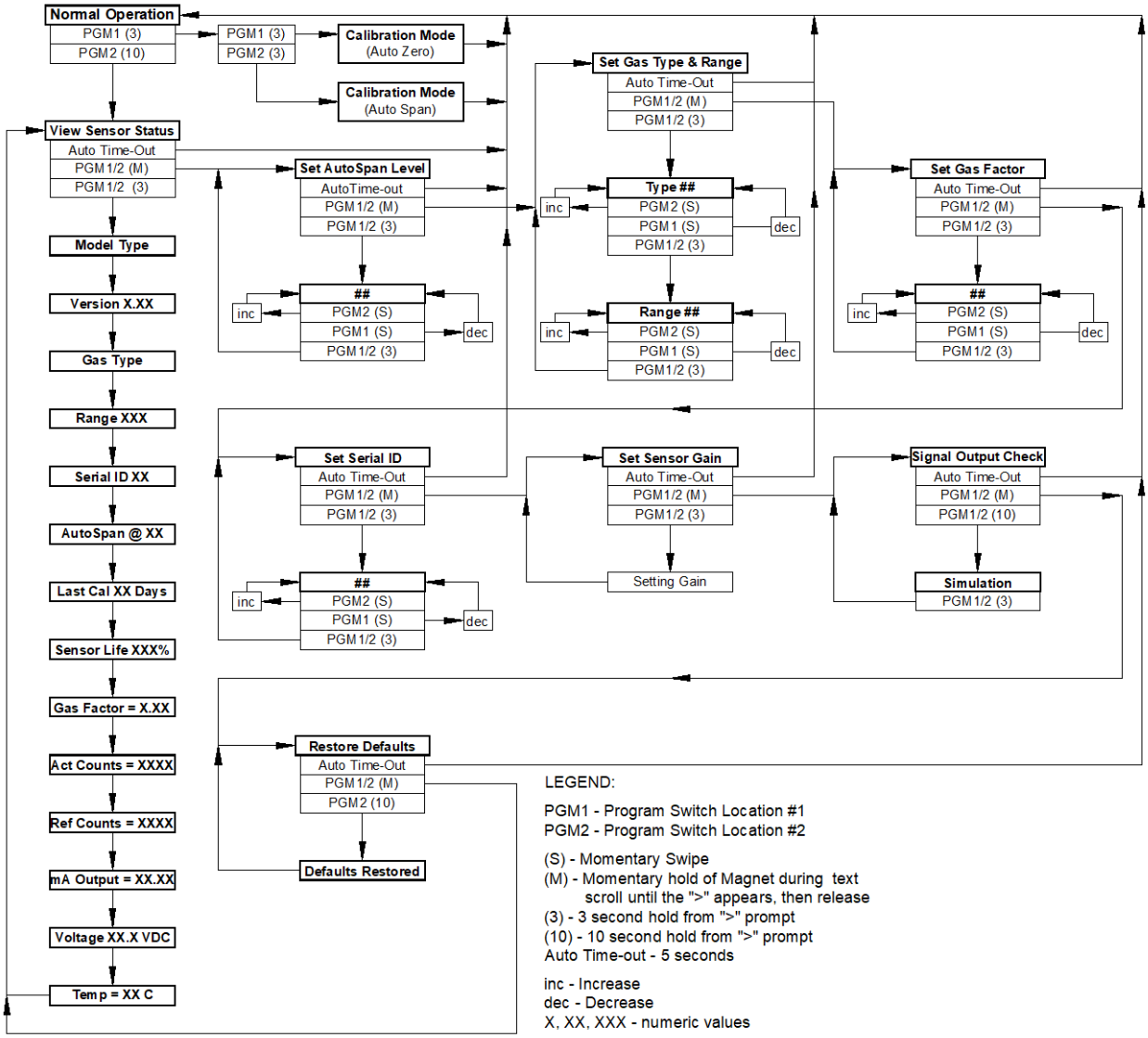

Figure 12 IR-700 Software Flowchart

5.3 Normal Operation

In normal operation, the ITM Display continuously shows the current sensor reading. Once every 60 seconds the LED display will flash the sensor's measurement units and gas type (i.e. ppm H_2S or % CO_2). If the sensor is actively experiencing any diagnostic faults, a "Fault Detected" message will scroll across the display on the ITM display once every minute instead of the units of measure and the gas type. At any time, while the sensor is in "Fault Detected" mode, PGM1 or PGM2 can be swiped to prompt the sensor 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.

5.4 Calibration Mode

5.4.1 AutoZero

For both the DM-700 H_2S and IR-700 CO_2, the zero is set without the target gas present. This should be performed periodically or as required. This can be performed with zero air or pure N_2. For dual-gas Analyzers, the H_2S sensor and CO_2 sensor must be zeroed separately. The following steps apply to both sensor types:

1. Connect the zero air or N_2 cylinder to the calibration port on the 3-way valve.
2. Turn the 3-way valve so that the arrow is pointing toward the "Calibrate" port. The sample is now being drawn from the calibration port.
3. Open the fixed-flow valve on the zero gas regulator.
4. 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=AutoZero …PGM2=AutoSpan**". Hold the programming magnet over PGM1 for 3 seconds once the "►" prompt appears to execute AutoZero (or allow to timeout in 5 seconds if AutoZero is not desired).

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 sensor is in calibration mode.

5. The ITM will display the following sequence of text messages as it proceeds through the AutoZero sequence: Zero Cal…Setting Zero…Zero Saved… (each will scroll twice)
6. Remove the zero gas from the "Calibrate" port
7. Turn the 3-way valve back to the "Sample" port.
8. Repeat sequence for the other sensor or proceed with Span Calibration, as needed.

5.4.2 AutoSpan

The AutoSpan function is used to span calibrate the sensor, and should be performed periodically or as needed. Unless otherwise noted, span adjustment is recommended at 50% of range. Because the Analyzer sample stream to the H_2S sensor is diluted, while the sample to the CO_2 sensor is not, the calibration procedures are slightly different for each sensor.

NOTE: Before performing AutoSpan Calibration, verify that the AutoSpan level matches the span calibration gas concentration.

<u>Analyzer IR-700 CO_2 calibration</u>

1. Verify that the AutoSpan Level is equal to the calibration span gas concentration. (Refer to View Sensor Status in the Software Flow Chart, Figure 12.) If these do not match, adjust the AutoSpan level as described in section 5.5.3.
2. Connect the CO_2 calibration gas cylinder to the CO_2 calibration port and open the 3-way valve so the arrow is pointing to "Calibrate."
3. From Normal Operation, enter Calibration Mode by holding the programming magnet over PGM1 on the IR-700 detector 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=AutoZero . . . PGM2=AutoSpan"**. 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 ITM will then scroll **"Apply XX % 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 sensor is in calibration mode.

4. Apply the span calibration test gas at a flow rate of 200-500 cc/min. As the sensor signal begins to increase the display will switch to reporting a flashing "XX" reading as the ITM 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 ITM will return to normal operation, aborting the AutoSpan sequence. The ITM will continue to report a "Range Fault" and will not clear the fault until a successful AutoSpan is completed.

5. If the sensor detects an acceptable signal change, after about 1 minute the reading will auto-adjust to the programmed AutoSpan level. During the next 30 seconds, the AutoSpan sequence checks the sensor for reading stability. The sensor will automatically repeat the stability check up to three additional 30-second periods.

   If the sensor fails the last stability check, the unit reports a "Stability Fault" twice and the ITM returns to normal operation. The ITM will continue to report a "Stability Fault" and will not clear the fault until a successful AutoSpan is completed.

6. If the sensor passes the stability check, the ITM reports a series of messages:

   AutoSpan Complete … Sensor Life XXX% … Remove Span Gas …

7. Remove the span gas from the calibration port.

8. Apply either zero air or N_2 to the CO_2 calibration port to purge the sensor following AutoSpan. The ITM display will alternate between "Remove Gas" and the live gas reading. When the reading clears below 5% of full scale, the ITM will display "Span Complete" and will revert to normal operation.

   If the sensor fails to clear to less than 5% full scale in less than 5 minutes, a "Clearing Fault" will be reported twice and the ITM will return to normal operation, aborting the AutoSpan sequence. The ITM will continue to report a "Clearing Fault" and will not clear the fault until a successful AutoSpan is completed.

9. After the sensor reports "Span Complete" remove the air or N_2 cylinder and turn the 3-way valve so that the arrow is pointing towards "Sample."

Analyzer DM-700 H_2S calibration

1. See table 5-1 for the correct calibration gas and flow rate settings for the H_2S sensor.

2. Verify that the AutoSpan Level is equal to the calibration span gas concentration. (Refer to View Sensor Status in the Software Flow Chart, Figure 11.) If these do not match, adjust the AutoSpan level as described in 5.5.3.

3. Connect the H_2S calibration gas cylinder to the H_2S calibration port and open the 3-way valve so the arrow is pointing to "Calibrate."

4. If the calibration gas is in air or nitrogen background, adjust the H_2S Sample Flow rotometer to match the "Span Gas Flow" column in Table 2.

5. From Normal Operation, enter Calibration Mode by holding the programming magnet over PGM1 on the DM-700 detector 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=AutoZero . . . PGM2=AutoSpan"**. 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 ITM will 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 sensor is in calibration mode.

6. As the sensor signal begins to increase the display will switch to reporting a flashing "XX" reading as the ITM 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 ITM will return to normal operation, aborting the AutoSpan sequence. The ITM will continue to report a "Range Fault" and will not clear the fault until a successful AutoSpan is completed.

7. If the sensor detects an acceptable signal change, after about 1 minute the reading will auto-adjust to the programmed AutoSpan level. During the next 30 seconds, the AutoSpan sequence checks the sensor for reading stability. The sensor will automatically repeat the stability check up to three additional 30-second periods.

   If the sensor fails the last stability check, the unit reports a "Stability Fault" twice and the ITM returns to normal operation. The ITM will continue to report a "Stability Fault" and will not clear the fault until a successful AutoSpan is completed.

8. If the sensor passes the stability check, the ITM reports a series of messages:

   AutoSpan Complete … Sensor Life XXX% … Remove Span Gas …

9. Remove the span gas from the calibration port.

10. Apply either zero air or N_2 to the CO_2 calibration port to purge the sensor following AutoSpan. The ITM display will alternate between **"Remove Gas"** and the live gas reading. When the reading clears below 5% of full scale, the ITM will display **"Span Complete"** and will revert to normal operation.

    If the sensor fails to clear to less than 5% full scale in less than 5 minutes, a "Clearing Fault" will be reported twice and the ITM will return to normal operation, aborting the AutoSpan sequence. The ITM will continue to report a "Clearing Fault" and will not clear the fault until a successful AutoSpan is completed

11. After the sensor reports "Span Complete" remove the air or N_2 cylinder and turn the 3-way valve so that the arrow is pointing towards "Sample".

12. Adjust the Sample Flow rotometer back to the "S→" sample flow setting indicated in Table 2.

Table 2 Flow Rate and Cal Gas

DM-700 Range (ppm)	Sample Flow (cc/min)	Air Flow (cc/min)	Span Gas Flow (cc/min)	H_2S Cal Gas (ppm)
0-10	200 Labeled "S⟶"	500	250 Labeled "C⟶"	10
0-20	200 Labeled "S⟶"	500	250 Labeled "C⟶"	10
0-25	200 Labeled "S⟶"	500	250 Labeled "C⟶"	10
0-50	200 Labeled "S⟶"	500	250 Labeled "C⟶"	10 or 25
0-100	200 Labeled "S⟶"	500	250 Labeled "C⟶"	25 or 50
0-150	200 Labeled "S⟶"	500	250 Labeled "C⟶"	25 or 50
0-500	80 Labeled "S⟶"	1000	100 Labeled "C⟶"	100

5.5 Program Mode

Program Mode provides a View Sensor Status menu to check operational and configuration parameters. It also provides for adjustment of the AutoSpan Level.

5.5.1 Navigating Program Mode

From Normal Operation, enter Program Mode by holding the magnet over PGM2 for 10 seconds. Note, the "◄" prompt will show that the magnetic switch is activated during the 10 second hold period. The ITM 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 PGM1 or "►" for PGM2) will appear, and immediately remove the magnet. The ITM 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 "◄"prompt ("◄" for PGM1 or "►" for PGM2) 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 ITM will automatically revert to Normal Operation.

5.5.2 View Sensor Status

View Sensor Status displays all current configuration and operational parameters including: sensor type, software version number, gas type, detection range, AutoSpan level, days since last AutoSpan, estimated remaining sensor life, raw sensor current, mA output, input voltage and sensor 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 sensor status parameters sequentially. See Software Flow Chart for complete menu sequence.

5.5.3 Set AutoSpan Level

Set AutoSpan Level is used to set the span gas concentration level that is being used to calibrate the sensor. This level is adjustable from 1% to approximately 75% or 95% dependent on full-scale range. The current setting can be viewed in View Program Status.

The menu item appears as: **"Set AutoSpan Level"**

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).

5.5.4 Set Serial ID

Model 700 sensors can be polled serially via RS-485 Modbus™ RTU. Refer to Section 6 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.

The menu item appears as: **"Set Serial ID".**

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).

5.5.5 Set Gas Type and Range

The full-scale range of a 700-Series sensor is determined at the time of order. The Intelligent Plug-in Sensor is factory calibrated for this range. However, if the application requirements change and the user needs to alter the original range, the "Set Range" function can be used to make field adjustments.

NOTE: Gas Type and Gas Factor menu options only appears for the CO_2-IR sensor and should be left at the default settings set by the factory. The H_2S menu option appears only as "Set Range."

From the **Set Gas Type & Range** text scroll, skip the "Set Gas Type" option (this should remain as CO_2.) When the display scrolls "Set Range" 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" 4 times and then return to Normal Operation).

For the CO_2 sensor, there are two different plug-in cell types. One sensor is used for the ranges of 0.3, 0.5, 1, 3, and 5% volume.

NOTE: The sensor should be recalibrated using both AutoZero and AutoSpan after any change is made to the sensor range.

5.5.6 Set Range Gain (CO_2-IR only)

Each Teledyne Detcon IR-700 sensor requires a one-time gain setting to match the plug-in IR sensor with the ITM electronics. This is set automatically during the "Set Sensor Gain" sequence. The "Set Sensor Gain" sequence determines the required gain resistance setting for optimal operation. This provides for uniformity in sensor-to-sensor operational performance.

NOTE: The "Set Sensor Gain" function is performed during factory calibration of every new IR-700. In the field, this menu item is only needed when a replacement plug-in IR sensor is being installed, or when mating a new IR-700 ITM with an existing plug-in sensor. It is also required if Restore Defaults menu item is executed.

From the **Set Sensor Gain** text scroll, hold the magnet over PGM1 or PGM2 until the "▶" appears and then hold continuously for an additional 3 seconds. The display will scroll "Setting Gain" and then show the count-up of the gain settings for the active (Ag) and reference (Rg) detectors. The typical final values are Ag = 7-14 and Rg = 30-45 (Rg maximum should be 65.) At completion, the ITM will display "Gain Complete" and revert to "Set Sensor Gain" text scroll.

5.6 Operational and Diagnostic Features

5.6.1 Operational Features

Over-Range

When gas greater than the full-scale range is detected, the ITM display will continuously flash the full-scale reading. This designates an over-range condition. The 4-20mA signal will report a 22mA output during this time.

Negative Drift

In cases where the sensor may drift negative, the display will show a negative reading between 5% and 10% of the sensors full scale range; I.E. if a 0-100ppm sensor drifts to negative 6 the display will indicate -6. In cases where the full scale range of the sensor is less than 10ppm, due to the limited space on the display, the decimal point will be displayed as an asterisk (*) to denote a negative reading. I.E. if a 0-5ppm sensor drifts to negative 0.32 the display will show 0*32.

In-Calibration Status

When the sensor is engaged in AutoZero or AutoSpan calibrations, the 4-20 mA output signal is taken to 2.0 mA and the in-calibration Modbus™ Status Register bit 14 is set. This alerts the user that the ITM is not in an active measurement mode. This feature also allows the user to log the AutoZero and 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 cell should be replaced within a reasonable maintenance schedule.

Days Since Calibration

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.

5.6.2 Fault Diagnostic/Failsafe Features

Model 700 sensors 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 1 minute 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 sensor. In these cases, the 4-20mA signal is dropped to the universal fault level of 0mA. These include the AutoSpan Calibration Faults, Sensor Fault, Processor Fault, Memory Fault, Loop Fault, and Input Voltage Fault. The 0mA fault level is not employed for Temperature or AutoSpan Reminder Faults. For every diagnostic fault condition the associated RS-485 Modbus™ fault register will be flagged to alert the user digitally.

Range Fault – AutoSpan

If the sensor fails the minimum signal change (Section 5.5.3) criteria during AutoSpan sequence, the "Range Fault" will be declared. A "Range Fault" will cause a "Fault Detected" message to flash intermittently on the ITM 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 sensor should be considered 'Out-of-Service' until a successful AutoSpan calibration is performed.

Stability Fault - AutoSpan

If the sensor fails the signal stability criteria (Section 5.5.3) during AutoSpan sequence, the "Stability Fault" will be declared. A "Stability Fault" will cause a "Fault Detected" message to flash intermittently on the ITM display and drop the mA output to 0 mA. The Modbus™ fault register bit for Stability Fault will be set and will not clear until the fault condition has been cleared. The sensor 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 (Section 5.5.3) during AutoSpan sequence, the "Clearing Fault" will be declared. A "Clearing Fault" will cause a "Fault Detected" message to flash intermittently on the ITM display and drop the mA output to 0 mA. The Modbus™ fault register bit for Clearing Fault will be set and will not clear until the fault condition has been cleared. The sensor should be considered as 'Out-of-Service' until a successful AutoSpan calibration is performed.

Zero Fault

If the sensor drifts to < -10% of range, an "Under-Range Fault" will be declared. An "Under-Range Fault" will cause a "Fault Detected" message to flash intermittently on the ITM display. The Modbus™ fault register bit for Under-Range Fault will be set and will not clear until the fault condition has been cleared. If an Under-Range Fault occurs, the 4-20 mA signal will be set at 0mA until the fault condition is resolved.

Sensor Fault

If the intelligent plug-in sensor is not plugged in, plugged in incorrectly, or there is a communication failure, a "Sensor Fault" is declared. A "Sensor Fault" will cause a "Fault Detected" message to flash intermittently on the ITM 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 detector has any unrecoverable run-time errors, a "Processor Fault" is declared. A "Processor Fault" will cause a "Fault Detected" message to flash intermittently on the ITM 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 4-20 mA signal will be set at 0mA until the fault condition is resolved.

Memory Fault

If the detector has a failure in saving new data to memory, a "Memory Fault" is declared. A "Memory Fault" will cause the "Fault Detected" message to flash intermittently on the ITM 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.

4-20 mA Loop Fault

If the sensor 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 ITM 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. If the 4-20mA current loop is still out of tolerance, contact Teledyne Detcon at Detcon-service@teledyne.com, or contact Teledyne Detcon customer service.

Input Voltage Fault

If the detector 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 flash intermittently on the ITM 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 detector is currently reporting an ambient temperature that is outside of the –40C° to +75C° range a "Temperature Fault" is declared. A "Temperature Fault" will cause the "Fault Detected" message to flash intermittently on the ITM 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 Reminder Fault

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

6. RS-485 Modbus™ Protocol

Model 700 sensors feature Modbus™ compatible communications protocol and are addressable via the program mode. Other protocols are available. Contact the Teledyne Detcon factory for specific protocol requirements. Communication is two-wire, half-duplex 485, 9600 baud, 8 data bits, 1 stop bit, no parity, with the sensor set up as a slave device. A master controller up to 4000 feet away can theoretically poll up to 256 different sensors. 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 sensor 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.

Sensor RS-485 ID numbers are factory default to 01. These can be changed in the field via the Operator Interface described in Section 5.5.4 Set Serial ID.

The following section explains the details of the Modbus™ protocol that the 700 sensors support.

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	700 Sensor	
03 06	40001 40001	Read Detectable Range[1,2] Write Detectable Range	R/W	100 10000	For 0-100 For 0-10000[2]	DM – 0 to 10000 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	DM – 1% to 95% 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, 3	DM, IR 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	
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 3)	
03/06	40012	Special #2	R/W		Function dependent on value of 40006 (See Special Register Table 3)	
03	40013	Special #3	R		Function dependent on value of 40006 (See Special Register Table 3)	
03/06	40014	Special #4	R/W		Function defendant on value of 40006 (See Special Register Table 3)	

FC	REG	Content Description	R/W	Content Definition		
				Value	**Meaning**	**Range**
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 N/A N/A Set 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	DM (40006 = 1)		IR (40006 = 3)
40011	Low Range= 0, 1, 2 0: Range >25 (0 decimal place) 1: Range 10-25 (1 decimal place) 2: Range <10 (2 decimal place)		Gas Factor **(R/W)** **Range = 20 to 565**
40012	0x8XXX 0x0XXX 0xX000 0xX096 0xX0C8 0xX12C	Positive Polarity Cell Negative Polarity Cell Bias = 0mV Bias = 150mV Bias = 200mV Bias = 300mV	Active Counts
40013	Gain Code (integer between 0 & 15)		Reference Counts
40014	Raw Counts 0-0xFFFF (0x8000 = nominal 0)		Range Divisor 1,10,100, or 1000

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.

7. Maintenance

7.1 Calibration Frequency

In most applications, quarterly span calibration intervals will assure reliable detection. However, industrial environments differ. 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. If, after 180 days, an AutoSpan Calibration is not performed, the ITM will generate an AutoSpan Fault.

7.2 Visual and Functional Inspection

All vents must be checked for clogs and debris once a month – this can be performed during standard maintenance.

Wipe surfaces clean with a non-corrosive solution as part of a regular maintenance.

Sensors, valves, meters, and tubing should be inspected for signs of corrosion, pitting, and water damage. Examine the plug-in sensor for signs of physical blockage, electrolyte leakage, or severe corrosion. Inspect the Junction Box for signs of water accumulations or terminal connector corrosions.

If analyzer must be repaired, validate correct functioning by running a full calibration.

Test flow fault sensor function by disconnecting the vacuum pump from P6 on the main PCB. This should stop all airflow to the flow fault sensor. When airflow ceases, the LED on the flow fault sensor board should be illuminated.

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 provides a critical function and should be replaced annually. Teledyne Detcon's PN is 960-202200-000.

7.3 Replacement of Intelligent Plug-In Sensor

7.3.1 Replacement of Plug-In CO_2-IR Gas Sensor

CAUTION: A hazardous area must be declassified before opening the junction box or removing and replacing the plug-in sensor.

1. Remove system power before proceeding with the replacement.
2. Use a wrench to loosen the compression fittings on the inlet and outlet tubing attached to the gas flow adapter. If the tubing is not flexible enough, both ends may have to be loosened and the section removed.
3. Unscrew the gas flow adapter from the bottom housing of the IR sensor.
4. Use a M1.5 Allen wrench to release the locking setscrew that locks the ITM and bottom housing together. (One turn should suffice—do not remove the setscrew completely.)
5. Unthread and remove the bottom housing from the ITM. This is a good time to inspect the bottom housing for corrosion or obstructions.
6. Gently pull the plug-in CO_2 IR sensor out of the ITM. Orient the new plug-in sensor so that it matches with the female connector pins. When properly aligned, press the sensor in firmly to make the proper connection.
7. Thread the bottom housing onto the ITM to a snug fit and tighten the locking setscrew using the M1.5 Allen wrench.
8. Thread the gas flow adapter to the bottom housing. This should be snug, but may have to loosen or tighten slightly to align with the inlet and outlet tubing.
9. Re-attach the inlet and outlet tubing. Compression fittings should be firm.
10. Restore system power.
11. Perform the Set Sensor Gain function, to match the new sensor with the ITM (see Section 5.5.6)
12. Perform a new zero and span calibration, to match the new sensor with the ITM (see Section 5.4). It is recommended to allow the sensors to warm-up on power for 1-2 hours before performing the zero and span calibration.

7.3.2 Replacement of Plug-In H_2S Sensor

NOTE: Although the DM-700 and toxic plug-in gas sensors are Intrinsically Safe, it is still prudent to remove power to the system during maintenance to avoid pulling live gas samples into the work area. In addition, the ITM must at least be power cycled to recognize the new plug-in cell .

NOTE: Sensor should be replaced with an analyzer version and not a standard H_2S sensor.

1. Use a wrench to loosen the compression fittings on the inlet and outlet tubing attached to the gas flow adapter. If the tubing is not flexible enough, both ends may have to be loosened and the section removed.
2. Unscrew the gas flow adapter from the bottom housing of the H_2S sensor.
3. Use a M1.5 Allen wrench to release the locking setscrew that locks the ITM and bottom housing together. (One turn should suffice—do not remove the setscrew completely.)
4. Unthread and remove the bottom housing from the ITM. This is a good time to inspect the bottom housing for corrosion or obstructions.
5. Gently pull the plug-in sensor out of the ITM. Orient the new plug-in sensor so that it matches with the female connector pins. Use the alignment marks provided to assure alignment is correct. When properly aligned, press the sensor in firmly to make the proper connection.
6. Thread the bottom housing onto the ITM to a snug fit and tighten the locking setscrew using the M1.5 Allen wrench.
7. Thread the gas flow adapter to the bottom housing. This should be snug, but may have to loosen or tighten slightly to align with the inlet and outlet tubing.
8. Re-attach the inlet and outlet tubing. Compression fittings should be firm.
9. Restore system power.
10. Verify the gas type and range of the new sensor by checking in View Program Status. Perform a new zero and span calibration after 1-2 hours of warm-up time.

7.4 Replacement of ITM

CAUTION: A hazardous area must be declassified before opening the junction box or removing and replacing the plug-in sensor.

1. Remove system power before proceeding with the replacement.
2. Open the junction box and loosen all the ITM wires from the sensor connections (see wiring diagram in Figure 7)
3. For the DM-700, remove the green/yellow wire from the ground screw at the bottom corner of the Enclosure.
4. Use a wrench to loosen the compression fittings on the inlet and outlet tubing attached to the gas flow adapter. If the tubing is not flexible enough, both ends may have to be loosened and the section removed.
5. Unscrew the gas flow adapter from the bottom housing of the ITM.
6. Use a wrench to loosen the locking nut at the top of the ITM and unthread the ITM from the junction box.
7. Use a M1.5 Allen wrench to release the locking setscrew that locks the ITM and bottom housing together. (One turn should suffice—do not remove the setscrew completely.)
8. Unthread and remove the bottom housing from the ITM. This is a good time to inspect the bottom housing for corrosion or obstructions.
9. Gently pull the plug-in sensor out of the ITM. Set aside the old ITM.
10. Orient the new plug-in sensor so that it matches with the female connector pins in the NEW ITM. When properly aligned, press the sensor in firmly to make the proper connection.

11. Thread the bottom housing onto the (new) ITM to a snug fit and tighten the locking setscrew using the M1.5 Allen wrench.
12. Feed the sensor assembly wires through the ¾" NPT mounting hole and thread the assembly into the junction box until tight and the ITM lens faces toward the front access point. Connect the sensor assembly wires inside the Junction box. (See wiring diagram in Figure 7).
13. For the DM-700, attach the green/yellow wire to the ground screw at the bottom corner of the Enclosure.
14. Thread the gas flow adapter to the bottom housing. This should be snug, but may have to loosen or tighten slightly to align with the inlet and outlet tubing.
15. Re-attach the inlet and outlet tubing. Compression fittings should be firm.
16. Restore system power.
17. For a IR-700 (CO_2) ITM replacement: Perform the Set Sensor Gain function, to match the new sensor with the ITM (see Section 5.5.6)
18. For both DM-700 (H_2S) and IR-700 (CO_2) ITM replacement: Perform a new zero and span calibration. (see Section 5.4). It is recommended to allow the sensors to warm-up on power for 1-2 hours before performing the zero and span calibration.

8. Customer Support and Service Policy

Teledyne Detcon Inc.

Shipping Address: 14880 Skinner Road, Cypress, Texas, 77429

Phone: 713.559.9200

- www.teledynegasandflamedetection.com
- Detcon-service@teledyne.com
- Detcon-sales@teledyne.com

All Technical Service and Repair activities should be handled by the Teledyne Detcon Service Department via phone or email at contact information given above. RMA numbers should be obtained from the Teledyne Detcon 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.

All Sales activities (including spare parts purchase) should be handled by the Teledyne Detcon Sales Department via phone or email at contact information given above.

Warranty Notice

Teledyne Detcon (also referred to as "the Company"), as manufacturer, warrants under intended normal use each new Model 1000 Series H_2S/CO_2 Process Analyzer gas detection system to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. All warranties and service policies are FOB the Company facility located in Cypress, Texas.

Teledyne Detcon Inc. will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by Teledyne Detcon Inc. personnel.

Defective or damaged equipment must be shipped to the Teledyne Detcon Inc. factory or representative from which the original shipment was made. In all cases, this warranty is limited to the cost of the equipment supplied by Teledyne Detcon Inc. The customer will assume all liability for the misuse of this equipment by its employees or other contracted personnel.

All warranties are contingent upon the proper use in the application for which the product was intended and does not cover products which have been modified or repaired without Teledyne Detcon Inc. approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, Teledyne Detcon Inc. disclaims all warranties with regard to the products sold. Including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of Teledyne Detcon Inc. for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

ITM Electronics Warranty

The Company, as manufacturer, warrants under intended normal use each new Model 700 ITM to be free from defects in material and workmanship for a period of two years from the date of shipment to the original purchaser. All warranties and service policies are FOB the Company facility located in Cypress, Texas.

Terms & Conditions

- The original serial number must be legible on each ITM.
- Shipping point is FOB the Teledyne Detcon factory.
- Net payment is due within 30 days of invoice.
- Teledyne Detcon, Inc. reserves the right to refund the original purchase price in lieu of ITM replacement.

Plug-In Sensor Warranty

Teledyne Detcon, as manufacturer, warrants under intended normal use, each new intelligent plug-in hydrogen sulfide cell (part no. 377-737301-000), for a period of 6 months from the date of shipment to the original purchaser. The Company, as manufacturer, warrants under intended normal use, each new intelligent plug-in carbon dioxide IR cell (370-865878-700 or 370-287724-700), for a period of two (2) years from the date of shipment to the original purchaser. The sensor cell is warranted free from defects in material and workmanship. Should any sensor cell fail to perform in accordance with published specifications within the warranty period, return the defective part to the Company.
Terms & Conditions:

- the original serial number must be legible on each sensor element base;
- shipping point is FOB the Detcon Factory;
- net payment is due within 30 days of invoice;
- Teledyne Detcon reserves the right to refund the original purchase price in lieu of sensor replacement.

9. Appendix

9.1 Technical Specifications

Sensor Technology:	DM-700 H_2S Sensor: Continuous diffusion/adsorption type, 3-electrode electrochemical sensor IR-700 CO_2 Sensor: Continuous diffusion/adsorption type, non-dispersive infrared.
Measuring Range:	0-10ppm H_2S, up to 0-500ppm H_2S (DM-700 H_2S Sensor) 0.3% Up to 5% (IR-700 CO_2 Sensor, low-range version) 10% up to 100% (IR-700 CO_2 Sensor, high-range version)
Accuracy/Repeatability:	± 10% of reading or ±2 ppm, whichever is greater (DM-700 H_2S) ± 5% full scale (IR-700 CO_2 Sensor)
Response/Clearing Time:	T80 <1 minute (DM-700 H_2S Sensor) T50 <30 seconds, T80 <60 seconds (IR-700 CO_2 Sensor)
Operating Temperature:	-20°C to +55°C
Operating Pressure:	Inlet: 10 ±2psig Outlet: Ambient ±1psig
Analog Output:	Linear 4-20mA DC 0mA All Fault Diagnostics 2mA In Calibration 4-20mA 0-100% full scale 22mA over-range condition
Serial Output:	RS-485 Modbus™ RTU Baud Rate 9600 BPS (9600, N, 8, 1, Half Duplex)
Warranty:	H_2S Sensor: 6 months, conditional DM-700 ITM: 2 years CO_2 Sensor: 2-years, conditional IR-700 ITM: 2 years
Input Voltage:	100-240VAC or 18-36VDC
Power Consumption:	925mA max (22.2Watts), 300mA nominal (7.2Watts) @ 24VDC
Certifications:	cETLus Class I, Division 1, Groups B, C, D
Installation Environment:	Pollution Degree 2
Analyzer Weight:	65lbs
Dimensions:	21”H X 21”W X 8”D

Table 5 Cross-Interface (H_2S Sensor)

Interference Gas	X ppm Interference	Looks like Y ppm H_2S
Carbon Monoxide (CO)	300 ppm	< 3 ppm
Carbon Dioxide (CO_2)	5000 ppm	0 ppm
Chlorine (Cl_2)	1 ppm	0 ppm
Ethylene (C_2H_4)	100 ppm	0 ppm
Hydrogen (H_2)	500 ppm	< 1 ppm
Isopropanol (C_3H_7OH)	1000 ppm	0 ppm
Methanol (CH_3OH)	1000 ppm	0 ppm
Nitrogen Dioxide (NO_2)	5 ppm	< ±0.5 ppm
Nitric Oxide (NO)	50 ppm	< 1 ppm
Sulfur Dioxide (SO_2)	5 ppm	< 1 ppm

9.2 Spare Parts

9.2.1 Analyzer

Part Number	Spare Parts
327-000000-000	Programming Magnet
949-0M1000-700	700 Series Inner Assembly without Pump
949-PM1000-700	700 Series Inner Assembly with Pump
943-200000-000	Activation Carbon Scrubber
823-101085-882	Genie Membrane Filter
350-300000-000	0.5Lpm Rotameter with no valve
348-900000-000	1Lpm Rotameter with valve
350-523081-02K	Mass Flow Controller
S927-737380-xxxy*	DM-700 ITM for Model 1000 Analyzer
377-73730A-xxx*	Replacement Plug-In H_2S Sensor (analyzer)
S927-405580-xxxy*	IR-700 (CO_2 low range) ITM for Model 1000 Analyzer
S927-420580-xxxy*	IR-700 (CO_2 high range) ITM for Model 1000 Analyzer
370-865878-700	Replacement Plug-In CO_2 Sensor (range ≤ 5%)
370-287724-700	Replacement Plug-In CO_2 Sensor (range ≥ 10%)

***Contact Teledyne Detcon Customer Service for complete part number**

9.2.2 Replacement of M1000 Electronic Sub Assembly

CAUTION: A hazardous area must be declassified before opening the junction box .

1. Remove system power before proceeding with the replacement.
2. Open the junction box lid. It may be helpful to take a picture of the installed sub-assembly before attempting to remove and replace it. Refer also to the wiring diagram in Figure 7 and the flow diagram in Figure X.
3. From the top board, disconnect the power input; either unplug the 3-pin terminal connector (P1) for AC power input or 2-pin terminal (P2) for DC power input.
4. From the top board, unplug the 6-pin terminal connectors (P4 and P5) for Sensor 1 and Sensor 2. No need to remove the sensor wiring from these connectors.
5. From the top board, unplug the two 6-pin terminal connectors for the 4-20mA output and the ModBus/Flow Fault output signals (P8 and P9).
6. There should be no need to disconnect wires between the two PCBs.
7. Loosen the three (3) screws attaching the entire sub-assembly to the bottom of the junction box and gently lift the sub-assembly out of the enclosure.
8. Once visible, identify the pump output tubing (which connects the pump to the flame arrestor port on the left side of the enclosure.) Disconnect this from the pump but allow it to remain connected to the flame arrestor port.

9. The sub-assembly should now be free of all connections. Gently lift it all the way out of the enclosure and set it aside.
10. Review the replacement sub-assembly. Orient it over the junction box opening, and first attach the tubing from the flame arrestor port to the pump outlet. This will not be very accessible once the assembly is inside the junction box.
11. Gently lower the sub-assembly into the box, orienting it to align with the standoffs. Keep the pre-wired terminal blocks from being pinched over covered by the sub-assembly.
12. Tighten the three (3) main screws on the subassembly—firm but not over-tightened.
13. Restore terminal block connections to the correct positions: terminal P4 and P5 to the Sensor 1 and Sensor 2 headers on the top left; terminal P8 and P9 to the current loop and Modbus/Flow Fault output headers on the top right.
14. Finally, plug the power connection into the appropriate place, either DC input to the 2-pin terminal (P2) in the center of the PCB, or the AC input to the 3-pin terminal (P1) on the center-right of the main PCB.
15. Review all the electrical and tubing connections to ensure they are firm, no stray strands to cause shorts. Compare with the wiring and flow diagrams in this guide as well as your starting picture.
16. Replace the junction box cover. Use the set screw to lock the cover in place.
17. Restore system power.

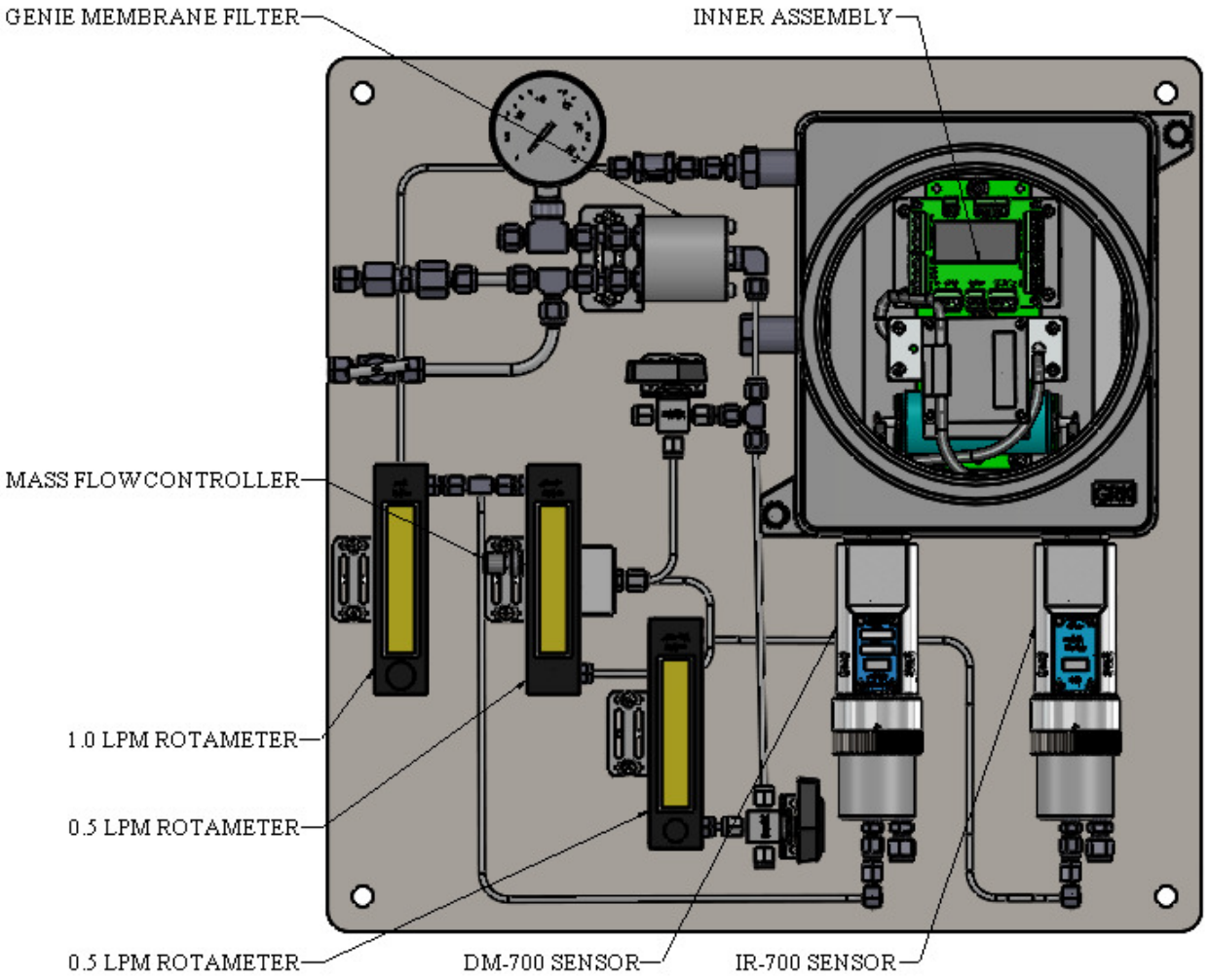

Figure 13 Analyzer Spare Parts

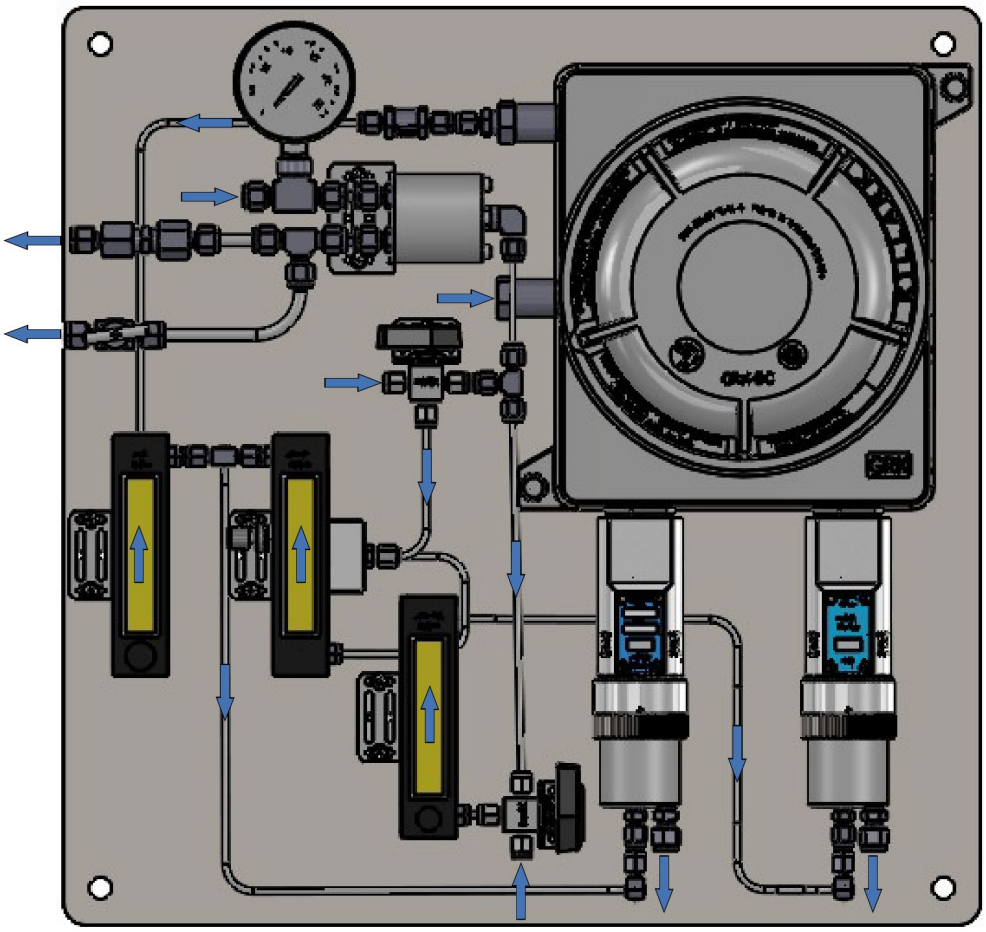

Figure 14 Analyzer Flow Diagram

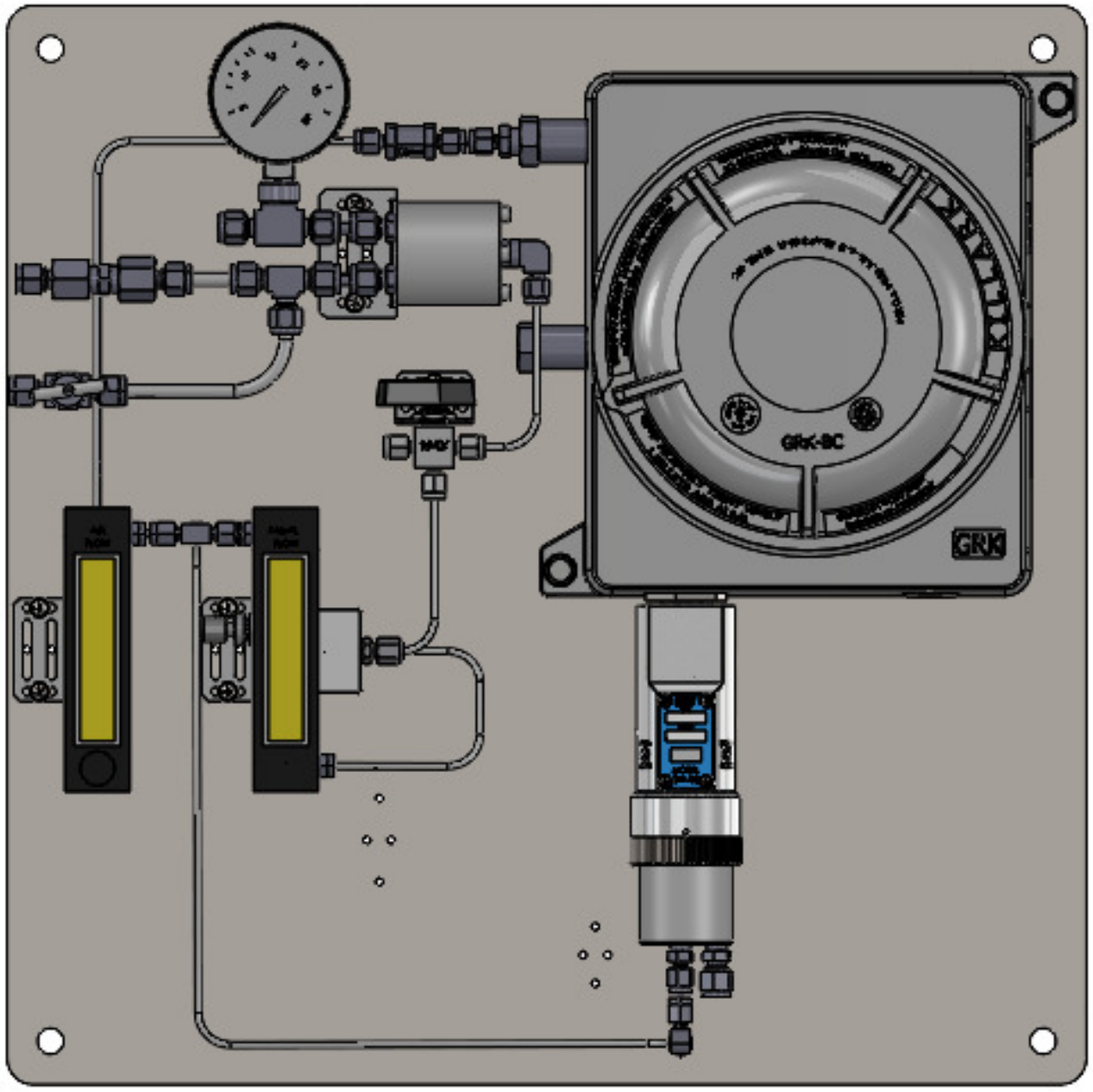

Figure 15 H_2S Analyzer

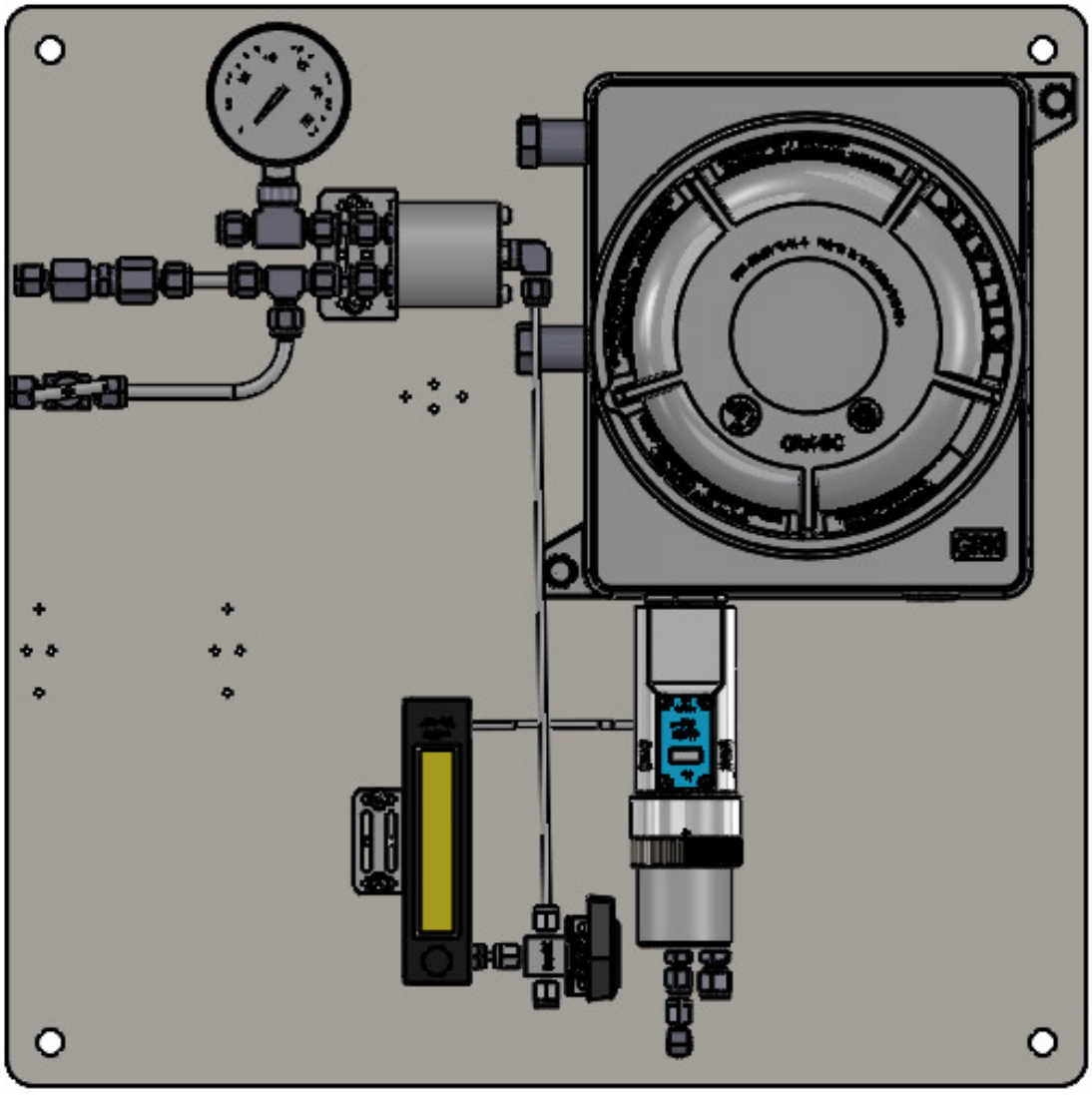

Figure 16 CO_2 Analyzer

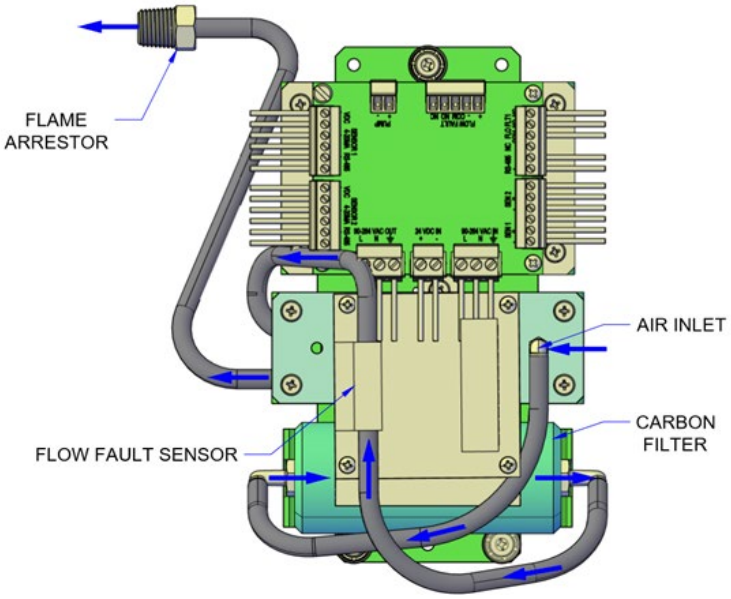

Figure 17 Pump Box Flow Diagram

9.3 Wiring Diagrams

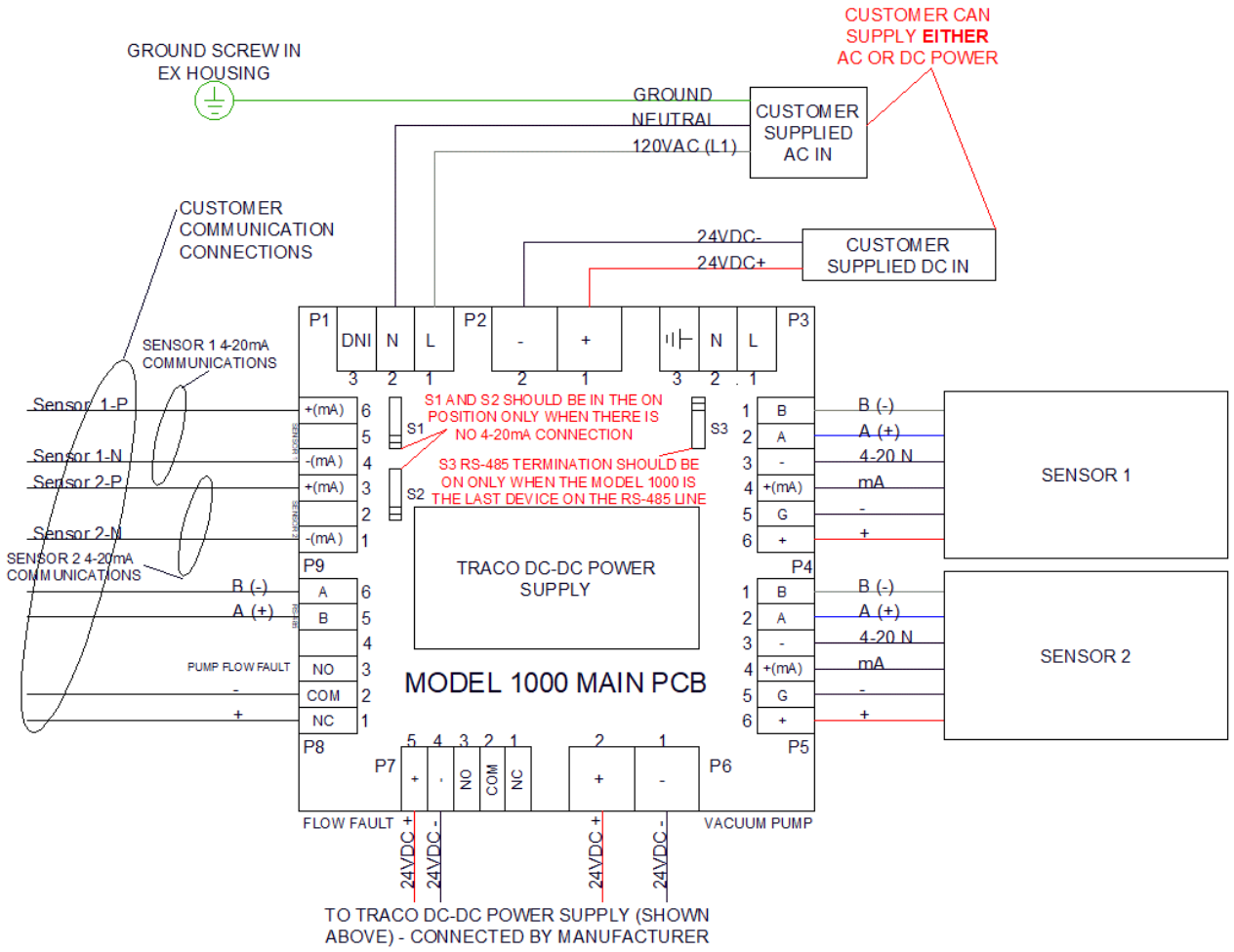

Figure 18 Full Wiring Diagram

10.Revision Log

Revision	Date	Changes made	Approval
1.0	06/21/24	Re-Issued for 700 Series Sensors.	KM
1.1	12/04/24	Updated Contact Information	KM

TELEDYNE
DETCON
Everywhereyoulook™

Americas
14880 Skinner Rd
Cypress, TX 77429
USA
Tel.: +1-713-559-9200

EMEA
Zl Est, Rue Orfila, CS20417
62027 Arras cedex
France
Tel.: +33 (0) 3 21 60 80 80

Asia Pacific
Room 04, 9th Floor, 275
Ruiping Road, Xuhui District,
Shanghai, China
TGFD_APAC@Teledyne.com

www.teledynegasandflamedetection.com