



Instruction Manual

SEC 2000 DIN Controller



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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.

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I. SPECIFICATIONS

Model:

Sensor Electronics Corporation SEC 2000 DIN
For use with SEC Millenium, SEC Signature or SEC
3000 Toxic Gas Detectors.

Available gases (partial list):

Combustible	Bromine(Br ₂)
Oxygen(O ₂)	Fluorine(F ₂)
Hydrogen(H ₂)	Arsine(AsH ₃)
Ammonia(NH ₃)	Ozone(O ₃)
Nitric Oxide(NO)	Chlorine(Cl ₂)
Sulfur Dioxide(SO ₂)	Phosgene(COCl ₂)
Carbon Monoxide(CO)	Diborane(B ₂ H ₆)
Nitrogen Dioxide(NO ₂)	Germane(GeH ₄)
Chlorine Dioxide(ClO ₂)	Phosphine(PH ₃)
Hydrogen Sulfide(H ₂ S)	Silane(SiH ₄)
Hydrogen Fluoride(HF)	Hydrogen Chloride(HCl)
Hydrogen Cyanide(HCN)	Hydrogen Selenide(H ₂ Se)

Detection Method:

Combustible Gas - Infrared
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

Power Consumption:

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

Controls:

Pushbutton 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:

Molded gray UL94-VO flame resistant lexan

Housing Dimensions:

6.5 (W) x 7 (L) x 6.5 (H) inches

Weight:

Approximately 2 lbs.

Optional Equipment:

SEC 2500 Hand Held Programmer
Sensor Separation Kit

II. GENERAL DESCRIPTION

The SEC 2000 DIN is a digital controller, that is designed to be used with either the SEC Millennium, SEC Signature or SEC 3000 gas detectors. The SEC 2000 DIN will display the concentration of the particular gas and provide an alarm when gas concentrations reach preset levels.

The SEC 2000 DIN when used with one of the above gas sensors and will provide relay outputs and LED display.

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

The SEC 2000 DIN operating parameters (relay action, alarm set values, sensor configuration, etc.) can be viewed or changed using the SEC 2500 Hand Held Programmer. The SEC 2500 can communicate anywhere on the network with any SEC 2000 DIN when connected to the RS-485 data highway.

An RS-485 digital output enables the SEC 2000 DIN to communicate to a dedicated monitor or with digital equipment including: SEC 4100 System Monitor or SEC Supervision Plus Software. The SEC 2000 DIN network can be connected on a single twisted shielded pair of wires, reducing cabling and installation costs.

A integrated push-button switch is used to perform calibration. The calibration sequence is user-friendly and typically requires only one person. The SEC 2000 DIN defaults to normal operation if the calibration push-button is inactive for fifteen (15) minutes.

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

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

Optional relays; four (4) 8 amp SPST relays respond to Low, Mid, and High gas alarms and any fault conditions.

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

III. DETAILED DESCRIPTION

Enclosure

The SEC 2000 DIN is contained within lexan-ventilated enclosure. The field wiring terminals are

connected to the SEC 2000 DIN with removable plug connectors. The calibration pushbutton, span, zero and analog output adjustment potentiometers can also be exposed by removing the detachable covers.

The enclosure can be wall, panel or DIN rail mounted. A transparent lexan lens allows the operator to view the LED display and indicators of the instrument.

The base of the enclosure has terminals for field wiring connections for power, sensor, data highway, analog output and optional relays.

Circuitry

The electronic circuitry for the SEC 2000 DIN typically consists of two rectangular printed circuit boards contained within the enclosure. The circuit boards are designed in a modular fashion and are easily removed and replaced.

Termination / Power Supply / Relay PCB

The Termination / Power Supply / Relay PCB is the bottom module on the SEC 2000 DIN stack. It contains the terminal blocks for field wiring connections to input power, alarm & fault relays, analog / digital outputs, pushbutton calibration switch and three adjustment potentiometers. The Termination / Power Supply / Relay PCB has two headers, H1 and H2 for interconnection to the upper Display / Microprocessor PCB. The Termination / Power Supply / Relay PCB is secured with two self tapping screws to the base plate of the SEC 2000 DIN enclosure.

There can be four (4) optional 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.

Display / Microprocessor PCB

The Display / Microprocessor PCB plugs into the Termination / Power Supply / Relay PCB. 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 / Microprocessor PCB has the microprocessor and associated logic circuitry which control operation of the SEC 2000 DIN. Also located on this board are a D/A converter, a watchdog timer, and an EEPROM. The EEPROM retains the operating characteristics of a particular SEC 2000 DIN (i.e., gas type, range, relay operation, etc.) even when there is no power applied to the device. The top of the SEC 2000 DIN enclosure can be removed (snap together parts) by carefully detaching the top part from the mounting base of the enclosure.

Control and Indicators

Calibration/Reset/Date (CRD) Switch

There is one internal control on the SEC 2000 DIN, a momentary push-button switch mounted on the Termination / Power Supply / Relay PCB. Pressing and releasing the pushbutton will activate different operations. Below is a list of actions:

Once:	(momentary): View Identification number of detector.
Once:	(and held in other submenus): 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 DIN recognizes certain numbers of consecutive push-button activation's and responds accordingly. This switch can be used to perform a 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 three (3) user adjustable controls on the power supply module. Each control is a 20 turn PCB-mount potentiometer.

P1: This control is used to calibrate the SEC 2000's analog output (4-20 mA). This is typically a one time factory adjustment.

P2 - ZERO Adjust : This sets the analog ZERO voltage for a gas free condition. This control is generally a one time factory adjustment, as the SEC 2000 DIN is software calibrated to the gas detector's

output using the CRD switch. The SEC 3000, Millenium or Signature gas detectors have their own calibration functions allowing them to be calibrated separately. See the associated gas detector instruction manual for calibration details.

P3 - SPAN Adjust: This control sets the sensitivity of the analog amplifier circuit from the gas sensor. This control a one time factory adjustment, as the SEC 2000 DIN is software calibrated or the SEC 3000, Millenium or Signature can be calibrated separately. See the associated gas detector instruction manual for calibration details.

Segmented LED Display

The segmented LED display is located directly behind the SEC 2000 DIN faceplate on the Display / Microprocessor PCB. It can be viewed through the lens on top of the enclosure window. 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

Gas Detector (sensor)

The gas detector is mounted in location for potential gas leaks, wired to TB4 on the Termination / Power Supply / Relay PCB. A plug connects to a mating socket located on the Termination / Power Supply / Relay PCB.

There are three (3) basic types of gas detectors used by the SEC 2000 DIN; SEC 3000 Toxic / Oxygen, SEC Millenium Infrared (HC or CO₂) and SEC Signature. Each of these gas detectors are a standalone gas detector, powered by 24 VDC. The sensor's output is a 4-20 mA signal is used as the input to the SEC 2000 DIN controller. There are four wires exiting the sensor's housing color coded, Red, Black, White and Blue (or sometimes Green).

Optional Equipment

SEC 2500 Hand Held Programmer

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

- Calibration of the SEC 2000 DIN with measured gas levels continuously displayed by the SEC 2500.
- Displaying and changing SEC 2000 DIN operating characteristics including gas type, gas units, range, bridge voltage, decimal places in display, calibration gas value, and SEC 2000 DIN identification number. Displaying and changing operating parameters of the individual SEC 2000 DIN 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 DIN identification number.
- Displaying a sensor synopsis which includes SEC 2000 DIN identification number; zone 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 DIN by direct 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.

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

Sensor Separation Kit

A Sensor Separation Kit (SEC 2001) is available so the sensor may be installed remote from the SEC 2000 DIN. 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 DIN. Cable runs should be made with shielded cable within properly grounded conduit. Four conductors are required.

IV. OPERATION

Installation and Startup

The first step in the installation process is to establish a mounting location for the SEC 2000 DIN. The SEC 2000 DIN should be solidly attached to DIN rail (provided by others) or using bolts through the mounting flanges at the base of the SEC 2000 DIN enclosure.

The field wiring must be brought to the SEC 2000 DIN. The use of shielded cable is highly recommended to prevent electrical interference from affecting the operation of the SEC 2000 DIN. 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 gas detectors 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 the terminal covers of the SEC 2000 DIN can be removed. The SEC 2000 DIN is supplied with a terminal block plugs that connect with a terminal block sockets on the Termination / Power Supply / Relay PCB.

SEC 2000 DIN wiring connections:

Power / RS485 Data / Analog Output (TB 1)

Designation TB1	Connection (L-R)
DC Common	1
+24 VDC	2
4-20 signal	3
Iso Communication	4
RS485 Data "A"	5
RS485 Data "B"	6

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

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 2000 DINs or monitoring devices.

Connect the Data A wire to the terminal block position marked "Data A" (TB1-5). Connect the Data B wire to the terminal block position marked "Data B" (TB1-6).

In total, the RS-485 wiring should not exceed 4000 feet or 68 ohms. If the wiring is to exceed 4000 feet or more than 32 network devices are on the data highway an SEC 4850 RS-485 Repeater must be installed. Please consult Factory for further details.

Gas Detector (sensor)

The SEC 2000 DIN is supplied with a terminal block plug that connects with a terminal block socket (TB 4) on the Termination / Power Supply / Relay PCB. This is used to connect the gas sensor to the SEC 2000 DIN.

There are four wires exiting the sensor's housing:

Color	Designation	TB4 Connection (L-R)
Blue (or Green)	4-20 signal	1
Red	+24 VDC	2
Black	VDC Common	3
White	Cal / Comm	4

Optional Relays

The SEC 2000 DIN can be supplied with a terminal block plugs that connect with a terminal block sockets (TB 2 and TB3) on the Termination / Power Supply / Relay PCB. If these plugs are present on the SEC 2000 DIN, the optional relays are installed. 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 shown below in the non-energized condition.

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

The following is the relay wiring connections for TB2.

Relay		Connection (L-R)
MID Relay	N/C	1
MID Relay	C	2
MID Relay	N/O	3
LOW Relay	N/C	4
LOW Relay	C	5
LOW Relay	N/O	6

The following is the relay wiring connections for TB3.

Relay		Connection (L-R)
FAULT Relay	N/C	1
FAULT Relay	C	2
FAULT Relay	N/O	3
HIGH Relay	N/C	4
HIGH Relay	C	5
HIGH Relay	N/O	6

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.

Startup

After the wiring has been completed, power can be applied to the SEC 2000 DIN. 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 DIN identification number. After this initial startup sequence is complete, all four (4) tricolor LEDs will go solid green and the segmented 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 DIN display reading will read FL 13 because the sensor is in warm up mode for one minute. 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 DIN is being installed on an RS-485 network, they must each be assigned a unique identification number.

In the case of duplicate ID numbers on the data highway, each SEC 2000 DIN 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 desired, the configuration and programming information contained in each individual SEC 2000 DIN 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 DIN should 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 DIN is ready for use. However, some gas sensing elements take up to 24 hours to stabilize if they have been powered down for a long time. The LED display continually indicates the status / current gas concentration. If connected to a monitoring device on an RS-485 network, the SEC 2000 DIN will report its status and programming information upon being polled. The SEC 2000 DIN also generates a 4-20 mA signal, on a continuous basis, representative of the display reading.

For a combustible gas version SEC 2000 DIN, 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.

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

For an oxygen version SEC 2000 DIN, 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 DIN is to activate alarms when gas concentrations approach dangerous levels. There are three (3) levels of alarm for gas concentration on the SEC 2000 DIN; 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 DIN 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 DIN 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 DIN, 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 DIN 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 DIN and return to the normal operating mode.

View Last Calibration Date

The date of last calibration on any SEC 2000 DIN 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 DIN will initially display: **dATE**

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

Example: **YEAr** and **5**

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 DIN to momentarily display **CnCI**, and then return to the normal monitoring display.

Press the CRD switch two times to advance. The SEC 2000 DIN 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 DIN 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 DIN 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 DIN will time out to the normal operating mode after five (5) minutes if the pushbutton switch remains inactive.

View/Change Calibration Gas Value

The value of calibration gas programmed into the SEC 2000 DIN 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 DIN will alternately display:

CAL

gAS

XX (XX = Value of Cal. Gas in SEC 2000 DIN memory)

XXX (XXX = Gas units in SEC 2000 DIN memory)

Example:

CAL

gAS

50

LEL

The SEC 2000 DIN 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 DIN interprets the sensor input.

To exit the calibration gas mode, press the CRD switch two times. The SEC 2000 DIN 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 DIN 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 DIN 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 DIN will automatically time out to the normal operating mode after five (5) minutes if the pushbutton switch remains inactive.

V. CALIBRATION

Sensor Calibration and Setting Calibration Date

The SEC 2000 DIN must be calibrated regularly using known gas samples, representative of the gas being detected.

Calibration consists of exposing the 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 DIN, 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.

The SEC 2000 DIN 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 DIN using the CRD switch:

1. If the SEC 2000 DIN has just been powered up, allow the sensor to stabilize, depending on the type of gas being sensed, this could take up to 24 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 DIN 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 DIN will alternately display:

CAL
gAS

XX (XX = Value of cal. Gas in SEC 2000 DIN memory)

XXX (XXX = Gas unit in SEC 2000 DIN 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 DIN to momentarily display: **CnCI**, and return to the normal monitoring display.

NOTE: If the calibration gas value displayed by the SEC 2000 DIN 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 DIN 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. To proceed with a standard calibration, push the CRD switch twice.

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

7. With the 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 sensor is uncertain, apply zero air to the sensor using the calibration adapter.

NOTE: For an oxygen sensor this step must be performed with an oxygen-free inert gas such as nitrogen.

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

9. The SEC 2000 DIN 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 sensor.

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

15. The SEC 2000 DIN will then flash **YEAR**, alternating with the year of last calibration currently entered into the detector's memory. (Example 5).

If the year displayed is not the current year, press and hold the CRD switch. The displayed year will then begin to ascend (Example: 1, 2, 3, 4, 5 ...). 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.

16. With the current year displayed, press the CRD switch two times to lock in this number. The SEC 2000 DIN 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 DIN, 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 DIN 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 DIN, 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 DIN 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 fifteen (15) minute timer to allow the sensor to clear out any remaining calibration gas. During the fifteen (15) 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 DIN, the fault codes will continue to be displayed until the fifteen (15) minute time out is completed. The SEC 2000 DIN will return to its basic monitoring mode after fifteen (15) 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 DIN is left unattended for more than fifteen (15) minutes, it will automatically return to the normal operating mode.

Analog Output Calibration

The SEC 2000 DIN 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 SEC 2000 DIN.
2. Remove terminal cover by TB4. Remove any field wiring and Locate P1
3. Connect a 4-20mA measuring device to SEC 2000 DIN analog output TB1-3 (+ meter lead) and DC common TB1-1 (- meter lead) Apply power to the SEC 2000 DIN.
4. Adjust this P1 until the analog output measured corresponds to exactly 4 mA. Upon initial power up the SEC 2000 DIN will remain in warm up mode with the software commanding the 4-20 mA output to 4 mA.
5. Remove power to the SEC 2000
6. Reconnect filed wiring and reassemble the SEC 2000 DIN.

VI. MAINTENANCE

General

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

Fault Code Description

FL 11 Insufficient gain
 FL 13 Zero drift
 FL 14 Excessive gain
 FL 21 Logic voltage out of tolerance
 FL 23 Supply voltage out of tolerance
 FL 34 EEPROM write fault
 CNFg Incomplete configuration in EEPROM

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

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 DIN diagnostic software has determined that more sensitivity can be obtained using the adjustable gain control on the Power Supply Module. The sensor must be calibrated using the procedure described in appropriate gas sensor instruction manual. After a successful sensor calibration the SEC 2000 DIN must be recalibrated using the pushbutton or the SEC 2500.

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 sensor must be calibrated using the procedure described in appropriate gas sensor instruction manual. After a successful sensor calibration the SEC 2000 DIN must be recalibrated using the pushbutton or the SEC 2500.

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 sensor must be calibrated using the procedure described in appropriate gas sensor instruction manual. After a successful sensor calibration the SEC 2000 DIN must be recalibrated using the pushbutton or the SEC 2500.

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 (or – 4.5 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.

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 DIN are non-serviceable and must be replaced when they lose their sensitivity. Refer to the appropriate sensor instruction manual for sensor replacement and trouble shooting.

Analog Adjustment

In order to adjust the analog voltage, you need to know the range the SEC 2000 DIN 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.

Use the following procedure to correct for individual sensor characteristics:

1. Connect the gas cylinder to the gas sensor 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.
2. Press the CRD switch five (5) times. The SEC 2000 DIN 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 DIN 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.

3. The SEC 2000 DIN will then 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

4. 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 then the reading should be adjusted.

5. Locate the potentiometer P2. With the sensor in a known gas free atmosphere, adjust this control until the voltage displayed by the voltmeter is 0.250 VDC \pm 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.

5. 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.

6. Locate the potentiometer P3. 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:

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

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

$$\begin{aligned}\text{Voltage} &= \frac{(25 \text{ PPM} \times 1.625\text{V})}{100 \text{ PPM}} + 0.250\text{V} \\ &= 0.65 \text{ volts.}\end{aligned}$$

Example 3. For a SEC 2000 O₂, 0-25%VOL, using 20.9%VOL (Normal Air) calibration gas;

$$\begin{aligned}\text{Voltage} &= \frac{(20.9\% \text{VOL} \times 1.625\text{V})}{25\% \text{VOL}} + 0.250\text{V} \\ &= 1.62 \text{ volts.}\end{aligned}$$

7. 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 using zero air. The Zero (P2) and Span (P3) controls have an slight effect on each other so these steps may have to be repeated.

8. 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.

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 its 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 20th and 21st 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

<u>Part Number</u>	<u>Description</u>
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IX. Drawing Section

<u>Figure #</u>	<u>Title</u>
Figure 1	SEC 2000 DIN Housing Dimensions
Figure 2	Wiring Diagram, Combustible Gas Sensor
Figure 3	Wiring Diagram, Toxic Gas and Oxygen Sensor
Figure 4	Wiring Diagram, Relay
Figure 5	SEC Sensor Separation Kit Sensor Reference Charts

