Sensor Electronics Corporation

Sensor Electronics Corporation is an innovative manufacturer of fixed system gas detection equipment, for combustible gases, oxygen and toxic gases.

Fixed Systems

Sensor Electronics Corporation offers a complete line of fixed systems. Available in stand-alone, rack, cabinet and wall mount configurations, these versatile systems can be tailored to meet the most demanding industrial applications. Our fixed systems are designed for continuous, multi-location monitoring and feature recorder outputs for long term data storage and software packages for PC based annunciation and recording.

Commitment

Our quality and service are uncompromising. We back each of our products with a one-year warranty on all materials and workmanship. We offer technical support, user training and on-site service and maintenance of equipment to meet the needs of our customers.

Gas Detection Service

Individually designed maintenance packages are available for specific customer needs. Service begins with verification of the system installation that includes an initial system check and calibration. We then offer customer training programs (on-site and at factory) to insure that technical personnel fully understand operation and maintenance procedures. When on-the-spot assistance is required, service representatives are available to handle any questions or problems immediately.

Table of Contents

I. SPECIFICATIONS

Model:
Sensor Electronics Corporation SEC 2000

Available gases:

Combustible	Bromine(Br2)
Oxygen(O2)	Fluorine(F2)
Hydrogen(H2)	Arsine(AsH3)
Ammonia(NH3)	Ozone(O3)
Nitric Oxide(NO)	Chlorine(Cl2)
Sulfur Dioxide(SO2)	Phosgene(COCl2)
Carbon Monoxide(CO)	Diborane(B2H6)
Nitrogen Dioxide(NO2)	Germane(GeH4)
Chlorine Dioxide(ClO2)	Phosphine(PH3)
Hydrogen Sulfide(H2S)	Silane(SiH4)
Hydrogen Fluoride(HF)	Hydrogen Chloride(HCl)
Hydrogen Cyanide(HCN)	Hydrogen Selenide(H2Se)

NOTE: For more detailed information regarding any of these sensor types, refer to the Sensor Reference Charts

Detection Method:
Combustible Gas - Catalytic
Toxic Gases - Electrochemical
Oxygen - Galvanic

Alarms:
Visual indication and relay contacts for low, mid, high and fault

Relay, Type and Rating:
SPDT: 8 Amps @ 250 VAC
8 Amps @ 30 VDC

Relay Operation:
User selectable latching or non-latching
User selectable normally energized or normally de-energized (except fault)
Manual relay control

Operating Voltage:
24 VDC. Operating range 18 to 32 VDC measured at the detector head

Sampling Method:
Diffusion, optional sample-draw

Power Consumption:

Combustible -	2.5 Watts nominal
	3.6 Watts maximum
Toxic gases and oxygen-	2.2 Watts nominal
	3.3 Watts maximum

Controls:
Magnetically coupled calibration/reset/date (CRD) switch

Indicators:
4 Digit, 8 segment LED display
4 Tricolor LEDs

Output (digital):
RS-485 LAN, maximum 4000 feet/68 ohms

Output (analog):
4-20 mA (Source type), max. 1000 Ohm load at 24 VDC supply voltage

Construction:
Enclosed in an explosion-proof aluminum housing

Housing Dimensions:
6.5 (W) x 7 (L) x 6.5 (H) inches
{165 (W) x 178 (L) x 165 (H) mm}

Weight:
Approximately 7 lbs.

CSA Certification:
Combustible, Toxic and Oxygen
Class I, Division 1, Groups B, C, and D.
CSA File #LR 60959

RFI:
Tested to military standard 462C

Optional Equipment:
SEC 2500 Hand Held Programmer
Sensor Separation Kit
Calibration Gas Kits
Calibration adapter
Gas sensor splashguard

II. GENERAL DESCRIPTION

The SEC 2000 is a digital gas detector, that is designed to detect one of a number of gases, display the concentration of that particular gas, and provide an alarm when gas concentrations reach preset levels. Some of the innovative features found in the SEC 2000 detector head include:

The SEC 2000 will operate as a stand-alone gas detector with its own relay outputs and LED display.

An industry standard 4-20 mA output enables the SEC 2000 to be connected to existing analog systems.

The SEC 2000 operating parameters (relay action, alarm set values, sensor configuration, etc.) can be viewed or changed using the SEC 2500 Hand Held Programmer. This device can communicate anywhere on the network with any SEC 2000 using either an infrared link, an RS-485 data highway, or by plugging directly into any SEC 2000.

Each SEC 2000 has a unique programmable identification number. This allows the SEC 2500 Hand Held Programmer to communicate to any specific SEC 2000 anywhere on the network via the data highway or any other SEC 2000 (peer to peer communication).

An RS-485 digital output enables the SEC 2000 to communicate to a dedicated monitor or with digital equipment including: programmable logic controller (PLC), a distributed control system (DCS), or a personal computer (PC). The SEC 2000 network can be connected on a single twisted shielded pair of wires, reducing cabling and installation costs.

A push-button sequence on the magnetic switch is used to perform a non-intrusive calibration. The calibration sequence is user-friendly and requires only one person. The SEC 2000 defaults to normal operation if the calibration push-button is inactive for five (5) minutes.

The SEC 2000 retains operating parameters and calibration settings when powered down.

An on-board microprocessor provides continuous self-diagnostics and identifies problems using fault codes.

Four (4) 8 amp SPST relays respond to Low, Mid, and High gas alarms as well as any fault conditions.

Calibration gas values can be changed without opening the SEC 2000 housing, using the same magnetic push-button switch for calibration. A display of the last calibration date is also available using this switch.

III. DETAILED DESCRIPTION

Enclosure

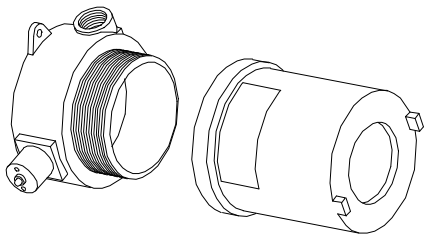
The SEC 2000 is contained within an explosion-proof aluminum enclosure.

The enclosure consists of an open base and a domed cover which threads onto the base. A transparent glass lens on top of the domed cover allows the operator to view the LED display and indicators of the instrument. The glass lens also permits the operator to communicate with the SEC 2000, using the SEC 2500 Hand Held Programmer.

The base of the enclosure has two 3/4" NPT threaded openings. A gas sensor is installed in one of the openings, while the other is used for cable connection and field wiring to and from the SEC 2000.

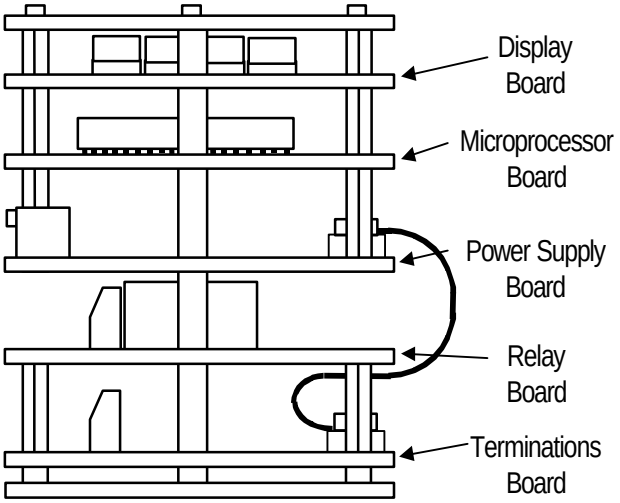
A magnetically coupled push-button switch is mounted on the outside of the enclosure base and is used to access electronic features of the SEC 2000.

Two flanges, on opposite sides of the base, provide a convenient means of mounting the SEC 2000.

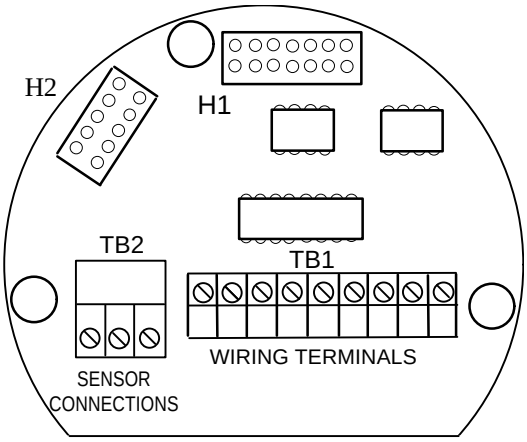


Circuitry

The electronic circuitry for the SEC 2000 typically consists of five(5) circular printed circuit boards contained within the enclosure. The circuit boards are designed in a modular fashion and are easily removed and replaced. At the bottom of the SEC 2000 is a base plate with three(3) support posts attached. Each module has three holes, which line up with the support posts. The modules slide onto these support posts and into place in the stack.



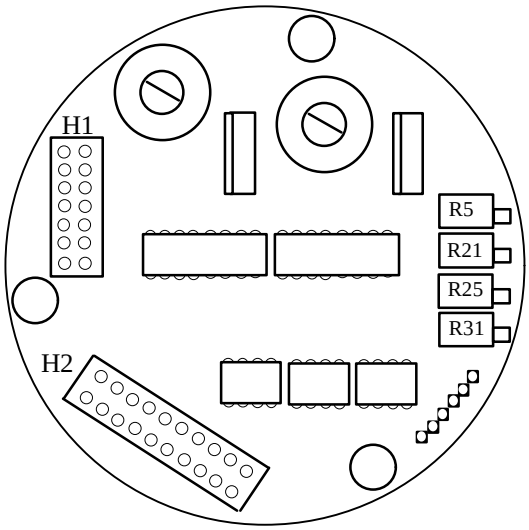
Termination Module



The Termination Module is the bottom module on the SEC 2000 stack. It contains a terminal strip for field wiring connections to input power, the magnetic switch, and the analog and digital outputs. A terminal strip socket provides the connection for the sensor. The Termination Board has two(2) ribbon cable sockets H1 and H2. H1 is used to connect the Termination Board to the Power Supply Board. H2 is used to connect the Termination Board to the optional Relay Board.

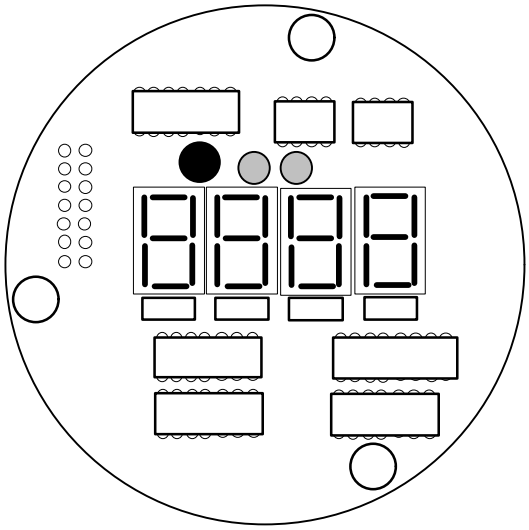
In addition to serving as a termination for the various inputs and outputs, the Termination Module also incorporates the RS-485 driver and protection circuitry, as well as a ground fault detection circuit.

Power Supply Module



The Power Supply Module is the only module unique to a particular gas type. It incorporates signal processing circuitry for the gas sensor, an analog output, an A/D converter, and the power supply required by the rest of the SEC 2000 circuitry. There are two basic types of Power Supply Modules, toxic/oxygen and combustible. Only the individual component values vary for different types of toxic/oxygen sensors.

Display Module



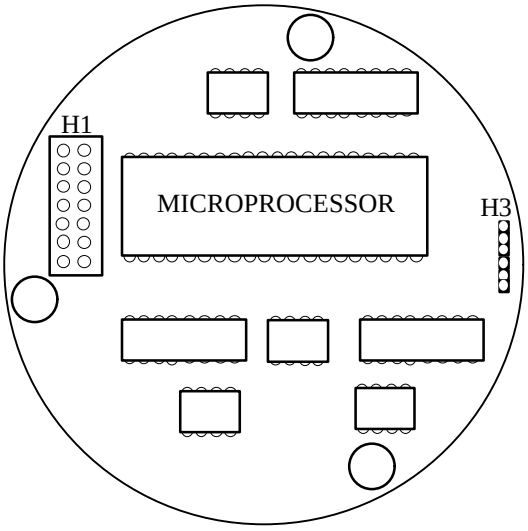
The Display Module plugs into the topside of the Processor Module and is secured to this module with standoffs. The Display Module contains four(4), digital displays (seven segment LED displays), four(4)

tricolor LEDs, and the driving circuitry for these devices. The Display Module also incorporates the infrared transmit and receive circuitry which allows the SEC 2000 to communicate with the SEC 2500 Hand Held Programmer.

A circular faceplate is attached to the top of the Display Module with standoffs. Three(3) holes in this plate line up with the three support posts attached to the bottom plate, providing a means of securing the Display, Processor, and Power Supply Modules.

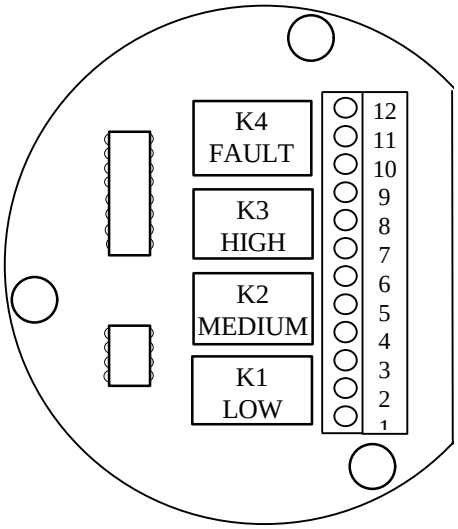
The SEC 2000 is capable of operation without the Display Module installed.

Processor Module



The Processor Module plugs into the topside of the Power Supply Module and is secured to this module with standoffs. The Processor Module contains the microprocessor and associated logic circuitry which control operation of the SEC 2000. Also located on the Processor Module are a D/A converter, oscillators for infrared communication, a watchdog timer, and an EEPROM. The EEPROM retains the operating characteristics of a particular SEC 2000 (i.e., gas type, range, relay operation, etc.) even when there is no power applied to the device.

Relay Module



The Relay Module is mounted above the Termination Module and connected with a 10-conductor ribbon cable to the Termination Module. The Relay Module consists of four(4) relays and associated driving circuitry. The four(4) relays, which correspond to Low, Mid, High and Fault conditions, are each sealed SPDT, and rated for 8 amps at 30 VDC or 230 VAC. The SEC 2000 is capable of operation without the Relay Module installed.

The Display, Processor, and Power Supply Modules are each connected together mechanically with standoffs and electrically with circuit board headers. These three(3) modules slide onto the three support posts and are held in place by a top plate.

Control and Indicators

Calibration/Reset/Date (CRD) Switch

There is a single external control on the SEC 2000, a push-button switch mounted on the base of the enclosure. The push-button is spring-loaded and coupled to a magnet inside the switch body. When the push-button is pressed, the magnet makes contact with the enclosure. Located inside the enclosure, aligned with the magnet, is a magnetic switch. This device is permanently potted within a cavity and can be identified by three wires (Red, Black and Yellow) protruding into the enclosure base.

When the push-button is pressed and the magnet contacts the enclosure, the magnetic field created is near enough to the switch to activate the device. When the push-button is released, the magnet moves further away from the switch and its magnetic field is no longer detected.

Once (momentary):
- ·View Identification number of detector.

Once (and held):
- ·Change displayed date in calibration mode.
- ·Change value in view/change calibration gas mode.

Twice:
- ·Reset latching relays.
- ·Accept zero, span or date values in calibration mode.
- ·Exit calibration mode.
- ·Accept value in view/change calibration gas mode.
- ·Advance through and exit view calibration date mode.

Three times:
- ·Enter view calibration date mode.

Four times:
- ·Enter view/change calibration gas mode.
- ·Change direction when adjusting value in view/change calibration gas mode.

Five times:
- ·Enter calibration and Acal mode.
- ·Cancel and exit calibration, view/change calibration gas value modes.

Table 2.1 Summary of CRD functions

The SEC 2000 recognizes certain numbers of consecutive push-button activation's and responds accordingly. This switch can be used to perform a non-intrusive calibration, examine the date of last calibration, change calibration gas values, or reset latching relays. Refer to Sections IV and V for more detailed information regarding the Calibration/ Reset/ Date (CRD) switch.

Internal Controls

There are four(4) user adjustable controls on the power supply module. Each control is a 20 turn PCB-mount potentiometer. The function of each control depends on whether the Power Supply Module is a combustible or toxic type.

BV or B: For a combustible type Power Supply Module, the BV (Bridge Voltage) control adjusts the bridge voltage of the sensor. For a toxic type Power Supply Module, the B (Bias) control adjusts the bias voltage (if required) for the sensor. Refer to Sensor Reference Charts for correct voltage.

NULL or ZERO: For a combustible type Power Supply Module, the NULL control sets the analog ZERO: voltage for a gas free condition. The ZERO control has the same function for a toxic type Power Supply Module. This control is generally only a factory adjustment, as the SEC 2000 is software calibrated. It may, however, be necessary to adjust this control when a sensor is changed. Refer to Section VI for further details.

I SP: This control, common to both types of Power Supply Modules, sets the sensitivity of the analog amplifier circuit (Input Span). This control is generally only a factory adjustment, although it may be necessary to make an adjustment when a sensor is changed. Refer to Section VI, Part C. for further details.

O SP: This control, also common to both types of Power Supply Modules, is used to calibrate the SEC 2000's analog output (output span). Again, this is primarily a factory adjustment. Refer to Section V, Part B for further details.

LED Display

The LED display is located directly behind the SEC 2000 faceplate on the Display Module. It can be viewed through the lens on top of the domed enclosure lid. The LED display is used to indicate the gas concentration, fault codes, and various operational messages.

Tricolor LED Indicators

Below the LED display are four(4) square tricolor LED indicators labeled PWR, LOW, MID, and HI. These LED indicators are each capable of illuminating a red, amber, or green color. The LOW, MID and HI LEDs

correspond to the relay setpoints and the PWR LED is for Power and Fault indication.

For the LOW MID and HI LED indicators
Green = normal operation
Red = alarm condition
Amber = relay latched
For PWR LED
Green = normal
Red = Fault condition

Sensor

The gas sensor is typically mounted in one of the openings on the SEC 2000's enclosure. Protruding from the sensor are two(2) or three(3) wires, which terminate in the terminal socket plug. This plug connects to a mating socket located on the Termination Module.

There are three(3) basic types of gas sensors used by the SEC 2000; combustible, toxic and oxygen.

Combustible Gas Sensors

Within the combustible gas sensor are a matched pair of elements, one of which is an active catalytic detector and the other a non-active compensating element. Each element consists of a coil of platinum wire embedded in a bead of alumina. The active element is coated with a catalytic mixture and the non-active element is treated so that catalytic oxidation of gas does not occur.

When a concentration of combustible gas comes in contact with the active element, the gas oxidizes, causing a temperature increase in the element. This temperature increase is directly proportional to the concentration of combustible gas at the sensor. The temperature increase in the element produces an increase in resistance, which is used by the electronic circuitry of the SEC 2000 to generate a display reading, analog and digital outputs, and activate alarms when required. The second, inactive, filament acts as a reference to compensate for various operating conditions.

The filaments are enclosed within a stainless steel housing with a sintered stainless steel flame arrestor. This allows an air sample to enter the sensor but prevents any outward propagation of flame, should an explosive atmosphere be sampled.

The combustible gas sensor is generally calibrated to methane but will respond to most hydrocarbons. Refer to the appropriate Sensor Reference Chart for conversion factors of the combustible gas sensor's response to gases other than the one to which it has been calibrated.

WARNING:
THE FOLLOWING SUBSTANCES WILL POISON AND AFFECT THE ABILITY OF THE COMBUSTIBLE GAS SENSOR TO ACCURATELY INDICATE COMBUSTIBLE GAS CONCENTRATIONS:
A) SILICONE
B) SILICANE
C) HALOGENATED HYDROCARBONS
D) ANTIKNOCK COMPOUNDS FOUND IN GASOLINE

Following exposure to any one of these substances, the SEC 2000 must be calibrated using the procedures detailed in Section V of this manual.

Toxic Gas Sensors

There are several types of toxic gas sensors available for use with the SEC 2000. Each of these sensors is located within a metal sensor holder. The type of gas, detected by the sensor, is indicated by a label located on the sensor holder cap. Access to the sensor can be gained by unscrewing the cap from the sensor holder.

Within the toxic gas sensor are two electrodes in an electrolyte solution. Air diffuses through a permeable membrane into the electrolyte at a constant rate. When the specific toxic gas is present in the air, it diffuses into the sensor producing a chemical reaction. This chemical reaction increases the current flow between electrodes. The increase in current is directly proportional to the concentration of the toxic gas in the air. This current is used by the electronic circuitry of the SEC 2000 to generate a display reading, analog and digital outputs, and activate alarms when required.

Toxic gas sensors will respond to gases other than the one they have been designed to detect. These are known as interfering gases. Refer to the appropriate Sensor Reference Chart for information regarding interference gases for any particular sensor.

Oxygen Sensors

The oxygen sensor available for use with the SEC 2000 is housed in the same metal sensor holder used for the toxic gas sensors. Instead of the circuit board, the oxygen sensor is held in place within the sensor holder with a metal collar and set screws. Two(2) wires (Red and White) are soldered directly to the sensor. Within the sensor are two(2) electrodes in an electrolyte solution. Air diffuses through a permeable membrane into the electrolyte

at a rate proportional to the partial pressure of oxygen. Oxygen in the air dissolves into the electrolyte causing a chemical reaction and producing a voltage directly proportional to the concentration of oxygen in the air. This voltage is used by the electronic circuitry of the SEC 2000 to generate a display reading, analog and digital outputs, and activate alarms when required.

Optional Equipment

SEC 2500 Hand Held Programmer

The SEC 2500 Hand Held Programmer is designed to be used in conjunction with the SEC 2000. The SEC 2500 can be used to perform the following functions:

- Non-intrusive calibration of the SEC 2000 with measured gas levels continuously displayed by the SEC 2500.

- Displaying and changing SEC 2000 operating characteristics including gas type, gas units, range, bridge voltage, decimal places in display, calibration gas value, and SEC 2000 identification number.
Displaying and changing operating parameters of the individual SEC 2000 relays, including alarm set levels, off delay from 0 to 255 minutes, latching or non-latching operation, and normally energized or de-energized operation.

- Manually toggling each individual relay on and off to verify operation.

- Resetting latching relays: Performing a lamp test to verify operation of all visual indicators and view the SEC 2000 identification number.

- Displaying a sensor synopsis which includes SEC 2000 identification number; fault code status; gas type; current gas level; range; calibration gas value; date of last calibration; active relays, if any; logic voltage; bridge voltage, if any; line voltage; and current analog output level.

The SEC 2500 communicates with the SEC 2000 one of three(3) ways:

- Infrared Link: The SEC 2500 must be pointed directly at the SEC 2000 display. Once communication is established with the SEC 2000 using the infrared link, the SEC 2500 can communicate with any SEC 2000 on the common RS-485 data highway.

- RS-485 Wired Connection: A data communications cable is plugged into the SEC 2500 and hard-wired to the Data A and Data B of the RS-485 data highway. The SEC 2500 can then communicate individually with any SEC 2000 installed on that particular RS-485 network.

- Direct-Wired Connection: A data communications cable is plugged into the SEC 2500 and a connector on the other end is plugged into a SIP connector located on the SEC 2000 processor module. The SEC 2500 can then communicate directly with the SEC 2000.

For more detailed operation of the SEC 2500 Hand Held Programmer, refer to the Instruction Manual for this unit.

Splash Guard

A splash guard is available for the combustible, oxygen and toxic gas sensor holders. This device threads into the face of the sensor holder and acts to prevent sand, water and mud from entering the sensor housing, which would possibly cause damage or restrict the air sample to the sensor.

Sensor Separation Kit

A Sensor Separation Kit is available so the sensor may be installed remote from the SEC 2000. The Kit consists of an Explosion Proof housing, with terminal block for terminating wire connections.

Consult Factory for the recommended maximum distance that the sensor should be located from the SEC 2000. Cable runs should be made with shielded cable within properly grounded conduit. The Toxic and Oxygen sensors should be located in the same general temperature environment as the SEC 2000.

Calibration/Sample Draw Adapter

Sample draw adapters are available. Consult factory for details.

IV. OPERATION

Installation and Startup

The first step in the installation process is to establish a mounting location for the SEC 2000. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas. The SEC 2000 should be solidly attached at the mounting location with the sensor pointed down, using bolts through the mounting flanges at the base of the SEC 2000 enclosure. If the detector is to be wall-mounted, 1/2 inch standoffs are recommended to bring the SEC 2000 away from the wall slightly, allowing easier access to the sensor.

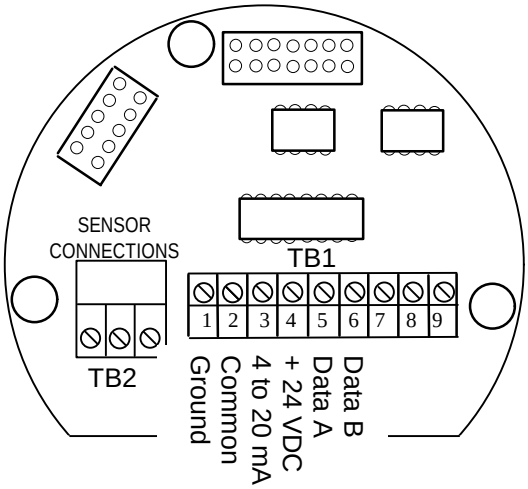
Next, field wiring must be brought to the SEC 2000. The use of shielded cable is highly recommended to prevent electrical interference from affecting the operation of the SEC 2000. The wiring must be installed in accordance with all applicable local electrical codes with special care and attention given to installations in a classified hazardous area. When installing the units in outdoor applications, extra care must be taken to ensure the wire entry is properly sealed to prevent water from getting into the housing.

With the wiring suitably in place, unscrew and remove the domed lid from the SEC 2000 enclosure. Using an allen key, remove the three(3) screws from the SEC 2000 face plate holding the top three modules in place. These three(3) screws are identified by half circles marked on the face plate on the outer edges of the screws. Slide the three(3) board module assembly up over the three support posts and off of the stack. For convenience, the three(3) board module assembly can be removed from the instrument altogether by disconnecting the ribbon cable at the Terminations Board.

Remove the three(3) slotted screws holding the relay module in place. Slide this module up over the three support posts and off of the stack. The Relay Board can be removed from the instrument by disconnecting the ribbon cable at the Relay Board or Termination Board. The following connections can now be made at the Termination board. The following connections can now be made at the Terminations module.

Power

Connect the positive supply wire to the terminal block position marked "+24 VDC" (TB1-4) by placing the stripped end of the wire into the side of the terminal block and securely tightening the screw on top. Connect the negative supply wire to the terminal block position marked "COM" (TB1-2).



If shielded wire has been used, connect the shield wire to the terminal block position marked with the ground symbol (TB1-1).

The supply wires must be sized so that they are able to supply the specified voltage (18-32 VDC) to the SEC 2000 at the rated current (see Specifications, Section I).

Analog Output

The analog output connection is made at the terminal block position marked "4-20 mA" (TB1-3). This connection is optional but will provide a 4-20 mA sourcing output signal (with respect to COM) which corresponds to the selected full scale of the SEC 2000.

RS-485

The RS-485 consists of two connections, Data A and Data B. It is recommended that the RS-485 wires be twisted pair and shielded. The RS-485 connection is optional but is required if the SEC 2000 is to be installed on a digital network with other SEC 2000s or monitoring devices.

Connect the Data A wire to the terminal block position marked "Data A" (TB1-6). Connect the Data B wire to the terminal block position marked "Data B" (TB1-5). The shield wire should be connected to ground (TB1-1).

In total, the RS-485 wiring should not exceed 4000 feet or 68 ohms. If the wiring is to exceed 4000 feet or 68 ohms, a SEC 4850 RS-485 Repeater must be used. Please consult Factory for further details.

Calibration/Reset/Date (CRD) Switch

The SEC 2000 is shipped from the factory with the integral magnetic switch wired to the CRD switch input terminals. This consists of three(3) wires; Black, Yellow and Red, connected to TB1-7, TB1-8 and TB1-9 respectively. If a remote CRD switch is required, these three(3) wires must be removed and a normally open, momentary action switch rated to operate at 5 VDC/20mA must be installed across the terminal block positions marked "COM" (TB1-7) and "SIG" (TB1-8).

Sensor

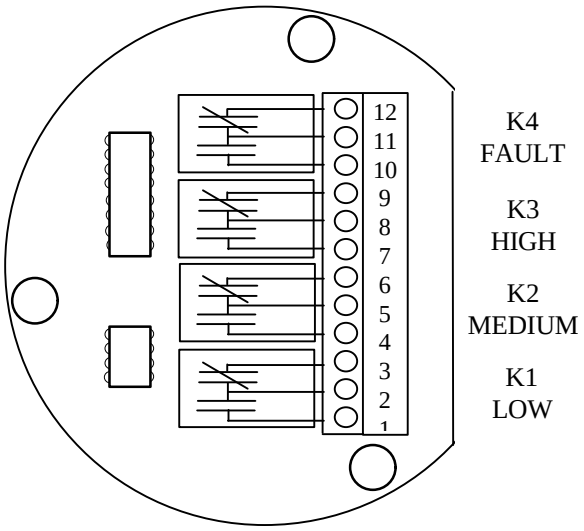
The sensor is supplied with a terminal block plug that connects with a terminal block socket (TB2) on the Termination Module.

The sensor may also be installed remote from the SEC 2000 using extension wiring. Consult factory for the recommended maximum distance that the sensor should be located from the SEC 2000. Cable runs should be made with shielded cable within properly grounded conduit. The toxic/oxygen type sensor should also be located in the same general temperature environment as the SEC 2000.

Reattach the Relay Module to the Termination Module using the ribbon cable. Make sure that the same conductor on the ribbon cable connects to the polarization marks on each module.

Slide the relay module onto the three support posts. Using the three slotted screws, reattach the module to the standoffs protruding from the termination module.

The relay connections can now be made at the relay module. There are four relays on the module; Low, Mid, High and Fault. Each relay has three terminal block positions; Normally Open, Common, and Normally Closed. The relay's dry contacts are shown on the module itself in the non-energized condition.



The load connected through each of the relays must not exceed 8 amps at 30 VDC or 230 VAC.

NOTE: During normal operation, the fault relay is always energized (de-energized upon alarm). All other relays can be set to be normally energized or normally de-energized using the SEC 2500 Hand Held Programmer.

After the relay wiring has been completed, reconnect the three-board module assembly to the 16 conductor ribbon cable. Make sure that the ribbon cable is attached correctly. Slide the module assembly onto the three support posts. Replace the three(3) allen head screws on the face plate. Screw the domed lid back onto the SEC 2000 enclosure.

Startup

After the wiring has been completed, power can be applied to the SEC 2000. Immediately upon applying power, the four tricolor LEDs go through a seven(7) pass flashing sequence going from red to amber to green. During this time, the LED display will indicate the assigned SEC 2000 identification number. After this initial startup sequence is complete, all four(4) tricolor LEDs will go solid green and the LED display will indicate the gas concentration.

For one minute after power up, the relays will be inactive. Typically, after being powered up, the SEC 2000 display reading will go upscale and then gradually fall as the sensors stabilize. This is normal and the relays are inactive during this time to eliminate unwanted alarm actions. During the one minute period, the analog output will remain at 4 mA, regardless of the display reading.

If more than one SEC 2000 is being installed on an RS-485 network, they must each be assigned a unique identification number.

If identification numbers have not been assigned at the factory, the default number for each is 9999. In this case, each SEC 2000 must be powered on one at a time, and have new identification numbers assigned to them using the SEC 2500 Hand Held Programmer, the SEC 4100 or Supervision Plus. If it is impractical to power up individual SEC 2000s, the three(3) board module assembly (Power Supply, Processor and Display Modules) may be removed from all instruments except one. After a new identification number has been assigned to this SEC 2000, replace the three(3) module assemblies on the SEC 2000s, one unit at a time, alternately assigning new identification numbers.

If desired, the configuration and programming information contained in each individual SEC 2000 processor module may be checked and changed if necessary using the SEC 2500 Hand Held Programmer (refer to the SEC 2500 Instruction Manual).

The SEC 2000 should now be calibrated according to the instructions found in Section V of this manual. It is then ready for use.

Monitoring

After the one minute warm up period, the SEC 2000 is ready for use as a fixed gas detector. The LED display continually indicates the current concentration of gas specific to the particular SEC 2000. If connected to a monitoring device on an RS-485 network, the SEC 2000 will report its status and programming information upon being polled. The SEC 2000 also generates a 4-20 mA signal, on a continuous basis, representative of the display reading.

For a combustible gas version SEC 2000, the concentration of combustible gas is displayed in terms of a percentage of the lower explosive limit (LEL). 100% LEL represents the minimum concentration of combustible gas in air that will cause an explosion.

CAUTION:
ANY RAPID UP-SCALE READING FOLLOWED BY A DECLINING OR ERRATIC READING MAY INDICATE A GAS CONCENTRATION BEYOND THE UPPER SCALE LIMIT WHICH MAY BE HAZARDOUS. HIGH OFF-SCALE READINGS MAY INDICATE AN EXPLOSIVE CONCENTRATION.

For a toxic gas version SEC 2000, the concentration of gas is generally displayed in parts per million (PPM) or parts per billion (PPB)

For an oxygen version SEC 2000, the concentration is displayed as a percentage by volume content in the air being monitored. Oxygen concentration in a normal air environment is 21.0%. If the concentration of oxygen falls below a normal value, a potentially dangerous situation exists due to oxygen deficiency.

Alarms

The most important function of the SEC 2000 is to activate alarms when gas concentrations approach dangerous levels. There are three(3) levels of alarm for gas concentration on the SEC 2000; Low, Mid, and High. They are independently adjustable using the SEC 2500 Hand Held Programmer or Supervision Plus.

All alarms activate on rising gas concentrations except for the low and mid oxygen alarms which activate on a falling concentration. When gas concentration exceeds the low alarm setpoint (or falls below the setpoint in the case of oxygen) the low alarm relay will activate and the low alarm LED will turn red. When gas concentration exceeds the mid alarm setpoint (or falls below the setpoint in the case of oxygen), the mid alarm relay will also activate and the mid alarm LED will turn red. When gas concentration exceeds the high alarm setpoint, the high alarm relay will activate and the high alarm LED will turn red.

If a fault condition exists, the fault alarm relay will activate and the tricolor power LED will turn red. The fault code will be displayed by the SEC 2000 alternating with the gas concentration. In the case of the "supply voltage out of tolerance" fault, the tricolor power LED will flash red for an over voltage condition and flash amber for an under voltage condition. Refer to Section VI, for a description of all SEC 2000 fault codes. During all alarm conditions, the analog output value will fall to 0 mA.

Normally Energized / De-energized

The action of the gas alarms can be independently set to normally energized or normally de-energized using the SEC 2500. Normal condition is defined as power applied to the SEC 2000 with no gas alarms in effect.

NOTE: The fault alarm is normally energized, and is de-energized in alarm conditions.

Latching / Non-latching

The action of all relays can be independently set to latching or non-latching using the SEC 2500. If an alarm is non-latching, the corresponding relay and tricolor LED will deactivate (reset) when the alarm condition has passed. If an alarm has been set to be latching, the corresponding relay and tricolor LED will remain active after the alarm condition has passed. In the case of a fault alarm, the fault code will remain displayed by the SEC 2000, alternating with the gas concentration. The relay, LED and fault code can then be deactivated (reset) using the SEC 2500 or by pressing the CRD switch two(2) times.

In the case of the latching low alarm only, the low alarm relay can be acknowledged when the low alarm condition still exists. This is true only if the gas concentration is below the mid alarm set level. After the low alarm relay has been acknowledged and during the time that the low alarm condition exists, the low alarm tricolor LED will flash amber.

Off Delay

All gas alarms can be configured to have an off delay. If an off delay has been set, the alarm relay and tricolor LED will remain active after the alarm condition has passed for the period of time specified as the off delay. After this period of time, the alarm relay and tricolor LED will automatically deactivate (reset). The off delay for each alarm can be independently set, using the SEC 2500 or Supervision Plus, to any value within the range of 0-255 minutes. During the time that the off delay is in effect, the alarm relay and tricolor LED can not be reset using the SEC 2500 or CRD switch. This feature applies to non-latching alarms only.

View ID Number

The ID number on any SEC 2000 can be viewed using the CRD switch with the following procedure;

Momentarily press the CRD switch once. The switch must be pressed so that the internal mechanism contacts the enclosure body and then is released fully.

The SEC will display:
ID
XXXX

It will then display the four (4) digit ID numbers of the SEC 2000 and return to the normal operating mode.

View Last Calibration Date

The date of last calibration on any SEC 2000 can be viewed using the CRD switch with the following procedure:

Press the CRD switch three(3) times. The switch must be pressed so that the internal mechanism contacts the enclosure body and then is released fully. Consecutive push-button actions must be no more than one second apart.

The SEC 2000 will initially display: **dATE**

It will then flash **YEAr**, alternating with the year the detector was last calibrated.

Example: **YEAr** and **97**

While in the calibration date mode, all four(4) tricolor LED indicators will flash green, the analog output will drop to 1.5 mA, and the relays will be inactive.

NOTE: The calibration date mode may be exited at any time by pressing the CRD switch five times. This will cause the SEC 2000 to momentarily display **CnCl**, and then return to the normal monitoring display.

Press the CRD switch two times to advance. The SEC 2000 display will now flash **mnTH**, alternating with the month (1-12) the detector was last calibrated:

Example: **mnTH** and **11**

Press the CRD switch two times to advance. The SEC 2000 display will now flash **dAY**, alternating with the day (1-31) the detector was last calibrated.

Example: **dAY** and **29**

Press the CRD switch two times to advance. The SEC 2000 display will now flash:

donE

Press the CRD switch two times to exit the calibration date mode and return to the normal monitoring

display. The four(4) tricolor LEDs will go solid green and the display will indicate the current gas concentration.

NOTE: While in the View Calibration Date mode, the SEC 2000 will time out to the normal operating mode after five(5) minutes if the magnetic switch remains inactive.

View/Change Calibration Gas Value

The value of calibration gas programmed into the SEC 2000 memory can be viewed or changed using the CRD switch. This programmed value must equal the actual value used when the detector is calibrated.

Use the following procedure to view/change calibration gas value:

Press the CRD switch four times. The switch must be pressed so that the internal mechanism contacts the enclosure body and then is released fully. Consecutive push-button actions must be no more than one second apart.

The SEC 2000 will alternately display:

CAL
gAS
XX (XX = Value of Cal. Gas in SEC 2000 memory)
XXX (XXX = Gas units in SEC 2000 memory)

Example:
CAL
gAS
50
LEL

The SEC 2000 will then flash **gAS** alternating with the value of calibration gas currently entered into the detector's memory. While in the calibration gas mode, all four(4) tricolor LED indicators will flash green, the analog output will drop to 1.5 mA, and the relays will be inactive.

The operator can now either exit the calibration gas mode or change the value of calibration gas displayed.

NOTE: The calibration gas value should only be changed immediately prior to a calibration as it will instantaneously affect the way the SEC 2000 interprets the sensor input.

To exit the calibration gas mode, press the CRD switch two times. The SEC 2000 will momentarily display **donE**, and return to the normal monitoring display. The four(4) tricolor LEDs will go solid green and the display will indicate the current gas concentration.

To change the calibration gas value programmed into the SEC 2000 memory, press and HOLD the CRD switch. The displayed calibration gas value will begin to ascend (example: 51, 52, 53 ...).

To change the direction that the display is counting (i.e., descend) press the CRD switch four times. Now when the CRD switch is pressed and held, the displayed calibration gas value will count down (i.e., 53, 52,...).

When the desired calibration gas value is displayed, release the CRD switch. With the correct value displayed, press the CRD switch two times to lock in this number.

The SEC 2000 will momentarily display **donE**, and return to the normal monitoring display. The four(4) tricolor LEDs will go solid green and the display will indicate the current gas concentration.

Note: While in the View/Change Calibration Gas mode, the SEC 2000 will automatically time out to the normal operating mode after five(5) minutes if the magnetic switch remains inactive.

V. CALIBRATION

Sensor Calibration and Setting Calibration Date

The SEC 2000 must be calibrated regularly using known gas samples, representative of the gas being detected. The combustible gas version SEC 2000 must also be calibrated following exposure to any of the following poisoning agents:

Silicone
Silicane
Halogenated Hydrocarbons
Antiknock compounds found in gasoline

Calibration consists of exposing the SEC 2000 sensor to the known gas sample and adjusting the electronic circuitry to generate a reading equal to the concentration of the calibration gas. This adjustment is done electronically by the SEC 2000, eliminating the need for any special tools or to open the enclosure.

For maximum accuracy, the concentration of the calibration gas should be a significant percentage of the measuring range. Prepared gas mixtures in pressurized disposable cylinders, calibration

accessories, and calibration kits are available from Sensor Electronics Corporation.

The frequency of calibration is dependent upon how often the instrument is used and in what type of environment it is being used. A good indication of how often the SEC 2000 should be calibrated is the amount of adjustment required when a calibration is performed. If the SEC 2000 must consistently be adjusted a significant amount, the calibration interval should probably be more frequent.

Located in the back of this manual are calibration forms on which information should be recorded every time the SEC 2000 is calibrated. This information will be useful for establishing a calibration interval and keeping track of individual SEC 2000 performance. Contact Sensor Electronics Corporation for advice in setting up a particular calibration program.

The SEC 2000 may be calibrated using the CRD switch, SEC 2500 Hand Held Programmer or Supervision Plus. For a complete description of calibration using the SEC 2500 or Supervision Plus, please refer to the respective instruction manuals.

The following procedure describes the calibration of the SEC 2000 using the CRD switch:

1. If the SEC 2000 has just been powered up, allow the sensor to stabilize, depending on the type of gas being sensed, this could take several hours.

2. If using an SEC Calibration kit, connect the regulator/flow meter to the appropriate cylinder of calibration gas. Connect the flexible tubing to the regulator and to the calibration adapter.

NOTE: The Calibration gas value programmed into SEC 2000 memory must be the same as the actual calibration gas used. Refer to Section IV; View/Change Calibration Gas Value for instructions to change the calibration gas value.

3. If the gas cylinder does not have an integral regulator/flow meter, use flexible tubing to connect the cylinder's valve, through a 0-2 SCFH (0-1 LPM) flow meter to a calibration adapter (refer to the Section VIII Parts List, for the required calibration adapter).

4. Press the CRD switch five times. The SEC 2000 will alternately display:

CAL
gAS
XX (XX = Value of cal. gas in SEC 2000 memory)
XXX (XXX = Gas unit in SEC 2000 memory)

NOTE: The switch must be pressed so that the internal mechanism contacts the enclosure body and then is released fully. Consecutive push-button actions must be no more than one second apart.

Example:
CAL
gAS
50
LEL

NOTE: While in the calibration mode, all four(4) tricolor LED indicators will flash green to red, the analog output will drop to 1.5 mA, and the relays will be inactive.

NOTE: The calibration mode may be exited at any time by pressing the CRD switch five times. This will cause the SEC 2000 to momentarily display: **CnCl**, and return to the normal monitoring display.

NOTE: If the calibration gas value displayed by the SEC 2000 during this step is not the same as the calibration gas being used, it must be changed. Refer to View/Change Calibration Value in the section IV Operation of this manual.

5. The SEC 2000 will begin to toggle between **ACAL** and a voltage. This feature allows the display to function as a voltmeter showing the analog voltage from the sensor. For complete details on performing an analog calibration using this feature, refer to Section VI Maintenance: Analog Calibration, in this manual. To proceed with a standard calibration, push the CRD switch twice.

6. The SEC 2000 will then flash **ZErO**, alternating with the current gas concentration.

7. With the SEC 2000 sensor in a known gas-free environment, press the CRD switch two times to lock in the zero gas value.

NOTE: If the atmosphere surrounding the SEC 2000 sensor is uncertain, apply zero air to the sensor using the calibration adapter.

NOTE: For an Oxygen version SEC 2000, this step must be performed with an oxygen-free inert gas such as nitrogen.

8. The SEC 2000 will then assign this new value to zero and will display **ZErO** for one second.

9. The SEC 2000 will then change the display to flash **SPAn**, alternating with the current gas concentration.

10. Open the valve on the calibration gas bottle. If using a flow meter, adjust until the flow meter reads 1 Lpm.

11. Attach the calibration adapter to the SEC 2000 sensor.

12. The display on the SEC 2000 will indicate the concentration of calibration gas being applied to the sensor. Allow at least one minute for the display reading to stabilize.

13. Press the CRD switch two times to lock in the span gas value

14. The SEC 2000 will then display **SPAn** solidly for one second. Remove the calibration adapter and close the cylinder valve.

15. The SEC 2000 will then flash **YEAr**, alternating with the year of last calibration currently entered into the detector's memory. (Example 98).

If the year displayed is not the current year, press and hold the CRD switch. The displayed year will then begin to ascend (Example: 96, 97, 98 ...). When the current year is displayed by the SEC 2000, release the CRD switch.

NOTE: If the current year is "missed," continue to hold down the CRD switch. When the display reaches 99, it will advance to 0 and begin counting up again.

NOTE: When the year reaches 2000, the unit will stay in the 2000's, to return to the 1900's you will need use a SEC 2500, SEC 4100 or Supervision software to change back

16. With the current year displayed, press the CRD switch two times to lock in this number. The SEC 2000 will then flash **mnTH**, alternating with the month (1-12) of last calibration currently entered into the detector's memory. If the month displayed is not the current month, press and hold the CRD switch. The displayed month will begin to ascend.

17. When the current month is displayed by the SEC 2000, release the CRD switch.

NOTE: If the current month is "missed," continue to hold down the CRD switch. When the display reaches 12, it will advance to 0 and begin counting up again.

18. With the current month displayed, press the CRD switch two times to lock in this number.

The SEC 2000 will then flash **dAY**, alternating with the day (1-31) of last calibration currently entered into the detector's memory.

If the day displayed is not the current day, press and hold the CRD switch. The displayed day will then begin to ascend.

19. When the current day is displayed by the SEC 2000, release the CRD switch.

NOTE: If the current day is "missed," continue to hold down the CRD switch. When the display reaches 31, it will advance to 0 and begin counting up again.

20. With the current day displayed, press the CRD switch two times to lock in this number.

The SEC 2000 will then flash **donE**.

21. To end the calibration sequence, press the CRD switch two times.

The display will indicate **donE** solidly for one second and then begin a five (5) minute timer to allow the sensor to clear out any remaining calibration gas. During the five (5) minute time out period the tricolor LEDs will flash green to red and display the gas concentration. The analog voltage will remain at 1.5mA and the relays will be inactive. If there were any fault codes being displayed prior to calibrating the SEC 2000, the fault codes will continue to be displayed until the five (5) minute time out is completed. The SEC 2000 will return to its basic monitoring mode after five (5) minutes. The four tricolor LEDs will go solid green and the display will indicate the current gas concentration.

NOTE: At any point during the calibration sequence, if the SEC 2000 is left unattended for more than five(5) minutes, it will automatically return to the normal operating mode.

Analog Output Calibration

The SEC 2000 analog output has been factory calibrated and generally should not have to be field adjusted. If it is discovered that the output, 4-20 mA, does not exactly correspond to the instruments range, 0 to full scale, the following procedure may be used to calibrate the analog output.

1. Remove power from the SEC 2000. Unscrew and remove the domed lid from the enclosure.

2. Using an allen key, remove the three screws from the SEC 2000 face plate holding the top

three(3) modules in place. These three(3) screws are identified by half circles marked on the face plate on the outer edges of the screws. Slide the three(3) board module assembly up over the three(3) support posts and off of the stack.

3. Remove the three slotted screws on the bottom of the Power Supply Module, attaching it to the Processor Module. Unplug the Power Supply Module.

4. Locate the two pin male header labeled "**OUT CAL**" on the Power Supply Module. It will be located near the edge of the circuit board near the six(6) pin test header. Install a two pin jumper on the "OUT CAL" header.

5. Connect a 4-20mA measuring device to SEC 2000 analog Output (pin 3 on the Termination Module). Apply power to the SEC 2000.

WARNING:
DO NOT POWER UP THE SEC 2000 WHILE THE ENCLOSURE LID IS REMOVED AND IT IS SITUATED IN A HAZARDOUS AREA.

6. Locate the potentiometer on the Power Supply Module labeled 0 SP. Adjust this control until the analog output measured corresponds to exactly 20 mA.

7. Remove power to the SEC 2000.

8. Remove the jumper from the "OUT CAL" header and reassemble the
SEC 2000.

VI. MAINTENANCE

General

General maintenance of the SEC 2000 consists primarily of periodic checks to be sure that the display remains at zero (20.9 for oxygen) and that it is responsive to gas. The four(4) tricolor LEDs beneath the SEC 2000 display should also be checked periodically to verify that the instrument is in a normal operating condition (all LEDs solid green).

If the SEC 2000 on-board relays are used to control any auxiliary equipment, they can be tested using the manual relay control function of the SEC 2500. Refer to the SEC 2500 manual for more information regarding manual relay control.

Fault Codes

In the event of an operating fault, the SEC 2000 will generate an alarm. The fault relay will become de-energized and the power LED will go red, the SEC 2000 display will indicate a fault code number alternating with current gas concentration. The analog output will fall to 0 mA.

Fault Code Description
FL 10 Sensor is bad
FL 11 Insufficient gain
FL 12 Analog signal out of range
FL 13 Zero drift
FL 14 Excessive gain
FL 21 Logic voltage out of tolerance
FL 22 Combustible sensor voltage out of tolerance
FL 23 Supply voltage out of tolerance
FL 34 EEPROM write fault
CNFg Incomplete configuration in EEPROM

Table 6.1-SEC 2000 Fault Codes

The following are probable causes and possible remedies for the faults listed in Table 6.1.

FL 10 - Sensor is bad

This fault code is generated immediately following a calibration when the sensitivity of the sensor has fallen below a pre-determined limit. When this fault code is displayed, a new sensor must be installed before normal operation of the SEC 2000 can resume. Refer to Section VI, for instructions to change sensors.

FL 11 - Insufficient gain

This fault code is also generated immediately following a calibration when the sensitivity of the sensor has fallen below a pre-determined limit. In this case, however, the SEC 2000 diagnostic software has determined that more sensitivity can be obtained using the adjustable gain control on the Power Supply Module. Refer to "Analog Adjustment" in Section VI, for instructions to correct this fault condition.

FL 12 - Analog signal out of range

This fault code is generated when the analog output from the sensor circuitry has drifted out of the measuring range of the analog to digital (A/D) converter located on the Power Supply Module. Refer to "Analog Adjustment" in Section VI, for instructions to correct this fault condition.

FL 13 - Zero drift

This fault code is generated when the output from the sensor drifts above or below the zero point, set during last calibration, by more than 5%. To correct this fault condition, the SEC 2000 must be calibrated using the procedure described in Section V of this manual.

FL 14 - Excessive gain

This fault code is generated when the diagnostic software of the SEC 2000 has determined that the sensitivity of the sensor circuitry is too high, making it impossible to measure 115% of full scale within the range of the A/D converter. To correct this fault condition, the gain control on the Power Supply Module must be adjusted as described in "Analog Adjustment", Section VI.

FL 21 - Logic voltage out of tolerance

This fault code is generated when the voltage powering the logic circuitry of the SEC 2000 falls below or rises above its nominal value of 5 volts by more than 5%. This voltage is generated on the Power Supply Module. To correct this fault condition, the Power Supply Module must be repaired or replaced. Use the following procedure to replace the Power Supply Module:

1. Remove power to the SEC 2000 and unscrew and remove the domed lid from the enclosure.

2. Using an allen key, remove the three screws from the SEC 2000 face plate holding the top three modules in place. These three screws are identified by half-circles marked on the face plate near the outer edges of the screws.

3. Slide the three board module assembly up over the three support posts and off of the stack. Remove the module assembly from the instrument altogether by disconnecting the ribbon cable at the Power Supply Module.

4. Remove the three(3) slotted screws from the bottom of the Power Supply Module and unplug this module from the Processor Module.

5. Install a new Power Supply Module in the reverse order of the above procedure.

6. Adjust the analog gain settings on the Power Supply Module as described in Section VI, "Analog Adjustment".

FL 22 - Combustible sensor voltage out of tolerance

This fault code is generated when the sensor voltage differs from the value programmed into the SEC 2000 memory by more than 5%. The sensor voltage in the SEC 2000 memory can be viewed using the SEC 2500 (refer to SEC 2500 Instruction Manual).

NOTE: This fault condition applies only to catalytic type combustible sensors. Use the following procedure to adjust the combustible sensor voltage:

1. Unscrew and remove the domed lid from the SEC 2000 enclosure.

WARNING:
DO NOT REMOVE THE ENCLOSURE LID WHILE THE SEC 2000 IS POWERED UP AND LOCATED IN A HAZARDOUS AREA.

2. Locate the six(6) pin male header on the outer edge of the Power Supply Module (refer to Figure 5 in back of manual). Connect a voltmeter across Pin 6 (Common) and Pin 1 (Positive) of the header. The voltmeter will display the current value of sensor bridge voltage.

3. Locate the potentiometer on the Power Supply Module labeled BV/B. Adjust this control until the correct combustible sensor voltage is displayed on the voltmeter. For the correct voltage, refer to Figure 3 in the back of this manual.

4. Replace the domed lid on the SEC 2000 enclosure.

FL 23 - Supply voltage out of tolerance

This fault code is generated when the DC voltage powering the SEC 2000 falls below or rises above its nominal value of 24 volts by more than 25%. To correct this fault condition, adjust the system power supply within the range of 18-32 VDC.

NOTE: A low voltage fault can be caused by high wire losses, or high contact resistance at wire connections.

FL 34 - EEPROM write fault

When any information is changed in the SEC 2000 memory, the microprocessor will verify the change by reading back the entire content of the EEPROM. Fault code 34 is generated when the programmed information and the information read back do not agree. To correct this fault condition, the processor module must be repaired or replaced.

CnFg - Incomplete configuration in EEPROM

This message is generated when there is not enough information programmed into the SEC 2000 memory. This condition generally occurs only when an unconfigured SEC 2000 is powered up for the first time or when a blank EEPROM has been installed in the Processor Module. To correct this condition, all configuration parameters must be entered into the SEC 2000 memory using the SEC 2500 Hand Held Programmer.

Sensor Maintenance

All of the sensors used with the SEC 2000 are non-serviceable and must be replaced when they lose their sensitivity. This loss in sensitivity is signaled by a Fault Code 10 generated immediately after a calibration is performed.

Changing Sensors

Use the following applicable procedure to change sensors on the SEC 2000.

For Combustible Sensors only:

1. Disconnect power from the SEC 2000. Unscrew and remove the domed lid from the SEC 2000 enclosure.

2. Using an allen key, remove the three screws from the SEC 2000 face plate holding the top three modules in place. These three screws are identified by half circles marked on the face plate near the outer edges of the screws.

3. Slide the three board module assembly up over the three support posts and off of the stack. Remove the module stack from the instrument altogether by disconnecting the ribbon cable at the Power Supply Module.

4. Remove the three slotted screws securing the Relay Module to the standoffs protruding from the Termination Module.

5. Slide the Relay Module up over the three support posts and off of the stack. Remove the Relay Module from the instrument altogether by disconnecting the ribbon cable at the Termination Module.

6. Locate the sensor plug/socket on the Termination Module. Carefully pull the plug out of the socket. Unthread the combustible sensor from the SEC 2000 enclosure opening. Thread in a new sensor and plug its connector into the socket on the Termination Module.

NOTE: A 3/4" NPT to 1/2" NPT reducer may be required to install the combustible sensor.

7. Reassemble the SEC 2000 in reverse order of the above procedure.

8. Power up and calibrate the SEC 2000.

For City Tech H2S and O2 series 6C Gas Sensors:

1. Unscrew the cap from the sensor housing.

2. The toxic sensor plugs into a three(3) pin socket located on a circuit board mounted within the sensor holder. Unplug the H2S sensor and plug in a new one of the same type.

3. Replace the three(3) screws and sensor holder cap.

4. Power up and calibrate the SEC 2000.

For Other Toxic Gas Sensors:

1. Unscrew the cap from the sensor housing.

2. Remove the three slotted screws securing the toxic sensor holder.

3. The toxic sensor has an attached cable with a three(3) pin socket on the end. Carefully remove

the shrink tubing around this connector and unplug the toxic sensor and plug in a new one of the same type.

4. Replace the three(3) screws and sensor holder cap.

5. Power up and calibrate the SEC 2000.

For City Tech C/Y Oxygen Sensor Only:

1. Unscrew the cap from the sensor housing.

2. Unsolder both wires (red and white) from the tabs located on the sides of the oxygen sensor.

3. Using an allen key, loosen the three(3) set screws holding the oxygen sensor in place within the sensor holder.

4. Slide in a new oxygen sensor and secure using the set screws.

5. Resolder the red and white wires to the tabs on the oxygen sensor. (The red wire is connected to the tab closest to the sensing end of the sensor).

6. Replace the sensor holder cap.

7. Power up and calibrate the SEC 2000.

Analog Adjustment

It is possible that, after the sensor has been replaced and the SEC 2000 has been calibrated, the instrument may display fault codes 11, 12, or 14. This is because the initial analog adjustment required for individual sensors varies, even between two new sensors of the same type.

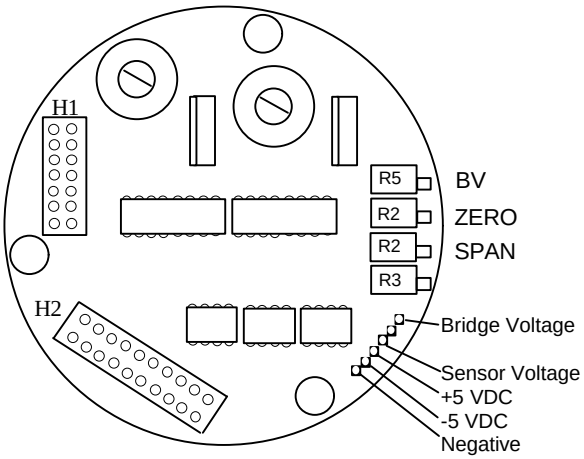
In order to adjust the analog voltage, you need to know the range the SEC 2000 is programmed for. The Range value can be found by using the SEC 2500 Handheld Programmer or the SEC 4100 System Monitor or the Supervision Plus software. If none of these methods are available, record the serial number of the SEC 2000 and contact the factory.

Use the following procedure to correct for individual sensor characteristics:

1. Unscrew and remove the domed lid from the SEC 2000 enclosure.

WARNING:
DO NOT REMOVE THE ENCLOSURE LID WHILE THE SEC 2000 IS POWERED UP AND LOCATED IN A HAZARDOUS AREA.

2. On SEC 2000 Gas Detectors without a CRD push-button, locate the six(6) pin male header on the outer edge of the Power Supply Module. Connect a voltmeter across Pin six(6) (Common) and Pin three(3) (Positive) of the header. The voltage displayed is the amplified sensor input to the A/D converter.



3. Connect the gas cylinder to the gas detector through the integral regulator/flow valve and flexible tubing that comes with the calibration kit. If you are using some other source of calibration gas, make sure that the source of gas is regulated to 1 lpm (0-2SCFH) of flow.

4. Press the CRD switch five (5) times. The SEC 2000 will alternately display:

CAL
gAS
XX (XX = Value of cal gas in SEC 2000 memory)
XXX (XXX = Gas unit programmed into SEC 2000 memory)

Example:
CAL
GAS
50
LEL

While in the calibration mode, all four tricolor LED indicators will flash green, the analog output will drop to 1.5mA, and the relays will be inactive.

NOTE: If the calibration gas value displayed by the SEC 2000 during this step is not the same as the calibration gas being used, it must be changed to the value to be used for calibration.

5. The SEC 2000 will than display **ACAL** and begin to function as a volt meter, alternately displaying the analog signal from the sensor and **ACAL**.

Example:

ACAL
0.25
ACAL
0.25

6. If the sensor is located in a clean air environment the display will read 0.25. If the display is not reading 0.25 and it is located in a clean air environment than the reading should be adjusted.

7. Locate the potentiometer on the Power Supply Module labeled NULL (for combustibles) or ZERO (for toxics). With the sensor in a known gas free atmosphere, adjust this control until the voltage displayed by the voltmeter is 0.250 VDC ± 0.01 VDC.

NOTE: For oxygen, this step must be performed while the sensor is surrounded by a known oxygen free gas such as 100% nitrogen.

8. Apply calibration gas to the sensor using the method and flowrate specified. (Prepared gas mixtures in pressurized disposable cylinders and calibration accessories are available from Sensor Electronics Corporation).

NOTE: For oxygen, this step can be performed with the sensor in a known normal air environment; i.e., 20.9% oxygen.

9. Locate the potentiometer on the Power Supply Module labeled I SP. After applying gas to the sensor and allowing the meter reading to stabilize, adjust this control until the following voltage is displayed:

$$\text{Voltage} = \frac{(\text{Cal Gas Value} \times 1.625\text{V})}{\text{Full Scale Value}} + 0.250\text{V}$$

Example 1. For a SEC 2000 combustible, 0-100% LEL, using 50% LEL calibration gas:

$$\text{Voltage} = \frac{(50\%\ \text{LEL} \times 1.625\text{V})}{100\%\ \text{LEL}} + 0.250\text{V}$$
$$= 1.06 \text{ volts.}$$

Example 2. For a SEC 2000 H2S, 0-100 PPM, using 25 PPM calibration gas;

$$\text{Voltage} = \frac{(25\ \text{PPM} \times 1.625\text{V})}{100\ \text{PPM}} + 0.250\text{V}$$
$$= 0.656 \text{ volts.}$$

Example 3. For a SEC 2000 O2, 0-40%VOL, using 20.9%VOL (Normal Air) calibration gas;

$$\text{Voltage} = \frac{(20.9\%\text{VOL} \times 1.625\text{V})}{40\%\text{VOL}} + 0.250\text{V}$$
$$= 1.10 \text{ volts.}$$

10. After setting the voltage with gas applied, remove the gas (or apply 100% nitrogen in the case of oxygen) and observe the voltage on the voltmeter decrease and stabilize.

NOTE: For toxic gases, it may be more practical to flush any residual toxic gas from the sensor holder using zero air. If the voltage does not stabilize at 0.250 VDC ± 0.01 VDC, repeat steps c through e. The ZERO/NULL and I SP controls have an effect on each other so these steps may have to be repeated.

11. After the successful completion of the analog adjustment, the sensor now needs to be calibrated. Refer to section **V. CALIBRATION**; step 5, for calibration procedure.

Bias Voltage

If the particular sensor used by the SEC 2000 requires a bias voltage (refer to the appropriate Sensor Reference Chart), it should be checked occasionally and adjusted if necessary using the following procedure.

1. Remove power to the SEC 2000. Unscrew and remove the domed lid from the enclosure.

2. Using an allen key, remove the three(3) screws from the SEC 2000 face plate holding the top three(3) modules in place. These three(3) screws are identified by half circles marked on the face plate near the outer edges of the screws.

3. Slide the three(3) board module assembly up over the three(3) support posts and off of the stack.
4. Place a jumper between S2 and S3 on TB2 on the Termination Module.

NOTE: On some sensors there will already be a jumper between S2 and S3, therefore this step may be omitted.

5. Connect a voltmeter between S3 (negative) and S1 (positive) TB2 on the Termination Module.

NOTE: The sensor does not need to remain connected to adjust the bias voltage.

WARNING
DO NOT POWER UP THE INSTRUMENT WHILE THE ENCLOSURE LID IS REMOVED AND IT IS SITUATED IN A HAZARDOUS AREA.

6. Re-apply power to the SEC 2000.

7. The voltmeter will indicate the current bias voltage setting. If this value is not within ±10 mV of the bias voltage listed on the sensor reference chart, it must be adjusted.

8. Locate the potentiometer on the Power Supply Module labeled B. Adjust this control until the reading on the voltmeter equals the specified bias voltage. This control should be adjusted by no more than a quarter turn at a time and the reading on the voltmeter must be allowed to stabilize before further adjustments are made.

9. Once the correct bias voltage has been achieved, the sensitivity of the analog circuitry must be checked following the procedure as detailed in Analog Adjustment section.

NOTE: If the bias voltage has been changed a significant amount, or if the instrument has been powered down for any amount of time, the sensor must be allowed to bias until it has stabilized. This may require several hours.

10. Reassemble the SEC 2000 and calibrate it following the procedure detailed in Section V of this manual.

VII. Warranty

Sensor Electronics Corporation (SEC) warrants products manufactured by SEC to be free from defects in workmanship and materials for a period of two (2) years from date of shipment from the factory. Any parts returned freight pre-paid to the factory and found defective within the warranty will be repaired or replaced, at SEC's option. SEC will return repaired or replaced equipment pre-paid lowest cost freight. This warranty does not apply to items which by their nature are subject to deterioration or consumption in normal service. Such items may include:

Fuses and Batteries.

Catalytic, Toxic and Oxygen sensors, that may be covered by a standard warranty based on the specific application. (Consult Factory)

Warranty is voided by abuse including rough handling, mechanical damage, alteration or repair. This warranty covers the full extent of SEC liability and SEC is not responsible for removal, replacement costs, local repair costs, transportation costs or contingent expenses incurred without prior written approval.

Sensor Electronics Corporation's obligation under this warranty shall be limited to repair or replacement of any product that has been returned to Sensor Electronics Corporation for warranty consideration.

This warranty is expressly in lieu of any and all other warranties expressed or implied, and all other obligations or liabilities on the part of Sensor Electronics Corporation including but not limited to, the fitness for a particular purpose. In no event shall Sensor Electronics Corporation be liable for direct, incidental, or consequential loss or damage of any kind connected with the use of it's products or failure to function or operate properly.

Year 2000 Compliance

All Sensor Electronics products have been tested and are certified by Sensor Electronics to accurately process date/time and date/time related data from, into and between the 20^{th} and 21^{st} centuries.

Sensor Electronics products neither contain nor create any logical or mathematical inconsistency, will not malfunction, and will not cease to function when processing date/time data.

Please contact Sensor Electronics for further information.

VIII. Parts List

Stock Number	Description
165-1036C	Combustible gas sensor VQ21
165-1000C	Combustible gas sensor VQ24
165-1037C	Combustible High Temp VQ21T
165-1004C	Hydrogen Sulfide sensor
165-1007C	Oxygen sensor - C/Y (O_2)
165-1038C	Oxygen sensor - 6C (O_2)
165-1014C	Sulfur Dioxide sensor (SO_2)
165-1009C	Chlorine sensor(CL_2)
165-1015C	Nitrogen Dioxide sensor (NO_2)
165-1012C	Nitric Oxide sensor (NO)
165-1008C	Carbon Monoxide sensor (CO)
165-1011C	Hydrogen Cyanide sensor (HCN)
165-1010C	Hydrogen Chloride sensor (HCL)
165-1020C	Hydrogen Fluoride sensor (HF)
165-1013C	Ammonia sensor (NH_3)
165-1018C	Hydrogen sensor (H_2)
165-1031C	Arsine sensor (AsH_3)
165-1030C	Bromine sensor (Br_2)
165-1029C	Chlorine Dioxide sensor (CLO_2)
165-1028C	Diborane sensor (B_2H_6)
165-1027C	Flourine sensor (F_2)
165-1026C	Germane sensor (GeH_4)
165-1025C	Hydrogen Selenide sensor (H_2Se)
165-1024C	Ozone sensor (O_3)
165-1023C	Phosgene sensor ($COCL_2$)
165-1022C	Phosphine sensor (PH_3)
165-1021C	Silane sensor (SiH_4)
157-1016C	Power Supply module, Combustible sensor, 0-100% LEL
157-2004C	Power Supply module, H_2S sensor, 0-100 PPM
157-2002C	Power Supply module, O_2 sensor, 0-40% VOL
157-2011C	Power Supply module, SO_2 sensor, 0-20 PPM
157-2005C	Power Supply module, Cl_2 sensor, 0-10 PPM
157-2009C	Power Supply module, NO_2 sensor, 0-15 PPM
157-2008C	Power Supply module, NO sensor, 0-100 PPM
157-2003C	Power Supply module, CO sensor, 0-500 PPM
157-2007C	Power Supply module, HCN sensor, 0-20 PPM
157-2006C	Power Supply module, HCl sensor, 0-20 PPM
157-2014C	Power Supply module, HF sensor, 0-20 PPM
157-2010C	Power Supply module, NH_3 sensor, 0-100 PPM
157-2012C	Power Supply module, H_2 sensor, 0-1000 PPM
157-2022C	Power Supply module, AsH_3 sensor, 0 to1000 PPB
157-2016C	Power Supply module, Br_2 sensor, 0 to 2 ppm
157-2017C	Power Supply module, CLO_2 sensor, 0 to 2 ppm
157-2018C	Power Supply module, B_2H_6 sensor, 0 to 1000 ppb
157-2019C	Power Supply module, F_2 sensor, 0 to 2 ppm
157-2020C	Power Supply module, GeH_4 sensor, 0 to 1000 ppb
157-2021C	Power Supply module, H_2Se sensor, 0 to 1000 ppb
157-2024C	Power Supply module, O_3 sensor, 0 to 2 ppm
157-2015C	Power Supply module, $COCL_2$ sensor, 0 to 2 ppm
157-2025C	Power Supply module, PH_3 sensor, 0 to 1000 ppb
157-2029C	Power Supply module, SiH_4 sensor, 0 to 1000 ppb
157-1010C	Termination module
157-1011C	Relay module
157-1013C	Microprocessor module
157-1014C	Display module
135-0203C	Model XPSH Flame Arrestor
135-5179C	Splash Guard; combustible sensor
135-5178C	Splash Guard; toxic sensor
181-0001C	Calibration Adapter for Toxic and Oxygen
135-5182C	Calibration Adapter for Combustible Gas Sensor
135-5183C	Calibration Adapter for Toxic Gas Sensor
147-0000C	6", 16 cond., Ribbon cable
147-0001C	4.5", 10 cond., Ribbon cable
121-0004C	SEC 2000 Enclosure base with hall effect sensor
143-0001C	SEC 2000 Magnetic actuator
157-3000C	Relay Module Upgrade Kit; includes relay module, ribbon cable, standoffs, and hardware
157-3001C	Display Module Upgrade Kit; includes display module, top plate, domed lid with glass lens, standoffs, and hardware
172-0175C	SEC 2500 Hand Held Programmer
147-1000C	SEC 2500 Data Communications Cable
171-0000	Combustible board stack
171-0001	Toxic board stack
181-0001C	Calibration Adapter (Toxic)
181-0004C	Calibration Adapter (Combustible)
190-1000	SEC 2001, Sensor Separation Kit

IX. Drawing Section

Figure #	Title
Figure 1	Model SEC 2000, Overall layout
Figure 2	SEC 2000 Housing Dimensions
Figure 3	Wiring Diagram, Combustible Gas Sensor
Figure 4	Wiring Diagram, Toxic Gas and Oxygen Sensor
Figure 5	Combustible Sensor, Power supply board details
Figure 6	Wiring Diagram, Relay Module
Figure 7	SEC 4100 Network Overview
Figure 8	SEC Supervision Network Overview
Figure 9	SEC Sensor Separation Kit
	Sensor Reference Charts
	Calibration Forms

CALIBRATION FACTOR CHART

Calibration factors referenced to methane			
Acetaldehyde	1.7	Ethylcyclopentane	2.5
Acetic Acid	1.8	Ethylene	1.4
Acetic Anhydride	2.2	Ethylene Oxide	1.9
Acetone	1.9	Ethyl Formate	2.3
Acetylene	1.8	Ethyl Mercaptan	1.8
Allyl Alcohol	1.8	n-Heptane	2.6
Ammonia	0.8	n-Hexane	2.8
n-Amyl Alcohol	3.1	Hydrazine	2.2
Aniline	2.5	Hydrogen	1.3
Benzene	2.5	Hydrogen Cyanide	2.1
Biphenyl	4.0	Hydrogen Sulfide	2.5
1.3 Butadiene	1.8	Methyl Acetate	2.0
n-Butane	1.7	Methyl Alcohol	1.2
iso-Butane	1.9	Methylamine	1.3
I-Butane	2.2	Methyl Cyclohexane	2.3
cis-2-Butene	2.1	Methylethyl Ether	2.3
trans-2-Butene	2.0	Methylethyl Ketone	2.4
n-Butyl Alcohol	2.9	Methyl Formate	1.5
iso-Butyl Alcohol	2.9	Methyl Mercaptan	1.6
tert-Butyl Alcohol	2.9	Methyl Propionate	2.0
n-Butyl Benzene	3.2	Methyl n-propylketone	2.5
iso-Butyl Benzene	3.2	Naphthalene	2.9
n-Butyric Acid	2.6	Nitromethane	1.7
Carbon Disulphide	5.7	n-Nonane	3.2
Carbon Monoxide	1.3	n-Octane	2.7
Carbon Oxysulphide	1.1	n-Pentane	2.2
Cyanogen	1.1	iso-Pentane	2.2
Cyclohexane	2.4	Propane	1.8
Cyclopropane	1.6	n-Propyl Alcohol	2.1
n-Decane	3.1	n-Propylamine	2.1
Diethyl Ether	2.2	Propylene	1.9
Dimethylamine	1.7	Propylene Oxide	2.2
Dimethyl Ether	1.6	iso-Propylether	2.3
2.3-Dimethyl Pentane	2.5	Propyne	2.4
2.2-Dimethyl Propane	2.5	Toluene	2.5
Dimethyl Sulfide	2.3	Triethylamine	2.5
1.4 Dioxane	2.2	Turpentine	3.2
Ethane	1.5	Vinylethylether	2.4
Ethyl Acetate	2.0	m-Xylene	2.6
Ethyl Alcohol	1.4	o-Xylene	2.8
Ethylamine	1.9	p-Xylene	2.6
Ethyl Benzene	2.8		

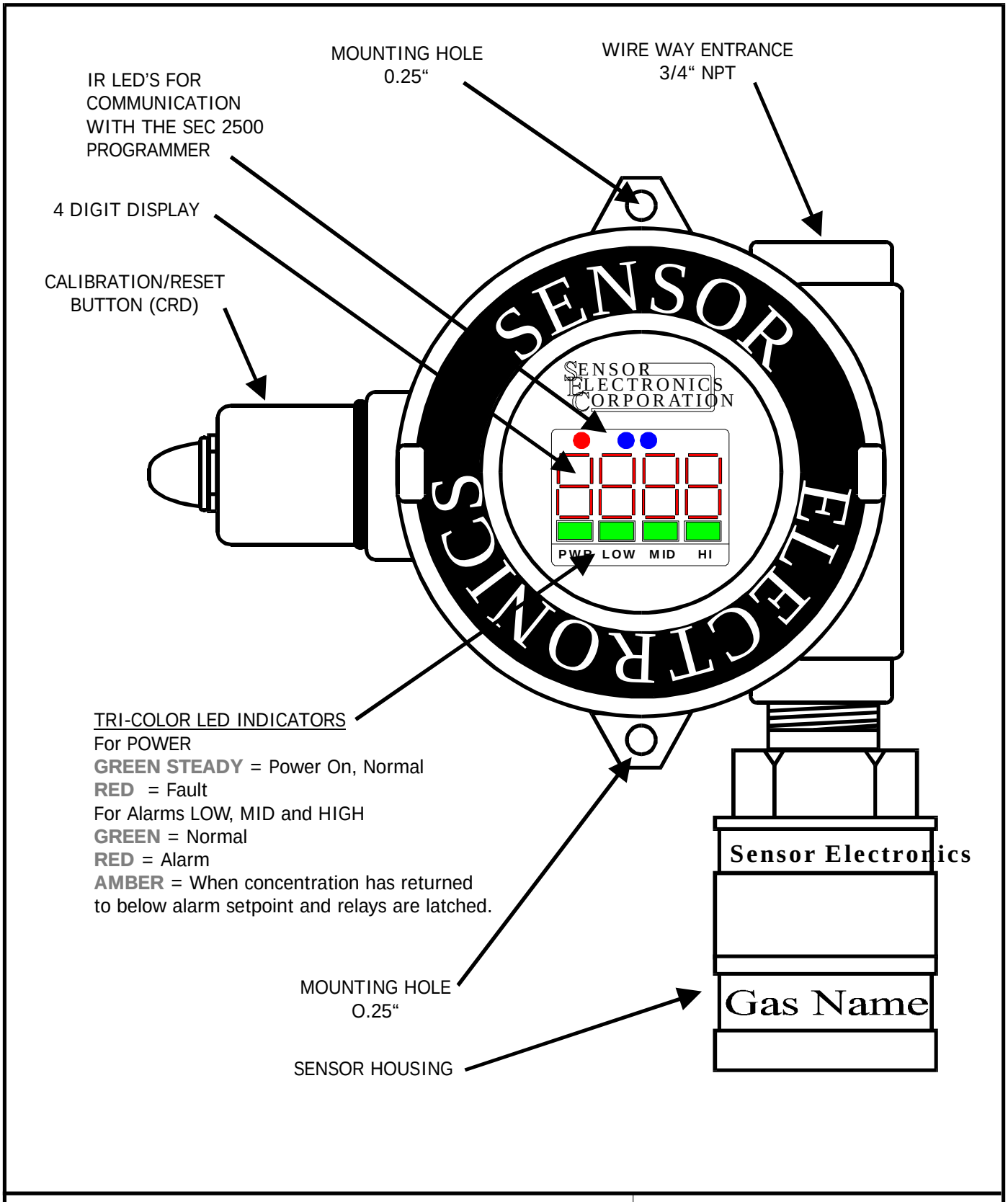
These calibration factors are for detecting gases other than methane, but using methane as the calibration gas.

The methane calibration gas value multiplied by the calibration factor = the new calibration gas value.

Example: If the unit is set up to sense acetone, and 50% LEL methane is to be used for calibration gas:

50% X 1.9 = 95%, 95% is the new factored calibration gas value.

The display will now show 95% LEL; when 50% LEL methane is applied.



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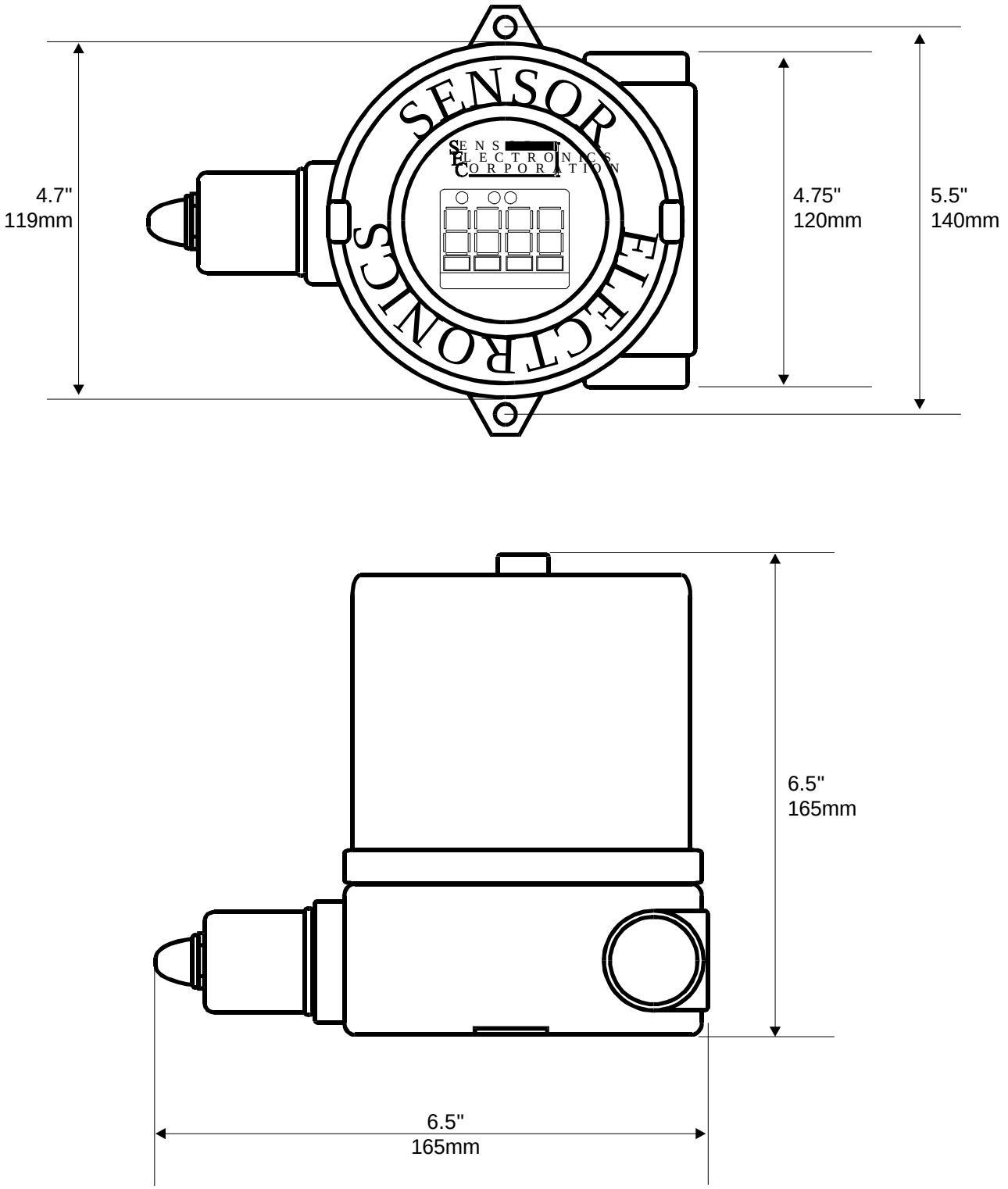
OVERALL LAYOUT

FIGURE 1



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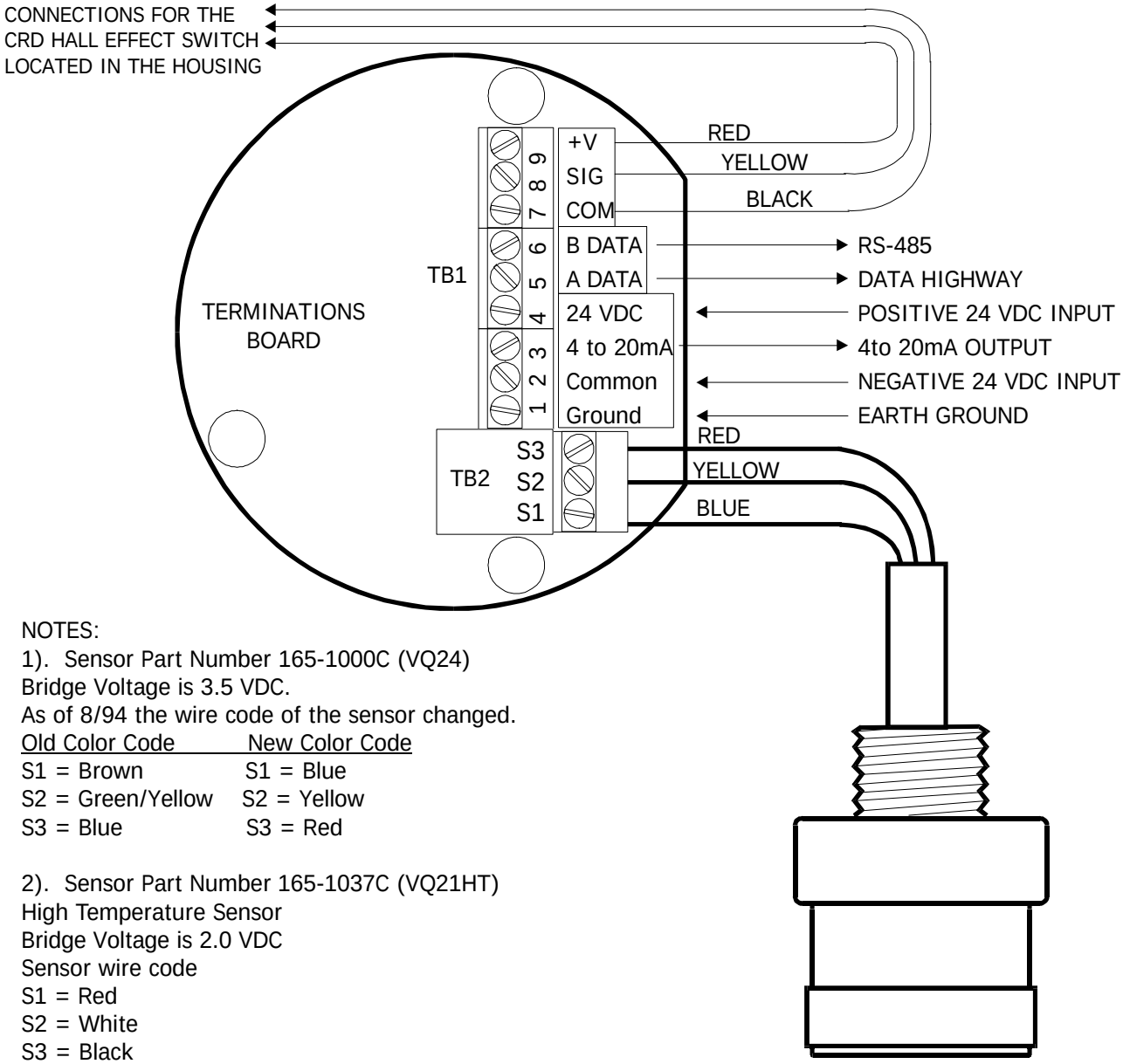
SEC 2000 HOUSING DIMENSIONS

FIGURE 2



NOTES:

1). Sensor Part Number 165-1000C (VQ24)
Bridge Voltage is 3.5 VDC.
As of 8/94 the wire code of the sensor changed.

Old Color Code	New Color Code
S1 = Brown	S1 = Blue
S2 = Green/Yellow	S2 = Yellow
S3 = Blue	S3 = Red

2). Sensor Part Number 165-1037C (VQ21HT)
High Temperature Sensor
Bridge Voltage is 2.0 VDC
Sensor wire code
S1 = Red
S2 = White
S3 = Black

3). Sensor Part number 165-1036C (VQ21)
Standard combustible sensor supplied with SEC2000.
Bridge Voltage is 2.0 VDC
S1 = Blue
S2 = Yellow
S3 = Red

For instructions on adjusting the Bridge Voltage refer to Figure 5.

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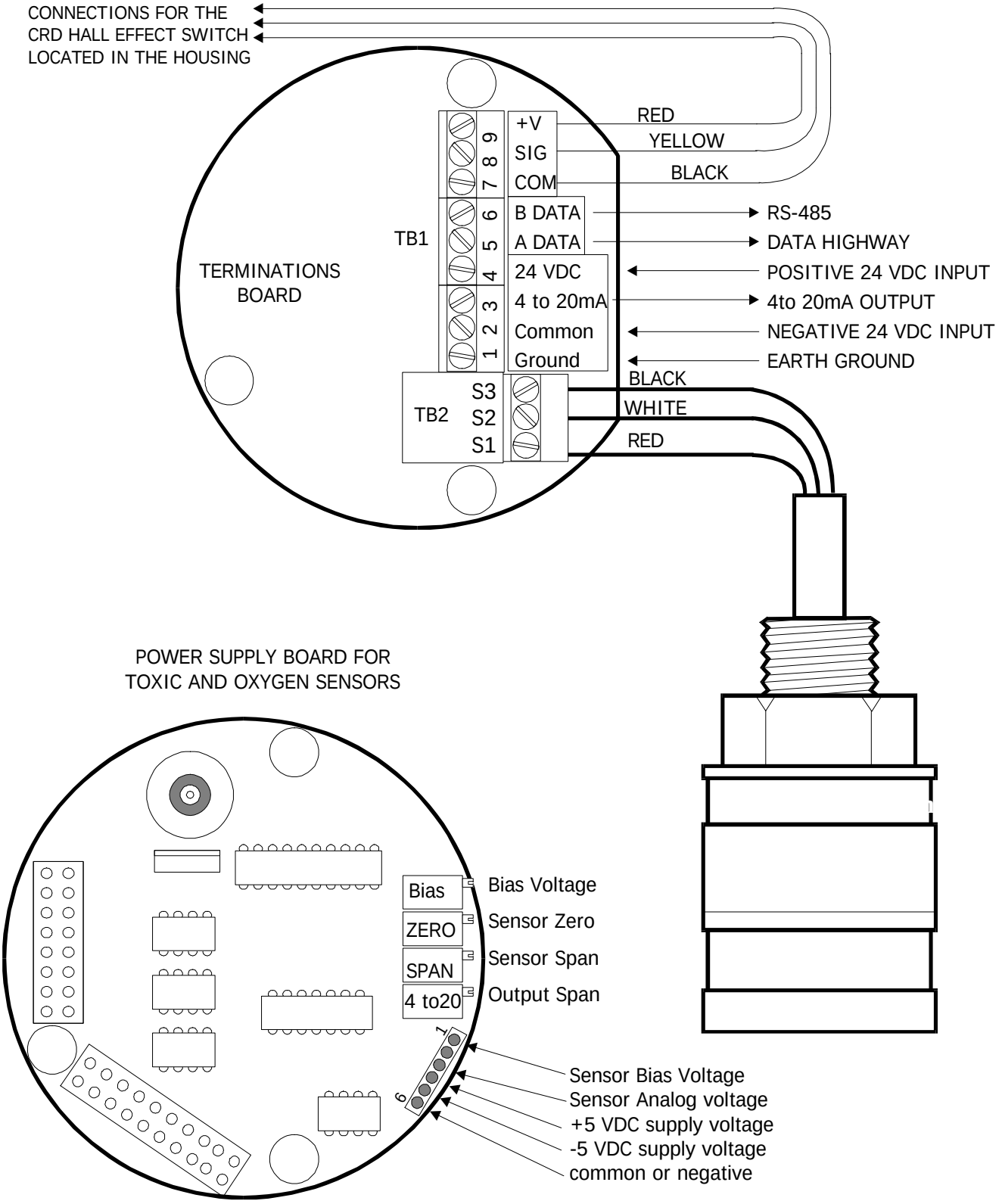
WIRING DIAGRAM
COMBUSTIBLE SENSOR

FIGURE 3



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WIRING DIAGRAM; TOXIC & OXYGEN SENSORS

FIGURE 4